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The Bonus Plan and Accidents

A number of companies have adopted the plan of giving a bonus in addition to the regular wages to motormen and conductors for operating during a given period of time without accidents. Just what the effect of such practice will be in the long run, is hard to determine by a few months trial. In some cases the bonus arrangement has been made to take the place of an increase in wages. In such a case, it means practically an increase in wages for a large percentage of the men, and tends to make them more careful. Some companies which have tried it, believe thoroughly in the system; others fear that the tendency which it has to make the motormen and conductors fail to report petty accidents is likely to result in more harm than the accidents which would occur if the bonus was not given. As one manager, who is opposed to the system, put it, "It is not the large accidents that are the most to be feared from a financial standpoint; such accidents are to be regretted and avoided, but a certain number of them are inevitable in the operation of any street railway system. When they are due to the fault of the company or its employees, claims arising from such accidents should be paid promptly as a matter of course. What companies have occasion to fear the most is the multiplication of claims arising from petty accidents which are never reported, or fake claims which are without any foundation. Anything which tends to withhold from the company full information about these petty accidents puts the company at a disadvantage in handling damage claims arising from them."

It would seem that this objection to the system of paying a bonus for freedom from accidents would depend very much on what the management of the company included as accidents when making up the list of those to receive the bonus. We believe most of the companies which are operating under this plan do not include petty accidents which cost the company nothing when deciding upon the motormen and conductors who are entitled to a bonus on account of freedom from accidents. In some cases, where the accident has resulted only in injury to some portion of the equipment, like the car body, it is the practice to charge the cost of the repair to the motorman and conductor. Of course, with accidents resulting in injury to persons, it is occasionally difficult to foretell whether the casualty will cost the company anything or not, but it seems as if at the end of two or three months, the claim department should be in a position to know what accidents could safely be counted out in the reckoning of the bonus.

An Exhibition Room

Street railway managers will watch with interest the way in which M. B. Hereley, general superintendent of the Chicago Union Traction Company, will work out his plan to establish an exhibition room for street railway appliances at the company's headquarters. While the scheme is not altogether new, if Mr. Hereley's present plans are fully carried out, the Chicago Union Traction Company will go further than any company has ever gone in the equipment of a room of this kind. A number of companies have construction rooms where the trucks and electrical equipment are so arranged that employees can go to the room and easily study the parts and method of operation of the electrical equipment. Mr. Hereley's plan is broader than this, as it consists of an invitation to all manufacturers of street railway devices suitable for exhibition in such a room, and of any possible merit, to furnish samples for exhibition and trial. The room is to be open to all employees, who will thus have a chance to become posted on some of the latest and best appliances brought out in the electrical railway field. If employees of the company are sufficiently convinced of the merits of any device for the particular use of the company, it will be given a trial. Suggestions from employees as to improvements on existing devices will be welcomed. Such an exhibition room should have considerable educational value. We can imagine that the management will have to exercise some judgment if the space is not to be all taken up by impractical inventions, but nevertheless, it will not be the intention to draw the lines too closely, as the exhibition room will, as far as possible, be run on a free for all plan, which will encourage ideas from everybody.

Why the Double Truck is Popular

Occasionally the controversy as to the relative merits of single and double-truck cars for street railway service in large cities breaks out afresh, but year by year there is less interest in this question, as the double-truck car with four-motor equipment seems to be becoming generally accepted as the proper thing in a large city. In spite of this fact, it is quite common to hear arguments advanced for the desirability of the double-truck four-motor equipment which are entirely fallacious. When we get to the bottom of the matter, it is not unlikely that the easy riding qualities of a double-truck car have had more to do with its adoption than anything else, even though that may not be the reason recognized by some managers who have adopted it. The realization of this was recently forcibly brought to mind by a well-known manager, whose system is equipped almost entirely with double-truck cars, and who has recently made very large additions to his rolling stock with cars of the same kind. He remarked that if he could build a new street railway system from the ground up, according to his own ideas, he thought he should equip it with single-truck cars. However, he had to take conditions as he found them, and a double-truck car rides much easier on an imperfect track than a single-truck car. For this reason, he has adhered to the double-truck ear. He said it was a serious question in his mind whether the saving in conductors' and motormen's wages with a big car during rush hours would offset the large amount of power required to propel the extra dead weight around the streets during the hours when the cars were not filled. It is frequently argued that power is the cheapest thing that an electrie railway company has, but when it eomes to propelling a big double-truck four-motor equipment on a high schedule speed in city service, the power cost per car mile begins to run up in the neighborhood of the motormen's and conductors' wages. With the car making a schedule speed of 10 miles per hour, and trainmen's wages of 22 cents, the cost of wages per mile is 4.4 cents. If the car has a large four-motor equipment, it will take not less than 2.5 kw-hours per ear mile, and it may often take considerably more at such a schedule. If power is delivered at 1 cent per kw-hour, the power would be 2.5 cents per car mile. Power is likely to eost more than the above figure delivered at the car, and the consumption of energy is equally apt to be more. When we consider how much dead weight or non-paying load we are obliged to propel around the streets during the middle of the day when long cars are used and the cars are not filled, it is to be seen that there is not a very overwhelming balance left in favor of the long car, even after we have taken out the saving in trainmen's wages during the rush hours. We have, nevertheless, a car which can be operated at fast schedule over much rougher track than would be permissible with single-truck cars, and in fact on anything but a most perfect track. The public has a strong preference for the double-truck car, partly because of this and partly because usually single-truck cars have longitudinal seats, while double-truck cars are most frequently equipped with cross seats. It is sometimes considered that because double-truck cars are much heavier than single-truck cars they are much more substantial from a structural standpoint, but it is a question whether the durability is enough greater to make up for the increase in weight. As a compensation for carrying around the extra dead weight of a double-truck ear, there is the faet in favor of long cars, that a smaller number of train erews are required as extras during the rush hours than if single-truek cars were used with a larger number of trippers. This is assuming, of course, that double-truck ears are to be run partially empty during the middle of the day, as is almost invariably the praetice where these cars are in use. A reduction of the number of trippers is usually desirable, from a superintendent's standpoint, because of the difficulty of giving trippers and extras enough hours of work in a day to keep good men in the service. Taken altogether, the two real decisive and underlying reasons for the adoption of the double-truck car seem to be its easy riding qualities and the reduction in number of trippers required.

Electricity for Elevated Railway Service

Although New York City is the metropolis of the Western Hemisphere, and prides itself on being in advance of many of the other cities in this part of the world, it was the last to adopt improved methods of street transportation. Both the authorities and public opinion prevented the surface lines from adopting the overhead system by what has always seemed to us an absurdly strained idea of street æsthetics, and while a practicable underground conduit system was finally developed by the courage and ingenuity of those in charge of what was then the Metropolitan Street Railway Company, it was only by an enormous expenditure of capital and time.

The elevated railroad system in New York was also the last in this country to adopt electricity as a motive power. Although at the time that operation was commenced, third-rail roads on both surface and elevated structures were in common use in all parts of the country, there was considerable skepticism expressed in the daily papers as to the possibilities of commercial success. These criticisms were espeeially pronounced about fifteen months ago, when after a memorable sleet storm there was some delay in the operation of the elevated electric trains. In spite of the fact that the management took every pains to assure the public that these troubles were only temporary and were eaused principally by the faet that the line was not completely equipped with eleetric power, but had a divided serviee of steam and electric ears, the dissatisfaction was very general.

We took occasion at that time to eall attention to the faet that these fears were absolutely unfounded, and that the troubles were of a temporary character only. The oeeasion for referring to this matter now is that the winter of 1903-04 has praetieally passed, and in rigor has exceeded, according to the reeords of the Government Weather Bureau, any since its establishment, over thirty years ago. In spite of this fact, the elevated railroad eompany has had no diffieulty in moving its trains at all times during the year, and has successfully demonstrated the contention whieh it maintained at the opening of the road, viz., that the electric system was as reliable as it was superior to steam power for the transportation of passengers. As we have stated in previous editorials and in our news columns, the road is now earrying more passengers daily than at any other period in its history, even on the days of greatest traffie with steam, and with practically the same traekage, nearly twiee as many persons as were formerly considered a maximum haul under ayerage eonditions. Railroad managers are often obliged to suffer abuse, and we believe that it is equally just to award them the meed of praise when it is their due.

Switching Problems

Mr. Stillwell's paper on group switches, published in this issue, calls up some interesting reflections on the switchboard problem in general. It is no easy matter to realize the change which the last few years have made in the necessities for current handling appliances. In the days when generators of a few hundred kilowatts' capacity were ample for the needs of the largest railway power houses, the control of the energy was a very simple matter indeed. Almost any kind of a switch, if fairly well designed, and of ample size, answered all reasonable requirements, and manual operation was the universal rule. If the circuit-breakers had replaced fuses they were as likely as not tied up to avoid the trouble of closing them. But in these days of enormous direct-connected units, the switchboard of a large station may well cost more than the whole equipment of a station ten years ago, and its design is squarely in the category of heavy engineering. Even the laws of energy in the switchboard connections ceases to be anywhere nearly negligible, and the entire problem takes on a serious aspect. Among switchboard designers there are two radically different points of view. One favors connections of the simplest practicable kind, and the taking of whatever chances may be necessary to preserve simplicity. The other endeavors to include provisions for every possible contingency or combination of contingencies, so that no chances shall be taken in any event. The group switch discussed by Mr. Stillwell belongs to the armory of the second class named. Its function is to handle a group of feeders simultaneously inside the regular switches, an act which may sometimes be desirable. Its use is alien to the use of an extra switch on a single feeder, save in so far as it may be necessary to switch several feeders simultaneously. This matter of extra switches is one which has been often discussed without any definite results.

It seems to us that, as a practical matter, the weakest part of the system in a good many recent power houses, is that part which lies between the generator terminals and the exit of the feeders from the building. If extraordinary precautions are to be taken, it strikes us that they should first be directed to cutting the several generators clear of the switchboard and all that appertains thereto. If the whole board is relayed, as is now a rather common practice, the function of a group-switch as such seems to us comparatively insignificant, for with the relay switches under one's fingers, there is no time lost. In a manually operated board the group-switch may save valuable time, but very large station switches are seldom manually operated. As a practical question, therefore, we are disposed to look upon the group switch as a safety switch to stand behind the regular feeder switch in case of emergency. It thus is merely a species of insurance which may or may not be worth the while in any particular case. In a big station the results, when anything does go wrong, are so grave that it is worth while to be fairly liberal in the way of precautions. But precautions at the switchboard are only partial, as witness the celebrated case of the deflagrated cat, and the cable fire in the great Niagara plant. It seems to us that if we were building a great plant, we should not only get the best engineer obtainable to plan the work, but retain a second one merely as Devil's Advocate, to go around in a friendly endeavor to pick out the weak spots. You cannot make a plant quite on the lines of the famous "one horse shay," but it should be possible to avoid having a series of breaks of the same general kind. As a matter of fact, most of the shut-downs in large plants have of late been due to seemingly trivial causes. There is no unimportant link in the chain that furnishes power to a great system, and none that can safely be neglected.

Picking Men for Interurban Service

Every interurban manager is brought face to face with the question as to where best to secure his motormen and conductors. Some managers have a strong leaning towards steam railroad brakemen and conductors, because of their previous training in the operation of high-speed trains under train despatching rules and train despatchers. However, there are not usually anywhere near enough good men of this kind to fill the vacancies. It is, therefore, not uncommon to pick the best men from city street railway service. When interurban railroading is a few years older it will be possible to obtain more men trained by years of experience in the operation of high-speed cars under a despatching system. Until this has become drilled into a man, so as to become almost second nature, he can hardly be entirely satisfactory to serve on an interurban car as motorman or conductor.

A former steam railroad superintendent, who has recently entered the field of interurban management, recently expressed to us some ideas on interurban management which are worth considering. He believes in having as little "red tape" as possible in connection with the despatching system, but that when orders are given by a despatcher they should be safeguarded in every way possible. For example, cars which run through, from one terminal to another, report to the despatcher only once, as long as they are on schedule time. If the car gets off time or fails to meet the other car at a regular meeting point, so that despatcher's orders are necessary, he throws every safeguard possible around the receipt of the order. The conductor is required to write a duplicate order, and to read the order to the motorman. By reducing as much as can be the number of orders which must be received he believes that the men will be more careful when the emergency arises that an order must be taken, than if they were receiving orders at every turn-out with cars on time. He believes that the conductors and motormen should be held jointly responsible for an interurban car, just as are the conductor and engineer on a steam road. He has known of instances in steam road operation where the engineer has been prevented from pulling out, without orders, by the conductor. If only one man of the crew had been responsible, as on some interurban roads, the train would have gone ahead without orders.

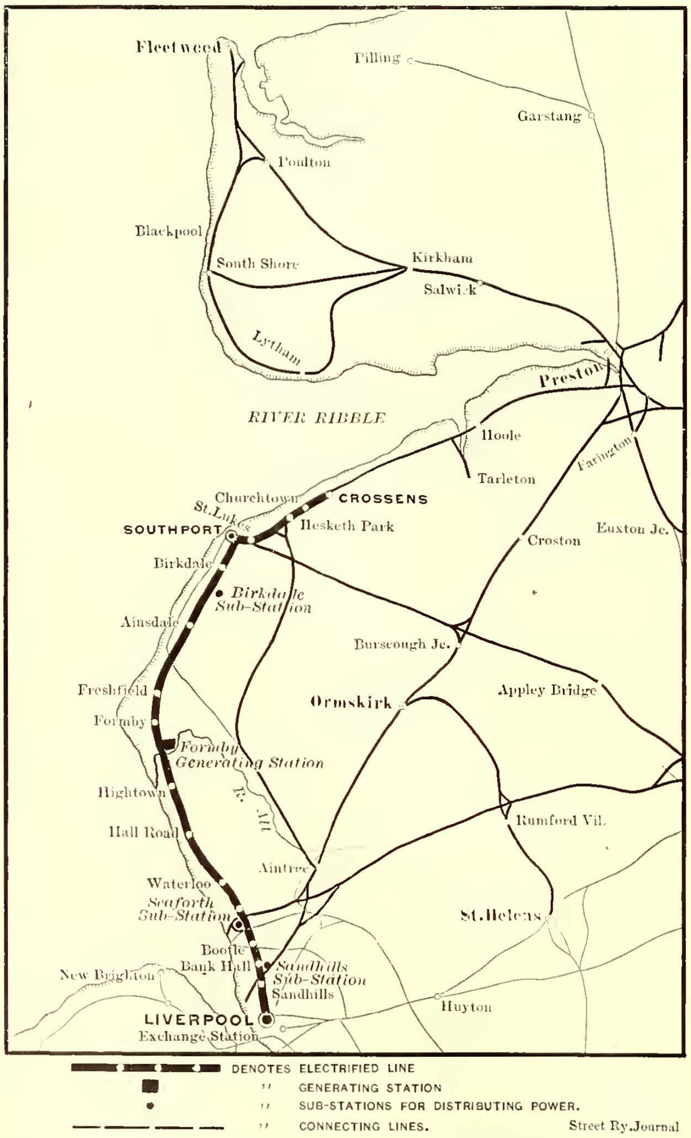
As regards collection of fares, he finds conductors trained in city service the quickest. Steam road conductors are accustomed to having plenty of time for the collection of fares between stations, and have little responsibility in the way of putting off passengers at signal stations. The street railway conductor, on the other hand, is accustomed to hustling to get his fares and to stopping his car at numerous places to let off passengers. He is, therefore, better trained for the multitude of details that an interurban conductor must look after than is the steam railroad conductor.

In selecting new employees it is an old question whether men trained in the city or in the country are best. The city-bred conductor is usually quicker at making change, in replying to inquiries from passengers and in understanding city conditions, while the man from the country is supposed to be more reliable and used to hard work. While it is difficult to lay down any general rule, we have found that most managers prefer the city-bred conductor, and some have very positive convictions on this point.

THE ELECTRICAL EQUIPMENT OF THE LIVERPOOL & SOUTH-PORT DIVISION OF THE LANCASHIRE & YORKSHIRE RAILWAY

Several short articles on the apparatus used in this system have already appeared in this paper, particularly in the issue of Jan. 30 last, but as the work is now completed opportunity is afforded for a full description. It is well known that the British steam railway companies have progressed farther than those in any other country in the actual equipment of their lines with electric power, and the Lancashire & Yorkshire Railway Company enjoys the distinction of being not only the first of these companies to put their trains in practical operation, but among the first of the steam railway companies in the world to operate electrically-equipped multiple-unit trains.

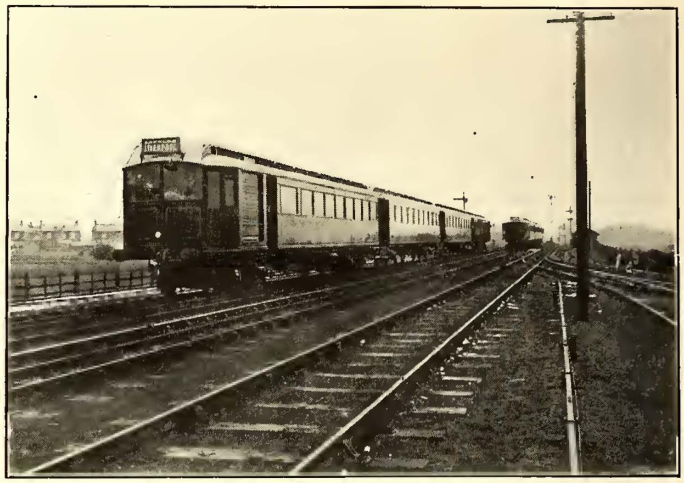
The plan for the electrical equipment of the Liverpool & Southport branch of the Lancashire & Yorkshire Railway had been maturing for a considerable time before any public announcement was made on the subject, and was made after a



MAP OF DISTRICT AROUND LIVERPOOL, SHOWING ELECTRIC LINE OF THE LANCASHIRE & YORKSHIRE RAILWAY

careful study of electric railway conditions in America and elsewhere. The scheme generally was originated by J. A. F. Aspinwall, the general manager of the company, who long ago realized the possibilities of great traffic development in the excellent residential districts which lie between Liverpool and Southport, and on the north side of the latter town, and which could not be satisfactorily served by a steam-train equipment.

The history of the equipment of the line, subsequent to the decision to employ electric power, can be briefly summed up. The entire contract, with the exception of the rolling stock, which was made at the Horwich and Newton Heath Works of the railway company, was entrusted to Dick, Kerr & Company, Ltd., of London, Preston and Kilmarnock, who have completed their work in a remarkably short time. Twelve months ago the work of construction had not been begun, yet on March 1, 1904, a scheme embracing 47 miles of permanent way, a



ELECTRIC TRAIN AT CROSSENS

transmission plant of 12,000 hp, and a complete train system has been carried out, all without interference with the running of the steam service.

The distance between Liverpool and Southport is nearly 18½ miles, the total length of track equipped being practically equivalent to 47 miles of single line. The grades on the road are slight, and there are but few curves, the steepest grade being a short length of 1 in 85 near Waterloo, and the sharpest curve one of 462 ft. at Southport. With these exceptions the line is level and straight. There are fourteen intermediate stations, which lie at an average distance of about 1 mile apart on the southernmost portion of the route, but are more widely separated on the northern portion. The traffic is almost wholly passenger, business people going to and returning from Liverpool in the morning and evening, with a considerable shopping and miscellaneous traffic during the day.

Under steam conditions there were about thirty-six trains per day in each direction between Liverpool and Southport; a similar number running in each direction between Liverpool and Hall Road, a station some 7 miles from Liverpool. The majority of these trains stopped at every station, a few expresses being run in the morning and evening for the accommodation of the business men. The running times of the trains were as follows: Express trains, 25 minutes; way trains, 54 minutes; Hall Road way trains, 25 minutes. The total train mileage per diem was about 1900.

With electricity the train mileage will be increased to 3200. The number of trains in each direction between Liverpool and Southport will be increased from thirty-six to sixty-five, and between Liverpool and Hall Road from thirty-eight to fifty-four. Moreover, the running time from Liverpool to Southport will be decreased from 54 minutes as with steam to 37 minutes, and from Liverpool to Hall Road from 25 minutes to 17 minutes; the schedule time of the fast trains will remain unaltered, but there will be an express in each direction hourly, instead of only rarely. In addition to this the express trains will run on to Crossens, giving that suburb a service of seventeen trains each way during the day. These arrangements, however, do not represent the ultimate capacity of the line, and if the traffic in the course of a year or two were to demand it, there would be no difficulty in running an even more frequent service. It is intended to shorten the stops at the intermediate stations, and as this will make fresh arrangements necessary to deal with baggage and parcels, a special baggage car has been built to deal only with this service. This car will make numerous trips between Liverpool and Southport, and will immensely increase the ease and rapidity with which parcels can be delivered in the residential districts between Liverpool and Southport.

GENERAL OUTLINE OF SYSTEM

The portion of the line which has been electrified is shown on the map, and it is obvious that the distance, quite apart from conditions of service, demanded a system of high-tension transmission. The electrical energy is generated as three-phase alternating current of 7500 volts pressure, and transmitted direct to sub-stations, where the voltage is stepped down by statics and transformed by rotary converters into direct current of 650 volts pressure, the maximum voltage at the train being 600.

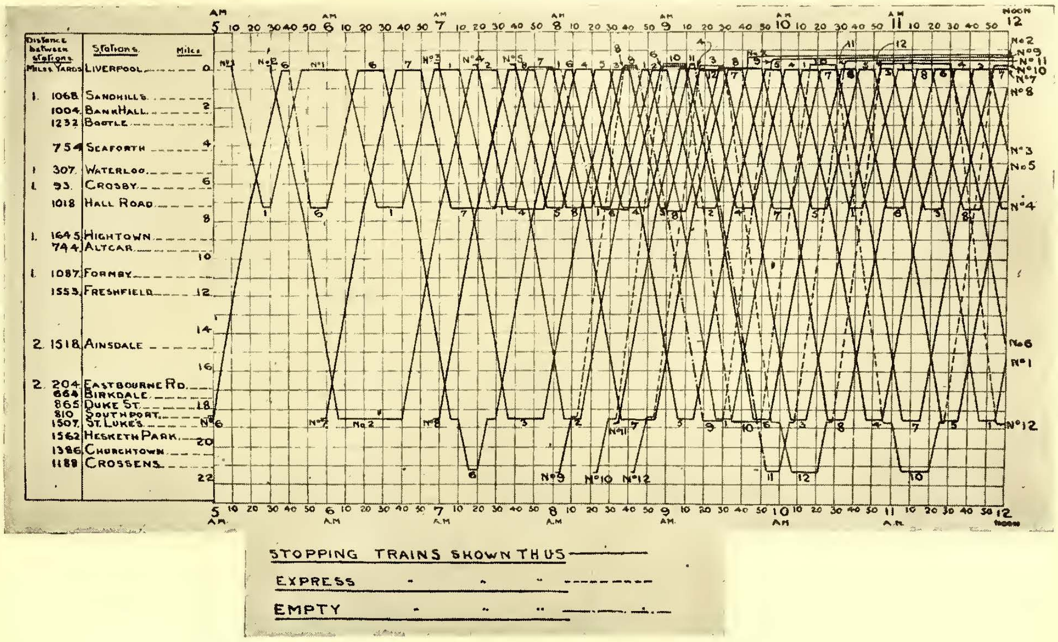
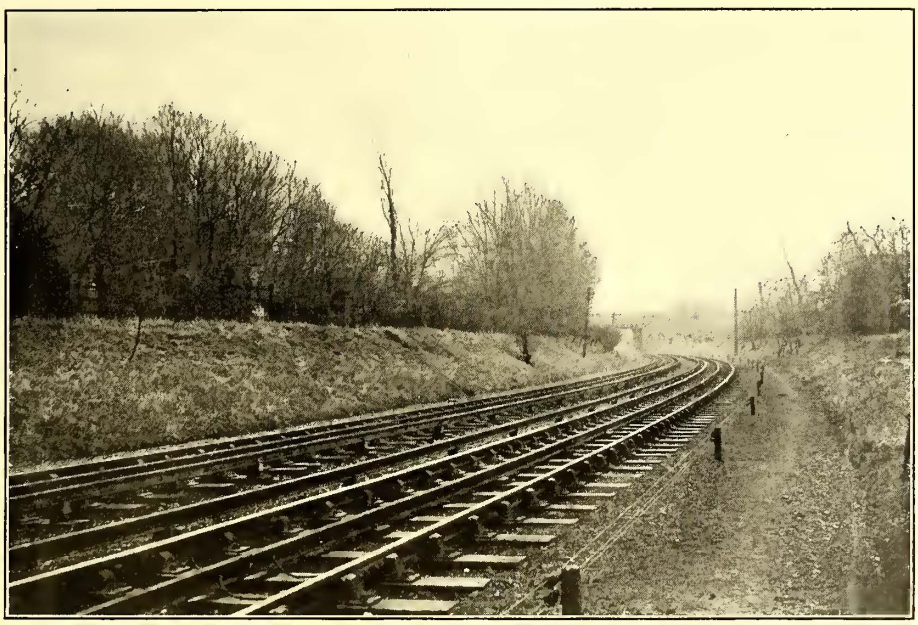


DIAGRAM OF TRAIN SERVICE ON LIVERPOOL & SOUTHPORT DIVISION

The power house is situated approximately about the center of the line, near Formby, directly on the River Alt, being thus favorably situated as regards economical distribution and a plentiful supply of water. The power house is utilized at the same time as a sub-station, from whence part of the electric energy is distributed direct to the adjacent track. In addition to the rotary converters at the main power house the scheme embraces three sub-stations, the first being at Sandhills, the second at Seaforth, and the third at Birkdale. The distances of these sub-stations from Liverpool are as follows:

Sandhills sub-station, distance from Liverpool, 2 miles.
Seaforth sub-station, distance from Liverpool, 3¾ miles.
Formby power house sub-station, distance from Liverpool, 10¼ miles.
Birkdale sub-station, distance from Liverpool, 16⅛ miles.



SECTION OF TRACK ON CURVE, SHOWING THIRD RAIL AND RETURN RAIL

Near Liverpool it has been necessary to arrange the sub-stations closer together than on other parts of the line, in order to cope with the considerably heavier traffic of the local trains running from Liverpool to Hall Road, and vice versa. The extreme ends of the line—from Sandhills sub-station toward Liverpool, and from Birkdale sub-station toward Southport and Crossens—are each fed by one sub-station, while for the intermediate sections of the line two sub-stations supply the energy. The sub-stations are situated near the track, thus avoiding any low-tension cabling, except a short connecting length.

The system is arranged so that any sub-station can be disconnected if required.

POWER STATION

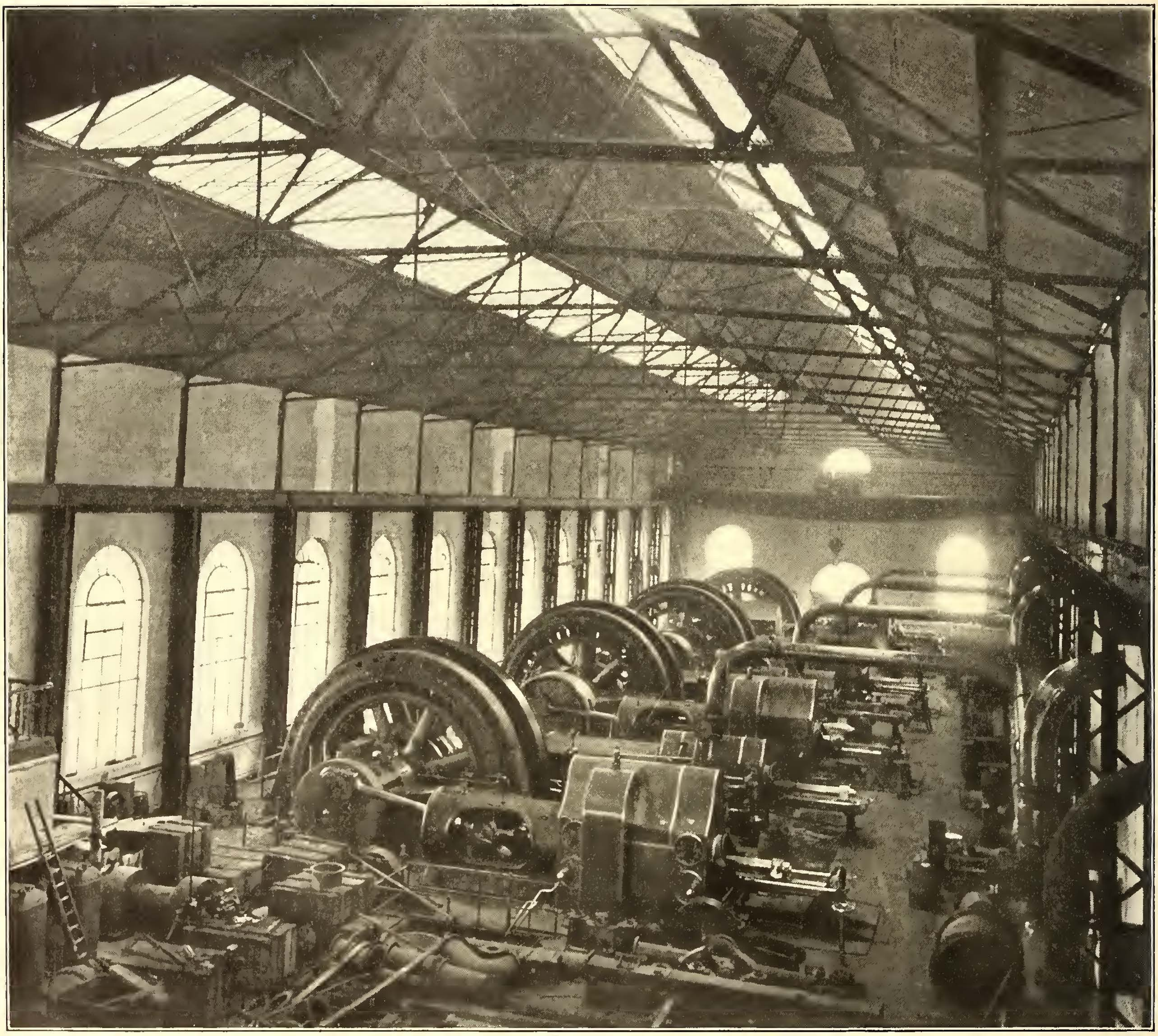
The equipment of the power house has been laid down on simple lines, and there are none of the unnecessary luxuries and refinements which characterize many of the modern power and lighting plants. The building is a plain and substantial one, with no ornamentation, but admirably adapted for the purpose for which it was constructed. It consists of two divisions, the engine room being 280 ft. x 65 ft., and the boiler house, which is 50 ft. wide with similar length of 250 ft. The building consists of a steel roof in two bays, carried upon steel columns, all of which are independent of the brickwork. The engine room is provided with admirable lifting and traveling machinery, in the way of overhead cranes, which are capable of dealing with pieces of machinery up to 20 tons, and which are operated electrically. They were built by Jessup & Appleby, of Leicester.

For obvious reasons the size of the units is as large as possible, compatible with the running of a reduced service with a good load factor.

There are installed four 1500-kw units, of which three will, under normal conditions, meet the demands. In addition, there is a fifth unit of 750 kw, which will form a useful link between the larger units, and thus permit considerable flexibility in obtaining a good load factor with high efficiency.

The four main engines are of the horizontal cross-compound type, the fifth engine being a vertical cross-compound. The horizontal engines have cylinders 32 ins. and 64 ins. in diameter, 54-in. stroke, and run at 75 r. p. m. The normal load of each engine is 2310 hp, with a steam pressure of 160 lbs. per square inch, but they are designed to give an overload of 20 per cent. The main engines, as well as the boilers, were supplied by Yates & Thom, as sub-contractors to Dick, Kerr & Company, Ltd. The cylinders of the main engines are of the built-up type, with separate ends and barrel, the valves, which are of the double-ported type, being placed in the cylinder ends, the cylinder end thus forming the steam box. The exhaust valves have a plain motion, derived like the motion for the steam inlet valves, from eccentrics fixed on the crank shaft. The question of government is an extremely important one in work of this character, and specially powerful and sensitive governors have been fitted to the engine, in connection with which are several devices, designed for securing good parallel running, and for dealing with greatly varying loads. Each governor is also fitted with a special safety stop arrangement, which will completely stop the engine in the event of its reaching a speed 10 per cent above the ordinary working speed, and will also shut down the plant in the event of any failure of the governing gear, yet this is accomplished without interfering with the engine taking excessive overloads, even beyond the full range of the cut-off gear.

Each cylinder is bolted at the front end to a massive cast-iron bed frame of the Corliss trunk type, having bored out guides formed in them for the piston rod cross-heads, the outer or bayonet ends of these frames being bolted up to suitable facings cast on the crank shaft pedestals, which are large independent castings resting directly on the foundations. The Corliss trunk frames are so designed as to bear upon the foundations throughout their entire length. Each fly-wheel is 22 ft. in diameter, and is directly attached by strong bolts to the rotor, which is otherwise independent of the fly-wheel.



GENERAL VIEW OF INTERIOR OF POWER STATION

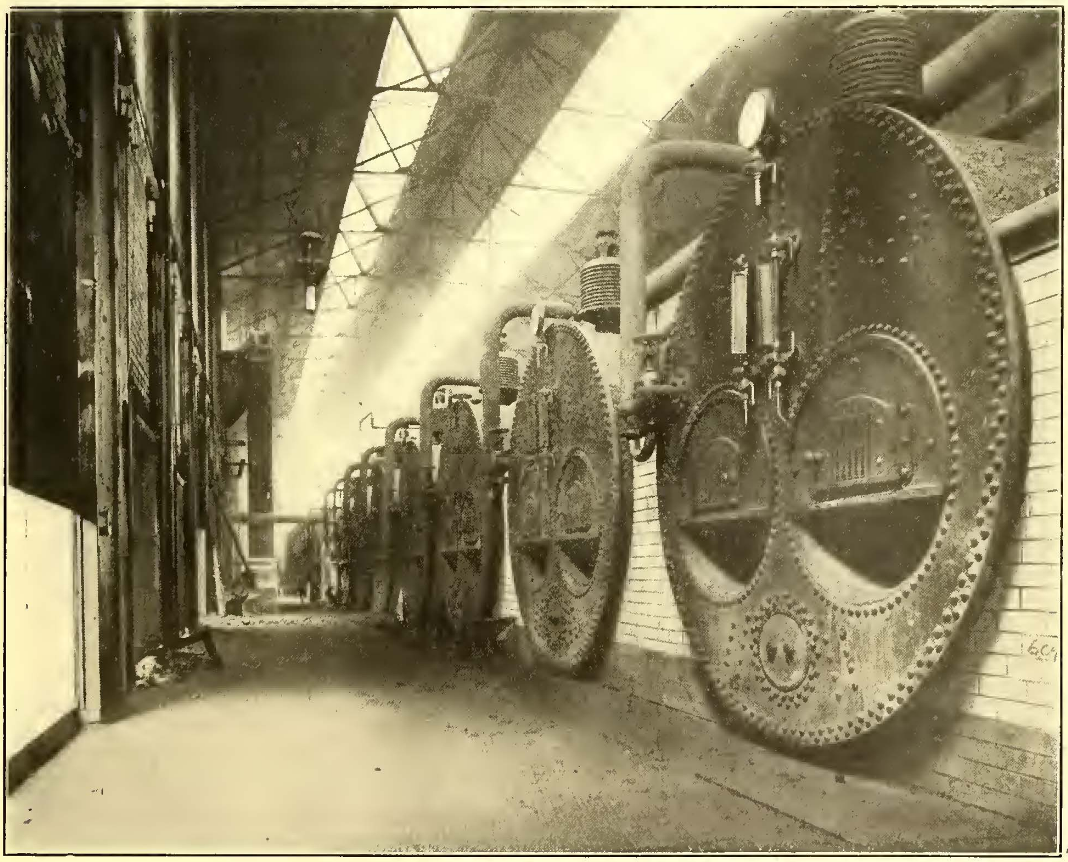
The engines are solidly constructed, and of massive proportion, the weight of each bed-frame being 14½ tons. Each crank shaft main bearing weighs about 11 tons, and the crank shaft 17 tons, the crank weighing 5 tons each.

The pistons are of cast-iron, fitted with Ramsbottom rings, the low-pressure pistons having also bands of white metal, to improve their wearing properties. The piston rods are made of Siemens-Martin steel, secured to the pistons by means of large nuts. They are cottered into the cross-head in the usual way, and carried through the back ends of the cylinders, being made of a large size so as to serve as a substantial support to the weight of the pistons.

The cross-heads are made of wrought-iron of the solid type, fitted with gunmetal steps, having suitable adjustment. The connecting rods are made of wrought-iron, the crank pin ends being solid, and the cross-head end of the jaw type, fitted with hard steel pins, held in place by large nuts. The crank pin steps are of gunmetal, lined with babbitt metal, and provided with suitable wedge adjustment. The crank shaft is made of Siemens-Martin steel. The crank shaft main bearings are of cast-iron, lined with babbitt metal, fitted with a special arrangement of oil pipes, giving ample lubrication.

A very complete system of lubrication is employed, the various parts of the engines being protected against splashing by oil throwers.

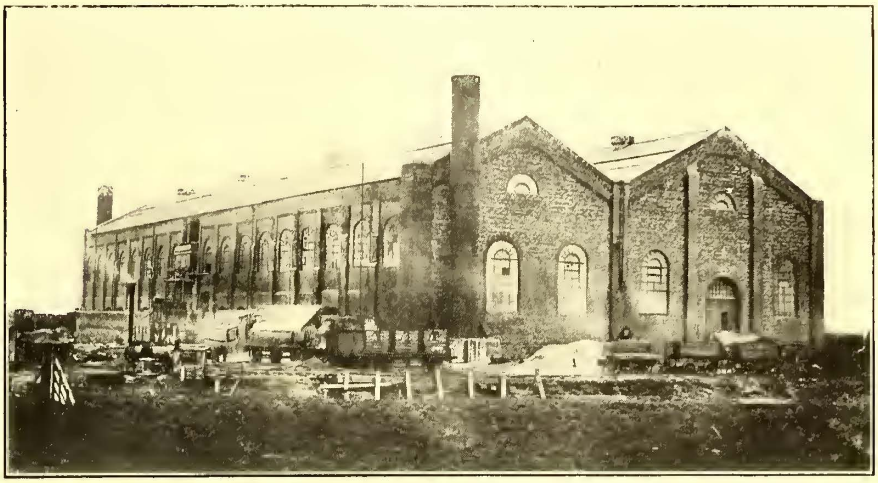
Each engine is fitted with a condensing apparatus, consisting of two Edwards air pumps, worked from the low-pressure tail-rod by means of links and levers. The condenser, which is of the jet type is suitably placed relatively to the cylinder and to the air pumps, and has in connection with it a sluice valve and an automatic exhaust valve, so that the condensing apparatus can be thrown out of action, and the engines run non-condensing when required.



GENERAL VIEW IN BOILER ROOM OF POWER STATION.

The vertical-cross-compound engine has cylinders 23 ins. and 46 ins. in diameter, 3-ft. 6-in. stroke, and will develop 1180 hp when running at 94 r. p. m. The general construction of the cylinders, valve gear and other parts is similar to that of the horizontal engines described, the main difference being in the framework and staging. A similar arrangement of condensing apparatus has also been adopted, the air pumps being worked by means of levers from the low-pressure main cross-head. With each engine is also supplied a barring gear, driven by a small electric motor.

The alternators are three-phase, 25 cycles, the larger running



EXTERIOR OF POWER STATION

at 75 r. p. m., and the smaller at 94 r. p. m., with a pressure of 7500 volts. These machines, along with the remaining electrical plant, were made at the Preston Works of Dick, Kerr & Company. Each rotor or magnet wheel is carried between the cranks, the armature ring, or stator, being erected on its own slide beds, concreted in and bolted down on the engine foundations. The rotor of the 150-kw generator carries forty radial cast-steel poles of oval section, secured by tap bolts to the outside rim of two finished cast-steel rings of massive T-section, carried and driven from a central cast-iron spider through the medium of sixteen axial bolts.

The pole tips are of laminated steel with central air space, corresponding to grooves on the pole sides and the clearance between the rotor rings, dovetailed tight into the poles to keep the field coils in position. These are of bare copper strip, wound edgewise. The surface of the coils is left bare to aid the dissipation of heat, while the central ducts on the poles give ample ventilation to the iron. The cast-iron spider is built in halves and clamped to the shaft by four heavy bolts. The magnet rings are also in halves, but staggered relative to each other and the spider and shrunk together by double headed keys. The cast-iron slip rings are of stiff section, carried on either side of a cast-iron spider by axial bolts insulated with ebonite. On each slip ring there are three carbon brushes. The weight of the magnet complete is about 48,500 lbs., of which the poles account for 12,800 lbs., and the spools 6350 lbs.

The core segments of the stator are of annealed iron, punched in sections with their paper insulations. The sections break joints to equalize the reluctance, and are strung on through bolts that clamp them up between a deep internal flange and a stiff cast-iron ring built in sections. The complete stator weighs 75,800 lbs.

Each coil is fully insulated, dried and tested to 15,000 volts before being inserted in the slots, the stator when completed being adequately tested. Special ventilation ducts are provided, the rotating field forcing cool air through these ducts and out at apertures cored in the frame. The winding of each phase is distributed over two slots per pole. The connection is star with center earthed. The stator terminals consist of three

VIEW OF SWITCHBOARD GALLERY, MAIN POWER STATION

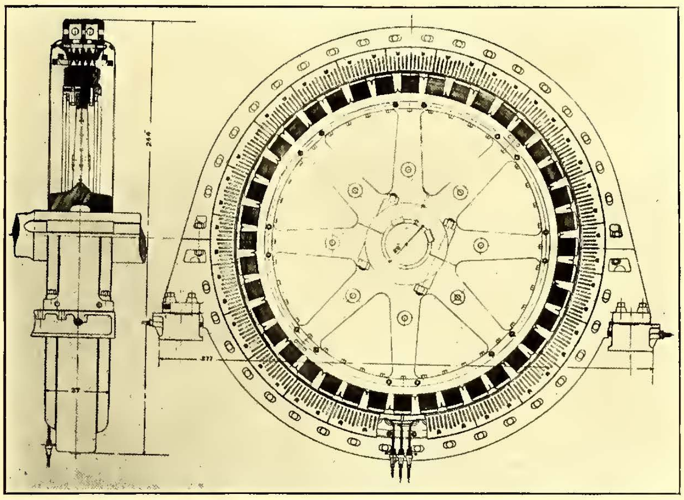
high-tension porcelain pots carried on a bracket at the bottom of the frame and enclosing the bare couplings. In each alternator provision is made for shifting the stator axially by ratchet jacks to clear the rotor and give comfortable access to the windings.

The constructional features of the 750-kw alternator are almost identical with those of the 1500-kw sets.

There are three direct-current exciter sets, each consisting of a standard four-pole, 100-kw generator, coupled to a Willans & Robinson high-speed engine, running at 380 r. p. m., the working voltage being 125. They also operate the station lights and ash conveyor and barring motors.

The main switchboard is erected on a gallery over a fireproof high-tension chamber, and is built up of thirty-three 2-ft. panels of enamelled slate. Starting from the right there are swing brackets carrying two A. C. bus-bar voltmeters, reading to 8000 volts, synchronizing voltmeter 0 to 16,000 volts and synchronograph with lamps. There are then five main alternator panels, one blank panel, one total station power panel, six high-tension feeder panels for distant sub-stations, Seaforth, Sandhills and Birkdale; three exciter panels, one sub-station total power received panel, four high-tension sub-station transformer panels, one blank panel, four rotary converter direct-current panels, one blank panel, one sub-station total power delivered panel, also comprising one sub-panel switch for starting the rotary converter from the D. C. 600-volt bus-bars; four sub-station feeder panels, lastly, one station lighting and blower-motors' starting panel, and swing bracket with rotary converter bus-bar voltmeter and paralleling voltmeter. All the sub-station gear is for the local sub-station at Formby.

The whole of the high-tension switch gear, oil switches, instrument transformers and bus-bars are erected in a fireproof h. t. chamber, the dimensions of which are 79 ft. x 12 ft., and constructed of steel girders and concrete. Connection between the terminals of each stator and its oil switch is made by short leads to a trifurcating box in the pit, thence by a three-core h. t. lead-covered cable passing along an independent duct through the foundation up to the cellar ceiling, along which it is run by ducts through the h. t. chamber floor, where it ends in a second trifurcating box on the wall. The rest of the h. t. wiring is by individual conductors. The three-core h. t. leads are of stranded copper cable, paper insulated and lead covered. The single cables are rubber insulated, taped and braided; they were designed to pass a flash test of 25,000 volts between the phases and each to earth. The solid copper rod h. t. bus-bars are insulated in a similar manner, and reduced in section from alternators to local sub-station panels as power is tapped. The bus-bars and individual leads are carried on corrugated h. t. porcelain pots, connection between oil switch and bus-bar being made through a h. t. insulating or "hook switch." In the instrument transformers, supplied with the ammeters by Elliott Bros., the primary is simply a straight length of lead or bus-bar enclosed by the secondary and iron circuit. In the wattmeter current transformer, supplied by the Stanley Instrument

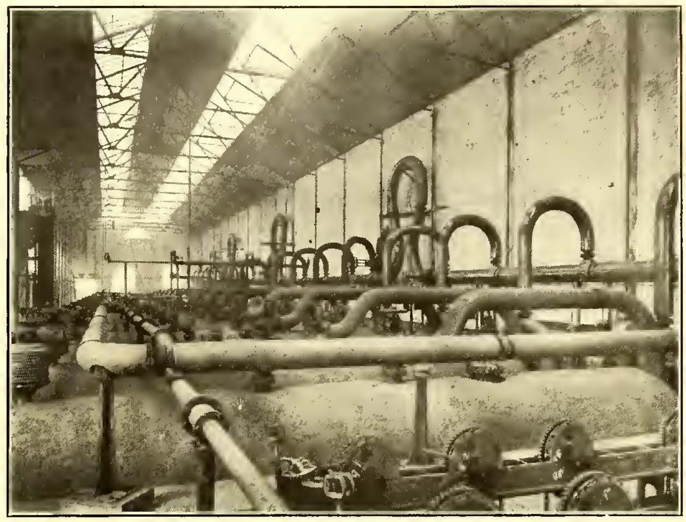


ELEVATION AND SECTION OF MAIN ALTERNATOR

Company, with its meters, the primary consists of a few turns in series with a bus-bar.

In all cases the low-tension secondary leads pass through the ceiling to the switchboard above.

The total A. C. power generated, before passing to the sub-station feeders, is recorded in an integrating wattmeter. Connection to each triplet of transformers in the sub-station is made through a hook switch, oil switch and three cast-iron tail-end glands, bushed with corrugated porcelain bobbins, piercing the front wall of the chamber. Each transformer is single-phase split-phase, and has two independent secondaries, the six of the triplet being grouped in double mesh to afford six phases for operating the rotary convertors. Connection between the grouped secondaries and the six rotary slip rings is



BOILER PIPE CONNECTIONS

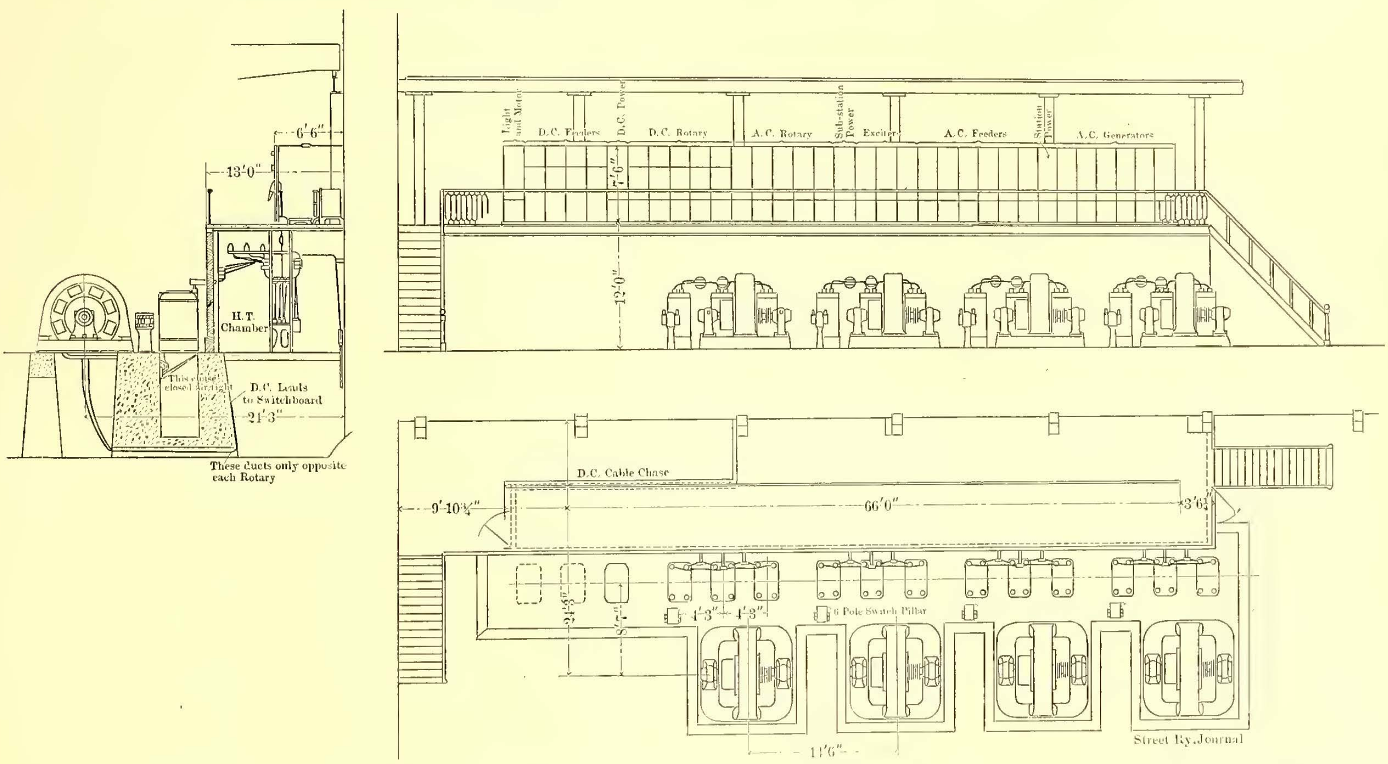
made through a pair of three-blade switches carried on a stand, on which is also placed the equalizer switch for the series field.

The chief feature of the alternating board is that the high-tension current is confined to the pit below the board, this being effected by the long-arm oil switches which are used throughout the system.

The rotor field rheostats are of massive construction, and consist of cast-iron grids insulated with hard micanite and assembled in frames forming layers in a vertical stack, which open top and bottom for thorough ventilation.

BOILERS

There are sixteen boilers, made by Yates & Thom, and of the Lancashire type. Each boiler is 32 ft. long by 8 ft. 6 ins. in diameter, with two flues, each 3 ft. 5 ins. in diameter, and is constructed for a working pressure of 160 lbs. per square inch, the shell plates being 13-16 in. thick, flue plates 9-16 in. thick, and the end plates 3/4 in. thick, and each shell being in five rings



PLAN, ELEVATION AND SECTION OF FORMBY SWITCHBOARD, SHOWING GALLERY AND HIGH-TENSION CHAMBER of one plate each. The boilers were tested satisfactorily to 260 lbs. per square inch. They are equipped with a full set of fittings and mountings, made by the same firm, and are hand-fired. They are arranged in two batteries of eight each in one row.

In each of the down-take flues at the back end of the boilers

GENERAL VIEW OF INTERIOR OF SUB-STATION

is fitted a superheater of the Galloway type. The feed pumps were supplied by Mather & Platt, Ltd.

The fans for the induced draft work are two in number, each capable of furnishing sufficient air for the consumption of 10,000 lbs. of coal per hour, with a temperature of the flue gases after passing through the economizers about 400 degs. F., and this under a normal speed of 175 r. p. m. The fans are of the three-quarter housing over hung-blast wheel type, and are directly connected to horizontal side crank engines. The housings are built on an angle-iron framework, side plates of No. 8 gage steel, scroll plates of No. 10 gage steel. The side plates are further stiffened by 4-in. x 5-in. x ½-in. horizontal and vertical angle-iron braces on engine sides, and by 4-in. x 4-in. x ½-in. angle-iron braces on the inlet sides of fans. The housings are supported on 4-in. x 5-in. x ½-in. base angles. The size of the inlets is 6 ft. 2 ins. in diameter. The size of the outlets is 4 ft. 11¾ ins. square. The blast-wheels are carried on steel shafts, 5 ins. in diameter, and supported by self-oiling water-cooled bearings, 27 ins. long. The products of combusiton after passing through the economizers enter the fans at a temperature of about 400 degs. F., and are discharged through underground brick ducts to the base of the chimney, located just outside the building. This chimney has a height of 60 ft. in order to discharge the products of combustion above the surrounding buildings. The whole of the induced draft apparatus was supplied by the Buffalo Forge Company.

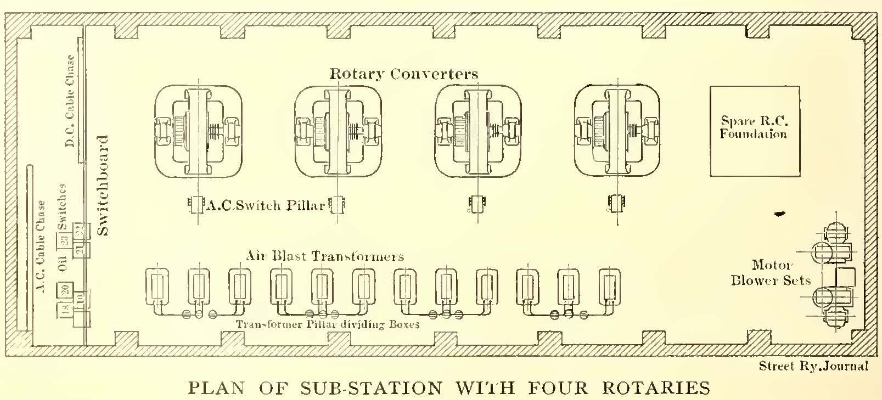
The economizers working in conjunction with the boilers were made by Green & Son, Ltd., and are constructed in groups of 120 tubes. The installation on the whole contains 1440 tubes, representing 14,400 sq. ft. of heating surface. The economizers are arranged in two separate batteries, one at each end of the boiler house, each consisting of 720 tubes. These are again sub-divided in two separate apparatus of 360 tubes, in sections of tens, so that both can be worked together or independently as occasion requires. Each group is coupled together by expansion elbows at top and bottom. The scrapers are actuated by a double set of gearing on the top of the economizers, and the whole is driven by a direct-geared electric motor. The economizers are specially constructed to work at high pressure and the top boxes are fitted with internal lids of the latest pattern. The total water capacity of the economizers is some 9000 gallons. The whole of the steam-feed exhaust and injection main and auxiliary piping was supplied by the contractors, and fitted at their Kilmarnock works. The feed ring (6 ins. in diameter) runs the whole length of the boilers, branches to each boiler being taken through check valves. The ring is supplied from pumps in triplicate. The feed water can be passed either through the economizers or direct to the boilers by a duplicate system.

The main steam piping, which is 12 ins. in diameter, is a combination of the ring and bye-pass systems. The steam is taken from the boilers, passed through superheaters and then into the main ring, or direct through a bye-pass to the engines. The steam pipes are entirely on the duplicate system, and are of steel.

The exhaust pipes from the main engines are 24 ins. in diameter, and connected direct to jet condensers. The whole of the exhaust piping from exciter sets, fan engines and boiler feed pumps is connected to an auxiliary surface condenser. The blow-off and main drain are connected to a common blow-down tank.

SUB-STATION EQUIPMENT

The sub-station equipment, save as regards amount of plant, is identical, and to describe one in detail will give an adequate idea of the whole of them. The three largest, Seaforth, Sandhills and Formby, have each four rotary converters, while Birkdale has three, provision being made in each case for extensions. Each rotary converter is arranged with its corresponding groups of statics alongside, the high-tension oil switches being placed underground.



PLAN OF SUB-STATION WITH FOUR ROTARIES

The rotary converters are in appearance similar, in general design, to the standard d. c. machines. They are eight-pole, developing 600 kw, at 600-650 volts at 375 r. p. m. The core discs are segmental, and dovetail into machined grooves on a C. I. spider, the rim of which, following standard practice, is sectional to avoid shrinkage strains. On the alternating-current side of the machine are six gunmetal slip rings, connection between the radials and the outer rings being effected by insulated bolts carried through the intervening rings. Each slip ring carries three laminated copper brushes.

The average finished weights of this rotary are: Armatures, 10,380 lbs.; magnets, 21,100 lbs.; complete machine, 40,940 lbs.

The transformers are of the air blast type, and have each a capacity of 200 kw. They are circular, and are built up of copper strip, wound on edge and insulated with special wrappings, repeatedly impregnated and dried. The secondaries

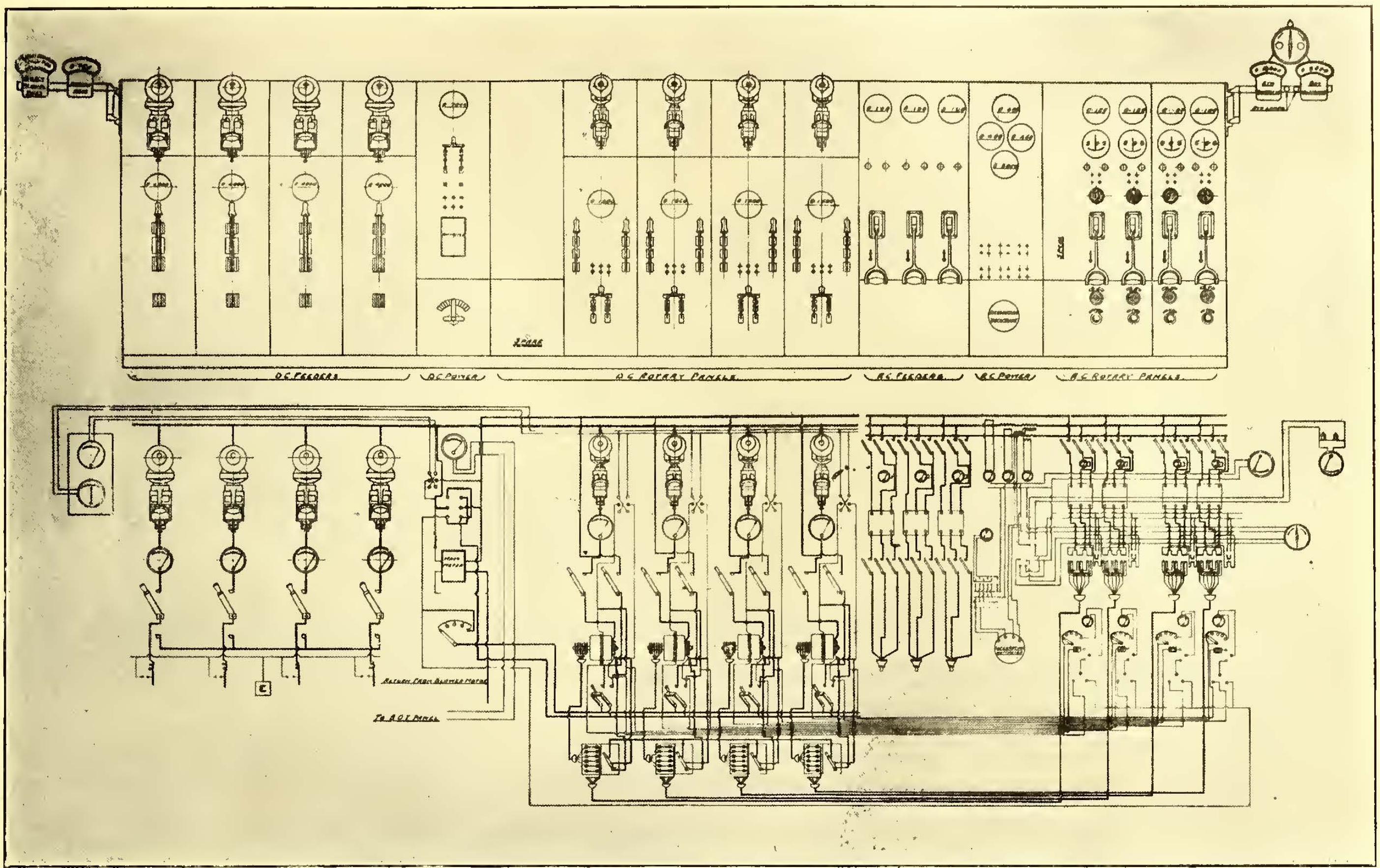


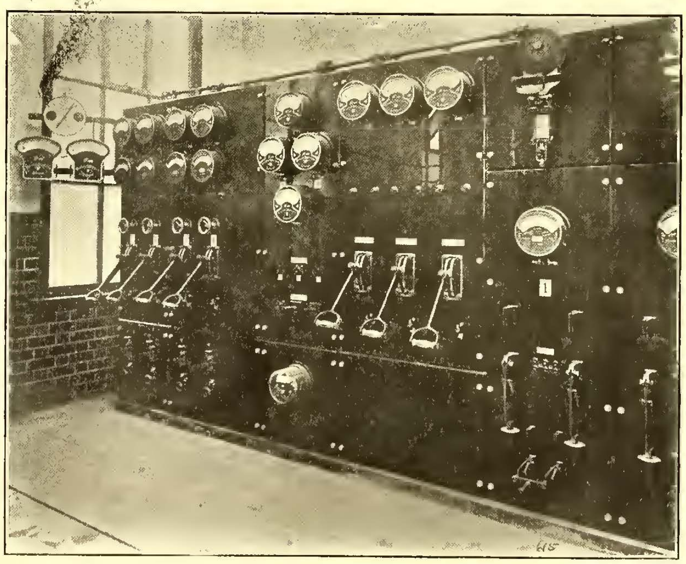
DIAGRAM AND FRONT ELEVATION OF SUB-STATION SWITCHBOARD

are inside next the core, the primaries above and outside. Ample ducts are left between the coils, core, casing and each other to afford free passage for the blast, which, entering below, may be regulated by a baffle above.

The core plates are of the best annealed soft iron, coated with a special insulating japan, in two widths, as a first approximation to a circular section. The primary leads pass out at a pair of corrugated porcelain bobbins sealed into the hood and screw-couple to the leads emerging from the h. t. chamber through a tall end gland, ebonite screw sockets encasing the naked connection. The windings may be readily inspected on unscrewing the sheet-iron sides. The secondary loads pass under the floor up the slip ring stand. The primaries were flashed at 15,000 volts to earth and secondaries, the latter at 2500 volts to earth. Each transformer weighs approximately 5450 lbs. The blowers, of which there are two in each sub-station, consist of a standard 5-hp motor, coupled on a combined base to a Davidson Sirocco fan, which is keyed direct on the motor shaft. The capacity of each fan is 8000 cu. ft. of air per minute, at a pressure of 2 ft. to 3 ft. of water.

The sub-station switchboards consist of a high-tension and low-tension side, the latter having been supplied by Elliott Bros., the switches and circuit breakers being of the standard Dick-Kerr pattern. On the sub-station total power-received panel are three A. C. ammeters, one in each phase, and an integrating wattmeter on the sub-panel. On the transformer panels are an A. C. ammeter, center zero rotary field ammeter, voltmeter synchronizing plug, oil switch, operating gear, field rheostat hand wheel, field break switch and field two-way switch.

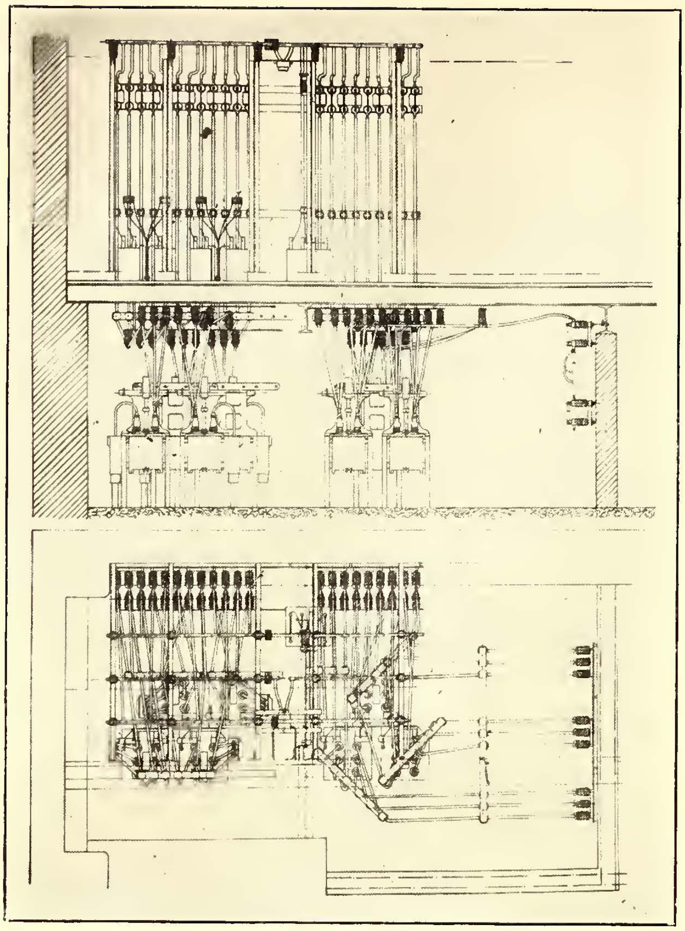
The rotary converter panels carry an auto-circuit breaker, and on the D. C. super-panel is an ammeter two-way paralleling plug and two single-pole knife switches, with starting bar coupler switch on sub-panel. On the power-delivered panel are an ammeter, two-pole change over switch, two-way voltmeter plug and integrating wattmeter. On the sub-panel the rotary D. C. starter, a multiple-contact switch connected to a grid resistance behind. On each of the four D. C. feeder panels are an auto-circuit breaker on the super-panel, D. C. ammeter and



HIGH-TENSION SWITCHBOARD AT SUB-STATION

S. P. change-over switch, a Garton lightning arrester and choking coil being behind.

The change-over switches are chiefly for burning out a fault in one of the feeders, by cutting out the others or for disconnecting a sub-station. Other panels control lighting switches and motors, and a further board carries the Board of Trade instruments.



SUB-STATION SWITCHBOARD CONNECTIONS

HIGH-TENSION TRANSMISSION

The high-tension cables leading from the power house are arranged in each case in triplicate. Under ordinary working conditions all three cables are used, but in case of breakdown of any of the cables, the two remaining ones can do the work without the drop or the current density exceeding the permissible limit.

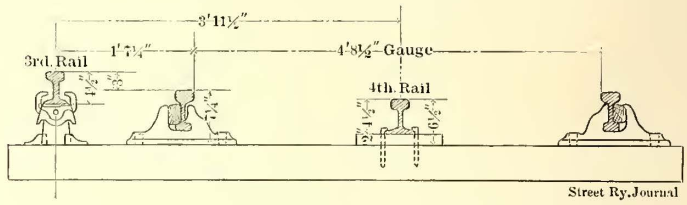
The whole of the cables were manufactured and laid by W. T. Glover & Co., Ltd., as sub-contractors. The extra high-tension cables are of the triple-triangular type, diatrine paper insulated, lead covered and armored, laid on the solid system.

Four different sizes of cable were used, viz., 37-15, 37-16, 19-15, 19-16; the length of each being, respectively, 13 miles, 6½ miles, 6½ miles and 18 miles—a total of 44 miles.

The insulation consists of manila paper impregnated with diatrine by a special process, which ensures that the paper is thoroughly impregnated, the surplus compound being removed from the surface of the paper by means of a special apparatus.

The thickness of the insulation is .36 in. between conductors, and .26 in. between conductors and the lead sheath. This latter lessened thickness is accounted for by reason of the system being earthed at the center point of the machine winding, the cables being made for a working pressure between conductors of 10,000 volts, and a pressure to earth of 5780 volts. Each of the insulated cores is finished off with a different colored layer of paper strip, which serves as a distinguishing mark.

The lead sheathing varies from .125-in. to .15-in. thick, according to the size of cable. The armoring is of galvanized steel wires, .08 in. to .1 in. in diameter, which acts as a mechanical protection in addition to making a most satisfactory and efficient earthing conductor. The joints are of the plumbed lead-sleeve type, the lead sleeve being filled up with diatrine compound.



CROSS SECTION OF TRACK, SHOWING THIRD AND FOURTH RAILS

The troughs are made of stout wood, tarred and creosoted, filled with compound and covered over with tiles. Specially prepared impregnated wood bridges support the cables at 18-in. intervals. Three cables run in each trough. The cables are laid for the most part in the 6-ft. way, and where they pass over bridges or in exposed situations are laid in stout steel troughs.

All cables were tested with 30,000 volts between cores and to earth for 1 hour before leaving the works.

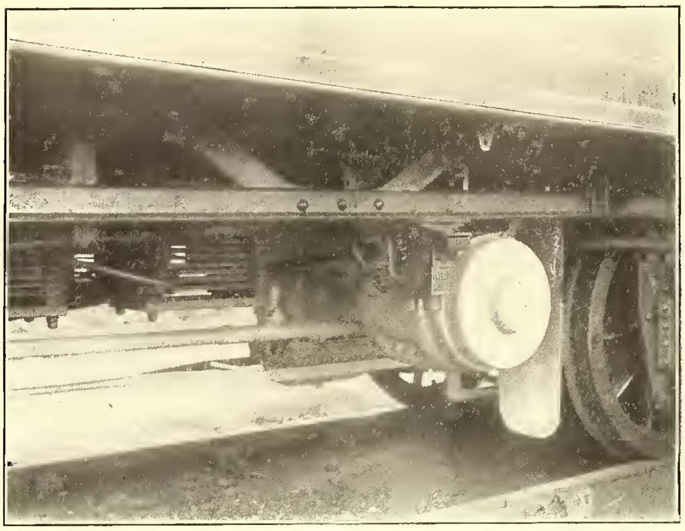
TRACK CONSTRUCTION

The track is furnished with two "third" rails, one for distributing and one for returning the electric current to the

VIEW AT GRADE CROSSING, SHOWING THIRD AND FOURTH RAIL INCLINES, THE FORMER PROTECTED BY GUARDS

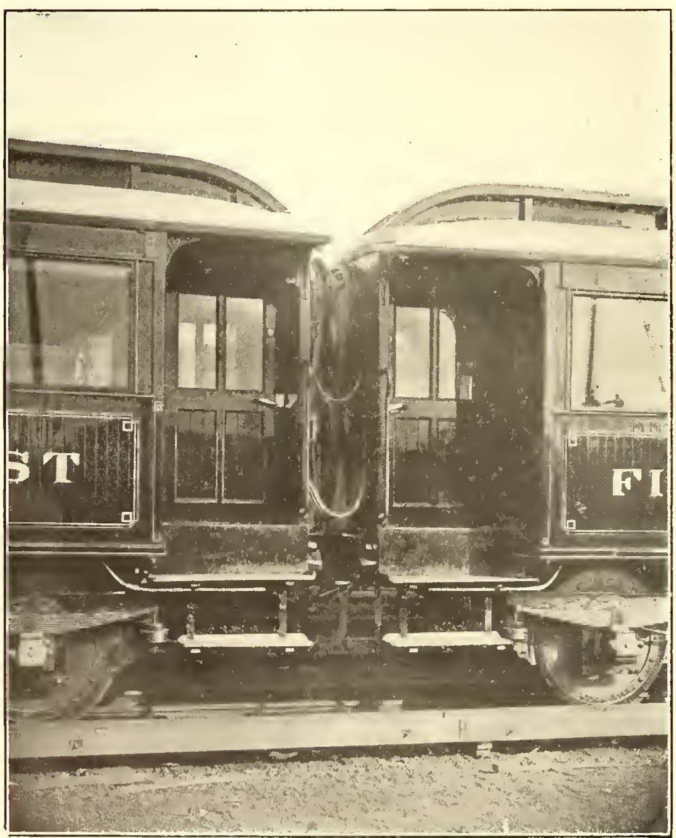
VIEW ON TANGENT AT FRESHFIELD

VIEW AT SANDHILLS, SHOWING JUNCTION OF ELECTRIC AND STEAM RAILROAD DIVISIONS power station. The former is carried alongside each track in the usual way, while the other rail is placed between the running rails, uninsulated on the ties, thus forming the principal part of the return circuit. While the joints of both the third and the fourth rail are bonded in the ordinary way, in the



MOTOR-DRIVEN VACUUM PUMP

manner described below, the fourth rail is also cross-bonded to the running rails at their ends. While, by this arrangement, the troublesome bonding of the running rails is avoided, as are also the complications involved in using an insulated fourth rail for the return, the further advantage is obtained that the



VIEW OF VESTIBULE CONNECTION BETWEN CARS

iron in the running rails is utilized as part of the return current. No collector shoe is provided on the train for the fourth rail, the current being delivered through the wheels to the running rails, and thence through the cross-bonds to the fourth rail. The installation of this rail also makes it a comparatively simple matter to renew the running rails, without unduly interfering with the continuity of the return circuit.

The third and fourth rails are both of equal section, and consist of mild steel of special high conductivity, the resistance being proved by test to be not greater than seven and one-quarter times that of pure copper. As a matter of fact, the average resistance is somewhat lower. The rails have been supplied by the Northeastern Steel Company, of Middlesborough; are of the T-section, weigh 70 lbs. per yard, and are in lengths of 60 ft.

The third rail is supported at intervals of about 10 ft. on insulators of reconstructed granite, held in position by two clips, the center of the rail being exactly 3 ft. 11½ ins. from the center line of the track, and the top of the rail 3 ins. above the surface of the track rails. This dimension may be regarded as the British standard, having been agreed upon by all the main line steam railroad companies, at a meeting held at the Railroad Clearing House, on March 3, 1903, in order to obtain uniformity in case of extensions of third rail systems. It is of ample section to convey the full amount of current required by the trains,

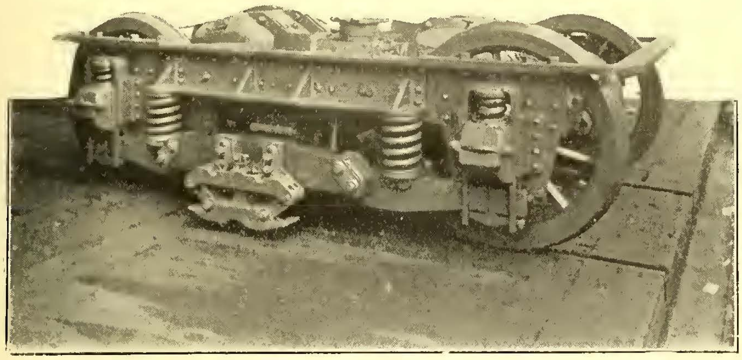
SECTION PILLAR, OPEN

when between two sub-stations, without causing any appreciable loss in voltage. Generally, the third rail is placed in the 6-ft. way between the tracks, but occasionally it is brought outside the track to suit special conditions, and at all grade crossings the gaps are bonded with cable underground. Timber guards have been provided at all the busy places on the line, to prevent the possibility of any person coming into contact with the third rail. The fourth rail is supported on wooden blocks, and is placed in the middle of the 4-ft. way, between the two running rails.

At most stations the third rail is interrupted and the ends are connected by cables to section switches. This apparatus consists of four knife switches, one for each end of the up and down line, which, in the ordinary way of working, are connected in parallel. By cutting out one of these switches in two adjacent boxes any part of the up or down line may be made currentless.

In providing for expansion and contraction, due to change of temperatures in the rails, they are divided into sections of 300 ft., and the joints between the rails making up this section are known as "fixed joints." The joints connecting the sections themselves are known as "expansion joints." At the fixed joints no provision is made for expansion or contraction, this being concentrated at the expansion joints. The fish-plates at the fixed joints are made as rigid as possible, and the bonds are four in number, two bonds being fixed in the web of the rail and two bonds in the flange of the rail.

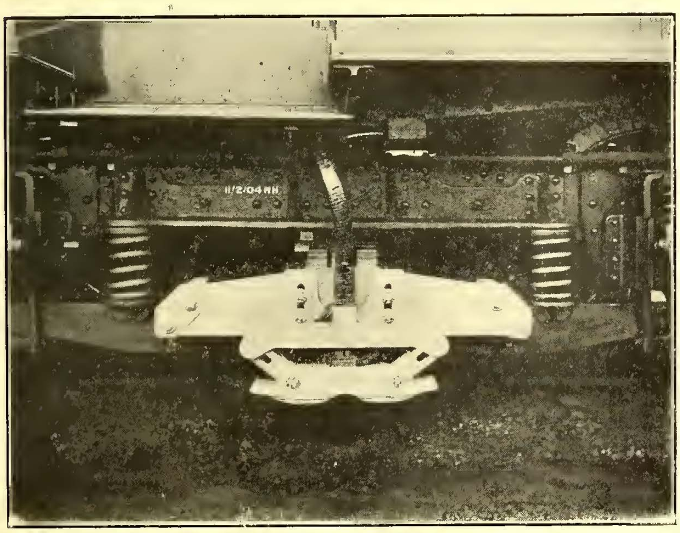
It was deemed advisable to use bonds of semi-flexible type, which have a conductor built up of parallel strands of copper ribbon or "flat wire" with solid copper terminals. They are thus sufficiently flexible to provide for any movement which may take place at the joints, and are more easily adjusted in case of any variation in distance between the bond holes at



SIDE VIEW OF TRUCK

the time of construction. The bonds at the expansion joints are four in number, of the same cross-section as those at the fixed joints, but all four are fixed in the flange of the rail. These bonds are also made of "flat wire."

The fish-plates at the expansion joints are of special design, and properly slotted to provide for any change of length which may take place in the 300-ft. section. This system of bonding is carried out on both the third and fourth rails. The terminals of all the bonds are of solid copper, and are expanded in the bond holes by means of screw or hydraulic compressors. Each



THIRD-RAIL COLLECTING SHOE

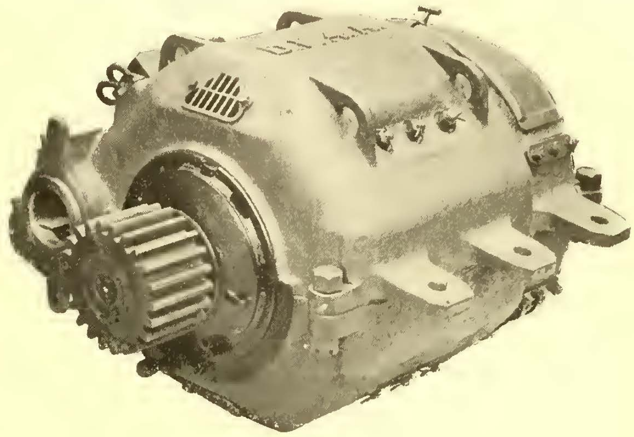
track rail is bonded to the fourth or negative rail by means of flexible cable bonds. The bonds were supplied by the Forest City Electric Company.

THE ROLLING STOCK

The trains consist in most cases of two first and two third class cars, the latter being at either end. Views of these cars and of complete trains were publishel in the issue of Jan. 30.

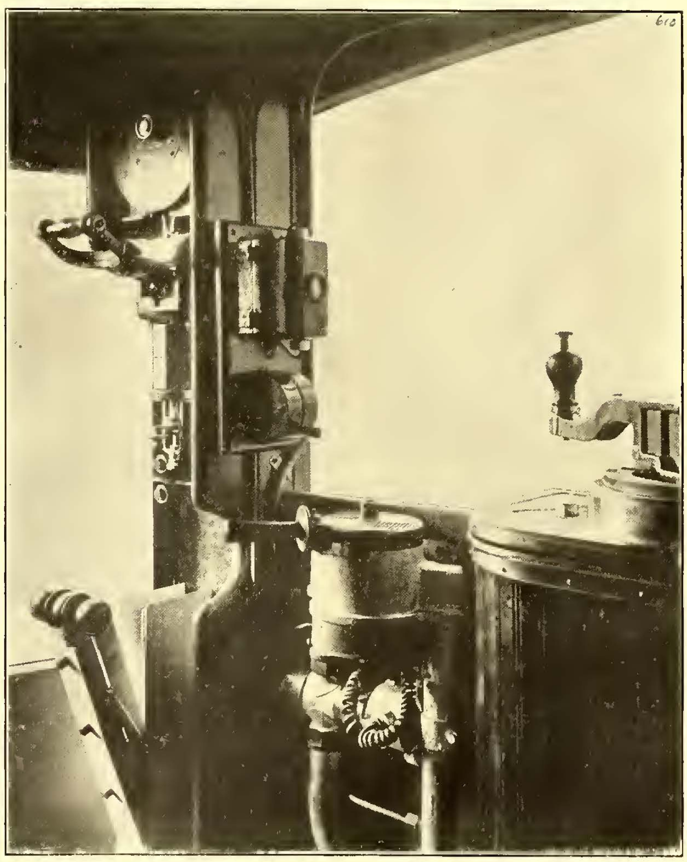
The third-class cars, which are the end cars, are also the motor cars, and as each truck carries two 150-hp motors, there are eight motors per train. The current is conveyed to the motors through a cast-steel shoe, attached to a beam on each side of the motor truck, as shown. Both types of cars are 60 ft. long and 10 ft. wide, being the widest car in Great Britain, and have an 8 ft. wheel base and 40 ft. 6 in. truck base. They are arranged with straight sides, matchboarded below the side lights.

There is a monitor or clerestory roof 6 ft. 2 in. wide, the top being 12 ft. 7⅞ inches from the rail level. The vehicles are



SIDE VIEW OF MOTOR

painted in the company's standard colors of brown and crimson lake. The motor cars are divided into two main compartments, with a baggage and motor compartment; access being obtained through entrance vestibules which are recessed back at either end, the whole arrangement being so designed that the doors shall not project beyond the 10 ft. width when extended. Immediately inside the compartments the seats are placed longitudinally against the side of the car so that ample space is

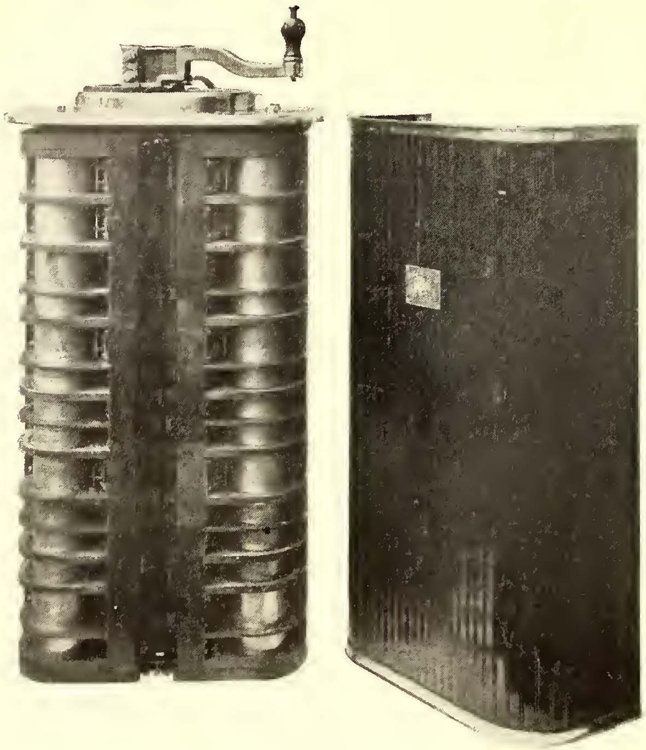


INTERIOR OF MOTORMAN'S CAB—LEFT-HAND SIDE

allowed for the inlet and outlet of passengers. The cars are otherwise fitted with cross seats and reversible backs with a passage between, the first-class accommodating two on either side and a total of sixty-six passengers per car, the third class seating three on one side, and two on the other, and a total of sixty-nine passengers per car, the total accommodation in a normal train being in this way 270 passengers.

Large fixed side lights give passengers an excellent view of the country while passing, and ventilation is obtained through hinged light in the monitor roof. All cars are vestibuled.

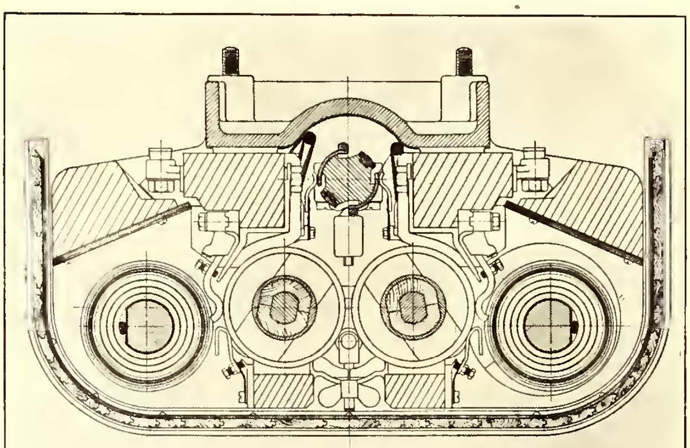
The first-class trailer cars are finished in polished mahogany,



CONTROLLER WITH CASE OFF

with polished Kauri pine panels, the seats being upholstered in epingle; nearly all the seating in these cars was supplied by Hale & Kilburn, for whom G. D. Peters & Company are British agents. The floor is covered with a crimson velvet carpet over "kork."

The third-class motor cars are finished in polished wainscot oak, all seats being covered with light rattan canework to match. Side lights and general fittings are similar to those

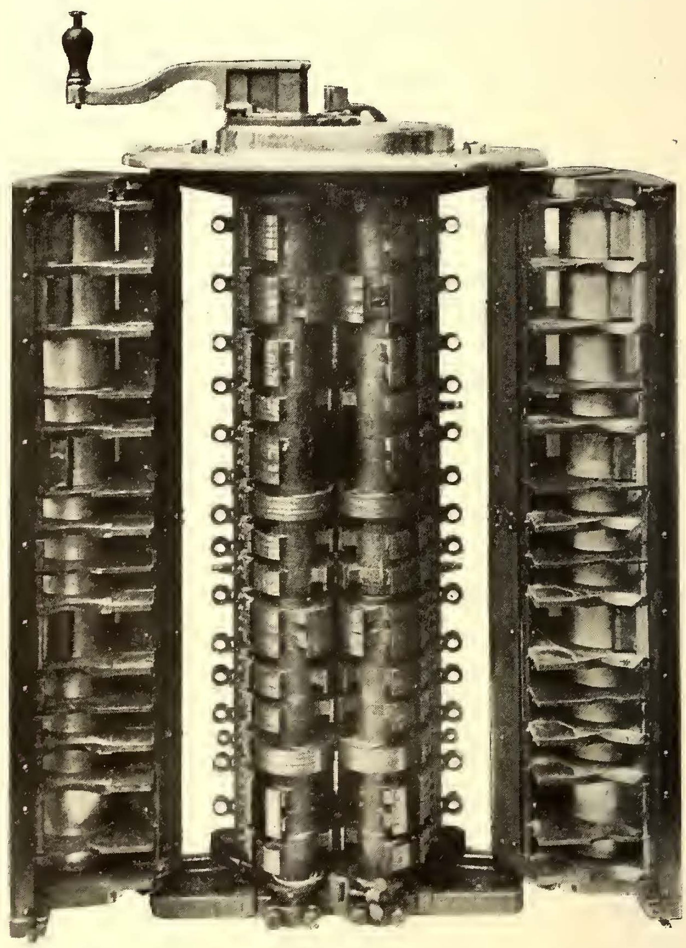


HORIZONTAL CROSS SECTION OF CONTROLLER

in the first-class cars. In the center of the motor roof is an oak rail, with leather hand straps for the use of passengers when the train starts at a station. At the driving end a baggage compartment is arranged for light luggage. Oak shutters on either side which roll down in blind fashion, and close or open the whole length of the compartment, have been arranged with the object of facilitating the work of the guard. The under frames throughout are of steel, the sides and centre sills being of channel section, each sill being trussed with rods passing over the bolsters to the steel-plate headstocks. The bolsters are of steel channel, riveted to the underside of the sills and supported by straps. Central buffing and drawbars are arranged at each end of the trailer cars, and the trailing end of the motor cars, the couplers being fitted with side guide springs to damp oscillation and lateral motion when passing over crossings and round curves. At the motor compartment end, standard buffing gear is utilized to simplify the running or shunting of these trains if brought in contact with the ordinary rolling stock.

All cars are electrically lighted and heated, the necessary switches being placed in the vestibule entrance of each coach, and so arranged as only to be accessible by means of a special key carried by the guard. There is a through bell communication which enables the guard, by means of a special key, to give the motorman the signal to start from any vestibule entrance on the train.

The total weight without passengers of each trailer car is



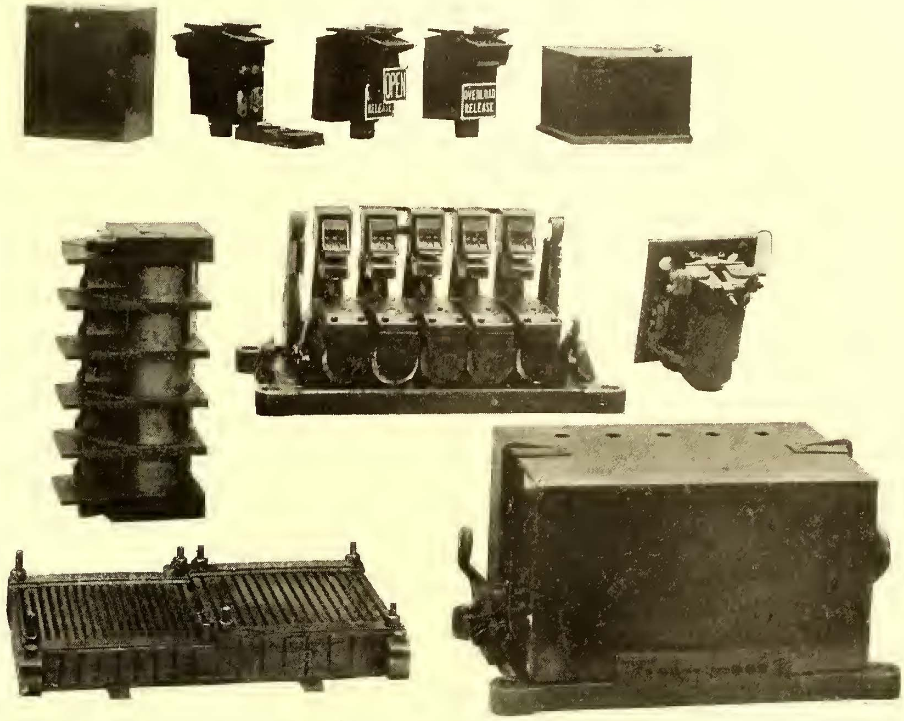
CONTROLLER WITH BLOW-OUT MAGNETS DETACHED

26 tons, making the total weight of each car train 140 tons, and a length over all of 248 ft. 6 in.

The trucks for the trailer cars are the company's standard, the frame being composed of angle steel section, and channel steel bolsters. Special springs have been introduced to insure easy riding.

The motor truck is entirely built of steel, and as stated before, has 8 ft. wheel base; the wheels are 3 ft. 6 in. diameter. The weight of the car is transmitted from the top bolster by means of elliptical springs to the swing bolster, the weight being transmitted thence in the usual method by swing links to the truck side frame. Steel angles from the side frames, cast-steel stifleners riveted to the outsides of these form nests for the tops of the heavy helical springs, which intervene between the truck frame and the straight equalizer bar. This equalizer bar is carried in stirrups below the axle boxes, the stirrups themselves bearing on the box tops by means of very stiff three-coil helical springs. A special feature in connection with the axle-boxes is that the fillets on the journals are kept quite clear of the brasses, thus avoiding a fruitful source of hot bearings. The gears are solid and trussed to the axle and keyed.

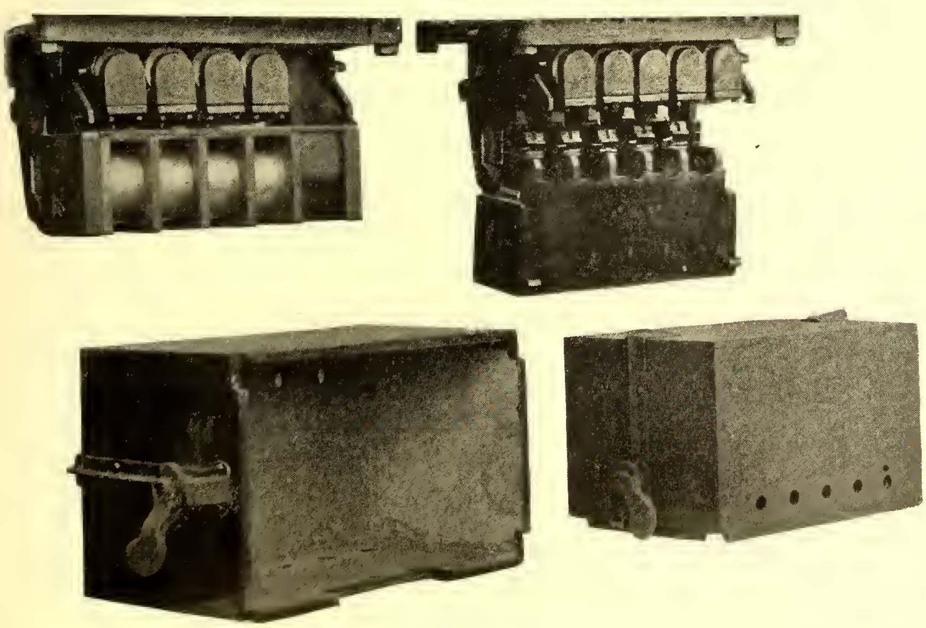
The current, as already stated, is collected by cast-steel shoes on each side of the motor truck. These shoes weigh about 90 lbs. each, and have so far given the greatest satisfaction. On straight runs of third rail, there are thus four shoes collecting at one time. From these shoes, which are suspended by forged slotted links from a wooden beam carried on extensions on the truck, a highly flexible lead of special construction is carried to a fixed terminal, from which the main cables pass to the controller.



REVERSES WITH OVERLOAD RELEASES AND SOLENOID SHUNT SWITCHES

The vacuum brake is used on the trains, thus making them adaptable for service with the company's other rolling stock and locomotives at any time. The general arrangement of fittings and brake cylinders is similar to that already in use; the steam ejector is replaced by a twin cylinder-geared vacuum pump driven by a 3-hp 600-volt motor; the usual ball valves on the brake cylinder are dispensed with, and an electrically actuated valve is substituted. The movement of the motorman's valve, when the brake handle is placed in the brake-off position, lifts these valves along the train, procuring, if desired, an almost instantaneous relief of the brake. Automatic electro-pneumatic regulators in the pump motor circuits maintain a constant vacuum in the vacuum reservoir.

A large motor car horn, containing a reversible reed of special construction is used in place of a whistle, a onnection to the vacuum reservoirs enabling the air for blowing it to be supplied from the atmosphere.



REVERSES WITH COVER OFF

The motorman's compartment, in addition to the controller and switches for the main motors, contains a motorman's brake valve, a vacuum gage, a single pole switch for starting the brake motors and fuses for the pump motor and brake control circuits.

The motor compartments have, with the exception of the roof, which is covered with sheet-steel plates, been lined with Uralite, a well-known fireproof material, the floor also being fireproof. In addition to the cable troughs, in which the cables are placed for conveying current to the motors and equipment, being lined with Uralite, the whole of the floor over the motors is covered with the same material and thin steel plates. All the trains carry fire appliances, and ample steps have been taken to insure safety in this respect.

The motors are of the Dick-Kerr 4-A railway type, rated to develop 150 hp at an armature speed of 470 r. p. m. The weight of the complete motor is 6050 lbs, the armature 1920 lbs, and the gear wheels and housing 500 lbs.

The conditions of performance which the motor has to fulfill, both as regards speed and high acceleration, have necessitated liberality in design, and in consequence they will give considerable overloads for short periods with a moderate rise in temperature. The main features of the motor are similar to those of the standard traction type. The magnetic field is built up of steel shells, in which are four laminated steel poles secured to the shells by bolts. The spools are built up of copper wire and asbestos ribbon, heavily taped all over, impregnated and baked. The core discs of the armature are of annealed magnetic steel, punched with keyways and air ducts, and are strung direct on the shaft. The windings are former wound, insulated with a special combination of mica. The commutators are built up of drop forged copper bars insulated with pure mica, the whole being carried on a special hard micanite ring. The complete design of the motor is such that ready access is obtained to the brushes and the commutator.

One of the most interesting features of the equipment is the method of control, which may be termed the direct multiple control system, in contra-distinction to the multiple unit, the main difference in the systems being that in the case of the former it is possible to control the whole equipment of the train by means of two main cable. Previously the great difficulty in the way of such an arrangement lay in the construction of the controller and the necessity of carrying the whole current through one controller.

In the Dick-Kerr system this is rendered possible by the use on the controller of the metallic shield blow-out. Each controller, as shown in the illustrations herewith, contains two power cylinders, each controlling one-half of the train, that is, one motor car is actuated from one cylinder, and the rear motor car controlled from the other. Without, therefore, interfering in any degree with the completeness of the train, it would be possible to divide one of the present trains into two distinct units.

The train is entirely operated by the motorman in his cab at the front. In the cab is a Dick-Kerr d. m. 4 controller, capable, in conjunction with eight reversers, which are bolted up adjacent to their various motors under the floor, of operating the eight motors on the pair of motor cars. The two power cylinders of the controller are geared together and operated from a crank handle, each cylinder barrel being flanked by a powerful metallic shield blow-out solenoid. These may be swung open on hinge pins, such action automatically cutting the winding out of circuit, or, if necessary, lifted off and removed for inspecting the cylinders and contact fingers.

The reversal of direction of the motors is affected by means of a special apparatus operated by the controller reversing barrel. This reversing apparatus carries contacts which are normally left open by gravity, but can be closed by an electro-magnet, which becomes operative through the agency of the controller reversing barrel. There are eight reversers per train, one per motor, which are arranged in four parallels of two in series across the system. In series with each reverser pair are the contacts of two magnetic overload releases, the coils of which are each in the main circuit of one of the motors, its reverser contacts and solenoids. Consequently, whether a pair of motors be in series or in parallel, the overload current in either one will cause both releases to open and cut out the pair. These releases are inclosed in small neat cast-iron boxes mounted on the sides of the car near the truck, facing outwards. When open, a flap falls down exhibiting "open" in raised letters letters on a scarlet ground, which catches the eye immediately. The releases may also be tripped by hand to cut out any pair of motors that may become disabled.

Powerful action of the reversers is secured by a compact magnetic circuit and a free and balanced suspension of a heavy clapper, while uniform and reliable contact is insured by the use of several independent spring contacts, so hung as to render sticking impossible.

In circuit with each pair of reversers is a cartridge fuse and hand knock-out switch in the cab. The latter is for opening the relay circuits of the reversers in order to cut off the motors should the controller cylinders stick in any way, or an accident be imminent. In accordance with the usual practice, the power cylinder is locked when the reversing is in an "off" position, and only then can the handle be removed, while the reversing is locked when on "reversed" or "ahead," and the power on one of the notches.

The power couplings between two cars simply consist of stationary male plug contacts in insulating tubes screwed to the ends of the coaches, with dummies facing them on the coaches opposite, into which female plugs, buried in insulating handles at the end of long flexible leads click home, according to whether connection or disconnection is required.

The heat,light and reverser couplings are mechanically in one and similar in arrangement to the power. They are all mounted about half-way up the car wall, comfortably in reach from the platform, thus obviating all risk of getting on the track and shocks from the third rail.

M. B. HERELEY ON STREET RAILWAY MANAGEMENT

Some ideas upon street railway management recently expressed to a representative of the Street Railway Journal by M. B. Hereley, who was last fall appointed general superintendent of the Chicago Union Traction Company, are of interest, as coming from a man in Mr. Hereley's position, and one whose entrance into the field of street railway management has been comparatively recent. Although a very strict disciplinarian, Mr. Hereley believes that titles should not count in the operating department of a large street railway system. "A superintendent and an assistant superintendent are of course needed, as centers of authority, but when it comes to keeping a traction system in running order, the highest official must not be slow to leave his office and go to the place where orders are to be enforced. An official of this department cannot afford to have social engagements, and there are times when he cannot even think of sleeping." While he believes that each assistant must be held responsible to his chief, it is no reflection on these assistants when a superintendent sees fit to go to the scene of a breakdown. If the chief does not sleep when there is trouble with the service his assistants are less likely to do so.

Since his appointment as general superintendent last November, Mr. Hereley has been particularly fortunate in regard to the number of accidents. For a period of three months the system was operated without a serious accident to a passenger. Part of this good fortune Mr. Hereley is certainly justified in believing to be due to good discipline and co-operation on the part of all the employees. "Strict discipline will not make enemies, so long as the rules are just and there is no discrimination," is Mr. Hereley's terse way of putting this. Every employee, from track sweeper up, is encouraged to make suggestions for the improvement of the service. The men are given encouragement for honesty and efficiency, and are taught to have an interest in the affairs of the company. Mr. Hereley does not think it less a part of his duty to compliment a conductor for returning a pocketbook, or a motorman for avoiding an accident, than to reprimand an employee for neglect of any kind. Inquiries among conductors and motormen of the Chicago Union Traction Company show that the rank and file of the employees believe that they are receiving entirely fair and just treatment by the management. It has been noticeable that there have been few complaints on the part of employees during Mr. Hereley's term of office.

EXHIBITION ROOM FOR NEW APPARATUS

Mr. Hereley is about to inaugurate a new departure in street railway practice, namely, a large room set aside for the exhibition of new street railway appliances. In the equipment of this room, the company will go further than simply making it an instruction room, equipped with standard appliances as used on the road.

Besides the usual standard car equipments, it is the intention to invite manufacturers of all kinds of street railway appliances suitable for exhibition in such a room to furnish samples. This room will be open to all of the employees of the Chicago Union Traction Company, and they will be free to come and study these new devices and to express opinions as to their practical value in connection with the company's work. If employees express themselves as sufficiently favorable to new devices, they will be given a trial. The exhibition room will be on the top floor of the company's office building, at 444 North Clark Street, and it is probable that very soon advertisers in the Street Railway Journal will receive a communication from Mr. Hereley in regard to furnishing sample devices to go into this room. The objects in equipping this room are for the instruction of the rank and file of employees as to the latest street railway appliances, and for picking out of new devices of real merit.

THE MENDELBAHN

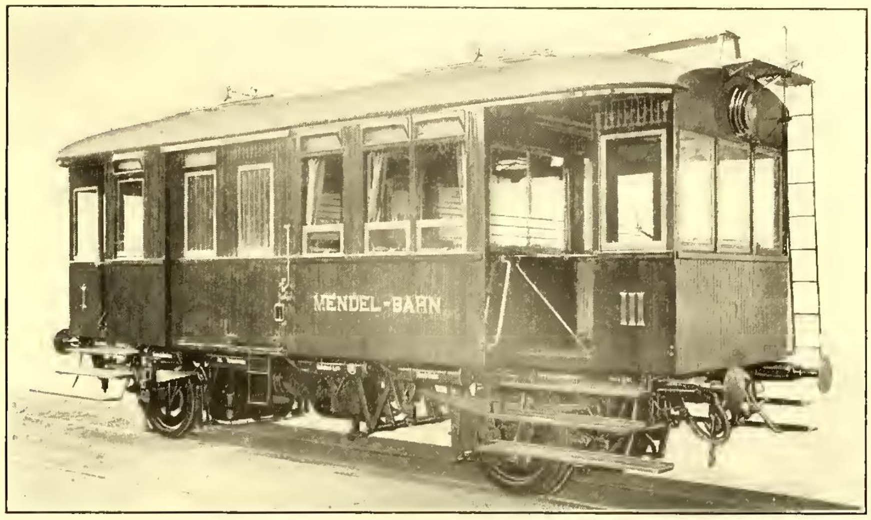
The town of Bozen-Bries, located in the beautiful Etsch Valley of Southern Tyrol, has long enjoyed the patronage of thousands of tourists, many of whom come to visit the famous Mendel Pass nearby. Until the completion of the Mendelbahn, visitors to the Pass were obliged to go in carriages, the usual length of the trip being 6 hours. The Bozen-Kaltern Railway has been in operation since 1898, and travelers to the Pass now start from Kaltern, which is about 1350 ft. above sea level, lying on a small lake below the Mendel Pass.

The Pass, which is about 4500 ft. above the sea, is covered by extensive pine forests. From this point extensive views are presented of the Nons Valley, the Brenta-Presanella range and the Ortler group. The builders of the Mendelbahn took every precaution not to disturb the beauty of the surroundings, the presence of the line being perceptible here and there only by the projection of some viaduct.

In May, 1902, the owners of the Bozen-Kaltern railway determined to extend their line to the Mendel Pass. This extension, which is partly electric and partly cable, was planned and constructed by E. Strub, the well-known engineer of Zurich, Switzerland. The line is operated from April to November.

ELECTRIC RAILWAY

This division of the line begins at the Kaltern depot of the Ueberetscherbahn as a standard gage single-track line, running southwest to St. Anton, via Kaltern and Mitterdorf. At St. Anton connection is made with the narrow-gage cable railway which runs through the Pfusserlahn gulch to the Penegal and Mendelhof Hotels at the Mendel Pass.



MOTOR CAR USED ON THE MENDELBAHN

UPPER PORTION OF THE MENDELBAHN

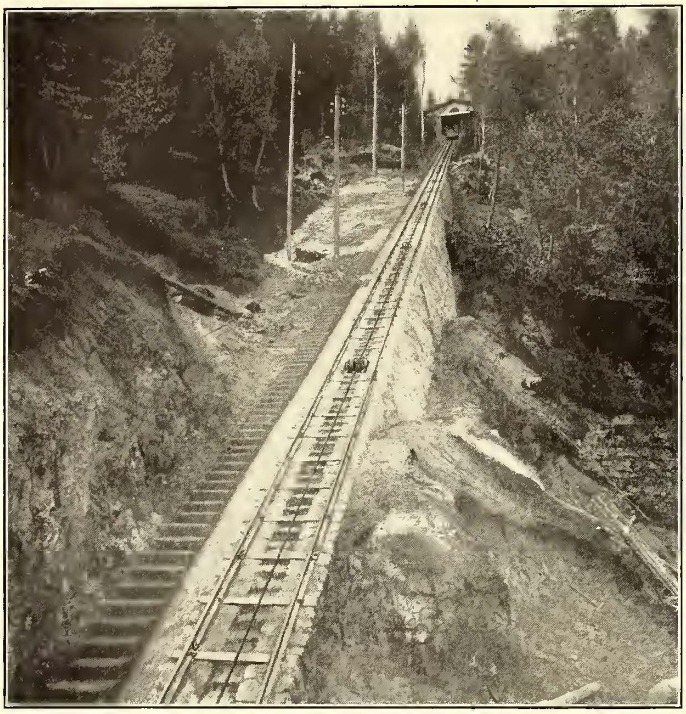
The electrical division is about 1.2 miles long, and in that distance has a change in level of 344 ft. The track, which is laid on larchwood ties, weighs 52.4 lbs. per yard (26 kg per meter).

The rolling stock consists of two motor cars and one open trailer. At Kaltern the steam locomotive is replaced by one of the motor cars, which hauls a passenger car, and frequently a freight car, of the Uebertscherbahn.

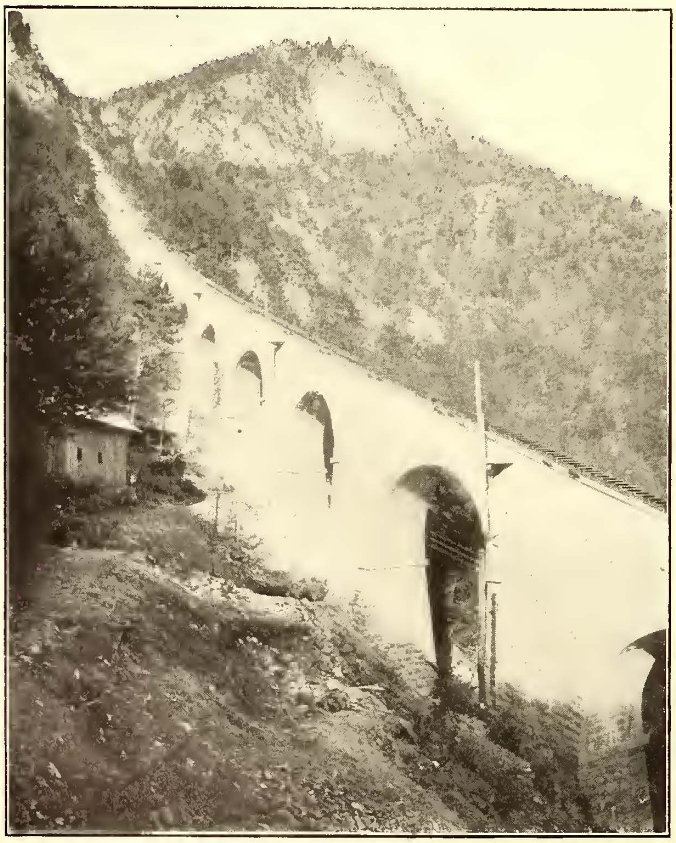
Each motor car has five first-class seats, fifteen second-class seats, and platform room for about eleven passengers. The trailer has fifteen first-class seats, thirty third-class seats, platform room for about fifteen passengers, and a baggage compartment. The weight of an empty motor car is 18.5 tons, of a trailer 12.5 tons, and of a loaded motor car and trailer 35.5 tons.

VIADUCT WITH TWO ARCHES ON MENDELBAHN

The motor cars are furnished with two Schuckert motors, each of 60-hp capacity. Current is taken through two contact bows. The cars are fitted with Hardy automatic brakes and ordinary hand brakes. The trail car is furnished with air and hand brakes.

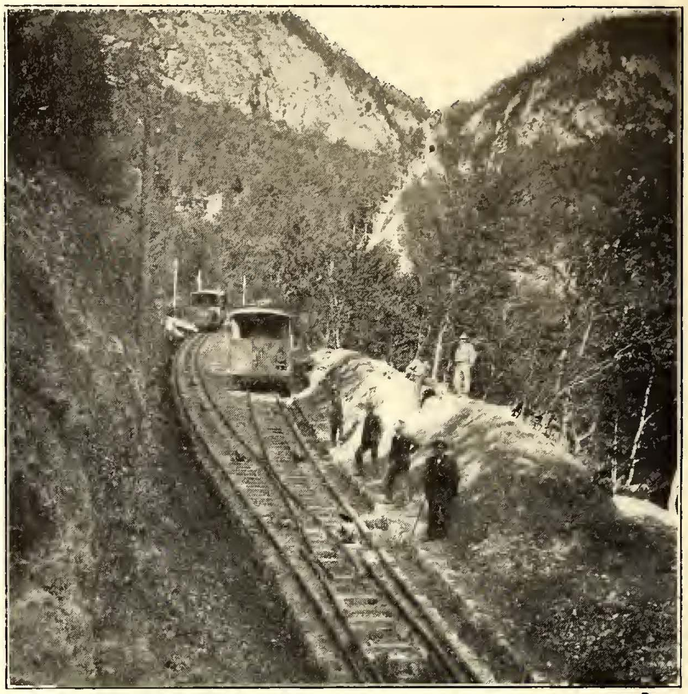


TRACK CONSTRUCTION AT THE GREATEST ELEVATION OF THE MENDELBAHN



VIADUCT ON THE MENDELBAHN OVER 328 FT. LONG, WITH SEVEN ARCHES

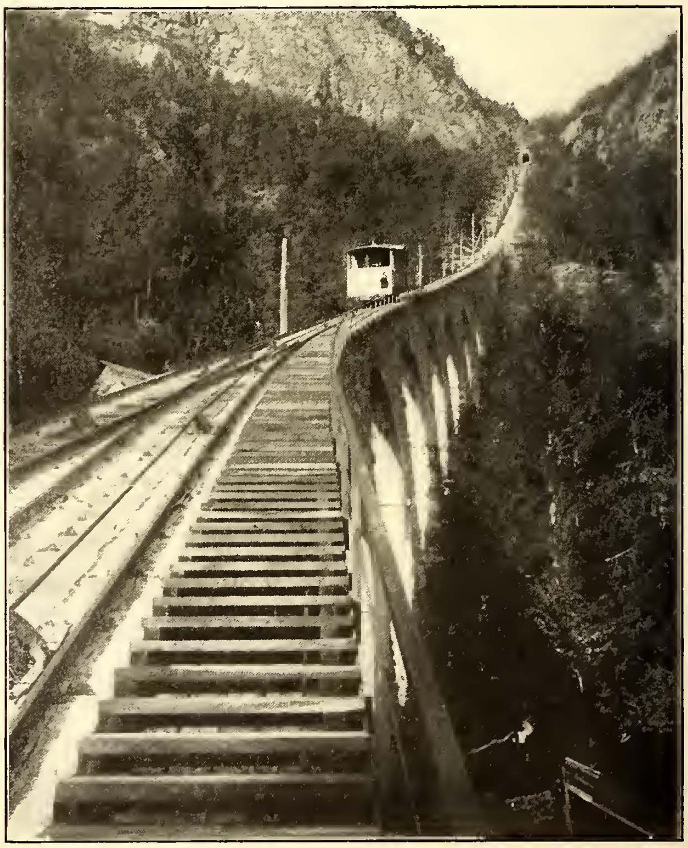
The entire Bozen-Mendel line is over 12 miles long, has a difference in level of about 3280 ft., and on a straight run can be covered in 1 hour 22 minutes, or in 1 hour 40 minutes, including stops at Kaltern and St. Anton. Five trains, which connect with the Ueberetscherbahn, are run in each direction every day. Provision is made, however, for extra trips.



TURN-OUT ON THE CABLE RAILWAY DIVISION

CABLE RAILWAY

The geological formation along this division includes disintegrated limestone in the lower portion, red and blue sandstone



CABLE CAR NEAR TURN-OUT CROSSING LONGEST VIADUCT

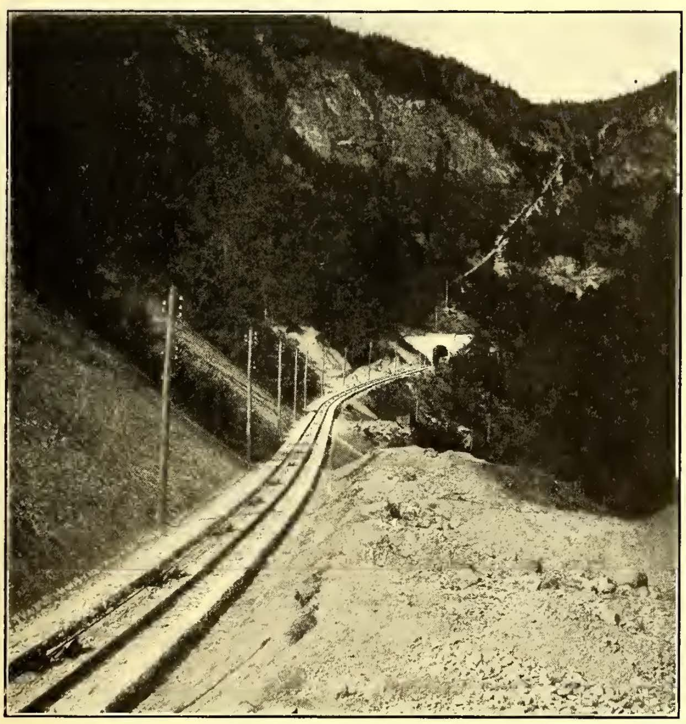
in the middle section and split limestone in the upper part. The roadbed was built to correspond with these variations. For about 3600 ft. (1100 m) it consists of broken stone laid on stone embankments, followed for the next 983 ft. (300 m) by mortar-work construction. The rest of the line is built of concrete. The road is provided with a concrete stairway, built along the mountain side, and another in the center with stairs spaced every two or three ties. Along the viaducts the projections of the ties on the valley side form the support of a foot path, which is provided with a substantial hand railing.

The cable railway division includes two 230 ft (70 m) tunnels, a 328-ft. (100 m) viaduct, with seven arches, and an 82-ft. (25 m) viaduct, with two arches. The lower tunnel is built through blue sandstone, and is covered; the upper tunnel is built through limestone and is partly open.

The piers for the long viaduct were sunk to a depth of 16.5 ft. (5 m) before reaching solid rock. This viaduct begins with a curve of 6562-ft. (2000 m) radius. The lower portion of the viaduct also carries the upper part of the turnout.

The track used on this division weighs 54 lbs. per yard (26.8 kg per meter), and is of 39.37-in. (1 m) gage. The turn-out has a radius of 835 ft. (280 m), and the distance between its ends is 380 ft. (116 m).

The cable used is over 8200 ft. (2500 m) long, weighs 22,050 lbs. (10,000 kg), and on a 57 per cent grade pulls a load equivalent to 15,435 lbs. (7000 kg). As its breaking strength is 154,350 lbs. (70,000 kg), the factor of safety is 10.



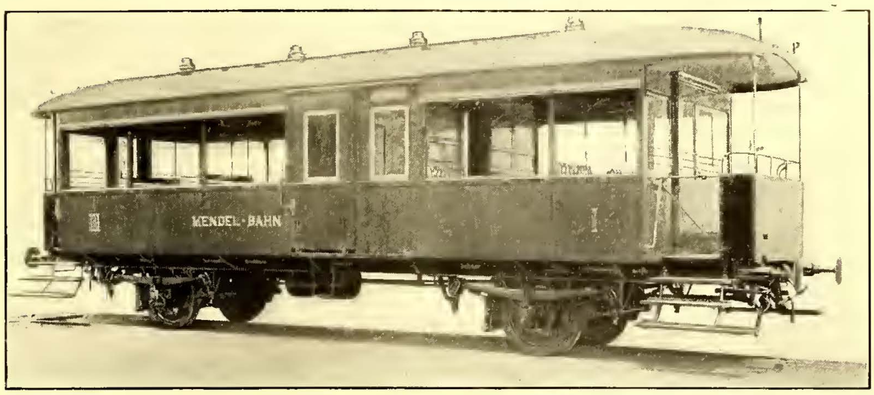
VIEW OF THE LOWER PORTION OF THE CABLE DIVISION

The cable rests on sheaves placed about 29.5 (9 m) apart. The sheaves used on straight track are about 12 ins. (30 cm) in diameter, and those on curved track 16.5 ins. (42 cm) in diameter.

The cable cars have twenty first-class seats and thirty-two third-class seats, all inclined, as is customary on mountain railways. The weight of an empty car is 13,340 lbs. (6050 kg), and of a loaded car about 22,050 lbs. (10,000 kg).

POWER SYSTEM

The station at the upper end of the cable railway contains a motor which operates the cable through a system of intermediate gearing. The electric installation for the cable also includes the necessary controlling apparatus and a 650-volt, 90-hp, direct-current shunt-wound motor, running at 600 r. p. m. Power from this motor to the main cable wheel is transmitted by belting. This station, in addition, contains transformers and three rotary converters for converting the current received from the Novella hydro-electric station through a 4000-volt, polyphase transmission system. The two 200-hp units furnish the current for lighting the Mendel Hotel, the remaining 350-hp rotary being used for the Mendelbahn.



TRAIL CAR USED ON ELECTRIC DIVISION OF THE MENDEL-BAHN

The storage battery used has a capacity varying from 250 amp.-hours to 400 amp.-hours.

The car schedule is so arranged that when the electric railway cars are running uphill the operation of the cable division is suspended, because the total power required to operate both lines simultaneously at normal speeds exceeds the capacity of the railway power equipment. The electric railway usually requires 150 amps. and the cable railway 35 amps.

The rotary converter equipments were furnished by the Vereinigten Elektricitäts-Gesellschaft, of Vienna. The electrical equipment of the cable railway was built by the Austrian Union Elektricitäts-Gesellschaft.

Five copper feeders, carried on wooden poles, and suitably protected from lightning, run along the cable railway, connection to the electric railway being made at St. Anton. The electric railway division is furnished with two telephone wires for signaling. The cable railway, besides the telephone wires, has two others, one of which serves to indicate at the power station when cars reach and leave the terminals, and the other for communication between the machinist and conductor.

The car house at Kaltern is illuminated by incandescent lamps, operated five in series. The cars are also furnished with incandescent lamps.

"An Egg Hunting Contest" for the children of Nashville will be conducted by the Nashville Railway & Light Company, at Glendale Park, on April 2—the day before Easter Sunday. A similar contest was held last year, and proved a great attraction. The company provides 1000 candy eggs, which are hidden throughout the park by a committee of women appointed for the purpose. One of the eggs is dyed with gold, and a reward of $5 is offered to the child finding it. Other eggs are rated at various sums, ranging from $3 down to 25 cents, the total amount of the prizes offered being $100. The amount of the prize, if any, to which the finder is entitled is indicated on each of the eggs, those containing no mark possessing only their intrinsic value as eggs (or candy). Glendale Park is owned by the Nashville Railway & Light Company, and covers some 75 acres. The company provides numerous attractions to increase its summer traffic, including a "zoo," a casino and theatre, at which vaudeville performances are given, shooting gallery, merry-go-round, Ferris wheel, miniature railroad, etc. Among the coming attractions are a roller coaster (by the Ingersoll Construction Company, of Pittsburg) and a "Cave of the Winds and House of Trouble."

THE DUNEDIN (NEW ZEALAND) TRAMWAYS

Recently the principal cities of New Zealand have been giving considerable attention to the conversion of their lines from animal to electric traction. Although Auckland enjoys the distinction of being the first New Zealand city to have electric railways, Dunedin is a close second, as the lines in that city were formally opened on Dec. 16, 1903.

It is noteworthy that nearly all of the Dunedin operating equipment is based along American lines, while a great deal of the practice on the Auckland system follows English lines. The conversion of the Dunedin lines was carried out for the municipality by Noyes Brothers, of Sydney, Melbourne and Dunedin, under the supervision of W. G. T. Goodman, their resident engineer.

PERMANENT WAY

Double track is used in the important streets, but single track prevails where traffic is light. The rails used throughout are in 40-ft. lengths, weigh 93 lbs. per yard, and have a bearing surface of 6 ins. on the ties. They are bonded with Edison-Brown plastic bonds. The ties are of Australian hardwood, 7 ft. 6 ins. long, 9 ins. wide and 4½ ins. thick. They are set 2 ft. 6 ins. apart from center to center. Where the soil is poor the ties rest on a concrete layer about 6 ins. thick, but in good soil metal ballast is laid to a depth of 6 ins. The surface of the track is made up of a layer of 1½-in. metal, covered by 2 ins. of tarred screenings rolled and finished off with coarse sand. This has resulted in securing a smooth and almost dustless surface. The switchings, crossings and special work are of the Lorain Steel Company's manufacture. All of the curve work has been laid down with easement curves.

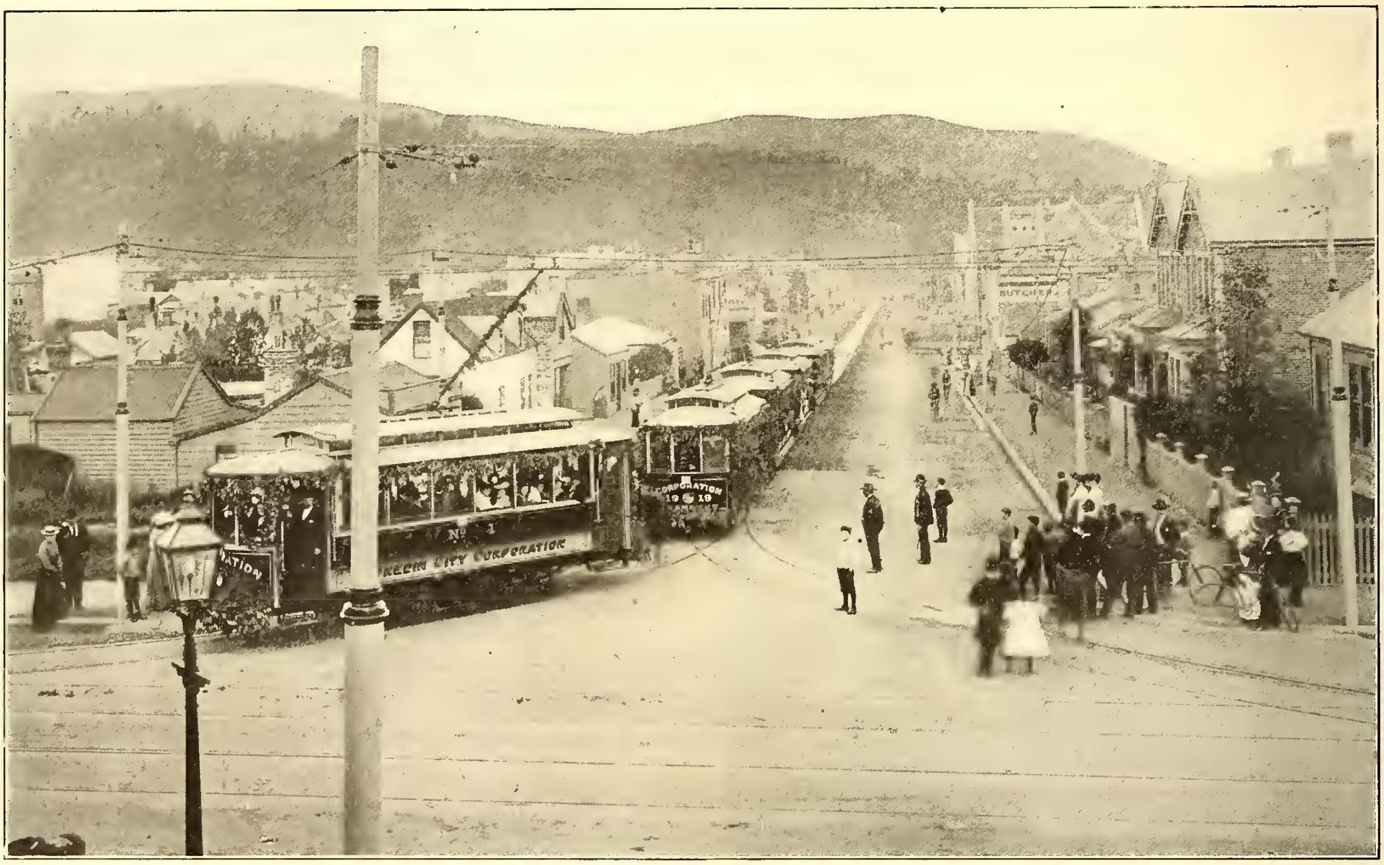
OVERHEAD CONSTRUCTION

The poles used for the overhead work are seamless steel tubes, made by the Mannessman Company, of Düsseldorf, Germany. The center poles are 29 ft. high and set in concrete to a depth of 6 ft. All poles are set about 125 ft. apart. Side poles are used for certain streets and where curves are necessary. Power is taken from a No. 00 copper wire supported on insulated hangers, which in turn are insulated from the poles by ball insulators.

ROLLING STOCK

The present rolling stock comprises thirty-five cars. Fourteen are of the box type, with enclosed vestibules at each end. The car body is 18 ft. long, while the complete car is 29 ft. long over all and 7 ft. 6 ins. wide. Fourteen combination cars have also been provided. These are 29 ft. long over all, have cross-seats in the open part and longitudinal seats in the closed portion. There are, in addition, six open cars, with ten cross-benches capable of seating five passengers each.

The cars have monitor deck roofs, fitted with shutters to provide adequate ventilation. The woodwork is of quartered oak, with aluminum stenciling. The window sashes are also made of quartered oak, and are set in felt to minimize vibration.



A GALA DAY IN DUNEDIN

Ample provision has been made for lighting from handsome electroliers, each car being furnished with nine 16-cp incandescent lamps and one 32-cp headlight. The car bodies are in Indian red, and the framework, dashers, etc., in yellow and gold.

The equipment also includes a sprinkling car of 2500-gal. capacity, capable of watering the streets to a distance of 10 ft. on either side of the center of the track.

All of the rolling stock was furnished by the J. G. Brill Company, and was shipped in sections which were assembled on arrival at Dunedin. The trucks used are No. 21-E, with 33-in. diameter wheels. The electrical equipment of each car is of Westinghouse manufacture, embracing two No. 68 motors, controllers and magnetic brakes.

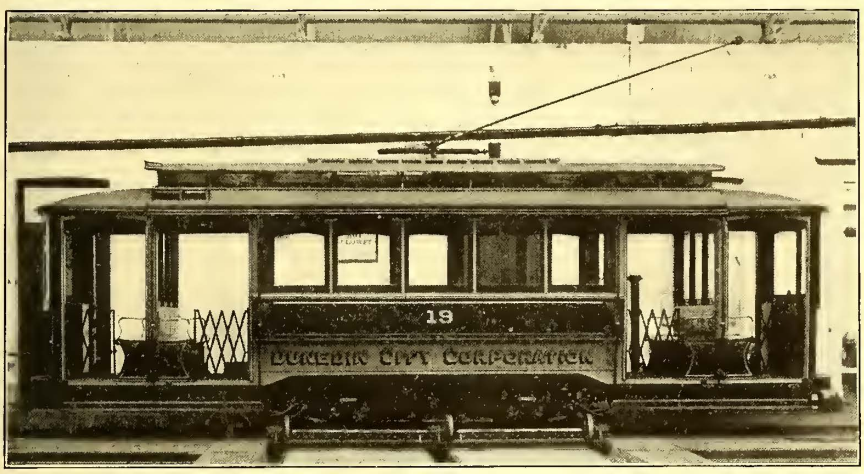
POWER HOUSE

The power house is located on the site formerly occupied by the tramway stables in Cumberland Street. The old portion of the houses is used for the steam plant, while the part rebuilt is used for the engine room and converter station. The engine room contains two 300-hp units, running at 380 r. p. m., each unit consisting of a Bellis-Morcom engine coupled to a Westinghouse generator. The steam piping is brought in from the boiler room overhead, and the exhaust taken away in underground conduits covered with iron checker plates. The boiler house contains four boilers of the Babcock & Wilcox type, with a heating surface of 619 sq. ft.

The converter sub-station, which adjoins the steam plant, consists of a converter room, transformer room, and an upper and lower battery room. The rotary converters will transform current received from an hydro-electric plant.

CAR HOUSE AND MACHINE SHOP

The car house is located on Market Street, and presents a striking appearance, owing to its somewhat military outlines. The ground floor covers an area of 165 ft sq., and receives abundant light through a saw-tooth roof of glass and iron. Four large lifting doors lead to the turnouts, and from these there are thirteen tracks, connected by a traversing track, so that a car can be run with facility from any part of the car house. Provision has been made for accommodating fifty-two cars, or nearly twenty more than ordered, to provide for future equipment. The floors are built of concrete and drained by channels. There are eight bricked car pits approached by steps.



COMBINATION CAR USED IN DUNEDIN

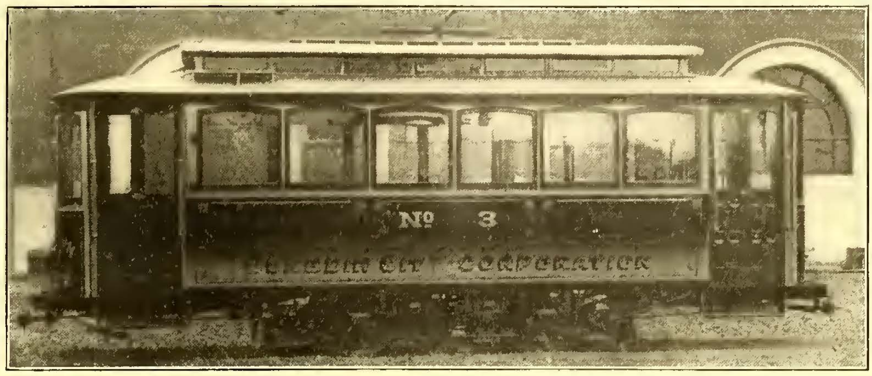
The machine shop, which is behind the car house, is equipped with American drills, lathes and planers, together with overhead traveling cranes and an hydraulic wheel press capable of a pressure of 100 tons.

Adjoining the car house are to be found the armature repairing shop, foreman's office, store rooms, a fireproof oil and paint shop, and a recess containing a gas oven for drying out coils. The executive offices also adjoin the car house. Gas piping has been laid throughout the buildings, so that in the event of an accident to the electric plant the buildings need not remain in darkness. The ground floor contains the cashier's office for receiving conductor's returns. A room behind this office contains separate lockers for the personal property of motormen and conductors employed on the lines.

The United Railroads of San Francisco report total earnings of $482,403 for the month of February, 1904, as against $445,161 for February, 1903, an increase of $37,241.

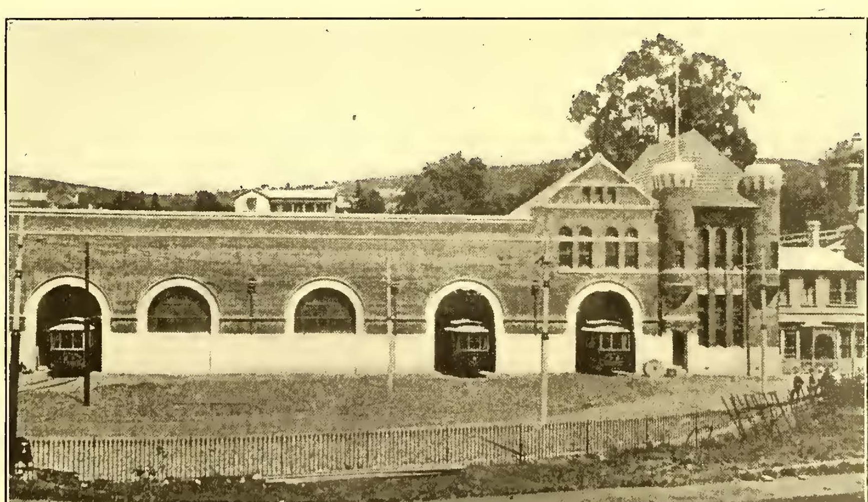
SOUTHERN OHIO TRACTION COMPANY WINS SUIT INSTITUTED BY CITY OF DAYTON

The Southern Ohio Traction Company won in a decision rendered by the Supreme Court in an error case from Montgomery County, in which the city solicitor of Dayton was plaintiff in error, and the traction company defendant in error. Judgment of the Circuit Court was affirmed. The city instituted proceedings in the Common Pleas Court for the inforcement of certain specifications of contract, claiming the company had violated its franchise in that it did not operate cars at sufficient intervals inside the city limits, that it did not have tickets for sale on its cars, and that it ran its cars at a higher rate of speed than permissible. The lower court held that the company specifically performed its contract with the city. The city appealed to the Circuit Court, which dismissed the case. The city then carried the case to the Supreme Court, and the judgment was affirmed. The Southern Traction Company is now the Cincinnati, Dayton & Toledo Traction Company.



SEMI-CONVERTIBLE CAR OPERATED IN DUNEDIN

The Northwestern Traction Company of Indiana has completed the first of the small depots which it will place along its lines. The first building is at Whitestown. It provides a waiting room which will shelter about fifty persons, and a storeroom for freight. Between these two rooms is the office of the agent. It is the intention of the company to put these depots in each town of 500 or more inhabitants. This is the first attempt of the Indiana interurbans to provide permanent passenger depots.



HEADQUARTERS OF THE DUNEDIN TRAMWAYS

ELECTROLYSIS AS CAUSED BY THE RAILWAY RETURN CURRENT

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In reviewing this subject to date, it will aid those who have not followed the matter carefully to commence with the fundamental laws governing electrolysis and then to bring out clearly the remedies that have been most successfully employed.

It will be assumed here that the trolley is positive, as this is the common practice, and that the ground return current is conducted back to the power station by all means of conduction presented to it. Each path of conduction will carry that portion of the whole current, which is exactly in proportion to the aggregate conductivity of all paths presented. When a current of electricity is delivered to the rails from the wheels of an electric car it seeks all paths back to the power station, and as the rails are in contact with moist earth in all city and most suburban construction, we have to deal with a conductor system of three kinds. The earth in contact with the rails is usually an auxiliary conductor system, but in city construction the normal resistance of this path is greatly reduced, and conductivity increased by the presence of iron piping systems buried in the earth. This causes a larger flow of current from the rails which is collected by these piping systems, and is conveyed back toward the power station at which it is generated. If no provision has been made the current will leave the surface of the pipe, ordinarily in districts adjacent to the power station, and in this way an electrolytic action may be effected.

Electrolysis, as known to the electric railway engineer, is the action set up when an electric current leaves a metallic surface buried in soil which holds moisture in suspension, but it does not follow that whenever these conditions exist electrolysis takes place. For instance, if the water that surrounds the metallic surface is pure, it acts as an insulator, or it may hold in solution solvent constituents, which, on being decomposed by the flow of current through it, produce an active ion which will not in turn act on the exposed iron surface or other metal. Furthermore, there must be a certain energy expended on a unit surface in order that the ion can be dissociated from its primary combination and become active in forming a new combination. Again, on the other hand, when the current density becomes very great per unit surface, electrolytic action practically ceases and all the energy appears as heat.

It is well known that one of the standard methods of determining the unit of current is by a deposition of silver in a silver bath containing a silver salt, but it will be necessary to remove the variables in order to appreciate what actually occurs in underground electrolysis. In standard practice the composition of the silver salt bath is precisely specified, the temperature in which it is to be used is also stated, and the current density per unit surface is fixed, thus eliminating the variables which are continually present in electrolysis arising from a stray earth current. This subject is not amenable to practical treatment from theoretical deductions.

It will be my aim in this article to give the outcome of investigations covering many of the largest cities in the United States relative to the methods of determining the conditions, causes and remedies for this trouble.

It has been assumed that there are certain characteristics on the surface of a metal which indicate electrolytic action. For instance, in cast-iron a pit in the surface of a pipe which is filled with a graphitic substance can be readily gouged out with a knife, leaving a greater or less depth of pit in the metal. In the case of wrought-iron, the developed fibrous structure of the metal is considered indicative of this action. Both of these conditions have been found also to be produced on metal surfaces by the corrosive action of the soil alone, and I have found no expert willing to state that these are of necessity indications of electrolysis. In lead, the indications are external to the surface itself in so much that the carbonate of lead, or the compound that is formed, migrates through the soil in veinings toward the receiving plate. Carbonate of lead without the seaming through the soil is not indicative, for ashes around a lead pipe will produce a compound identical in appearance, but adhering to the pipe. Iron pipe will show fibre structure when exposed to a natural or artificial gas leak, and also condensed water, or pure water, will eat iron pipe and develop its fibrous structure, as well as water bearing sulphurous acid. Steel pipe will show pitting identical with that caused by electrolysis when free particles of carbon have been incorporated in the surface of the metal during the process of rolling. Here the action is local, the carbon particle forming one pole and the surrounding metal the other, the moisture adjacent to the pipe surface forming an electrolyte. A very good example of this is found in the Rochester (N. Y.) main from Hemlock Lake. Numerous pits were found in portions of this pipe, some of which penetrated completely through the metal of the pipe, yet no current flowed over this pipe.

It is important, therefore, for the electrical engineer to determine whether electrolysis is actually taking place in a piping system where damage is complained of. A method has been devised of determining this, and differentiating between this action and that of natural corrosion which goes on with any metallic surface in the soil when exposed to moisture contaminated with the solvent constituents of the soil through which it percolates. The pipe on which the experiment is to be made should be exposed for about 8 ft. of its length. Cast test shields are made which will surround the pipe, as shown in Fig. 1. These plates should be cast approximately of the same composition of metal as that of which the pipes are composed. These shields are cast so as the two halves of the shield will enclose the pipe. The length is generally taken about three times the diameter of the pipe. The inside surface of two halves which go together and form one of the shields enclosing the pipe, are carefully cleaned on the inside and amalgamated. The surface of the pipe with which the shields come in contact is also cleaned and amalgamated.

Another shield, identical in every respect, is clamped around the pipe, but is insulated from it by a sheet of rubber packing or other equivalent non-absorbant insulator. Before these shields are placed on the pipe they are carefully weighed and a memorandum is taken of their weights and of the identification marks put on the shields. The pipe is then covered in the usual method, the paving is replaced, and the whole is left undisturbed for a period of six months. At the end of that time the opening is made again, and the shields are removed. They are then thoroughly scrubbed with a bristle brush and crude oil until all the deposit and dirt on these shields are removed. They are then dried and reweighed, and the loss of weight found by subtracting the previous weight of the pair of shields connected from their present weight, the difference between the previous and present weights of the shields will be that due to electrolysis.

It is important for railway companies to make this determination for their own protection when they modernize their ground returns and bring the system up to the present requirements, otherwise they may be held for losses which they did not cause. Often damages are discovered years after they have been produced; yet they are attributed to present conditions, under which no electrolysis will occur.

There are general relations existing between piping systems and railway systems which modify or increase the hazard of damage from electrolysis.

It has been found in those cities where the pumping station and street railway power station are located in the same neighborhood that the piping system has been immune from damage.

The reason for this is that the area of a piping system and the dimensions of the main, and the area of the surfaces exposed gradually diminish as they ramify away from the pumping center, and also the rails of the railway decrease in the current density which they are required to carry as they depart from the power station, the result being that the area exposed in the outlying territory of the piping system is less, and the normal resistance between the rail and piping system is greater where the potential difference is greatest. Also it is found that where the current flows from the rail to the pipe the resistance is

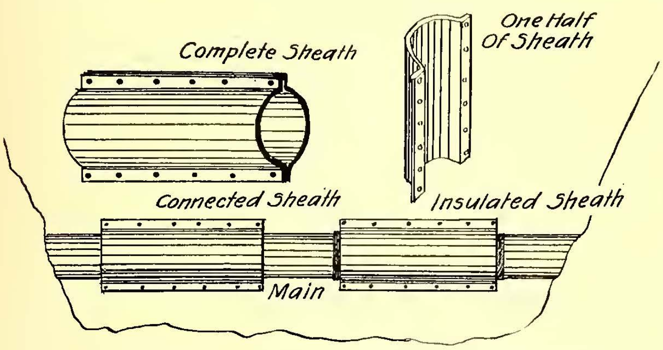


FIG. 1.—CAST-IRON SHIELDS FOR TESTING FOR ELECTROLYSIS

about four times greater for a given area exposed than where the current flows from the pipe to the rail, and, consequently, the volume of current on these outlying piping systems collected is much less under this relation of the railway and piping system. Again, when the current approaches the station, the area exposed for the dissipation of this current to the earth in its return path to the station is large and the resistance low, and in this case the condition is found of the energy per unit surface being too low to produce a disintegration of the metal surface.

In the case cited it will be found on measuring potential differences that they will average much higher over this system than where the power station and the pumping station are diametrically located in reference to the center of the city supplied. This would be considered unfavorable if the old method of establishing or predicting electrolytic hazard of the piping system were followed, but conclusions arrived at from potential surveys between the piping system and rails are of little value in determining the true electrolytic hazard, for the reason that the higher this earth resistance the greater the difference of the potential that can exist between the rail and the pipe.

The pavement over a street also offers protection to piping systems underlying where the pavement is impervious to surface moisture, such as asphalt, brick and belgian block, when laid with a sub-base of concrete 4 ins. to 8 ins. thick. Here the electrolyte against the pipe has not the circulation nor is it replenished, as in the case of an open street, and it is found that when the active constituents in an electrolyte surrounding a pipe have been reduced the chemical action ceases and will not be renewed until the voltage rises to approximately 1.5 volts between the surface of the metal and the electrolyte, and at this potential water can be decomposed, leaving pure oxygen to oxidize the metal of the pipe. Investigations made in regard to the rate of depreciation of a pipe have established the fact that the film of oxide formed on the surface of the pipe has a screening effect against the penetration of active constituents formed by the current flowing, and that the actual metal destroyed after the pipe has received this film of oxide rapidly decreases with time and current.

Again, the only potential that is active is the potential that exists between the pipe surface and the electrolyte immediately surrounding the surface. The difference of potential existing between the rail and pipe does not give us the criterion of what the potential may be between the pipe surface and the electrolyte. The potential fall, along this path of conduction, depends upon the resistance of the earth, the resistance of the electrolyte against the pipe and the resistance of the paving. Fig. 2 contains several curves showing how these conditions effect the distribution of potential along this path.

It will be seen that the normal earth resistance plays an important part in determining whether the critical potential at the surface of the pipe will rise to such a value at which electrolysis will take place. The following method of testing to find the actual potential adjacent the pipe is the only one in my experience that will give concordant and reliable results. The conditions under which this test has to be made are as follows:

First, the earth cannot be disturbed around the pipe; and, second, the instrument used to determine this potential must not introduce a resistance in this circuit which would disturb the normal difference of potential that exists between the electrolyte and pipe surface; and the test plate must not produce any local electromotive force which would disturb the true condition. To accomplish this a cadmium plate has to be used for the test plate, and the "Poggendorf" method must be followed. By this process the electromotive force measured is balanced against opposing electromotive force, whose value is known, and in this way the electromotive force existing between the surrounding electrolyte and the pipe surface is determined without disturbing the normal potential existing. Only a small opening is made exactly over the pipe in the street, and the test rods are driven through this opening until the cadmium plate is adjacent to the pipe and the other test rod is in contact with the pipe. Then the connections are made from these two rods, as shown in Fig. 3, and the measurements of

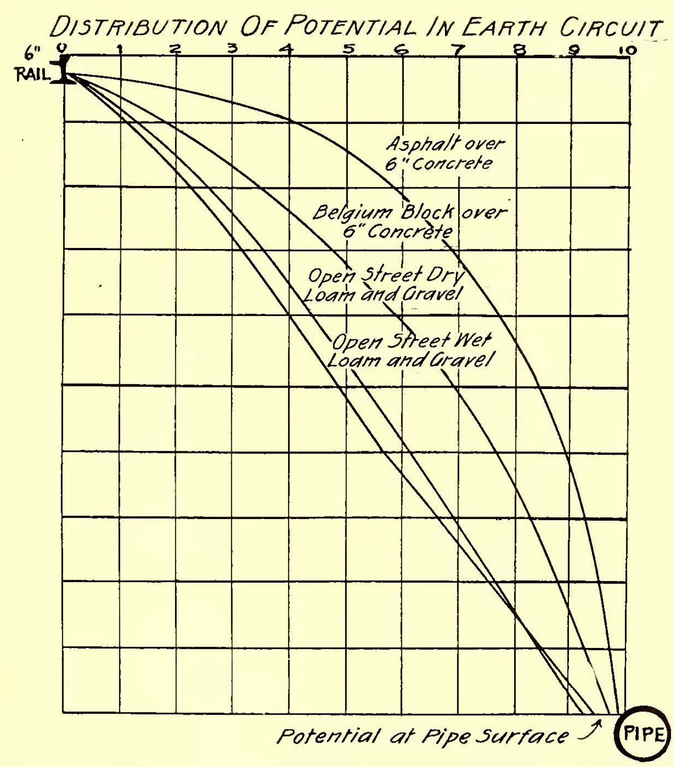


FIG. 2.—EFFECT OF MEDIUMS OF DIFFERENT RESISTANCE ON CURRENT FLOW

potential made. When it is desired to plot out the curve of potential between street surface and pipe the cadmium test point is driven in, and the potential is measured at several points as it approaches the pipe, from which data potential curves can be laid out.

Another condition common to systems affected by electrolysis is where a city is traversed by a river. This arises from the fact that the ramified piping systems on both sides of the river are brought to several mains crossing the river which connect these two piping systems. This also causes the current which has been collected over large areas of the pipes to be concentrated on these few mains, and trouble has arisen especially where the power station is located on the bank of the river adjacent to this piping system. Here the current must be dissipated from small areas of piping, and electrolysis may take place due to this concentration. Another case of trouble arising from concentrated action is where services pass underneath the track where the potential of the service pipe is positive.

In reference to protection of these points, a number of methods have been used to remedy this local trouble. One is to enclose them in a box, which will clear the service pipe all around by half an inch. This box should be filled with hot asphalt, and should extend at least 5 ft. beyond the outside rails of the track. Do not use coal tar for this purpose, as it is charged with ammonia and will actually make the resistance much less than it was before. This has also been found the case with pipe coating used for the purpose of preserving the pipe from corrosion. This coating, if it contains ammonia or free acids, reduces the resistance of the pipe in its contact with the soil over that of a bare and uncoated pipe. Rubber hose has also been used, the practice being to slip it over the service pipe before the last connection is made and extend it 5 ft. beyond the outer rails of the track. An insulated service pipe has been used with success. The trouble in regard to these local remedies is that a plumber is generally called in to make the repairs, and as any method of permanently protecting them would mitigate against his having to make this repair again shortly, effective remedies are not generally advocated.

Engineers of piping systems have applied a number of methods successfully, by which stray current can be greatly reduced in volume. The first question that arises is whether the current has been diverted from the rails of the railroad company to the piping systems through a metallic contact. It has sometimes happened that where pipes are carried over metallic bridges and are in contact with the metallic structure of the bridge the rails of the railroad company are also resting on the same metallic structure, thereby forming a metallic connection between the rails and the piping system. The remedies that have been used for this pipe construction is to insulate the pipe from any contact with the metallic structure of the bridge with wood or other insulating material which can stand the stress of this weight. Another method is to use insulating joints at the two portals of the bridge. This can be applied where the piping carries a non-conducting medium. Metallic connections are also made between the rail and the piping system through gate boxes, which are of metal, or pipes resting on the main and terminating on the street surface with covers. This pipe may be connected with the rails through this means where the gate box comes in contact with the rail. The remedy for this trouble is to use a wooden box between the pipe and the end of the casting holding the gate-box cover, as is done in Philadelphia, or to break up the metallic continuity of this gate box by interposing earthenware or insulating pipe. The only function of this gate box is to leave an opening in the street above the gate of the buried pipe so that the gate may be operated. Other sources of connection have been found where gas pipe service has been brought in contact with the rail. In early electric railroading metallic connections were purposely made between the rail and the pipe, and many of these still exist. These, of course, should be located and disconnected when they are in territories where the current will flow from the rail to the piping system. Where several stations are operating in a city, one of them being used as a reserve station and all employing the method of taking the current from the pipe by a metallic connection, a switch should be provided on such pipe feeders and should be opened when that station shuts down; otherwise this would afford a path for the current from the rails through this pipe to the operating station. Accidental connections have been found where the water pipe has been connected to hydraulically-lifted bridges over which electric railways pass, affording a means of metallic connections between rails and piping systems. In several cases, also, it has been found in constricted spaces over stone-arch bridges that the water main and rails have been brought together in metallic contact. The question arises how to locate exactly these metallic connections.

This may be done by dragging metallic brushes over the tracks, mounted on a separate truck, whose two wheels are

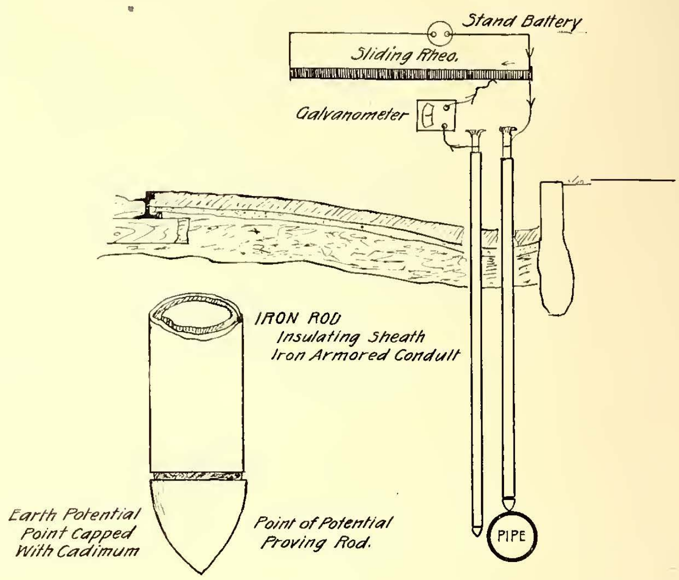


FIG. 3.—TESTING FOR ELECTROLYSIS BY THE POGGENDORF METHOD

insulated from each other on special test car. It has been the usual practice to place these brushes, a pair for each rail, 4 ft. apart, and connect them to a milli-voltmeter. The direction of the current will normally be toward the power station, but if there is a metallic connection with a pipe the current flow on the rail in this locality will reverse in direction from the power station until the point of connection is reached by the equipment carrying the drop brushes. The direction of the current will again reverse, and the local ground connection will be found between the equipment and the power station. A manually operated pop valve which will squirt paint or whitewash on the track is used to mark these points as they are discovered, and afterward these can be definitely located by measurement, but it is easy to spot ground connections, either visible, or otherwise, within 2 ins. It sometimes takes two or three runs over a track in order to locate these connections exactly. It is also necessary to carry in the test car a rheostat, which will give from 100 amps. to 200 amps., to be used when the normal current density on the rail is low, and in this way the circulation of the current on the rails can be traced and their deflection from the normal path to the power station followed up and the causes located. A ground return feeder connection to rails will give exactly the same indications as a metallic connection between piping systems and rails, but these feeder connections are known to the railroad company, and their locality need not be confounded with the ground connections. In making this test intersecting railways, both steam and electric, will divert and reverse the current on the rails, as a part of the current will follow back and pass over the best bonded part of the track to the power station.

Piping companies have successfully avoided electrolysis by using insulated joints in laying piping, thus breaking the continuity of the piping system as an electrical conductor. The East Ohio Gas Company, at Cleveland, uses insulated joints between the different sections of the pipes, and this practice is also followed successfully at Buffalo, N. Y. A rubber gasket is placed around the pipe over which a sleeve is slipped, so as not to allow the metallic portion of the separate section of pipe to come in contact. The old cement pipe was a form of insulated pipe which made a non-conductor system of the piping system. I understand that the water-works at St. Johns, N. F., use wooden wedges or rings instead of lead successfully, and in this way produce an insulated caulking between adjacent sections of the pipe. There are also a number of cements used for joining adjacent sections of pipe which are insulators, but I do not know of a practical use of these cements in water-works of any size.

In several cases where the main is laid directly under the tracks of the railroad company, a shield plate of cast-iron has been placed between the water pipe and railway tracks. When the shield is connected to the water pipe electrically in this way, the action of the electrolysis, which would have taken place on the pipe without the protection, is transferred to the shield plate. This method is applicable to many strictly local conditions.

Any ground plate can be connected to the piping system and located much nearer to rails than the water pipe. A large volume of current will be dissipated from this ground plate instead of from the surface of the pipe. The interposition of insulated joints on mains under special conditions of piping system—such as a long main paralleling a railway track and having no lateral connections—would be efficacious if a sufficient number of these joints were put in the pipe at such locations along its route as would reduce the current to a small quantity. But, in a ramified piping system, as laid out for city service, it is very hard to locate these joints so that in an equilateral piping system there will not be another metallic by-pass in the piping system around this joint, thereby rendering the joint useless for the purpose intended.

It has been found where a number of different piping systems exist that one set will collect the current from a large area and deliver it to another set of pipes. Sometimes this is transferred through the earth where these two systems approach each other and a local condition of electrolysis is produced. This condition can be remedied by metallic connection between these two piping systems with a conductor large enough to take care of the current flowing between them. It has also been found where a number of street railway systems are located radially or parallel through a portion of a city that if one of these lines of rails forms a great deal better conductor for the return current than the others, a shuttling action takes place, the current leaving the poorly bonded tracks and entering the piping system, and using this as a short cut across to the tracks, which have high conductivity, and in this way back to the power station. Where this shuttling action occurs on the pipe the pipe paralleling the well-bonded track becomes positive to the rails throughout its length, and the current is found to be passing along the lateral pipes through the streets which intersected the poorly bonded tracks.

The best way to carry out bonding is to commence from the power station and go radially, carrying the improved track work out to the same distance on the several parallel tracks. This method of carrying out new construction work will prevent shuttling. Where two tracks terminate near each other, or adjacent, and where there is considerable distance to the power station and the piping system underlies these two railway systems it is best to connect these two railway systems together by a feeder, tapping both systems of rails, and in this way equalizing the potential and averaging the drop from this point back to the power station. It will also be noticed on interurban roads that the current will flow along the rails toward the city and enter the piping system as a distributing earth plate, and pass back by this path to the interurban power station through the earth where the soil is against the rail, or earth plates have been used at the interurban power station.

The following data will be useful in calculating the normal earth leak in railroad systems having different track constructions:

A rail on ties, with gravel ballast, the ties average 5 ins. x 8 ins., and seventeen per 30 ft. Resistance per mile per single track of 60-lb. rails of A. S. C. E. section.

A rail and tie having concrete sub-structure reaching up to the foot of the rail. Resistance per mile per single track of 60-lb. rail A. S. C. E. section.

A concrete sub-structure in which the concrete reaches up to within 1 in. of the head of the rail. Resistance per mile per single track of 60-lb. rail A. S. C. E. section.

A rail with a concrete sub-structure on dies with belgian block pavement. Resistance per mile per single track of 60-lb. rail A. S. C. E. section.

A concrete sub-structure and asphalt pavement. Resistance per mile per single track of 60-lb. rail A. S. C. E. section.

Under normal conditions, where a pipe is relieved of its current by a metallic connection with the ordinary street service construction, between 5 per cent and 6 per cent of the total output of the station is returned by the pipe. This is only true where no metallic connection exist between the rail and the pipe. It also depends upon the drainage of the sub-soil, the character of the sub-soil and character of pavement as well as the proximity of the pipe to the rail.

In order to increase the resistance between the pipe and the rails a number of cities are using a distributing main on each side of the street, and from this main the services pass directly to the premises of the consumer. In this way the distance is increased between the rail and the pipe, and the current is not passed under the rail by services, thereby producing local electrolysis.

In investigating any system it is very important to locate any ground connections existing between the pipe and the rail, and also their value as an auxiliary return circuit to the power station. It will be noticed in comparing the variations of an ammeter, so connected as to indicate the current flowing back from the pipe to the negative bus of a power station, that if the variations of these two meters are synchronous, or the variations of the meter connected to the pipe return cable lags slightly behind the main meter, it is safe to conclude that there are no metallic connections existing between the piping system and the rails, and, furthermore, if the total current return on this pipe feeder is in the neighborhood of 5 per cent it is safe to conclude that the returns are due to earth leaks and not metallic connections. By having this special meter on a portable stand, so that its variations can be read simultaneously with those of one feeder meter after another, taken in turn, it will be found that this special meter will vary synchronously with one or two feeders on the system, and these are the ones which are feeding current into the rails in contact with the ground connections. By following this up the portion of the system that is connected electrically with the water pipe system can be discovered, and by means of the trailing brushes, as before described, the exact location of these ground connections can be located.

The question arises, what can the railroad company do in order to minimize this trouble? Reducing the rail return resistance, of course, increases the flow of current on the rails, and, proportionately, reduces that portion of the current returned on the pipe, and affects the location of the ground return feeders from the power station to the rails. In reference to the railway systems it has a great deal to do with the focusing of current on the piping system. If these feeders are taken to the rails, at points electrically and symmetrically located in reference to the current they conduct to the power station, a large unipotential area can be formed in the vicinity of the power station. This arrangement of the feeders will bring the potential differences within this area between the pipes and rails in the locality of the power station, so that the potential will not be sufficient to produce a destructive action on the piping system.

In a system where the station is located near the center of the city, or the ground return feeders are taken back to the power station from this center by designing and locating the ground return feeders in their connection to the different systems of rails interconnected at the center of the city, it will be seen that the neutral territory between the pipe and the rail floats over considerable distance, due to the load on that line of rail terminating at the common center.

To make this proposition as simple as possible, suppose a long stretch of railway passed by a station which was located near the center of the line of the road, and instead of tapping the rails immediately adjacent to the station and bringing the return back to the negative bus, two feeders were taken out, one being carried up the track and the other down the track for some distance. It will be found that the current on the rail lying parallel and adjacent to the station, and between the two feeders, will vary in its direction, depending upon the loads on the sections of track extending beyond these feeder taps. The potential, of course, between the pipe paralleling and underlying this rail would vary from positive to negative, or alternating-impressed electromotive force would be the potential to which this pipe would be subjected, and under this condition electrolysis would not occur.

Now, this same principle can be expanded to cover a ramified railway system where the rails are interconnected at the center of the city. Feeders can be so connected to different tracks that the center area in which the pipe before us was positive to the rail can be brought to an alternating potential by the interaction of the different currents entering this center, and the surging of electromotive force over this area due to the varying volumes of current entering this area and by care in adjusting these feeders in relation to the currents they have to carry and their return to the power station.

The prevalent method of protecting the pipes is the so-called "drainage system," where the current is taken off the pipes through a metallic connection and conveyed back to the power station. This method has been used in a large number of plants throughout the country with very fair results, but I find that in all cases it has not been intelligently done, and still a condition exists where damage may occur.

Before making this connection the piping system should be carefully studied, as it has been found that certain mains form an arterial system through which the majority of current returns; these are evidently the pipes which should be bled of their current, but in a number of cases a small pipe, or lateral, near the power station, has been selected, which has not sufficient cross section to carry the current delivered, thereby producing considerable fall in potential along this pipe, and creating a difference in potential through which electrolysis may occur. Again, in a number of cases it is not advisable to connect the pipe immediately adjacent to the power station, for in that case the resistance of the feeder would be low and would increase the normal flow of current over this pipe. But by locating this feeder in the territory where the pipe is practically neutral to the rails and carrying the maximum current, a point can be so selected, in most systems, on a main or large pipe from which all the other piping systems branch. Here a feeder can be connected, so that the amount of current carried back to the power station will reduce the local potential between the track and pipe in the positive area to a point below that at which the electrolysis can take place. The best method found to connect electrically this feeder with the water pipe is by making yokes to embrace the water pipe having the inside of the yoke amalgamated, also, the outside of the water pipe amalgamated where this surface comes in contact and to this yoke attach the pipe feeder by soldering or other means. It is also important to ascertain when locating this connection whether the potential between other piping systems at this point and the piping system connection has been raised to a dangerous point. In any case it is wise to connect all these piping systems together by means of a copper cable sufficient in capacity to carry the current they deliver and bring the potential the same in this location.

There are conditions arising, especially in small cities, where the connecting of a pipe to the station presents a constant resistance path, yet the tendency of the current flow through this pipe in outlined districts depends upon the current flowing on the rail and the aggregate drop of the currents flowing. In order to prevent the current flow on the piping system changing its value as a conductor for this return current, its resistance should be changed in relation to the output of the station, or compounded so that the relation between the rail and the earth's return resistances will remain constant for variations of load.

It can be readily seen that by connecting this ground return pipe feeder to the rails at the point where it is connected to the pipe an electromotive force drop equivalent to a resistance can be interposed between the rail and the pipe feeder, so that the current flowing from the rails and over this pipe feeder back to the negative bus, will raise and lower the potential at this point and maintain the resistance of the external distribution system between the rails and the pipe at a constant relation. In this way it will compound this feeder proportionately to the load on the system and not force the piping system to assume various relations in reference to current return depending upon the load of this system of rails. The degree of compounding desired is that when the load on the line of rails is at its terminal, or at such a point where the ground return drop is greatest, the current will not flow over this tie from the rail to the pipe. This would occur where there were other pipe connections of lower resistance nearer the station than the pipe tap made, or a very low ground resistance between rails and piping system in their positive territory.

It is often important to determine what is the actual current flowing through a pipe, and it has been found with cast-iron that the electrical resistance of different pipe, even made by the same manufacturer at different times, varies so much that reliable results cannot be obtained by assuming any specific resistance for cast iron.

The best method for measuring the current flow on a pipe is when the pipe can be exposed to take 4 ft. or 6 ft. of the pipe between drop points and around the drop point connect two clamps connected by a low-resistance cable, in which is inserted an ammeter and also a switch. If the milli-volts are read across the drop points on the pipe when the switch is open, and again when the switch is closed, and also the current shunted around the drop points read at the same time, it will be found, after a number of readings have been taken, that the difference in drop with the switch open and the switch closed will bear a constant relation to the current by-passed. In this way the pipe can be calibrated in milli-volts per ampere, and correct results can be obtained. This method is especially useful where the pipe has been eaten or corroded, and its true cross-section is not known.

In determining the flow of current along a water system, testing from plug to plug can be used, and the method just described can be employed, except that the leads in this case are long enough to reach from one plug to the next. In order to be assured that there is no high resistance between the plug and the main to which it is connected, a connection can be made between the rail and the plug with a low-resistance conductor, in which is inserted an ammeter and also a drop wire with a voltmeter and connected between the rail and the next adjacent plug, or other local water connections to this main, and this will give the resistance between the plug and the main by dividing the volts dropped by ampere flow. In this way the resistance of the connection between the water plug and the main can be determined, but if this resistance is high, this plug should not be used in the determination of the current flow along the pipe.

This test will also locate bad electrical connections across the pipe joints along a section of pipe. The readings on this supplementary conductor between adjacent plugs will indicate whether the mains are continuous conductors or not, as a high initial potential will be obtained with the switch open and a low potential with large current flow when the switch is closed.

Very valuable data can be obtained, relative to the current distribution over the rails and piping system, by making tests from which a potential contour map can be laid out. This potential contour map can include the different piping systems as well as the rails of the railway system, and this test can be carried out as follows:

The different lines of street railway radiating from the center of a city present different resistance and also different volumes of current, depending upon the traffic condition, to the return current flowing through the rail.

This will give different distributions of potential relative to the power station for the various lines, and if the potential is measured from different points in the city, relative to the zero potential at the negative bus at the railway power station, the potential can be plotted out on a map or scale, and will give an electrical contour which can be expressed on the map exactly as the elevation contour of the city. To effect a pressure connection by which the difference of potential of the negative bus and the point to be tested, telephone wires can be used. A permanent connection is made through the telephone cable, from the negative bus of the power station to the telephone exchange test room. Then at the point of test in the streets a pair of telephone wires are tapped, and they were then located in the test room on the cable board by first ascertaining the number of the subscriber which they served. This pair of wires is then cut out from the exchange and connected by means of a jumper to the wires leading to the negative bus at the power station. This gives a pressure wire from the point of test to the negative bus, and when the rail is connected through a voltmeter to this wire it gives the loss in pressure from this point on the rail back to the negative bus at the power station. This connection is then taken from the rail and placed on a water plug or gas pipe or sheaths of cables. If a map is required of all underground structures the pressure may be read in each instance in the same manner back to the negative bus, corrections being made for the resistance of this pressure wire. A number of different stations are taken over the city, covering the different lines of electric road, and from these the contour map can be plotted. Solid black contour lines are usually the fall in potential on the rails, and dotted contour lines represent the distribution of potential on the water pipe system. Colors can be used for the other systems.

This data gives us graphically the relative ground resistance. Where two contour lines of the same potential coincide it indicates that a metallic connection exists, and if laid separately for each of the piping systems shows graphically at what location this difference of potential is sufficient to cause trouble. It is necessary to take a number of readings at each location that the results will be an average, and these readings are best not taken at peak loads, but when the station is giving average output.

From judicial decisions which have been rendered, especially in the Dayton case, it has been established that the railway company should use every endeavor to carry this current back to the power station and use all the modern improvements known to connect the different lengths of rail together, so as to make a continuous conductor and to use such supplementary ground return feeder systems so as to relieve the rail of any excessive volume of current which will produce a rapid fall of electromotive force along the track, as this condition is conductive to troubles with underlying piping systems. This article is written for the purpose of indicating to railway managers what has been done to remedy these troubles where they have arisen, and why some cities have had trouble while others are practically immune.

THE USE OF GROUP-SWITCHES IN LARGE POWER PLANTS*

BY L. B. STILLWELL

In a number of large electric generating plants recently designed in America, the feeder circuits are divided into a plurality of groups, and a switch designated a "group-switch" is connected into the circuit between the main bus-bars and each group of feeders. Obviously, no switch should be added to an organization of switch gear already very complicated and expensive, unless its practical usefulness fully justifies its adoption. As this subject has never been discussed by the Institute the writer avails himself of the opportunity presented by the invitation of the chairman of your transmission committee to introduce it.

In considering a subject such as this, accurate generalization is difficult if not impossible. Probably no one who knows what engineering means would affirm without qualification either that he approves the use of group-switches or that he does not approve their use. There are few hard and fast rules in engineering. If such matters as the use or non-use of group-switches could be settled once for all, and for all plants regardless of size, function, or attendant conditions, the purchasing agent would soon succeed the engineer, the pharmacist would take the place of the physician, and the capitalist investing his money in electric power development and use would have no occasion to seek among technical advisers for sound judgment resting upon broad experience and exercised in full knowledge of the existing state of the art, as well as recognition of its general direction and tendency. Instead of attempting a generalization, therefore, we may consider more profitably the arguments for and against the group-switch in the case of a typical plant, and then glance at some of the modifications of function and circumstance, which in the case of other plants would affect our conclusions. The group-switch first appeared in the plant of the New York City Railway Company, at Ninety-Sixth Street, but as the writer had nothing whatever to do with the design of that plant, he selects for consideration the plant of the Manhattan Railway Company. In this plant two complete sets of main bus-bars are used. Switches are provided by means of which each of these sets may be divided into two independent sets of bus-bars to each of which four alternators and four groups of feeders may be connected. Eight group-switches are provided, through each of which current is supplied to a set of auxiliary bus-bars, to which in turn the individual feeders are connected through their respective switches. One of the eight feeder groups is used to supply power to auxiliaries in the power house. The other seven groups supply power, respectively, to the seven sub-stations which receive power from this central source. All switches in the high-pressure alternating-current circuits are of the motor-operated oil type.

The arguments in favor of the group-switch as used in the plant of the Manhattan Railway Company are:

1. It affords an additional means of opening a feeder switch that fails to open its circuit when operated for that purpose. The advantages of the group-switch in respect to this function to-day appear materially less than they did five years ago, for the reason that the power-operated oil switch within the period named has demonstrated a high degree of reliability. However, it cannot be assumed that the feeder-switch is invariably reliable, and, therefore, opinion as to the weight of the argument

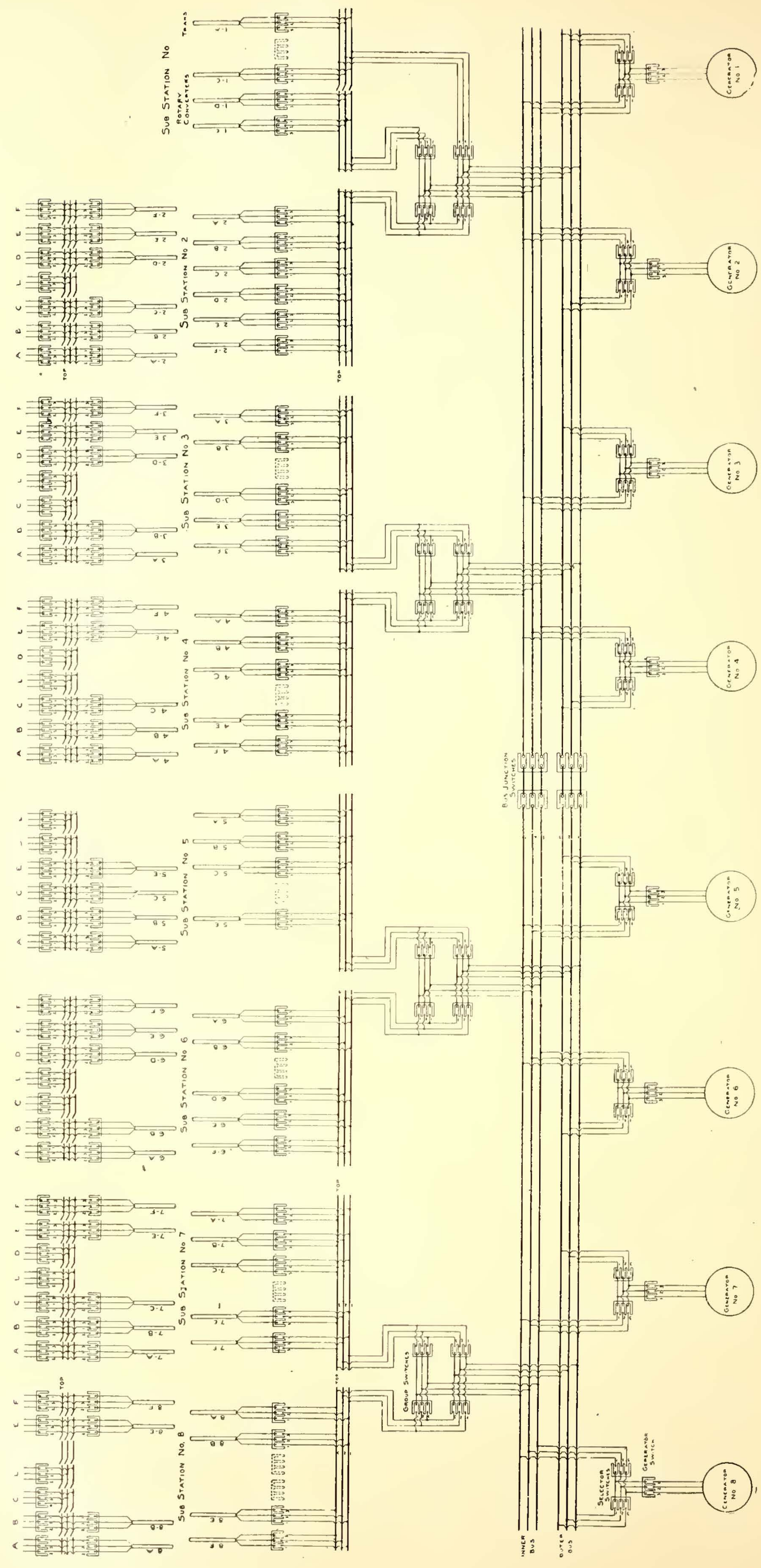
* Presented at the meeting of the American Institute of Electrical Engineers, March 25, 1904. Copyright, 1904, by A. I. E. E.

in favor of the group-switch, based upon its use as a reserve for the feeder-switch, becomes a question of judgment of the chances of failure of the feeder-switch on the one hand and the seriousness of total interruption of power supply on the other.

2. It affords means of reducing the aggregate load upon the power house in case of necessity, more rapidly and otherwise less objectionably than the usual method of cutting off individual feeders. It will sometimes happen in the operation of a power plant that it becomes necessary suddenly to shut down one of the generating units. If the load carried at the time be such that the shutting down of the generator implies reduction of the external load, this can be accomplished most conveniently by operating one or two group-switches.

3. Where duplicate main bus-bars are used it facilitates transfer of load from one set to the other, in case it becomes necessary suddenly in operation to make such transfer. As bus-bars and connections are now installed in our best plants, this necessity does not arise frequently; nevertheless, it is liable to occur, and obviously half a dozen group-switches may be used to affect the transfer in much less time than would be required were five or six times that number of individual feeder-switches used.

4. The grouping of the external feeder circuits in group units bearing a simple fixed relation to the generator units establishes a symmetry and proportion most useful to the operator, particularly in times of emergency. In the case of the plant under consideration, at times of full load, the power passing through each group-switch is substantially equal to the output of one generating unit. This relation, of course, does not exist under partial loads, but under such loads it is not difficult usually to keep in service generating capacity exceeding the load by a margin sufficient to make it possible to shut down one generator without cutting off feeders; and in cases where this margin of capacity is not kept in service it is, nevertheless, a more speedy and certain operation to cut off



ARRANGEMENT OF BUS-BARS, OIL SWITCHES AND A. C. FEEDERS AT THE SEVENTY-FOURTH STREET POWER STATION AND SUB-STATIONS OF THE MANHATTAN RAILWAY COMPANY, NEW YORK the necessary number of groups of feeders than it would be to cut off a proportionate number of individual feeders.

The arguments against the group-switch are:

1. It introduces additional apparatus, and, therefore, in itself increases the risk of interruption due to failure in switch insulation, etc. The successful operation of many plants, particularly in America, has been interfered with by the introduction of too much switch gear and too many safety devices, automatic and other; these additions in themselves being responsible in some cases for more trouble than they prevent; and it is to be noted that the group-switch implies the auxiliary bus-bar. Here, again, it is impossible to dogmatize, for as the result of additional experience, the judgment of to-day may be reversed five years from now. As an expression of personal opinion, however, I may say that if the group-switch and the auxiliary bus-bars be reasonably well insulated and installed, the interruption originating in this additional apparatus should be almost negligible in the case of such a plant as that which we are considering.

2. The group-switch and its bus-bars imply, of course, an increase of cost of the plant. In case of the Manhattan plant this increase is about 10 per cent of the cost of the switch gear and measuring apparatus, and about four-tenths of 1 per cent of the cost of the plant. To put it another way, the cost of the group-switches and bus-bars for the plant approximates $20,000, and the annual cost, assuming this to be 10 per cent of the investment cost, is $2,000, which is about two-tenths of 1 per cent of the annual cost of operating the entire plant, including sub-stations.

In the plants in which the feeder unit equals or exceeds the dynamo unit of power, the group-switch, of course, disappears. In this case, however, it may still be advisable to use two feeder-switches in series in order to avoid the necessity of shutting down the entire plant in case of the failure of a single feeder switch.

Obviously, also, there is no reason for attempting to use group-switches in cases where the total number of feeders is small.

For plants comparable in magnitude to the plant of the Manhattan Railway Company, using a very considerable number of feeders, the group-switch is important and its use generally advisable.

GANZ SYSTEM FOR CANADIAN LINE

The Canadian Electric Traction Company, of London, has accepted the tender of Bruce Peebles & Company, Ltd., Edinburgh, for motor cars and power house equipment for the St. Thomas & Port Stanley Railway, which will operate between St. Thomas and Port Stanley (Canada). The equipment will comprise 1000-hp power station equipment, three-phase transformers, etc., ten 250-hp three-phase motor cars, each to seat fifty passengers, speed 30 miles an hour. The Ganz system will be used, and the entire plant will be built in Edinburgh. The contract price is £42,250.

CAR HOUSE FIRE IN CINCINNATI

Twenty-five summer cars, valued at $75,000, two double-truck closed cars, valued at $10,000, and two salt cars, which cost $2,500, were destroyed Saturday morning, March 26, by a fire which completely wrecked Barn No. 1, of the Hewitt Avenue barn system of the Cincinnati Traction Company. The architecture of the structure was such that the flames were given full vent, and, aided by the stiff wind, spread with remarkable rapidity. The adjacent barns had a narrow escape from destruction and the fire walls that were between them in all probability prevented the flames from sweeping from one end of the series of barns to the other. The total loss is estimated at $94,000, and is covered by the blanket insurance carried by the company.

SOME IMPROVEMENTS IN TRACK CONSTRUCTION IN PHILADELPHIA*

Rail-joints, especially those used in street railway tracks, may be divided into two distinct classes—those, which I will call ordinary joints, where the parts comprising them may be assembled and taken apart with ease and comparatively small expense, and those, which I will call permanent joints, where the parts are permanently embodied in the joint and cannot be taken apart. The first class comprises practically all of the joints at present in use, and are those that consist of fish or joint-plates of various forms held by bolts or keys. The permanent joints represent a very small percentage of those in use, as they have been introduced comparatively recently, and consist of so-called cast-welded and the electrically-welded joints.

The different kinds of fish or joint-plates used for connecting ends of rails are well known. The principle involved in all of them is two wedge-shaped plates, that are, by means of bolts or keys, forced on to the rails, the latter having a similar outline; and upon the thorough, continuous and tight contact of these inclined surfaces the solidity and permanence of the joint depends. In any form of rolled steel exact uniformity of section is never obtained; one end is invariably larger in cross-section than the other, even when new rolls are used. This is due largely to the difference of temperature between the ends of the steel when on its final pass through the finishing rolls; and, further, as the rolls wear down, the rolled section becomes larger. This is true even with the simplest section, as a square or round bar, and it is considerably more pronounced in the deep rail sections that are used in street railway construction. In consequence, when joint plates and rails are assembled, while theoretically true and exact in their complementary design, in practice they vary greatly—sometimes as much as 1-16 in. But, assuming that the section of plates and rail are correct, as per design, rolled surfaces of steel are not continuous or perfectly smooth planes, but consist of minute elevations and depressions. Therefore, when the two joint plates are forced by the bolts into the fishing sections of the rail, continuous contact is not obtained, but only an intermittent or point contact. In other words, only the protuberances of the surface of the joint plate come in contact with those in the surface of the rail. The object of a rail-joint is to bridge over the ends of the rails and hold them against vertical and lateral movements under the load. Were it only for those movements, I believe, joint plates would be effective for a considerably longer period than they are in practice, for the protuberances mentioned above would hold out considerably longer against flattening under the weight of the load. But, besides the vertical and lateral movements, there is a longitudinal or bodily movement of the rails, due, principally, to contraction and expansion, and also on account of the wave motion of the rail under traffic. This movement acts like a file on the minute irregularities of the surfaces. Although this linear movement is small, maximum ¼ in. to ⅜ in. in severe changes of temperature, yet those point contacts are so small as compared with the extent of the movement of the rails, that this movement acts upon them like a long-drawn file. The result is, that no matter how tightly the plates were adjusted originally, in a very short time they become loose, and the ends of the rails begin to hammer under the passing wheels. Moisture percolating between the contact surfaces, due to capillary attraction, or otherwise, oxydizes those surfaces and greatly facilitates this filing effect. In steam roads this necessitates constant, almost daily, tightening of the bolts.

I have not mentioned here the loosening of the plates caused

*An address given before the Philadelphia branch of the American Institute of Electrical Engineers, by C. B. Voynow, assistant engineer Philadelphia Rapid Transit Company.

by the nuts being jarred loose from vibration; the reason being that I wish to present the fact to you that a joint, even under ideal conditions of fit and construction, could not be maintained in perfect condition very long. In street railway track construction the movement of the rails, due to changes of temperature, is not as great as in steam tracks, because the rails are buried in the pavement, yet it is large enough to cause the same filing effect. On the other hand this burying of the rails in the pavement entirely precludes the constant tightening of the bolts, for the expense of the constant digging up and replacing of pavement would be prohibitive. The consequence is, that the joints are allowed to remain loose a considerable length of time before they are uncovered and bolts tightened. Moreover, the constant hammering of the loose ends of the rails on the plates causes a depression on the surface of the plate and rail to such an extent that the tightening of the bolts does not avail; and the plates first, and very soon the rails themselves, are in such a condition that a renewal is the only remedy. Even before the ends of the rails and the plates have become damaged, the loose joints cause the ends of the rails to droop, and in connection with the rolling action of traffic, which elongates the upper surface of tread, bend the entire rail in a vertical curve by forcing up the spikes or ties in the middle of the rail. This makes the track a continuous succession of waves, which necessitates, at intervals, the digging up of the entire pavement for the purpose of retamping and respiking it. When once these vertical curves are formed the track can never be brought to a good condition. As a matter of fact, rails, after they have been removed for renewal, could in many cases have been used for several years more, as far as the middle part is concerned, were it not for the battered ends. In other words, the life of the track is mainly dependent upon the life of its joints. I shall not discuss here the loss involved in the maintenance of the rolling stock and pavement, but any one taking a ride on old track will feel the effect on himself of low joints.

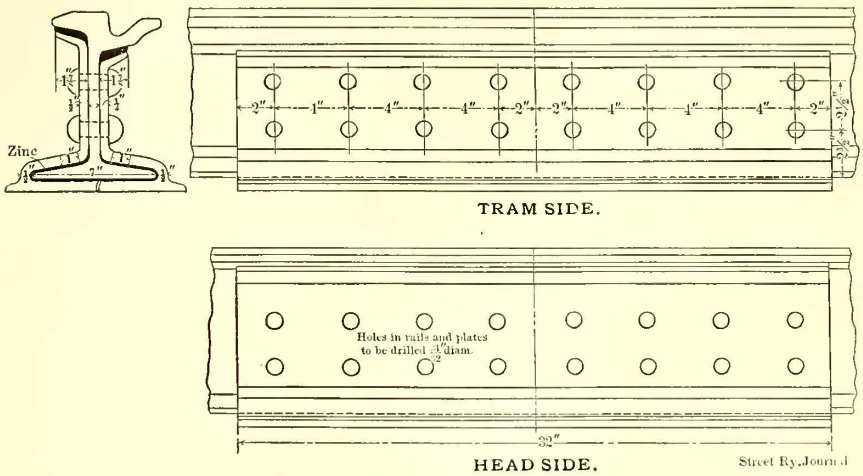


FIG. 1.—CROSS SECTION AND SIDE ELEVATIONS OF ZINC JOINT

Street railway track construction being a development of that of the steam roads, the idea prevalent in that branch was necessarily embodied in it, although there are radical differences between the two. The steam railroads, consisting of vast stretches in the open country, naturally do not require paving. The rail being entirely exposed on all sides, and, therefore, directly influenced by changes of temperature, great care must be taken that the expansion in the rails does not distort the alignment of the track. To prevent this, the rails are laid in short lengths, the joint holes in the rails are made considerably larger than the bolts, and spaces are left between the ends of the rails to allow free movement. This was also embodied in street track construction. But it has been gradually acknowledged that in street railways, where the rails are buried in paving, the changes of temperature in the atmosphere do not affect the rail proportionately; the friction between the paving and the rail exerts upon the latter such a force as to a great extent counteract the force of the stress due to expansion. Again, the material of the paving enclosing the rail on both sides, helps to keep the rail in permanent aligment and surface. This has evolved what I have called permanent joints, viz., the cast-welded joint, which is formed by pouring a mass of molten cast-iron around the abutting ends of the rails, and the electrically-welded joints, which is made by electrically welding two strips of steel plates to the sides of the webs at three or more points. While these joints have seemingly given better results, they also embody either defects or disadvantages which are quite important. In the cast-welded joint the comparatively large mass of molten metal anneals or otherwise affects, whether physically or chemically I do not know, the texture of the rail ends. This makes the track of an intermittent hardness, which is very soon shown in the difference in wear between the middle of the rail and at the joint. Moreover, on account of the sudden high temperature the rail ends expand vertically, and in cooling do not come back to their original cross-section. This causes either elevations or depressions at the joints. The elevations can be overcome by grinding or filing, but the depressions cannot be remedied, and they remain as permanent defects in the track. I am not as familiar with the electrically-welded joints, and therefore cannot give you the results that have been obtained with them. But the disadvantage that I know of is the fact that the transportation of the machinery and other expenses involved in placing them is considerable. The cast-welded joint does not give a perfect electrical connection, and I know of a railway in the neighborhood of this city where the management is judiciously using large copper plates in connection with this joint. Both of these joints have the further disadvantages that in case of changes in the track lay-out the joints can only be cut out and thrown in the scrap pile.

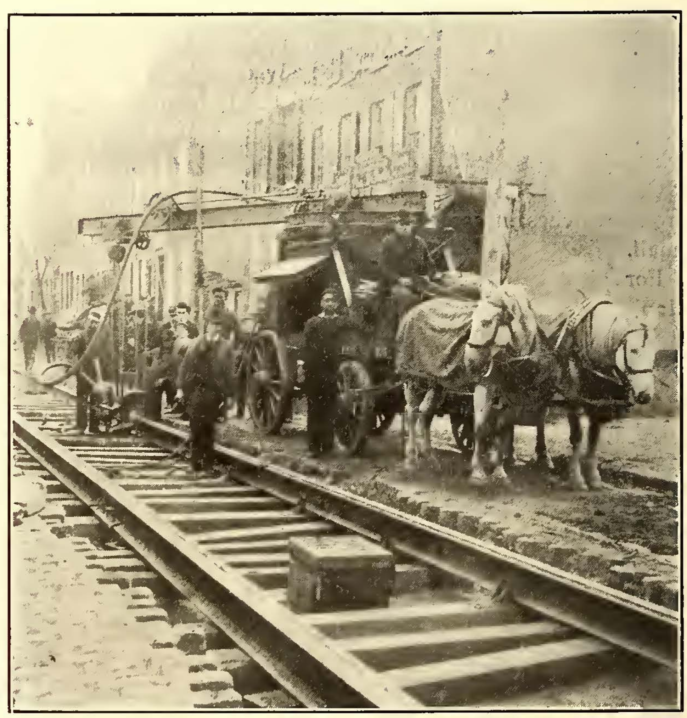


FIG. 2.—PORTABLE PNEUMATIC RIVETER AT WORK, SHOWING CRANE ARM FOR CARRYING RIVETER

The joints that are at present used in Philadelphia are supposed to remedy the above-mentioned defects and disadvantages. This will be seen from the following descriptions: The joint consists of what may be called two Z, or special bars (Fig. 1), which are riveted on to the webs of the rail. These plates are not made to fit the fishing section of the rail; on the contrary, spaces are left under the head, tram and around the foot of the rail. These spaces are filled with molten zinc, which enters into and fills out all the irregularities of the rolled surfaces, thus giving an absolutely continuous and perfect bearing throughout the whole length and width of the flanges of the plates. It is obvious that such a continuous contact could not be obtained by the most laborious machining or milling of those surfaces. The adhesion of the molten zinc to the rails and plates, together with the body-bound rivets, hold the joint permanently tight, and at the same time prevent expansion, thus making the rails continuous. The method of constructing the joint is as follows: After the material has been distributed and the rails placed on ties, but before the latter are spiked, both plates and rails are thoroughly cleaned by a portable sand blast. The plates are next placed on the rail ends and held in place by steel drift-pins, placed one in each end of the plate.

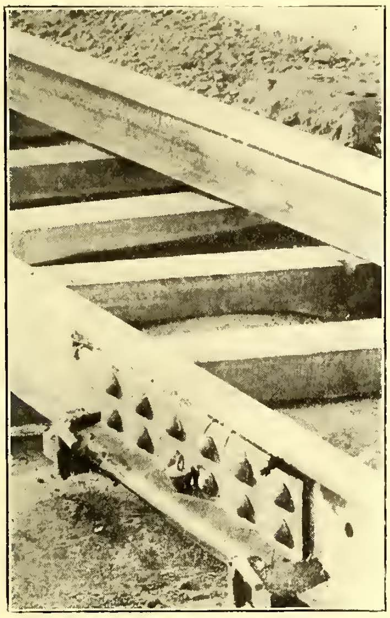


FIG. 3.—JOINT CLAYED UP AND CAULKED WITH ASBESTOS CLOTH, READY TO BE TREATED

FIG. 5.—POURING A JOINT WITH MOLTEN ZINC

FIG. 6.—VIEW OF COMPLETED JOINT, HEAD SIDE

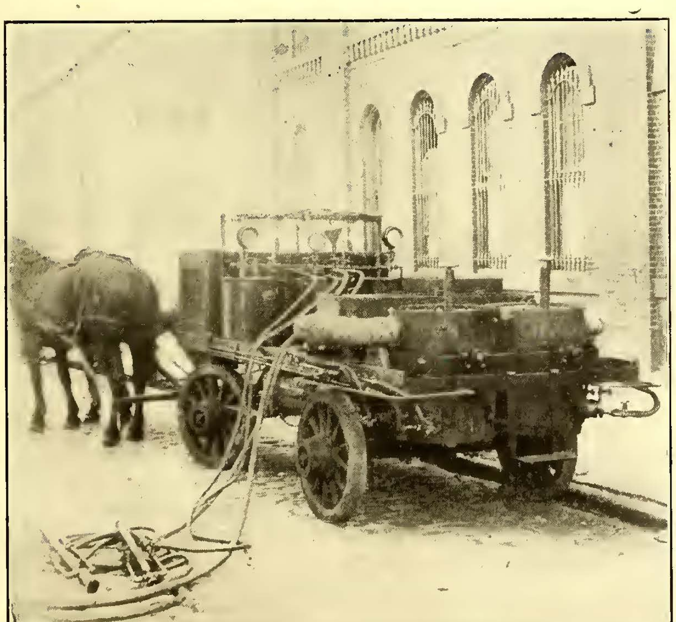


FIG. 4.—PORTABLE MELTER OUTFIT, WITH TWO MELTERS OF 400 LBS. CAPACITY EACH IN REAR; TANKS FOR FUEL OIL IN MIDDLE AND MOTOR COMPRESSORS IN FRONT OF WAGON, ALSO TWO FUEL OIL BURNERS FOR HEATING JOINT IN FOREGROUND

A steel straight edge is laid on the head of the rail, and the tread brought to a uniform surface by inserting wedges between the plates and the trams, or the plates and the head of the rail. The wedges are then driven in with a light hammer until the straight edge has a continuous bearing.

While the plates are held in place by four temporary bolts, the rivet holes are reamed to 1 1-32-in. diameter by a portable pneumatic reamer.* The twelve 1-in. steel rivets are then driven by a portable pneumatic riveter (Fig. 2). This insures the filling up of the holes by the rivets. The next step is to put in place the iron clamps for holding the asbestos cloth pads and clay on the bottom and at the ends of plate and above base of rail (Fig. 3). The spaces between the head and tram and plates are temporarily caulked with asbestos cloth. The plates are then warmed by fuel oil burners, operated by a portable compressor (Fig. 4), to a temperature of about 300 degs. to 400 degs., after which the molten zinc is immediately introduced through a 1-in. hole located in the center of the lower portion of plate, the remaining space underneath head and tram of rail being filled by the aid of dams (Fig. 5). These dams consist of aluminium castings padded with asbestos cloth. The completed joint is shown in Fig. 6.

From the above description it will be seen that this joint combines the characteristics and advantages of both classes of joints mentioned above, obviating their defects. While it is a permanent joint, in that it holds the ends of the rails permanently together, it can be easily taken apart and the parts replaced at a comparatively small expense. It does not distort the original cross-section of the rail, nor does it affect the physical or chemical nature of the metal. It not only obviates the initial defects in the fit of the rolled section, but also the aggravating cause—that of linear movement, due to expansion. As the plates and rails are thoroughly cleaned and heated before the molten zinc is poured in, the latter galvanizes on to the steel (this was proved on joints that were purposely opened

*Engravings illustrating the processes just described were published in the Street Railway Journal of March 1, 1902.

for investigation after having been in the ground for over two years), and, therefore, gives a thorough and continuous electrical connection. I know of very interesting data about the electrical bonding quality of this joint, but as this data is

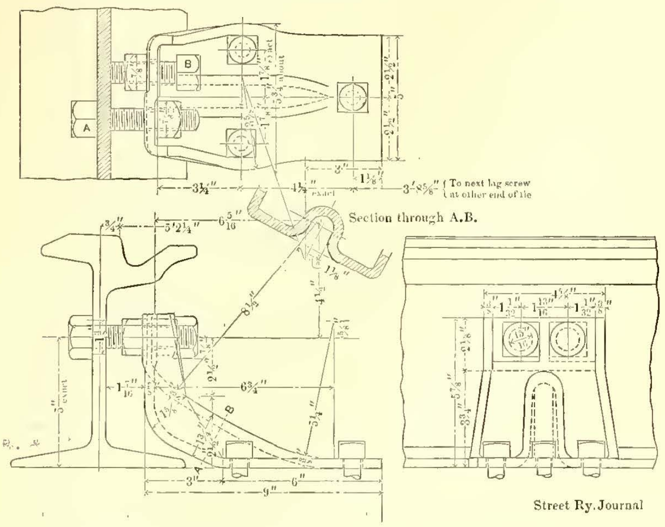


FIG. 7.—PRESSED STEEL RAIL BRACE FOR HOLDING TRACKS TO GAGE

the property of the Franklin Institute, I am not at liberty to divulge it at present. I will only say, that after a thorough test by an electrical expert of this city, of joints that had been in the ground over two years and under the heaviest traffic, the resistance was found to be less than the rails themselves. Another, and I think a very important, feature of this joint is the fact that its initial cost is practically a permanent investment. From the nature of its construction, having an intermediate soft metal between the surfaces of the steel, the plates cannot be affected by wear, and, therefore, practically the entire material that enters in the construction of the joint, that is, the plates and zinc, can be used over again after the rails have been worn out only necessitating new rivets.

Before describing the other improvements in track construction I think that it will be interesting to mention the novel idea involved in the construction of this joint. It seems, at first glance, rather an anomaly that malleable iron, cast-iron and even rolled steel plates of a high percentage of carbon have been used, or, in other words, different hard metal substances have been used as a support or foundation for certain vibrating loads, and they all proved more or less a failure. Yet, in face of these known failures it was proposed to support the same loads by means of a comparative soft metal, zinc. The fact is that this metal does form a better support. There is a well-known engineering principle which has a similar and close relation to this, and which will explain the seeming anomaly. Foundations of large and important structures are known to have been built on sand and even quick sand. It was only necessary to dam around the loose material under the foundations, and make the area of the latter large enough. The configuration of the plates forming wedge-shaped spaces under the head and tram of the rail, and the enclosed space around the foot is the damming, and the filling in under the entire width of base of rail, and of all the irregularities of the rolled surfaces is the enlarged area of the foundation.

The tendency in street railway track construction is toward a permanent roadbed of concrete, which should eliminate wooden ties entirely. There are many methods used in this so-called concrete construction of roadbeds, and a description of some of them would throw more light on the improvements introduced in similar construction in Philadelphia.

For the sake of brevity I shall confine myself to a description of the improved methods of holding the rails to line and gage temporarily, and of adjusting and holding the rails to per-

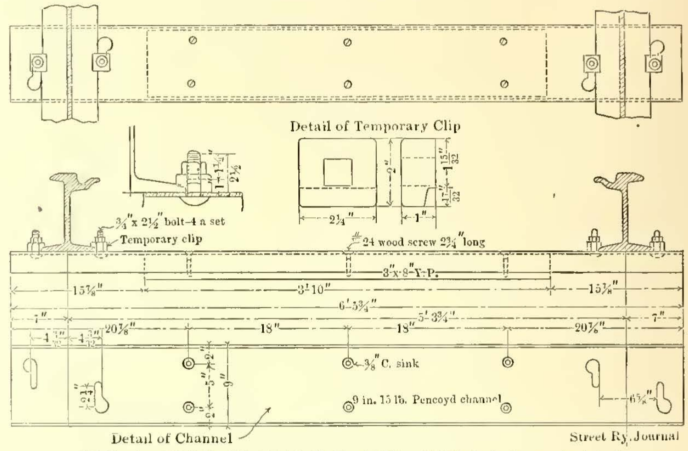


FIG. 9.—TEMPORARY TIE AND CLIPS FOR TRACK CONSTRUCTION

manent line and gage, which were adopted on the new tracks laid recently.

After the old rails and ties are removed, longitudinal trenches, 18 ins. wide by 20 ins. deep, are dug and temporary ties about 10 ft. apart are placed across them. These ties consist of 6-ft. long channels, to which short wooden planks are fastened by means of lag screws (Fig. 9). The channels have at each end two diagonally spaced holes of a bulb shape. The distance between the two pairs of holes is such that when the rails are bolted to the channels by means of cast-iron clamps, they are practically to gage. The rails are primarily laid on the ties between the two longitudinal trenches, and the joints formed, after which the rails are moved out toward the ends of the ties, and clamped to them by the clips. The cast-iron chairs are clamped to the base of the rails at intervals of 5 ft., they thus being suspended in the trenches (Fig. 10). U-shaped

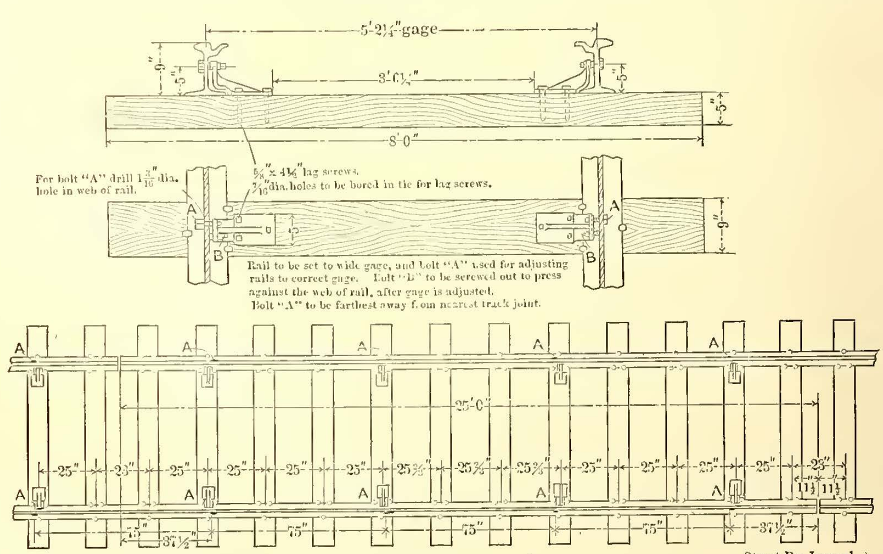


FIG. 8.—DRILLING AND TIE SPACING OF 50-FT. RAILS FOR RAIL BRACE CONSTRUCTION

round iron rods with the short U-legs downward, are also tied on to the base of the rail (Fig. 11). These are for the purpose of holding the concrete stringers against the possibility of spreading. The wooden parts of the ties, which come between the trenches, are then tamped so as to bring the track to a practically permanent line, and an absolute permanent surface. The trenches are then filled in with coarse concrete to within about 1½ ins. of the base of the rail (Fig. 12), and the rail tamped with a finer concrete and allowed to set for several hours, so as to permit the chairs to sustain the rails. The temporary clips are then taken off, and the ties removed (Fig. 13). The cast-iron chairs (Fig. 14) have two sets of bolts, one set of two vertical bolts that pass through permanent clips, which hold the rails down on the roadbed. The other set of two bolts press against the clips in a horizontal direction, and are for the final adjustment of the rails to gage and line. Before the chairs are attached to the rails, shims of about 1-16 in. thick steel are placed between them and the base of the rail. This is done for the following purpose: As the concrete shrinks slightly in setting, when these shims are removed and the vertical bolts tightened, it insures a thorough and continuous support for the base of the rails. A solid sheet of concrete is now filled in between the two rails, and for about 2 ft. outside of the rails, to form a permanent foundation for the paving. Concrete is also placed between the webs of the rails and the paving. Figs. 10, 11 and 12 show temporary wooden ties instead of the channels; the latter are of a later development.

In the track construction with ties, especially designed brace chairs are being used, which do away with the tie-rods. The latter stretch, and are generally inadequate to hold the rails to gage, and are in the way of paving. The ordinary braces were found to be inefficient, for the reason that the braces were generally spiked to the ties after the rail was spiked to gage, and the contact of the brace with the underside of the head, or web, or both, was depended upon to hold the rails to gage. But as neither the spiking nor the contact could be made sufficiently accurate they proved unsatisfactory. In the brace chair used in the Philadelphia construction, there are a number of novel improvements. The chairs are attached to the ties before they leave the yard by three lag screws, for which purpose a multiple machine drills the six holes simultaneously. The vertical legs of the brace have two holes. The rails are punched with single holes, as for tie-rods. When the rails are joined up they are set slightly to wide gage, and standard ⅞-in. bolts are passed through the holes in the web, and are engaged in a nut, which is locked by a corrugation in the brace; by tightening on these bolts the rails are brought to exact gage, when another ⅞-in. bolt is screwed into a nut, also locked by a corrugation in the chair, and when this bolt is tightened up it presses against the inside of the web, thus holding the rails permanently to gage. The track, after this, is ready for traffic without being spiked at every tie. This greatly facilitates construction. It will be seen that the brace not only holds the rails effectively to gage, but also has the function of adjusting

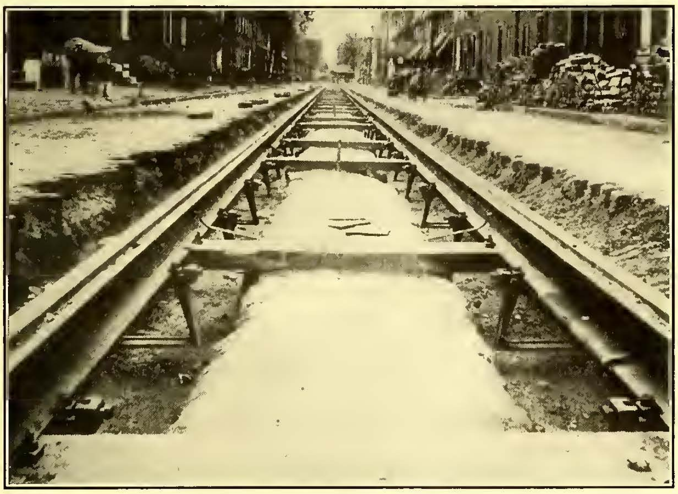


FIG. 10.—RAIL CLAMPED TO TEMPORARY TIES AND CAST IRON CHAIRS ATTACHED TO RAIL

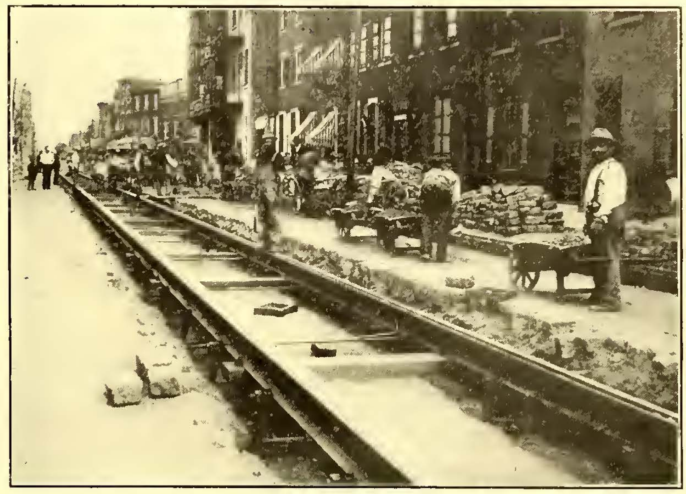


FIG. 11.—VIEW AFTER THE U-SHAPED TIE RODS ARE FASTENED TO THE RAILS

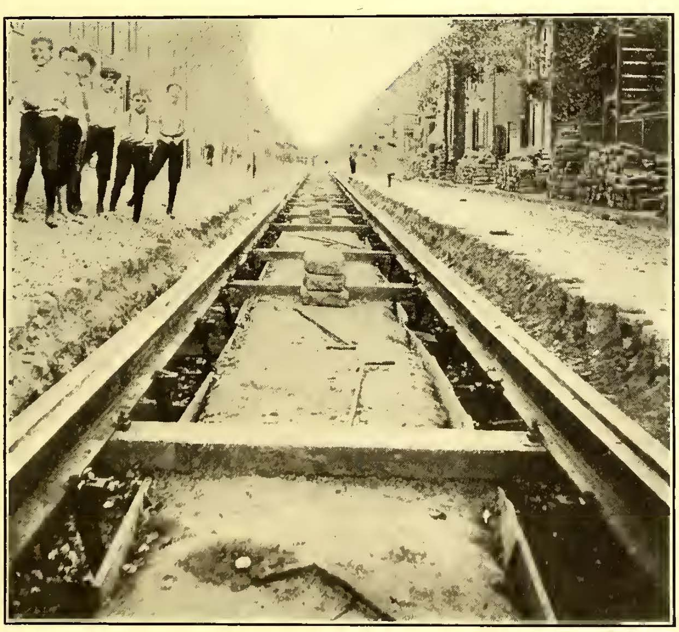


FIG. 12.—TRACK AS IN CONDITION SHOWN IN FIG. 10, BUT WITH TRENCH LINED WITH BOARDS

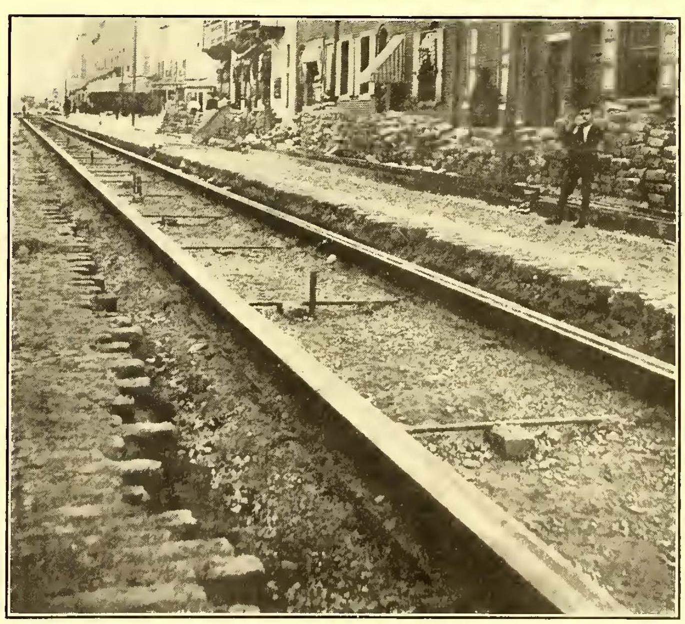


FIG. 13.—TRACK AFTER TEMPORARY TIES HAVE BEEN REMOVED AND CONCRETE FILLED UP TO BASE OF RAIL

the track to exact gage, which operation in the old way of spiking required more men and could never be made as exact. The chair itself is also, practically, a permanent investment, for in case of removal only the two bolts have to be replaced. The brace is shown in Figs. 7 and 8; in the latter the brace is shown as made originally of cast-iron.

DISCUSSION

In reply to inquiries addressed to Mr. Voynow, after the reading of the paper, the following additional points in regard to the zinc joint were brought out.

The joint is the invention of Messrs. Voynow and H. B. Nichols, chief engineer of the track department of the Philadelphia Rapid Transit Company. About 63 miles of track have

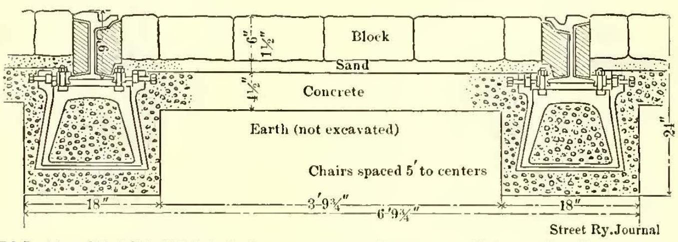


FIG. 14.—CROSS SECTION OF CONCRETE TRACK CONSTRUCTION

been laid with this joint. About 85 per cent of this mileage is laid with a 93-lb. rail, No. 206 section of the Lorain Steel Company, and the remainder with the new 137-lb. rail, section 371 of the Lorain Steel Company. The latter is the standard rail for paved streets of the Philadelphia Rapid Transit Company.

Zinc, the material selected for binding the joint, possesses a number of advantages for this purpose. It is particularly hard and crystalline in construction, but has at the same time a low melting point, and has given good service in special work where it has been used to hold steel plates in position at points of maximum wear and where the plates have been subjected to severe blows. Moreover, zinc keeps the iron from rusting by electrochemical action, as zinc is a more electro-positive metal. While some authorities claim that zinc does not expand on cooling others claim that it does, and as zinc is the only metal for which this property is claimed this feature is worthy of consideration.

Considerable experimenting was required before a satisfactory method of melting zinc was adopted. Originally an electric heater was tried. It consisted of a cast-iron kettle, on the outside of which four layers of German silver No. 14 wire were wound. This winding was originally covered with asbestos, but afterwards porcelain strips were used instead of asbestos. The resistance of the winding was designed so as to secure from 3 amps. to 5 amps. from the trolley circuit. The melting pot described was placed in another of larger diameter, and the space between the German silver wire and the outside jacket was packed with asbestos fibre. This apparatus would melt about 400 lbs. of zinc in 55 minutes, but was abandoned in favor of the hydro-carbon melter now used, because the German silver wire would burn out.

Zinc joints can be formed as rapidly as cast-welded joints. The Philadelphia Rapid Transit Company has at present three separate outfits for placing this joint, each with a capacity of from forty-five to fifty-five joints per day, depending on the conditions in the streets, and each requiring a working force of from sixteen to twenty-two men.

The steel joint plates are rolled, and are supplied to the Philadelphia Rapid Transit Company by the Continuous Rail-Joint Company. A pair of plates weighs about 107 lbs., and the cost per pound of these plates is about the same as for other deep rail plates. The twelve 1-in. rivets used for each joint weigh about 12 lbs. From 22½ lbs. to 26 lbs. of zinc are required per joint, depending upon the section of the rail.

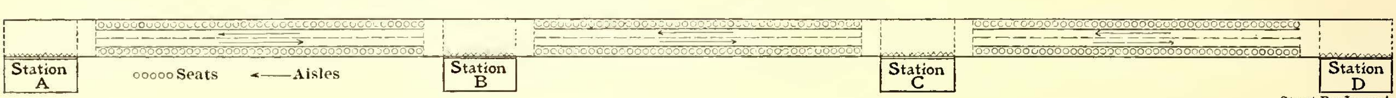
Adding to the price of this material the cost of labor, which is from 60 to 80 cents, depending upon the conditions in the street, and also adding 10 cents for depreciation of the tools used, gives the cost of the joint. The cost of the joint plates and zinc should be regarded as a permanent investment, as they can be used over again if the joint is taken up.

A considerable part of the track laid with this joint in Philadelphia has been used for three years, and no failures have yet been discovered. Where straight track is joined to special work it is the practice in that city to use ordinary rolled angle-plate for making the connection, as rail in special work does not last very long, and the question of joints is of secondary importance.

CONTINUOUS CORRIDOR TRAIN

Walter Wellman, of Washington, D. C., has submitted to the Board of Rapid Transit Commissioners, of New York, an ingenious modification of the moving platform plan as a solution for the rapid transit question in New York City. The novel feature in the plan proposed is the method of loading and unloading. The train is made up of cars very similar to those now in use, but, perhaps, of greater length, all vestibuled so as to form a continuous corridor. For loading and unloading it is proposed to dispense with all car-end steps, and to use instead platform cars, or transfer platforms, placed at regular intervals throughout the train, as shown in the illustration. The distance between these platforms is to be exactly the same as that between the station platforms and the train platforms, and station platforms are to be of equal length, with the exception that at stations where traffic is light the station platform need not be as long as the train platform.

The train or transfer platforms are to be without seats, and provided with gates or doors along the whole of one side, next to the station platform, these openings to be in charge of an ample corps of guards.



PLAN OF CONTINUOUS CORRIDOR TRAIN FOR ELEVATED RAILWAYS

The station platforms and train or transfer platforms are to be precisely equidistant, so that when the train stops at one station it stops at all simultaneously. The cars are to have two rows only, so that with a car 8½ ft. wide there would be an aisle 4½ ft. wide at the floor line and 5 ft. wide in the center of the car, giving opportunity for free passage at all times for walking through the train.

As the loading platforms and the train platforms are at equidistant positions it is not necessary to stop the train at every station. If, for instance, the train is stopped at every third station, as recommended by Mr. Wellman, when the stations are one-fifth of a mile apart, any passenger can dismount at his desired designation by selecting the train platform which stops at the station at which he desires to depart. To facilitate this all stations and their corresponding train platforms are in series of three, and all those in each series are to be painted alike—red, white or blue. All red train platforms will stop at none but red stations, white at white, blue at blue. On all time-tables, placards, etc., this color scheme will be used.

A passenger from a white station enters the train through a white platform. If he is bound for a white station he knows he is to use that white platform for his exit. If he is bound for a red station he knows the red platform which he must use is the next to the rear, or the blue is the next forward. This scheme can further be impressed on passengers by placards, which will be placed conspicuously on station and train platforms, which will give the names of the red, white and blue stations.

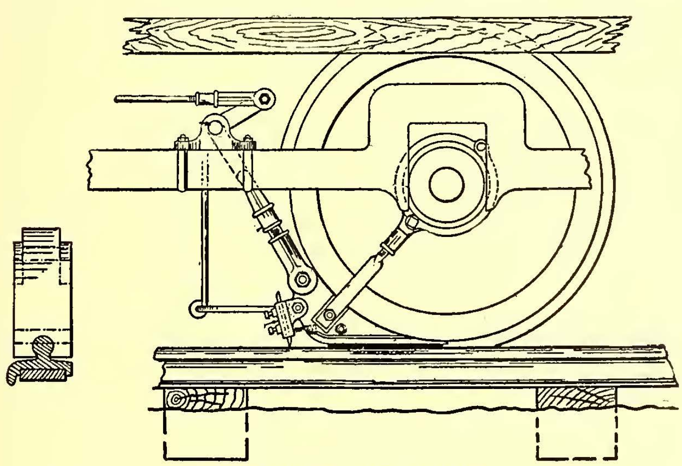
With all runs three-fifths of a mile long the inventor claims that with the same acceleration and retardation, as at present used on the Manhattan lines, a net speed of 24 m. p. h. could be secured, which would be equivalent to a seating capacity in each direction of 129,600 passengers per hour.

For locations where the traffic is not sufficient to warrant an endless belt train, with its very great capacity and many advantages, a modification is proposed, consisting of operating a few long units which would overlap at least three stations, so that the advantages secured by making few stops, but accommodating every passenger, as arranged in the plan already outlined, could be secured. This plan would be adaptable to the requirements of the traffic, as trains could be run close together, or even as an endless belt during the rush hours, and less frequently at other times.

As regards starting and stopping it is believed that with the entrance platforms 100 ft. long, as proposed, 300 persons could easily board the trains in 14 seconds from each station, and that the stops would not be longer than this. To avoid dangers in boarding platform gates would be used, but these would be supplemented by station gates, so that only those passengers would be admitted to a platform who could safely board a train. There would also be guards and an electric button signal at each station to insure safety.

EMERGENCY CAR-BRAKE

The accompanying cut shows the operating details and application of an emergency car brake, made by the Emergency



EMERGENCY CAR BRAKE

Car Brake Company, of Cumberland, Md. This brake is now in use on several cars of the Fort Wayne (Ind.) Traction Company. The brake-shoes are applied under the rear wheels, thus giving the front wheels more freedom in passing over curves and avoiding derailments.

The brake-shoes are operated by a roller bar, connected by a draw-bar to the brake-staff. To apply the brake for an emergency stop, the motorman gives the brake-handle half a turn, thereby unhooking the draw-bar from the brake-staff. The operation of the hanger and swing-bar swings the shoes under the wheels, getting the braking power from the weight and momentum of the car. Each brake-shoe is provided with a brace-bar, ice-cutter or track cleaner, and a detachable friction plate holder.

The ice-cutters are attached to the shoes with one bolt cushioned by a compression spring. The steel pieces, which are secured by set screws, remove all ice and dirt that might accumulate under the friction plates.

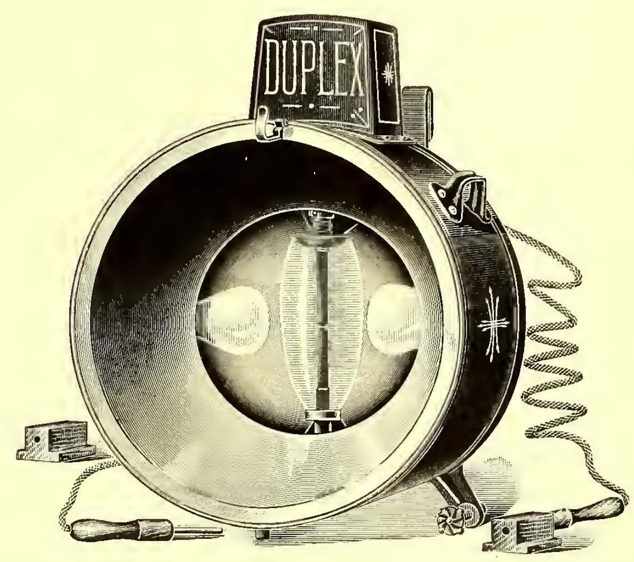
The friction plate holder is made of malleable iron, with a trunnion rib attached to the main shoe, secured by a cross bolt. By this means the friction plates are quickly replaced and adjusted to the rail. This holder is provided with a dove-tailed recess for the friction plates.

The friction plates are made of wool felt, which is compressed securely in the holder by a vise without the use of cement or rivets. This felt absorbs moisture and gives sure contact on wet or icy rails. It has been found that as many as thirty emergency stops can be made with one set of plates without renewal.

All the operating and connecting bars are adjustable, and can be attached to all styles of trucks.

COMBINATION HEADLIGHT

The combination headlight, illustrated herewith, is being placed on the market by the Duplex Headlight Company, of



COMBINATION ARC AND INCANDESCENT HEADLIGHT

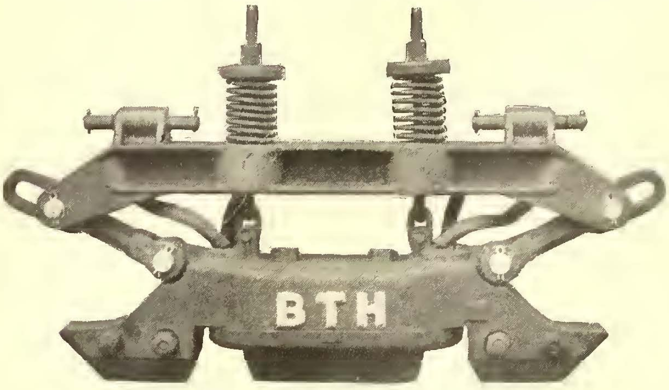
Cleveland, Ohio. This headlight combines both the arc and incandescent features, and will be known as the "Duplex." The lamp mechanism is very simple, so that rough handling or jarring will not derange it. The change from arc to incandescent, or vice versa can be made almost instantaneously, and is accomplished by throwing a two-point switch in the vestibule of the car, or by the insertion of an arc or incandescent plug in a receptacle provided for that purpose. The two incandescent lamps used can be removed and replaced without disturbing the case or front reflector. It is claimed that, owing to the peculiar design of the reflectors, more light is reflected by these two lamps than can be obtained from three ordinary headlights.

There are no rivets or solder in the case of this headlight. It is made in two parts, consisting of a substantial cast-iron back on which the lamp is built, and a steel casing. This casing is neatly finished and can be removed in a few minutes, which leaves the entire mechanism easily accessible. The simplicity of its construction permits the headlight to be easily cleaned and trimmed. By the use of ⅜-in. carbons, the travel of the arc is limited to the minimum, and the reflectors are so arranged that no shadow is thrown. This headlight is adjusted to operate on 1½ to 3 amps. It is 19 ins. high, 14 ins. in diameter and weighs 25 pounds.

NEW ELECTRO-MAGNETIC TRACK BRAKE

Considerable interest has been aroused by the report in England that the British Thomson-Houston Company was to put on the market an electro-magnetic track brake. The peculiar merits of this type of brake are well known, and some particulars of the form of the new brake are presented herewith:

Description.—This brake consists of a cast-steel shoe suspended from a bracket fastened to the side of the car truck. This bracket is well ribbed and braced, and provided with heavy lugs, which take the thrust of the brake through cast-steel links in compression.

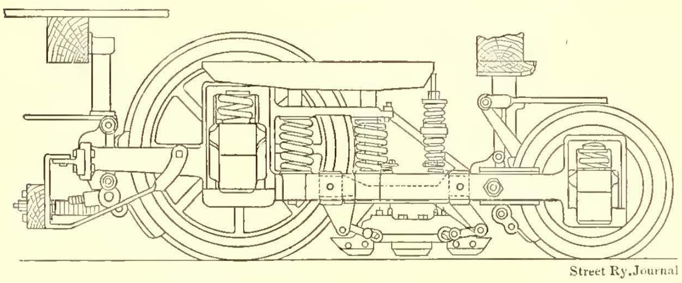


ELECTRO-MAGNETIC TRACK BRAKE

The bracket is formed to act as the seat for two compression springs, which support the brake proper by wrought-iron eye-bolts. These springs keep the brake-shoe free from the track when it is not in operation.

The brake-shoe itself consists of a heavy steel casting with a cored recess, into which the magnetizing coil, which is energized by current from the motors acting as generators, is placed. A brass cap or cover is placed over this coil, and so fitted as to form a water-tight protection to the coil. A steel core extends through the coil providing magnetic circuits, which are completed by sections of rail under the end of the coil.

The terminals of the magnetizing coil consist of insulated flexible wires, brought out through bushed holes in the top of the cast-steel frame of the shoe. They consist of two wires in duplicate, and are of sufficient length to extend from the end of the coil winding to the car underframing without a joint.



ELECTRO-MAGNETIC TRACK BRAKE ATTACHED TO TRUCK

Each shoe is provided with wearing plates for contact with the rails. These plates are steel castings, held in place by machined bolts, so placed that the plates may be renewed without removing the brake-shoe from the truck.

The brake has been developed in two different forms. The first consists of a large shoe with a bracket designed to suit the various types of single trucks. Two shoes of this type constitute a set, the windings being connected in parallel. This insures protection against failure due to an open circuit. The second is designed for double-truck cars, four shoes per car constituting a set, one shoe being attached to each side frame of each truck. The operating coils of the two shoes on one bogie truck are placed in series, and these are placed in parallel with the two on the other bogie truck. Thus in case of injury to any one shoe or coil only half of the braking effort of the car would be rendered inoperative.

The efficiency of the brake as an emergency and service brake has been demonstrated recently by a series of tests carried out under actual working conditions on one of the heaviest routes in England. A four-wheel double-deck car, with two motors, was used, and some tests were made with the magnetic track brake with the following results:

EMERGENCY STOPS

Speed on applying brake.	Time to stop.	Distance to stop.	Grade Down.
25 m. p. h.	4 seconds	25 yards	1 in 13
14 m. p. h.	1.6 "	5.3 "	1 in 14

SPEED REGULATION DESCENDING GRADES

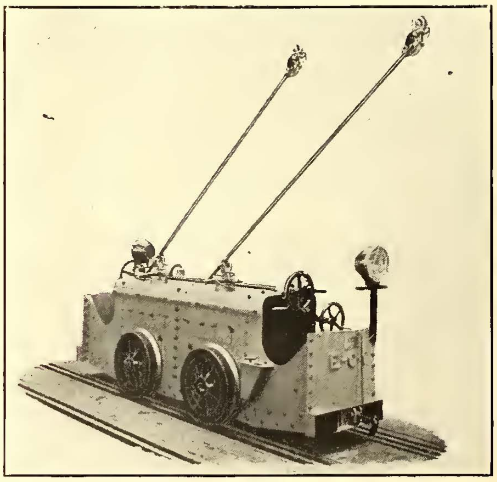
Speed maintained.	Grade.	Current per motor.
5 m. p. h.	1 in 13	4 amps.
5 m. p. h.	1 in 17	3.5 "
5 m. p. h.	1 in 45	2 "

The first test represents extreme conditions, such as a car running down a steep incline, and considering the grade and the high speed the stop was very rapid, being made in about two and one-half car lengths. The second test would correspond to the case of a car traveling at a moderate speed and obliged to pull up suddenly; it will be seen that such a stop can be made in less than a car length.

The second table is interesting inasmuch as it shows that a low and even speed can be maintained when the car is coasting down the steepest grades, so that it is always under perfect control. If necessary the car can be brought to a stop by further movement of the controller handle and held at rest by the wheel brake.

ELECTRIC LOCOMOTIVE

The accompanying illustration shows one of the latest locomotives designed by the Electric Construction Company, of Wolverhampton and London, to meet the demand for this convenient method of haulage both in mine and tunnel work. The great difficulty met with in this class of locomotives is, of course, the limited size of the tunnels through which they have to operate. In this particular instance the locomotives were specified not to exceed 3 ft. in width, 3 ft. 4 in. in height, as the tunnel is only 6 ft. high at its maximum point.



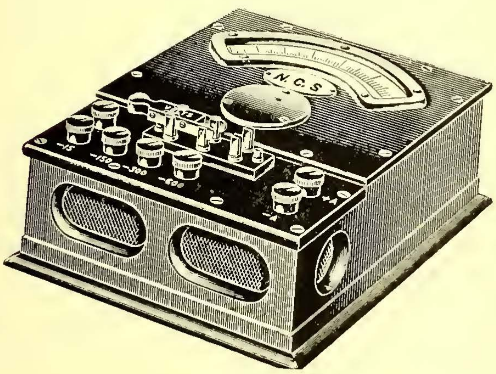
ELECTRIC LOCOMOTIVE

The total weight of a complete locomotive of this type is about 4½ tons. It is capable of hauling a load of 35 tons at a speed of 5 miles to 6 miles an hour, but when running light it can attain as much as 10 miles an hour. It is fitted with two motors, each having a normal capacity of about 12½ hp. They can be controlled from either end. Ordinary hand brakes and also emergency brakes are provided, by which the locomotive can be pulled up in almost its own length when running at full speed.

Power is conveyed to and from the locomotive by two overhead wires, as it was decided in this particular case that this would be the most suitable method. This, however, is only one of many arrangements designed by the above firm.

PORTABLE TESTING SET

A portable testing set, which contains many novel points, has been placed on the market recently by Nalder Bros. & Thompson, Ltd., of London. It is designed to meet the demand for an instrument that can be used in an engine room,



PORTABLE TESTING SET

and placed anywhere without the danger of obtaining erroneous results through stray fields. The screening of the instrument has received very careful attention, and is stated to be so efficacious that it is almost impossible for the reading to be affected, even if it be placed quite close to a dynamo or motor. The instrument is of the moving coil type, being absolutely dead beat; it is fitted with a white enameled metal scale and a metal mirror.

The voltmeter resistances are carried in the instrument itself, and the current shunts in another case. Measurements up to 1500 amps. and 600 volts can be made, and, as a double-pole change over switch is provided, resistances can be measured by the practically simultaneous observation of current potential difference. The pressure required to deflect the pointer to the top of the scale on the ammeter side (terminals AA) is .12 volts, and, as the scale is divided into 120 divisions, each division corresponds to .001 volts, so that the fall of volts on rail-joints, etc., can be tested conveniently. The current shunts are of a new design, and very convenient for connecting, in addition to which they are light. A complete set up to 600 amps. can be carried in quite a small box.

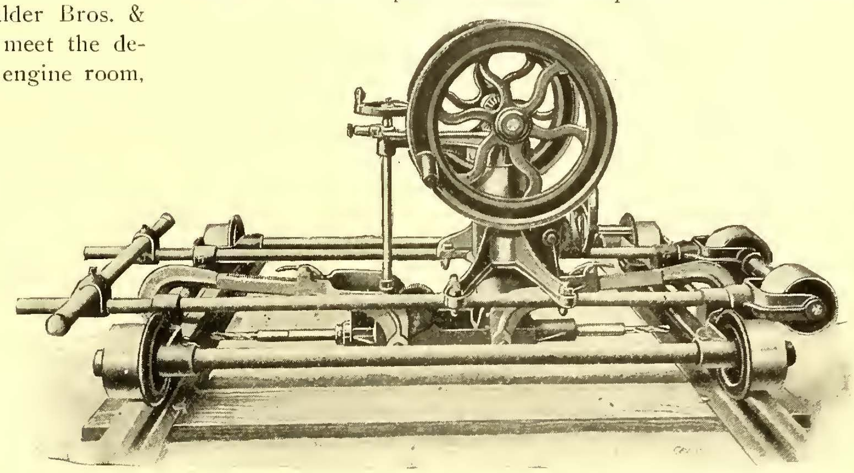
TRACK-DRILLING MACHINE

The accompanying illustration shows the new double driller now being placed on the market by the Ludlow Supply Company, of Cleveland, Ohio. In designing this machine the company has not only made such changes as a year's trial has shown to be necessary, but has added many improvements. The machine of last season was designed for new T-rail construction work only. This machine can be used on any class of rail work, and is especially adapted for paved streets where high girder rails are used, and where the machine has to be quickly removed from the track to allow cars to pass. With the roll-off attachment it takes but two men to remove machine in a few seconds.

As the machine drills either rail, it is especially adapted for tie-rod work. After drilling one rail it is only necessary to reverse the motion to drill the other rail directly opposite the first hole. This saves considerable time, beside requiring no expert to get holes exactly opposite.

A gage is placed on the side of the machine by which the operator can adjust his drill point as desired. The automatic feed is reversible, and will operate in either direction, or can be instantly changed to a hand feed. The clamps for holding machine to the rail are adjustable, so as to hold firmly at whatever position the machine may be in.

The motor provided this season is more powerful and will be placed in position, fully wired and equipped ready for instant service. It will be placed in a weather-proof box. It is stated

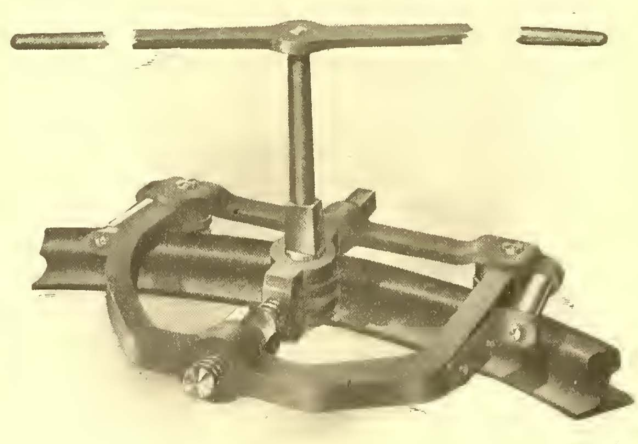


TRACK DRILLING MACHINE FOR ANY KIND OF RAIL

that this machine, with the electric motor, will easily drill a girder-rail in 30 seconds, and by hand power in from 40 seconds to 50 seconds. It can be raised from the lowest point to the highest, which will bring the bottom of the machine 2 ins. above the top of the rail in less than 10 seconds.

RAIL BENDER AND STRAIGHTENER

The roller rail bender and straightener shown in the accompanying illustration has been brought out recently by the Buda Foundry & Manufacturing Company, of Chicago, Ill. It is a development of the old form of rail bender, and is adapted for



RAIL BENDER IN OPERATION

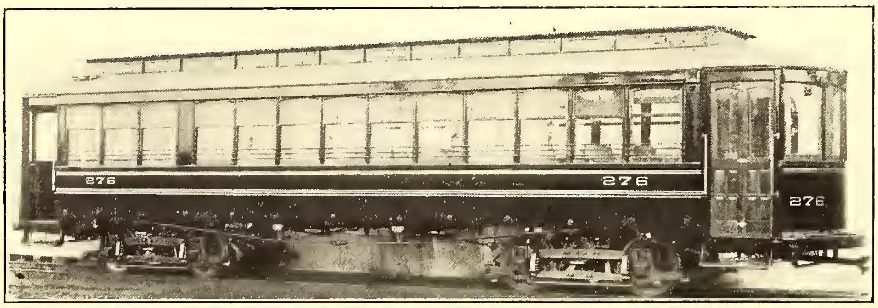
use on all sizes of rails. The new rail bender is operated as follows:

The bender is placed over the rail, and the nut on the center screws turned up with a long wrench, furnished with each machine, until set for the desired curve. The socket wrench is then placed on the pin in the center roller, the long lever put on top of socket, and then one or more men at each end of the lever can turn the center roller, which causes the machine to move forward on the rail, bending the same as it moves. To straighten the rails the machine is placed on the opposite side of the curve and then operated as before. The number of men necessary to do the work is governed by weight of rail and curvature desired.

The introduction of improved machinery and new methods of manufacture have enabled the manufacturer of this roller rail bender to produce it at considerably lower cost than heretofore, making it a tool which should be carried by every work train and section gang.

HIGH-SPEED SEMI-CONVERTIBLE CARS FOR THE WILKES-BARRE & WYOMING VALLEY TRACTION COMPANY

The car shown in the accompanying illustration is one of ten semi-convertible combination passenger and smoking cars



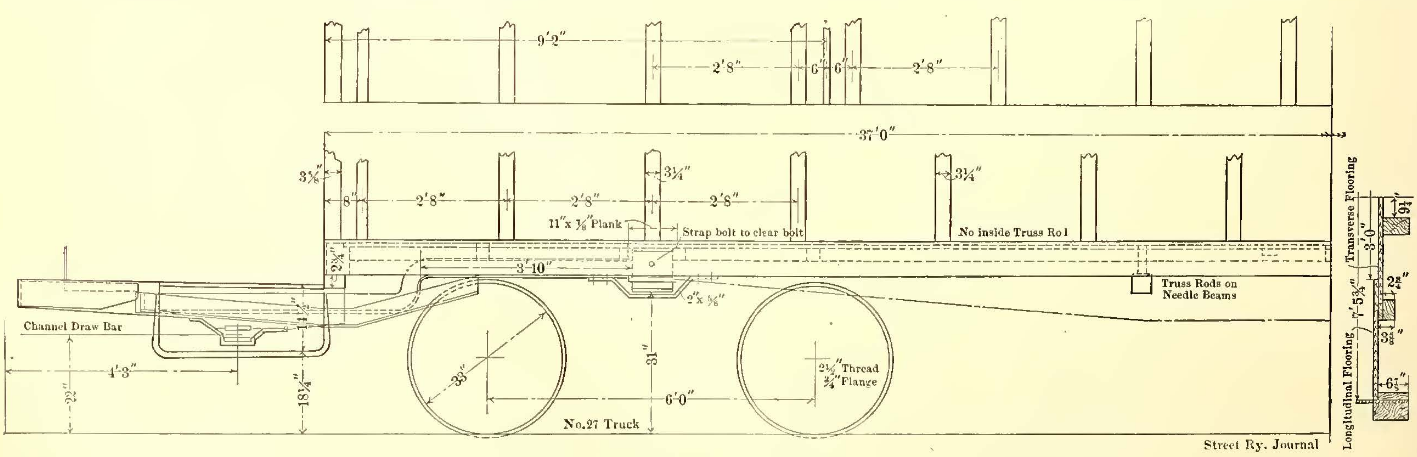
CAR EMPLOYED ON THE LINES OF THE WILKESBARRE & WYOMING VALLEY TRACTION COMPANY

lately delivered to the Wilkesbarre & Wyoming Valley Traction Company by the J. G. Brill Company. This is the second lot of large semi-convertibles of this type to be supplied to this system. The present cars are similar in dimensions and mounted on the same type of trucks as were those furnished two years ago.

The railway company operates all the lines in Wilkesbarre and in the Wyoming Valley. Wilkesbarre has a population of over 50,000, and the Wyoming Valley over 200,000. There are 65 miles of track, including divisions over which the cars are operated on fast schedules. The new cars are mounted, therefore, on No. 27-E-1 trucks, which are capable of very high speed. Wilkesbarre is 15 miles south of Scranton and is only second to that city in importance as an anthracite shipping center.

The cars are seated for fifty-two passengers, the seats being 37 in. long, and the aisles 24 ins. wide. A hard-wood partition with glass in the upper part, separates the smoking compartment from the rest of the car. The smoking compartment is 9 ft. 2 ins. long, and is furnished with longitudinal seats made of cherry slats. The window system is the builder's well-known semi-convertible type, including roof pockets. The tops of the window sills are 24 ins. from the floor, and protection for passengers' arms is provided by three-bar window guards. Cherry in natural color is the finish of the interiors and also of the platforms. The latter are very substantially supported by platform timbers reinforced with angle-irons and protected by angle-iron bumpers. The windows in the vestibules are arranged to drop into pockets in the wainscoting. The height of the platform steps is 18¼ ins. from rail to tread, and from tread to platform 14½ ins.. The side sills of selected long leaf yellow pine are 4 ins. x 7¾ ins., with 12 ins. x ⅜ in. plates on the inside. The white oak end sills are 5¼ ins. x 6⅞ ins. The needle beams are double trussed, and the plan of bottom framing follows the general practice of the builders in this type of car.

The length of the cars over end panels, 37 ft.; over vestibules, 46 ft. 5 ins.; from end panels over vestibules, 4 ft. 8 ins.; width over sills, 8 ft. 2½ ins.; over posts at belt, 8 ft. 6 ins.; sweep of posts, 1¾ ins. The cars are provided with sand boxes, channel-iron draw-bars, platform and conductor gongs, and other specialties of the builder's make. The trucks have a wheel base of 6 ft.; 33 in. diameter wheels and 4¾ in. axles. They are equipped with two 50-hp motors. The weight of a car and trucks without the motor is 30,920 lbs.



STRUCTURAL DETAILS OF CAR FOR WILKESBARRE & WYOMING VALLEY TRACTION COMPANY

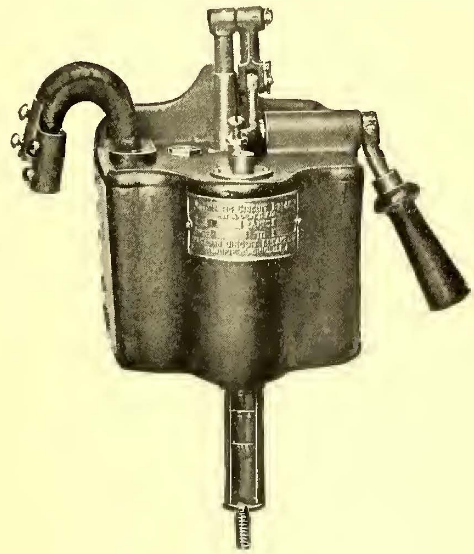
OIL CAR CIRCUIT BREAKERS

The use of circuit breakers as a means of protecting the car equipment from dangerous overloads has become quite general, and has led to the development of several different types of breakers designed especially for this class of service.

The oil car circuit breaker herewith shown, manufactured by the Hartman Circuit Breaker Company, of Mansfield, Ohio, is designed to take the place of the fuse block and hood switch on the car. It automatically opens the circuit in case of overload or short circuit, and it can be operated by hand as readily as the usual hood switch.

The switch and current-carrying parts are immersed in oil within a tight cast-iron case. The feature of oil insulation permits of more compact and simple construction than is possible with the usual magnetic blow-out type. The distinctive feature of the circuit breaker, however, is the use of a series break, consisting of five double-break plug contacts, connected in such manner as to give ten breaks in series. The circuit is broken simultaneously at ten distinct points, and as the break takes place in oil there is no destructive arcing, and the circuit breaker will open quickly and safely on the severest overloads.

The operating mechanism is very simple, and consists of a vertical rod, to the lower end of which are attached the movable bridging contacts. The rod operates in a brass bearing, and is controlled by a toggle. A slight turn of the handle will cause the toggle to straighten out, thus raising the contact rod and effecting the closing and locking of the switch. The tripping coil is immersed in oil within the case, and, when an overload occurs, the plunger or core operating within the brass tube of the solenoid, delivers a strong hammer blow against an



OIL CAR CIRCUIT BREAKER.

extension of the lower joint of the toggle, throwing the toggle out of center and effecting the opening of the switch.

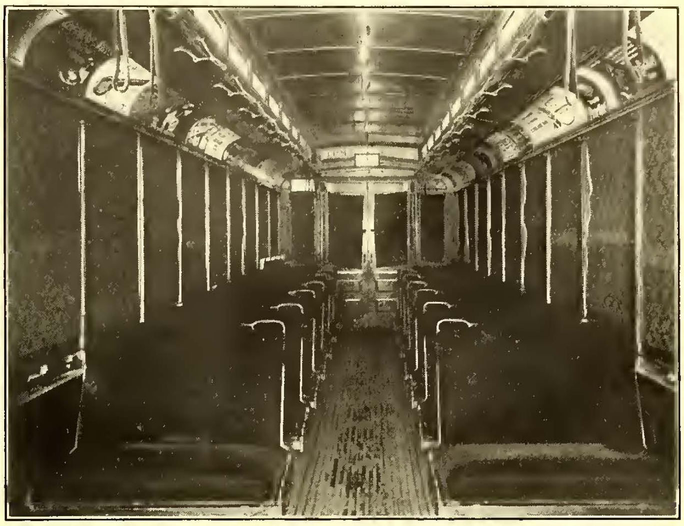
Ample space is provided between the live parts of the switch and the cast-iron case, and, as an additional precaution against grounding, the case is lined with insulating cement. Connection to the outside circuit is made within easy means of insulated cables. While the circuit breaker was primarily designed for car service it is also well adapted for switchboard use. It is usually placed on the back of the panel with the handle rod projecting through the board, and the circuit breaker is opened or closed by hand from the front of the board. The circuit breaker is also especially well adapted for the protection of motors in mills and factories, for the reason that it is not affected by damp and dirty locations, and as there are no exposed current-carrying parts the circuit breaker is never a source of danger to those who may be working in the vicinity.

SLIDEOVER SEATS USED ON THE BOSTON & NORTHERN STREET RAILWAY

The accompanying illustration shows the interior of one of the large cars now being operated upon some of the lines of the Boston & Northern Street Railway Company. These cars are finished in natural mahogany, with brass hardware, and are arranged to seat forty-eight persons. The seats are of the Wheeler "Slideover" type, manufactured by Heywood Brothers and Wakefield Company, of Wakefield, Mass., and are upholstered in a special grade of plain crimson plush made for the Boston & Northern Street Railway Company.

There are fourteen cross-seats to a car, each accommodating two persons. These seats are 34 ins. long, 18 ins. high from floor to top of cushion. The cushion is 17 ins. deep, and the back 19 ins. high. Each of the cross-seats is equipped with a bronze grab-handle for the convenience of standing passengers. This feature eliminates the necessity for overhead hand-straps, and prevents the wear on the aisle corner of the backs, occasioned by constant handling by passengers, and also by the conductors when reversing seats.

At either end of these cars there are two longitudinal seats,



SEATING ARRANGEMENT USED ON BOSTON & NORTHERN STREET RAILWAY CARS

each seating five persons. These are identical in construction with the cross-seats, except that a grab-handle is not necessary. The backs being of standard height, project above the window sills, but as they are fully upholstered on both sides, this feature not only is unobjectionable, but is a decided advantage, as it gives the passengers who are unable to secure places in the portion of the car equipped with cross-seats, an equally comfortable position. This is not the case where the usual method is followed and a corner cushion with a narrow back is used.

It would seem that the Boston & Northern management has come to the conclusion that the comfort of the passengers and the appearance of the interior of its cars depends very largely upon the seats used, and with this end in view, it has taken precautions to secure first-class seats as well as the most convenient arrangement.

COMBINED RETRIEVER AND TROLLEY CATCHER

The Wilson Trolley Catcher Company, of Boston, Mass., has brought out a combined retrieving device and trolley catcher. This apparatus will instantly reel up the cord and pull the pole down below the wire as soon as the wheel leaves it, and after it has pulled the pole down the wheel may be immediately replaced by taking hold of the trolley rope and releasing the tension, as with the well-known Wilson trolley catcher. This feature saves valuable time and helps to avoid accidents, because the retriever need not be pulled back to a certain point before it can be released and the wheel placed on the wire.

COMBINED RETRIEVER AND TROLLEY CATCHER

The new mechanism cannot be added to to the company's standard catcher now in general use. The combination device is similar in form, and slightly heavier, as it contains an extra spring. It has been in operation for several months, and is reported to be giving excellent service in all kinds of weather. The company offers to make an allowance to purchasers of the new device for returned Wilson catchers now in use, and is also willing to furnish retrievers for trial.

TELEPHONE SYSTEMS FOR ELECTRIC RAILWAYS

With the development of electric railways beyond city limits, complications have arisen which necessitate some form of communication between offices, power houses and points along the lines. Without doubt the telephone offers the best means for such communication.

Where the telephones are operated under ordinary conditions, standard magneto bell wall sets and desk sets are satisfactory when supplied with the proper generators and ringers for the lines upon which they are connected, but for communicating from outlying points to permanent stations there are three systems in use which are more generally applicable.

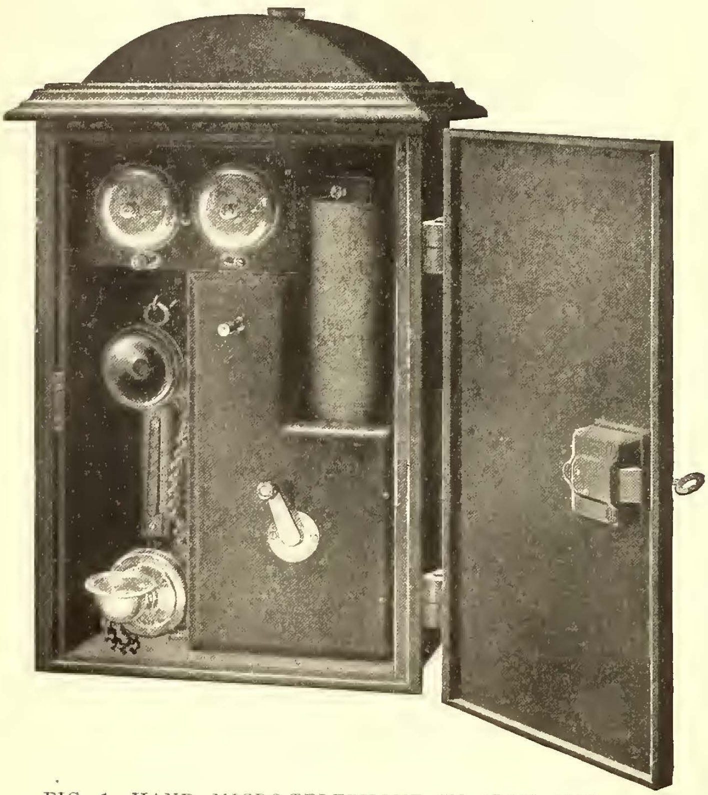


FIG. 1.—HAND MICRO-TELEPHONE IN IRON BOX

The first, most used, and perhaps the most satisfactory system, consists in the use of iron-box type instruments at varying distances along the line, especially at turn-outs.

FIG. 2.—PORTABLE TELEPHONE SET

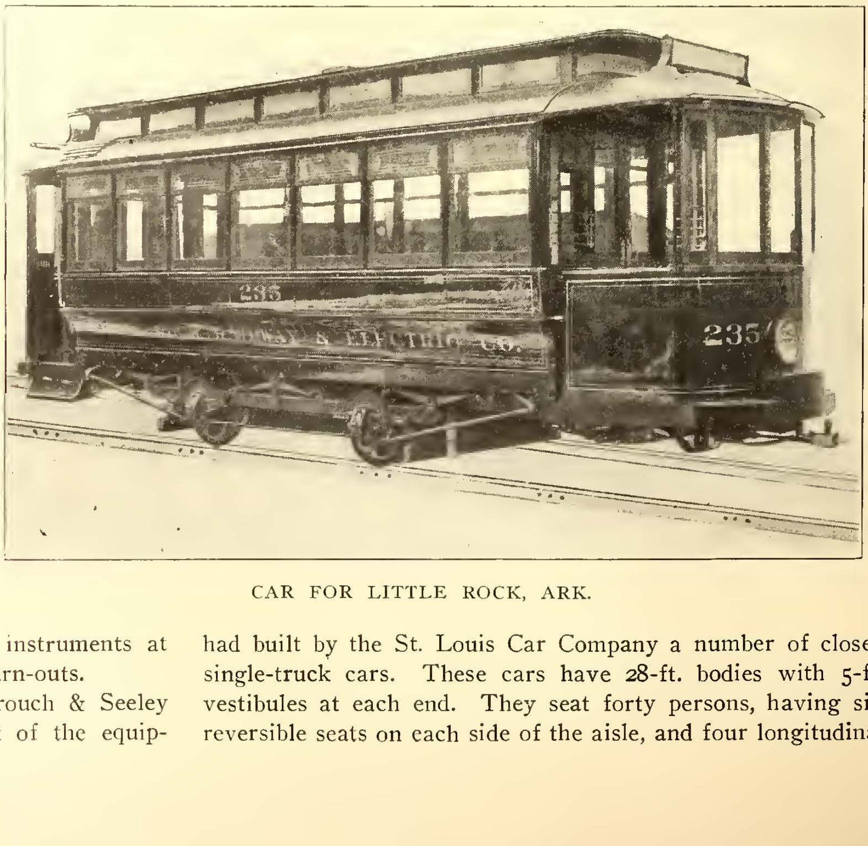
In the iron-box telephone, made by the Crouch & Seeley Company, of Boston, Mass., the talking part of the equipment is of the combined transmitter and receiver type known as a hand micro-telephone. It is shown in Fig. 1. The instrument is adjustable as regards the relative distance between the transmitter and receiver. When the receiver is placed to the ear of the party using it, the mouth-piece is in the proper position for speaking into it. This results in much greater efficiency than the old fixed transmitter type because the person using an adjustable instrument is always brought into the best speaking position, this condition being absolutely necessary to obtain satisfactory results where telephones are located in the open air. This instrument is usually cut in and out automatically by the opening and closing of the door. It is opened with a key.

The second method consists in using a portable telephone set like the above-mentioned company's instrument shown in Fig. 2. This is also provided with a hand micro-telephone for the talking circuit, and has a regular switchboard plug and cord, the whole making a neat, compact device for carrying on cars. Small iron jack-boxes are located on poles along the line, and whenever any car desires to talk, it is only necessary to plug into this jack at the nearest point, and when the conversation is finished, withdraw the plug. In addition, if there is a long delay and it is desired to call up this instrument from other points, it can be left in circuit until the requirement is accomplished. This telephone can be rung up like any other.

The third method is the use of portable sets like the foregoing, but instead of placing jack-boxes on poles, there is provided a jointed pole arrangement, usually in three sections, which can be quickly put together and connection made thereby with the wires running parallel with the trolley line. Where this method of connection is desired, it is better to run the wires perpendicularly one above the other instead of horizontally or on cross-arms. In fact, many lines are now using the iron-box instruments for outlying stations with standard equipment, but with the wires placed perpendicularly one above the other, so that these portable sets with jointed pole attachments can be carried on construction cars, snow-plows, or for the special use of others needing portable sets.

CARS FOR LITTLE ROCK, ARK.

The Little Rock Railway & Electric Company, for which Ford, Bacon & Davis are consulting engineers, has recently had built by the St. Louis Car Company a number of closed single-truck cars. These cars have 28-ft. bodies with 5-ft. vestibules at each end. They seat forty persons, having six reversible seats on each side of the aisle, and four longitudinal

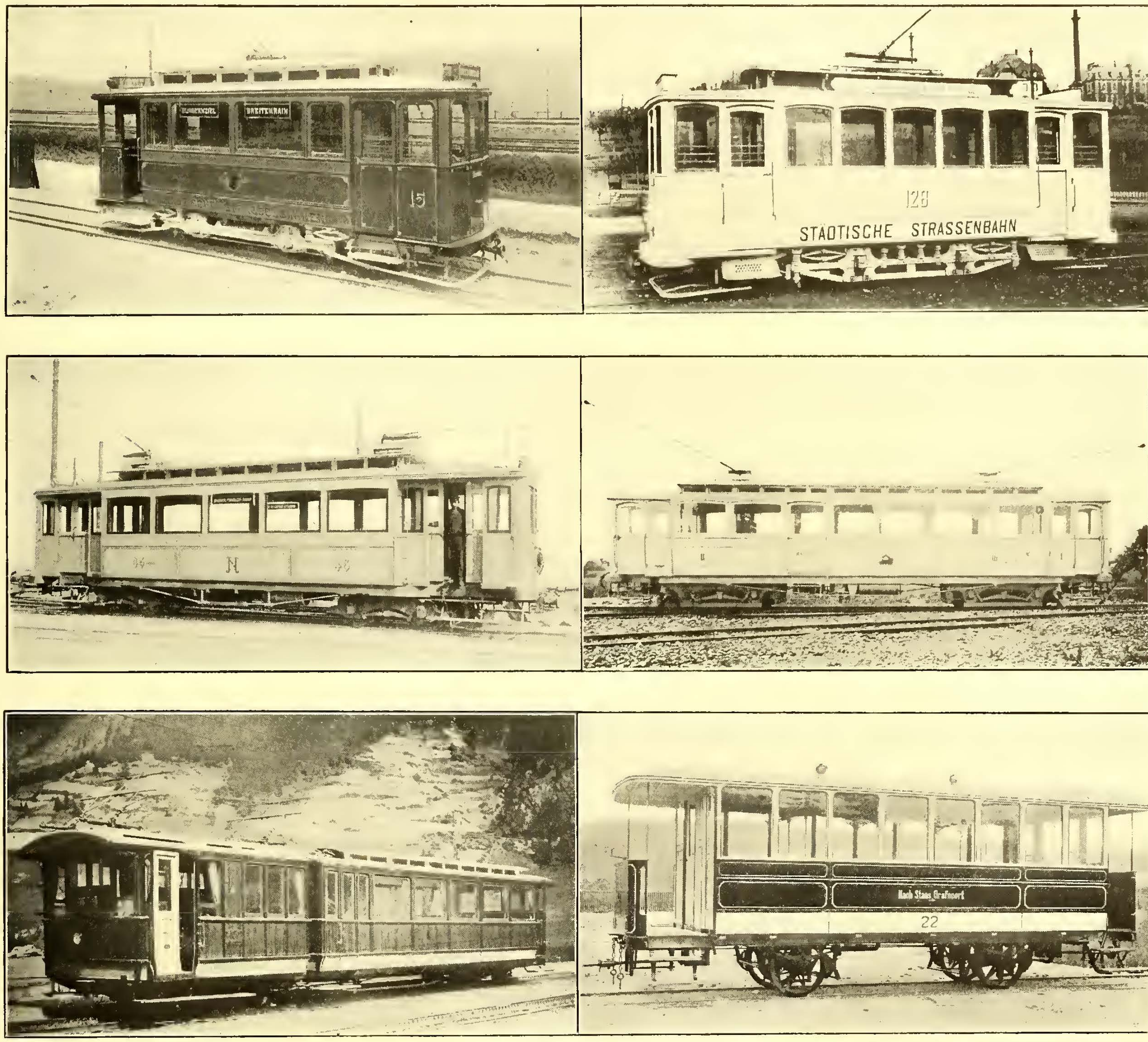


CAR FOR LITTLE ROCK, ARK.

end seats, each seating four persons. The upper sash is stationary, and the lower sash arranged to drop. St. Louis arc headlights have been put in these cars, which is notable in such a small car, as these lights have been previously used chiefly in long cars. These cars have the automatic twin door handle, which holds the sliding twin doors together except when the handle is pulled to force the door apart, when the movement of the handle releases the catch. The operation of the handle to the ordinary passenger is the same as that of any other handle, but it prevents the sliding open of doors when the car is going around curves.

RECENT SWISS ELECTRIC CARS

For several reasons the electrical industry has developed in Switzerland to a far greater extent in proportion to the size and population of the country than in any other part of Europe, and in many respects the rolling stock follows closely American lines. Some of the latest types of cars used in Switzerland are illustrated in the accompanying group of six engravings. The cars used exclusively for city service are, as a rule, short, owing to the narrow and crooked streets, but the interurban cars bear a very close resemblance, so far as the exterior of the cars is concerned, to American cars for the same service.



RECENT SWISS ELECTRIC CARS

Taking these views up seriatim, Fig. 1 shows a standard single-truck vestibuled car for the city service in Berne, and Fig. 2 a similar car used in Zurich. Both roads are owned by the cities in which they operate. As will be seen, both cars are equipped with fenders, a somewhat unusual practice in Europe. In both, also, the platforms are made quite long, and give standing room on the front platform, while the motorman is placed well forward in the vestibule.

Fig. 3 shows a double-truck vestibule car with steel underframing, and weighing, empty, 33,000 lbs. (15,000 kg). It is equipped with two trolleys, one for each direction of running, and Böker air brakes. It belongs to the Neuchatel & Boudry Electric Railway Company. Fig. 4 shows a somewhat similar combination baggage, smoker and passenger car on the Jorad Electric Railway line of Lausanne. This car weighs 41,400 lbs. (18,810 kg), and is equipped with Hardy vacuum and Schiemann electromagnetic brakes.

Fig. 5 shows a special type of car used for the Gornergrat Mountain Railway. It is a combination electric locomotive and passenger car, in which the locomotive is mounted on a single truck and the passenger compartment on one double truck, the other end being supported on the frame work of the locomotive. Fig. 6 shows a trail car equipped with the standard Continental flexible running gear instead of trucks, in use on the Stansstad-Engelberg three-phase electric line.

LEGAL DEPARTMENT*

IMPUTED NEGLIGENCE

The doctrine of imputed negligence is usually invoked in one of two well recognized classes of cases. If a young child be permitted to go into a dangerous place and be injured, the negligence of the parent or guardian may be, according to the law of New York, imputed to the child. A child may be permitted to recover if it be old enough to exercise some care, and it did exercise such care as was properly to be expected from one of its years. It is not chargeable with the exercise of the degree of care which would be required of an adult. If, however, the child be too young to have any judgment, its presence in a dangerous place will be considered the act of the parent or guardian in permitting it to go there, and such parental negligence will be imputed to the child so as to prevent a recovery in behalf of the latter. We have given the law of New York, and that of a few other States is similar. The courts of many of the States repudiate the theory of imputed negligence even as to very young children altogether. However open to theoretical criticism such doctrine may be, there is a good deal to be said, from the practical point of view, in its favor. As was remarked in this place on May 12, 1902: "The person injuring a child under such circumstances may have been guilty only of a very slight fault, and the principal contributing factor to the disaster may be the presence of an infant so young as to be unable to take care of himself in a place where he ought not to have been suffered to go. While the action for damages may be nominally in the name of the child, the substantial party in interest is frequently the very parent through whose negligence the child was permitted to be at large. Allowing recovery in such cases would tend to encourage the same neglect of children for speculation purposes, which has almost everywhere led to limitations upon the amounts for which insurance may be procured on childrens' lives."

The other condition of fact in which the theory of imputed negligence is invoked, is where a person riding with another as passenger or guest, is injured in part through the negligence of the driver. Collisions between street cars and other vehicles drawn by horses or driven by electricity, afford many cases in point. The law in many jurisdictions formerly was that the negligence of the driver of the vehicle would be imputed to the passenger with the same force as his own contributory negligence, so as to preclude a recovery against the owners of the street car. This phase of the doctrine of imputed negligence has now been repudiated by New York as well as other States. Two recent New York cases, which are fairly typical of the law throughout the country, may be cited:

In Waters vs. Metropolitan St. Ry. Co., decided by the New York Supreme Court, Appellate Term, in December, 1903 (85 N. Y. Supp., 1120) it was held that where the driver of a furniture van and his helper, who is injured in a collision with a street car, are not engaged in a common enterprise or joint adventure, but are merely fellow servants in the employ of the same master, but with distinct duties, the driver's negligence is not imputable to the helper, so as to prevent the latter's recovery. It was further held that the failure of a person riding in the rear of a van, who is injured through a collision with a street car, to jump off the vehicle on foreseeing the probability of a collision, is not contributory negligence as a matter of law, but the question is for the jury, dependent on whether, and when, a person of ordinary prudence would have jumped, and whether there was time enough left for the exercise of a deliberate judgment after the collision became imminent from the negligence of either the motorman or the driver of the vehicle, or both.

In Robinson vs. Met. St. Ry. Co., decided by the New York Supreme Court, Appellate Division, First Department, in February, 1904 (N. Y. "Law Journal," Feb. 19, 1904), the action had been brought by a child, 9 years of age, for personal injuries received in a collision between a car of the defendant and a truck, on which the plaintiff was riding with the driver. The evidence tended to show that when the horses on the truck were passing the easterly curb line the car was 100 ft. from the north crossing, approaching rapidly, and at that time the driver of the truck was urging his horses. There was no direct evidence that the driver looked or discovered the approach of the car. Neither the truck nor the car slackened speed. The car struck the rear end of the truck, and there was evidence that it was thrown against an elevated railroad post, with a crash. It was held that the negligence of the truck driver—if any—could not be imputed to plaintiff, and there was sufficient to support the jury's finding that defendant was negligent. It was further held that even if the plaintiff failed to call the driver's attention to the car or to jump from his seat, the question of contributory negligence was for the jury.

The Court in this case expressly laid down the rule that the standard for judging a boy of 9 is not the care that would be exercised by an adult, but only that to be expected of one of his age, of courage, intelligence and ordinary prudence.

It will thus be seen that as to passengers on vehicles the employment of ordinary care to escape injury from an impending collision is required, according to the circumstances of the case and age of the passenger. If a passenger ought to be expected to jump from the vehicle or move aside from the danger, and fails to do so, he will be guilty of contributory negligence on his own account, but the negligence of the driver is not imputed to him.

* Conducted by Wilbur Larremore, of the New York Bar, 32 Nassau Street, New York, to whom all correspondence concerning this department should be addressed.

LIABILITY FOR NEGLIGENCE

COLORADO.—Instructions—Street Railway—Injury to Alighting Passenger—Negligence—Evidence.

1. An instruction substantially covered by instructions given is properly denied.

2. A prima facie case of negligence is made against a street railway company by evidence that while a passenger was alighting, after its car had been stopped at a regular crossing for her to alight, the car suddenly started, throwing her to the ground and injuring her.—(Denver Consol. Tramway Company vs. Rush, 73 Pacific Rep., 664.)

GEORGIA.—Injury to Employee—Action—Pleading.

1. Where a petition shows the jurisdiction of the court; that the defendant was under a duty to the plaintiff, and the facts from which the duty arose; that there was a breach of the duty; and that plaintiff was damaged by such breach—the petition sets out a cause of action, and is good as against a general demurrer.—(North Augusta Electric & Imp. Company vs. Martin, 45 S. E. Rep., 455.)

GEORGIA.—Railroads—Dog Killed on Track.

1. This case is controlled by the decision of this court in the case of Jemison vs. Southwestern Railroad, 75 Ga. 444, 58 Am. Rep., 476, holding that a suit cannot be maintained against a railroad company for the negligent killing of a dog.

2. As the rule announced in the above-stated case has stood as good law since December 1, 1885, and the General Assembly has passed no act changing the same, this court is of opinion that the rule should not be now changed by overruling that case.—Strong vs. Georgia Ry. & Electric Company, 45 S. E. Rep., 366.)

MASSACHUSETTS.—Street Railroads—Injuries at Crossings—Children—Contributory Negligence—Failure to Look and Listen.

1. For a child six and one-half years of age to pass over a crosswalk leading from one side of a street to the other while on her way to school, through which street runs a street railway track, is not of itself negligence as a matter of law.

2. That plaintiff, a child six and one-half years of age, while on her way to school, crossed a street on which a street railway was operated, at a crossing, when she could have seen a car approaching had she looked, failed to look or listen before attempting to cross, did not constitute contributory negligence, as a matter of law, precluding a recovery for injuries sustained by her being struck by the car.—(McDermott vs. Boston Elevated Ry. Company, 68 N. E. Rep., 34.)

MICHIGAN.—Injuries Resulting in Death—Survival for Appreciable Time—Actions—Nature and Form—Damages—Elements.

1. Where a person injured by the wrongful act of another survived the injury for a moment, whether in a conscious or unconscious condition, the action accruing from such wrong was for injuries, under the act providing for the survival of actions for injuries, and not for wrongful death.

2. In an action for injuries which resulted in death, where the injured person survived the injury an appreciable length of time, his administrator was entitled to recover for the pain and anguish

suffered between the time of injury and death, together with decedent's loss sustained by being deprived, by his injuries, of the ability to labor during the time he would probably have lived had he not been injured.—(Olivier vs. Houghton County St. Ry. Company, 96 N. W. Rep., 434.)

MICHIGAN.—Street Railroads—Injuries to Animals—Contributory Negligence—Proximate Cause—Speed—Stopping Car—Distance—Presumptions—Common Knowledge.

1. Where plaintiff's cow was killed by a street railway car, plaintiff was not entitled to recover, notwithstanding his negligence in permitting the cow to be at large, on the ground that the cow stood on the tracks in plain sight of the motorman of the approaching car while it was going 150 ft. down grade at great speed, which was not lessened until after the collision, and that the car went nearly 100 ft. after it struck the cow before it was stopped, in the absence of evidence to show whether or not the car could have been stopped within the 150 ft. under the circumstances, or showing how much its speed could have been checked in that distance by the appliances at hand.

2. In an action for injuries to a cow in collision with a street car, it could not be assumed, as a matter of common knowledge, that the car could have been stopped, or its speed so checked as to prevent the injury, within 150 ft.—(Kotila vs. Houghton County St. Ry. Company, 96 N. W. Rep., 437.)

MISSOURI.—Street Railroads—Collision with Wagon—Duty of Motorman—Contributory Negligence—Expert Testimony—Cure of Error—Harmless Error—Instructions.

1. In an action against a street railway company for injuries, an ex-motorman was asked, as an expert, in what distance "he" could have stopped the car, to which he answered that "it could have been stopped" within a given distance. Held, that the error in question was cured.

2. As defendant's witnesses testified that the car could have been stopped in two-thirds the distance estimated by plaintiff's witness, and that it was actually stopped in one-third the distance, and this testimony and other evidence adduced fully advised the jury of the distance in which the car could have been stopped by a man of ordinary strength and skill, the error in the question was harmless.

3. A driver is not, as a matter of law, guilty of contributory negligence in turning into a street and driving along a street car track when he notices a car coming in the same direction, 500 ft. away.

4. When a driver turns onto a street car track 500 ft. ahead of a car, and drives in the same direction as the car is going, and the view of the motorman is unobstructed, it is the motorman's duty to check the car to avoid an accident, and if a collision occurs he is prima facie negligent.

5. Where the evidence showed that defendant's street car operator could have seen plaintiff driving on or close to the track for a distance of 500 ft. before reaching the street intersection just beyond which the collision with plaintiff's wagon occurred, the court properly refused an abstractly correct instruction that, though there was much variance in the evidence as to the exact distance from the street intersection to the place of the accident, plaintiff was conclusively bound by his statement that it was only a few feet, as the operator had sufficient time to stop the car and avoid the accident, even if it did occur near the street intersection.

6. An allegation that a street car collided with the rear end of a wagon is supported by evidence that the car collided with a hind wheel of the wagon.

7. While a street car is entitled to the right of way on its own track, this does not warrant the operator of the car in running into a vehicle that happens to be on the track, or excuse his failure to exercise ordinary care to avoid a collision with such vehicle.

8. Where the evidence in an action for negligent injuries showed that defendant's motorman had a clear view of plaintiff on or approaching defendant's track for a distance of 500 ft. before he ran into plaintiff's wagon from the rear, the court properly refused to instruct the jury to find for defendant if its motorman could not, by the exercise of ordinary care, have discovered that plaintiff was dangerously near the track in time to have avoided the accident.

9. The instruction was properly refused, even though defendant's showing was that plaintiff ran into defendant's car.

10. Where all the evidence in an action for injuries resulting from a collision with a street car with plaintiff's wagon showed that plaintiff looked for cars before driving on defendant's track, and saw the car 500 ft. away, and the court gave instructions fully covering the law as to plaintiff's contributory negligence, an instruction that plaintiff could not recover if he drove onto the track without looking was properly refused.

11. A requested instruction, in an action for negligent injuries against a street railroad, that defendant was entitled to a verdict if the accident was due to the negligence of both parties, was fully covered by an instruction that if plaintiff failed to exercise ordinary care to avoid the accident he could not recover, even though the defendant was guilty of negligence.

12. Plaintiff's petition alleged that defendant's car negligently ran into the rear end of his wagon, and the instructions to the jury made his rights to a recovery dependent on a showing that the collision occurred in that manner, and that it was due to defendant's negligence as charged. Defendant claimed that the collision was caused by plaintiff driving into its car, and requested an instruction that it was entitled to a verdict, if the jury found in accordance therewith. Held, that the refusal of the instruction was harmless error, as it only stated the converse of the proposition in the given instructions.—(Schafstette vs. St. Louis & M. R. R., 74 S. W. Rep., 826.)

MISSOURI.—Street Railroad—Crossing Accident—Negligence—Driver—Contributory Negligence—Duty to Stop—Ordinances—Proof—Evidence—Competency—Instructions.

1. In determining whether a sixteen-year-old boy, killed by a street car while driving over a crossing, was guilty of contributory negligence, his conduct is to be measured by the standard of an ordinarily prudent boy of his age, and not by that of a man of mature years.

2. Whether a sixteen-year-old boy, killed by a construction car while attempting to drive across a street car track at a street crossing, was guilty of contributory negligence, held, under the evidence, to be a question for the jury.

3. Where both parties to an action against a street railway for negligent death tried the case on the theory that defendant was not liable for a violation of the ordinances governing the running of street cars, unless it was shown that it had agreed to be bound by such ordinances, an ordinance showing such an agreement on the part of defendant was relevant.

4. By accepting St. Louis Ordinance No. 19,393, granting to defendant a franchise for a branch on condition that it complies with all the general ordinances and charter provisions in relation to street railroads then in force or thereafter to be enacted, and "applicable to its entire line of railroad, or any part thereof," defendant agreed to be bound by all the ordinances relating to street railroads, not only as to the branch, but as to its entire line, if such agreement was necessary.

5. Under the express provisions of Rev. St. 1899, section 3100, a volume of ordinances purporting to be published by authority of a city is admissible as evidence of an ordinance contained therein.

6. St. Louis Ordinance No. 15,954, granting to defendant a franchise to construct a line over certain streets and alleys, and authorizing it to run cars on that part at a rate of 20 miles an hour, is not in violation of City Charter, art. 3, section 28, providing that no special or general ordinance in conflict or inconsistent with a prior ordinance shall be valid until such prior ordinance, or its conflicting point, is repealed by express terms, as it does not attempt to repeal the general ordinance limiting the speed of street cars to 8 miles an hour, but only makes an exception to its operation, having it in full force as a general rule.

7. On a mere showing that a person had for twenty years the common experience of a city man traveling on street cars, he was not competent to give an opinion as to the speed of a car, based on the noise heard at a distance of more than 120 ft.

8. Where there was no evidence available to plaintiff in an action for negligent death to support the hypothesis that defendant's motorman failed to stop on the first appearance of danger to the deceased, it was error to instruct that, under an ordinance, defendant's motorman was bound to stop on the first appearance of danger, and was negligent if he failed to do so.

9. Where the evidence was conflicting as to whether defendant's street car had a headlight at the time of the accident, the court properly refused to instruct the jury to find in its favor if plaintiff's intestate was driving toward its track in a wagon which had no light, and defendant's motorman could not, by the exercise of ordinary care, have discovered the horse and wagon in time to avoid the collision after they came within range of the car.

10. Where, in an action against a street railway for the death of a driver at a crossing, there was no contention that defendant was liable notwithstanding the negligence of the deceased, the court properly refused to instruct that defendant was entitled to a verdict if the car was running at such a rate of speed that when the danger to the deceased could have been discovered the motorman could not stop the car in time to avert the accident, even though it was running at the highest rate of speed mentioned by any witness.

11. Whether a sixteen-year-old boy, killed at a street car

crossing, should have stopped to look and listen for a car before driving onto the track at a crossing on a dark and foggy night, held, to be a question for the jury; the evidence being conflicting as to whether the car had a headlight.

12. A requested instruction in an action against a street railway for the negligent death of a driver at a crrossing, that the deceased was negligent if he drove onto the track without looking and listening for a car, and could have seen or heard the car, had he done so, was not covered by an instruction that he was negligent if he failed to use ordinary care in driving across the track or looking out for approaching cars, and was improperly refused.—(Campbell et ux. vs. St. Louis & Suburban Ry. Co., 75 S. W. Rep., 86.)

MISSOURI.—Street Railways—Injury to Person on Track—Contributory Negligence—Discovered Peril.

1. A deaf person is guilty of contributory negligence in walking along a street car track without looking back frequently to see if a car is coming.

2. Plaintiff, who was deaf, was walking along the track of defendant's street railway, when a car approached him from behind; the motorman making no effort to check the car until he was within 10 ft. or 15 ft. of plaintiff, although he rang the gong, and at about the time he began to check the car shouted to plaintiff. The track was straight, and the motorman able to see plaintiff several hundred feet ahead. Held, that, though plaintiff was guilty of contributory negligence in walking upon the track, there was a question for the jury—as to whether the motorman was not guilty of negligence proximately causing the injury, in failing to sooner check the car after he became aware of plaintiff's dangerous situation.—Shanks vs. Springfield Traction Co., 74 S. W. Rep., 386.)

MISSOURI.—Street Railways—Negligence—Persons on Track—Duty to Stop Car—Signals—Contributory Negligence—Discovered Peril—Proximate Cause.

1. Where the motorman in charge of a street car sees a pedestrian about to cross the street a distance of eighty steps ahead of the car, he is not bound to put the car under control, instead of relying on an observation of the car by the pedestrian.

2. Where one crossing a street in front of a street car, the bell of which is being rung, does not stop or notice the car, but continues to go forward toward the track, apparently absorbed in a paper, such behavior should amount to a warning to the motorman to get ready to avoid an accident.

3. The fact that a person is deaf does not relieve him from care in crossing street railroad tracks, but imposes on him the duty of looking to learn whether he may safely proceed in crossing a track.

4. The negligence of a person in going on a street car track without looking for a car does not preclude recovery for an injury sustained by being run into by the car, if the motorman could have prevented the injury by reasonable efforts after negligence of the pedestrian.

5. The testimony showed that after plaintiff had heedlessly walked in front of an approaching car she turned around on the track, instead of clearing it, as she could have done by taking another step, and stood with her back to the car. Held, that she could not recover, since, though the motorman did not stop the car as quickly as possible, the conduct of plaintiff was the proximate cause of the accident.

6. It is not the duty of a motorman in charge of a street car to stop the car in anticipation that one going over a street crossing ahead of the car, and who has time to get over, may stop on the track.—(Aldrich vs. St. Louis Transit Co., 74 S. W. Rep., 141.)

MISSOURI.—Street Railroads—Vehicles—Collision—Injuries—Contributory Negligence—Discovered Peril—Actions—Instructions—Appeal—Harmless Error.

1. Contributory negligence of plaintiff in driving along a street railway track for a considerable distance without looking or listening for a car to approach from the rear, will not preclude a recovery for injuries sustained by a collision with a car so approaching, if the motorman in charge of the car saw, or by the exercise of ordinary care could have seen, plaintiff's peril in time to have avoided injuring her.

2. A person in a vehicle is entitled to use the track of a street railway line laid in a public street, subject only to the railway company's right of way over the same; and the latter is therefore bound to take all reasonable measures to avoid collisions, and to exercise a commensurate degree of care to discover the vehicle and prevent a collision.

3. Where a street car which collided with a vehicle in which plaintiff was riding carried no other agent of defendant except the motorman, error in an instruction construing a vigilant watch ordinance, in that it required such watch to be kept by both the conductor and the motorman, was harmless.

4. Where, in an action for injuries in a collision between a street car and a vehicle in which plaintiff was riding, plaintiff's negligence, if any, was not continuous to the instant of the collision, and did not directly concur in producing the collision, a provision in an instruction in favor of plaintiff on discovered peril, etc., limiting plaintiff's right to recover on a finding that, prior to and at the time of the collision, she and her husband were exercising ordinary care to look and listen for the approach of cars and to avoid injury, was superfluous and not prejudicial to defendant.—(Degel vs. St. Louis Transit Co., 74 S. W. Rep., 156.)

MISSOURI.—Street Railroads—Collisions with Vehicles—Injuries to Persons on Track—Negligence—Contributory Negligence—Excessive Speed—Ordinance.

1. Defendant's street car ran into plaintiff's hack while he was attempting to cross the track. He testified that he had an unobstructed view of the car, which was about 150 ft. away when he first saw it, and was approaching at a speed of 20 miles per hour; that he did not stop or whip up his horses until the car was within 40 ft. or 50 ft. of him. There was nothing to prevent him from stopping until it passed, and he could have crossed in safety, had he whipped up his horses when he first drove on the track. Held, to show contributory negligence, precluding his recovery.

2. Where plaintiff saw a car about 150 ft. away, approaching at a speed of 20 miles per hour, but did not stop or whip up his horses until the car was within 40 ft. or 50 ft. from him, and it struck his hack before he got across the track, and injured him, he had no right to assume that those in charge of the car would regulate its speed to conform to that limited by the ordinance.—(Ledwidge vs. St. Louis Transit Co., 73 S. W. Rep., 1008.)

MISSOURI.—Street Railways—Injuries to Passenger—Negligence—Contributory Negligence—Instructions.

1. Plaintiff's evidence tended to show that he was standing on the steps of the rear platform of defendant's street car while it was crossing a railroad track, having intended to get off before the car started to cross, and that the conductor, who had gone ahead to see that no railroad cars were approaching, boarded the car at the rear platform, while it was in motion, and in so doing collided with plaintiff and interfered with his footing, throwing him to the ground. The court instructed the jury that they must not infer the conductor's negligence from the mere fact that he struck plaintiff as the latter was getting off or standing on the car. Held, erroneous, as leaving out of view the fact that the conductor interfered with plaintiff's footing on the steps in boarding the car.

2. Where the perilous position of a passenger standing on the steps of the rear platform of a rapidly moving street car was seen by the conductor, who was attempting to board the car, it was negligence on the part of the conductor to mount the steps in such manner as to collide with the passenger and throw him to the ground.

3. In an action against a street railway for injuries to a passenger, defendant set up in answer that plaintiff was injured by reason of his contributory negligence in jumping off a moving car at an unusual place. The court charged that if plaintiff had taken a position on the lower step of the rear platform of the car for his own convenience in getting off at a point beyond the railway tracks which they were crossing, and knew that the conductor had gone ahead to signal the car when to cross the tracks, and would again get on, he was guilty of contributory negligence if he did not exercise ordinary care to avoid a collision with the conductor when the latter was attempting to board the car. Held, that the charge was not warranted by the plea.

4. Where plaintiff's evidence showed that he was on the rear platform of defendant's street car, in the act of getting off at a place where it had stopped before crossing some railroad tracks, but was prevented from doing so by the sudden starting of the car and its rapid motion, and there was no evidence to the contrary, it was error to predicate a charge of contributory negligence on the assumption that he had taken his position on the rear platform, not for the purpose of getting off before reaching the railway tracks, but for his own convenience in getting off at some point beyond them.—(Fleming vs. St. Louis & S. Ry. Co., 74 S. W. Rep., 382.)

MISSOURI.—Street Railroads—Collisions—Injuries to Motorman—Evidence—Trial—Demurrer to Evidence—Waiver—Question for Jury—Instructions—City Ordinances—Acceptance—Damages—Future Pain—Medical Expenses—Appeal—Review of Evidence.

1. A demurrer to the evidence at the close of plaintiff's testimony is waived by the subsequent introduction of evidence on defendant's behalf.

2. Where at the close of all the evidence defendant renewed a motion made at the close of plaintiff's case in the nature of a

demurrer to the evidence, and asked that the jury be instructed to find a verdict for the defendant, which was refused, defendant is entitled, on an appeal, to a review of the evidence as a whole.

3. In an action for injuries to a motorman sustained in a collision with a car of another company at a crossing, where the evidence tended to show that the collision was attributable to the negligence of defendants' motorman in the management of his car as it approached the crossing, and contained contradictory, inconsistent, and improbable statements of opposing witnesses, the case was properly submitted to the jury.

4. In an action for injuries to a motorman by a collision with a car of another company at a crossing, the court charged that it was the duty of defendant company to use ordinary care to prevent collision and to observe the provisions of the city ordinances which gave plaintiff's car the right of way, and that if defendant in the operation of the car which collided with plaintiff's car failed to give plaintiff's car the right of way and negligently collided with plaintiff's car, by reason of which he was injured, plaintiff was entitled to recover. Held, that such instructions were not erroneous as misleading.

5. The instructions were not erroneous as charging that defendant's mere violation of the ordinance was negligence per se.

6. In an action for injuries to a street railway motorman by collision with a car of another company at a crossing, the fact that plaintiff proved that defendant had accepted a city ordinance which gave plaintiff's car right of way at the crossing did not require an instruction on such subject, since the ordinance was binding on defendant without acceptance.

7. In an action for personal injuries, plaintiff's recovery is not limited to past bodily pain and suffering, but he is also entitled to compensation for such future suffering as will result from his injuries.

8. Where a street railway motorman injured by a collision with a car of another company at a crossing was taken to a hospital by his employer, which he thereafter left, and was taken to another hospital, at which he incurred and paid for medical treatment, he was entitled to recover for such expenses in an action against the owner of the colliding car for the injuries sustained. —(McLain vs. St. Louis & S. Ry. Co., 73 S. W. Rep., 909.)

MISSOURI.—Street Railways—Collision with Team Driving on Track—Contributory Negligence—Instruction—Damages.

1. The driver of a team which was struck by a street car from behind is not necessarily guilty of contributory negligence in driving along the car track, without looking back, where no warning was given, as should have been, if he was, or could by the use of ordinary care have been, seen, or if it was too dark to see him.

2. Failure of an instruction in an action for injury to several articles to limit the award for each article to the amount claimed therefor in the petition is harmless, the proof being that the damages were less than alleged, and the verdict being for a third the sum prayed for.—(Noll vs. St. Louis Transit Co., 73 S. W. Rep., 907.)

MISSOURI.—Carriers—Injury to Passenger—Prima Facie Case—Excessive Damages.

1. In an action for personal injuries sustained in a railway collision, the negligence charged was that defendant "did, by the servants in charge of said car, and its servants in charge of another of the cars, so carelessly manage and control said cars as to cause and suffer the same to collide." Held, that the rule that if, instead of pleading generally the relation of carrier and passenger, and the injury, and thus making out a prima facie case, plaintiff limits his right to recover to a specific act of negligence, he must prove such specific negligence, did not apply, and it was not necessary for plaintiff to show which servant so in charge of the cars was negligent.

2. The court, on appeal, will not set aside an award of damages as excessive unless the amount awarded shocks the judicial sense of right and justice.

3. In an action for personal injuries received in a collision between electric cars, plaintiff's evidence showed that his testicles, hip joint, kidneys, bladder, and spinal cord was injured, and that his abdominal wall was ruptured, compelling him to wear a truss. Held, that a verdict of $7,000 was not excessive.—(Malloy vs. St. Louis & S. Ry. Co., 73 S. W. Rep., 159.)

MISSOURI.—Street Railways—Injuries at Crossings—Negligence—Issues for Jury—Contributory Negligence—Look and Listen—Evidence—Credibility of Plaintiff's Testimony.

1. In an action against a street railway for injuries to a teamster, whether defendant was running its car at excessive speed, and neglected to slacken speed on approaching a crossing, or was guilty of negligence in not having a headlight and failing to sound the gong, held, under the evidence, to be questions for the jury.

2. In an action against a street railway company for injuries to a teamster, plaintiff's testimony that he stopped to look and listen for cars, but did not see the one that struck him, was not so incredible that it should have been disregarded, when the evidence of the motorman himself was that he could not see more than five feet ahead of his car, and there was evidence that the gong was not sounded.

3. Negligence of plaintiff which does not contribute to his injury will not bar a recovery.

4. There is no absolute duty incumbent on one who is about to cross a street railway track to stop, as well as to look and listen.

5. In an action against a street railway company for injuries to a teamster, an instruction that, in ascertaining whether plaintiff stopped to look and listen, the jury should consider all the facts and circumstances, and the testimony of other witnesses, as well as that of the plaintiff, was proper, without further charging that they were not bound to believe plaintiff's own testimony.

6. A party cannot complain of a clause in an instruction given of the court's own motion, which was contained in an instruction given at such party's request.—(Frank vs. St. Louis Transit Co., 73 S. W. Rep., 239.)

MISSOURI.—Carriers—Injury to Passengers—Negligence—Pleading—Evidence—Instructions.

1. The negligence charged by a petition in an action for injury to a passenger by derailment of a street car, alleging that the "running gear, that is to say, the wheels, axles, and other machinery, by means of which the said car ran along the said track, were defective and out of order, and unfit for the purpose of supporting the said car on the said track," and that though defendant knew, or should by the exercise of ordinary care have known, of such defective running gear, it "ran the said car along the said track, and into said curve at a high rate of speed," was general and not specific negligence, so that there was no failure of proof by want of evidence of defect in the running gear of the car.

2. Evidence, in an action for injury to a passenger by derailment of a street car, held sufficient to authorize the jury to find that the car left the track because of defects in the flange of a wheel, and because the car was run around a curve at the usual rate at which sound cars are run around it.

3. Any generality in an instruction as to negligence is cured by the other instructions, which limit plaintiff's right to recover to the specific negligence charged in the petition.

4. Defendant is not entitled to an instruction that the jury must be guided solely by the evidence, and should not be governed by sympathy for plaintiff, nothing having transpired to indicate that the jurors were unmindful of their sworn duty.—(Johnson vs. St. Louis & S. Ry. Co., 73 S. W. Rep., 173.)

MISSOURI.—Carriers—Collision—Injuries—Excessive Damages—Negligence—Instructions.

1. In a collision between electric cars, plaintiff was injured—sustaining a complete inguinal hernia, or rupture of the testicles—was compelled to wear a truss, and suffered great pain. Held, that a verdict of $3,900 was not excessive.

2. Plaintiff was injured in a collision between an electric car, on which he was riding, and a car on which the president of defendant company was riding. The court refused to instruct that if, shortly before the president's car reached a certain point, its motorman asked the motorman on a passing south-bound car if the latter car was the last car out, and was answered that there was one more car, and defendant's president understood the answer to be that the car was the last one out, and, relying on said advice, gave orders for his car to proceed, and if the collision was due solely to the president's misunderstanding of such answer, and such misunderstanding was purely accidental, and did not constitute negligence, the verdict must be for defendant. Held, properly refused, where the president himself testified that he knew there were nine cars on the road, and that only eight had passed.

3. The instruction was properly refused where the president testified that it was the duty of the manager of the road to regulate the running of the cars, and to notify motormen of the cars that were on the road.

4. The instruction was properly refused where the collision occurred on ladies' day at certain races, when the cars were crowded, and all the cars were needed to handle the crowds.

5. The instruction was properly refused; it appearing that the president's car was not a regular car on that part of the road, and there being nothing in the record to show that the manager or any motorman knew it was coming out.

6. As the president knew there was another car out, which would come in some time that evening, it was negligence for him to run his private car at a high rate of speed around a curve where a coming car could not be seen, or to run it over that part of the road without taking proper precautions to prevent a collision with such incoming car.—(Hennessy vs. St. Louis & S. Ry. Co., 73 S. W. Rep., 162.)

MISSOURI.—Street Railways—Personal Injuries—Care Required—Duty to Keep Lookout—Street Crossings—Ringing Bell—Res Gestæ—Expert Evidence—Testimony of Interested Party—Financial Interest—Instructions.

1. Whether the fact that a car ran about 125 ft. before coming to a stop after striking a child would indicate that it had been moving faster than 10 or 12 miles an hour, or that the motorman did not apply the brakes or reverse power properly, was a question for the jury, and not for expert witnesses.

2. Evidence that immediately after the stopping of a car which ran over a child the motorman came back to where the child was, and in answer to the question, "Are you blind, to run over a child like that?" replied, "I didn't see the child; I was looking at the car coming east," was not part of the res gestæ.

3. Rev. St. 1899, Sec. 4652, provides that "no person shall be disqualified as a witness in a civil suit by reason of his interest in the event of the same as a party or otherwise, but such interest may be shown for the purpose of affecting his credibility." Held, that the court erred in not requiring an attorney, who had testified as a witness for his client, to testify as to what financial interest he had in the suit.

4. If injury to a child results from failure of those in charge of an electric car to sound a bell or give other warning of the approach of the car to a crossing, or to keep a proper lookout for persons at that point, the company is liable, and it is immaterial that the petition does not allege negligence of such employees after becoming aware, or after they ought to have known of the child's danger.

5. An allegation "that the servants in charge of the car failed to keep a proper lookout for persons crossing" the tracks at a certain crossing does not present the issue that such servants were negligent in failing to see, when by reasonable care they might have seen, the person injured.

6. Where there is no law directing those in charge of a street car to ring a bell on approaching a crossing, failure to do so becomes negligence only when the circumstances render the ringing of the bell necessary, and is a question for the jury.

7. The motorman of an electric car approaching a crossing is bound only to use such care as a person of ordinary prudence and caution, according to the usual and general experience of mankind would exercise in the same situation and circumstances, in respect to keeping a lookout for persons crossing the track.—(Koenig et ux. vs. Union Depot Ry. Company, 73 S. W. Rep., 637.)

MISSOURI.—Street Railways—Personal Injuries—Duty of Public to Look Out for Cars—Negligence—Admissions—Evidence—Instructions—Triors.

1. The strongest admissions which a party makes against himself are those by which he must be concluded in determining the effect of his testimony, unless, before closing his evidence, he shows that there was some mistake or misapprehension in what he stated.

2. Plaintiff admitted that he was driving in the rails of a street car track, and was coming on a cross-track, when he first saw the car approaching on the cross-track, very near to him, and stated that he thought he had time to pass; that when he realized that the car was going to catch him his horses "were going toward the crossing on the track," and that he was struck before he got off. Held, to show a want of ordinary care, which precluded his recovery.

3. The rule that where defendant, by ordinary care, may discover and avert the peril wherein plaintiff has negligently placed himself, it is defendant's duty to exercise such care, does not apply where there is no testimony tending to show the facts essential to its application.

4. In determining whether or not plaintiff has a case to submit to triors of the joined issues, he is entitled to the benefit of every fact in evidence favorable to his contention, and of every reasonable inference therefrom.

5. Where, after giving plaintiff the full weight of every fact in evidence favorable to his contention, and of every reasonable inference therefrom, there is no testimony to support his contention on some material and essential feature of his case, the court may properly give a binding instruction to find for defendant.—(Cogan vs. Cass Ave. & F. G. Ry. Company, 73 S. W. Rep., 738.)

MISSOURI.—Street Railway—Maintaining Stump in Platform—Injury to Prospective Passenger.

1. A street railway which builds a platform for passengers around a stump placed by an electric light company in a street is not liable, on the ground of maintaining the stump, to one who, hurrying to catch a car, fell over it.—(Lucas vs. St. Louis & S. Ry. Company, 73 S. W. Rep., 589.)

MISSOURI.—Street Railroads—Injuries—Street Crossings—Sounding Gong—Negligence — Evidence — Instructions—Refusal.

1. Where, in an action for injuries in a collision with a street car, plaintiff alleged defendant's negligence in failing to sound the gong, and witnesses who were in a position to have heard the gong, if it had been sounded, testified that they did not hear it, such evidence justified a finding that the bell was not sounded.

2. Where, in an action for injuries sustained in a collision with a street car at a crossing, plaintiff testified that he saw the car coming toward the crossing, half a block away, the failure of defendant's motorman to sound the gong in approaching the crossing was not actionable negligence as to plaintiff.

3. Where, in an action for injuries in a collision with a street car, defendant's evidence justified the inference that plaintiff attempted to cross the track without looking or listening, and, if he had looked after he had passed in front of a furniture van in front of the car, he would have seen the car in time to have stopped before it reached him, it was error to refuse to charge that it was plaintiff's duty, before going on the track, to look and listen, and if by so doing he could have avoided the accident, by ordinary care, but neglected to do so, he could not recover.

4. The fact that the court, in an action for injuries, instructed that it was plaintiff's duty to use ordinary care for his own safety in attempting to cross a street car track, and then defined the term "ordinary care," did not justify the refusal of a requested instruction that if plaintiff failed to look or listen before going on the track, when, if he had done so, he could have avoided injury, he was guilty of contributory negligence.—(Murray vs. St. Louis Transit Co., 75 S. W. Rep., 611.)

MISSOURI.—Street Railroads—Injuries to Pedestrian at Crossing—Contributory Negligence—New Trial.

1. A decedent's contributory negligence in knowingly attempting to pass in front of an approaching street car at a street crossing, in such close proximity thereto as to make the danger of collision imminent, bars a recovery, though the street railway company was negligent in failing to sound the gong of the approaching car running at an excessive rate of speed, and even though it also failed to use proper care to stop the car after the dangerous position of the decedent became known to it.

2. Where the verdict of the jury is for the right party and in accordance with the law, it will not be disturbed, though the court gave erroneous instructions.

3. Plaintiff's decedent was killed by a street car at a crossing. The street was clear of obstructions, and there was plenty of light to see distinctly. There was no evidence that decedent looked or listened before going on the track, except that of the motorman, who tstified that when he saw her he hit his gong, but she continued until she got on the southbound track; that at that time the car, which was on the northbound track, was within probably 20 ft. from her; that she paused for an instant, and when the car got within 5 ft. of her she deliberately walked on the northbound track in front of the car and attempted to cross, when the car killed her. Held, as a matter of law, that decedent was guilty of contributory negligence.—(Moore vs. Lindell Ry. Co., 75 S. W. Rep., 672.)

MISSOURI.—Street Railways—Personal Injuries—Person Crossing Track—Failure to Look and Listen—Contributory Negligence—Discovered Peril—Evidence—Sufficiently—Demurrer to Evidence.

1. Where a demurrer is sustained to the plaintiff's evidence, every fact which the evidence tends in the slightest degree to prove must be taken as admitted.

2. In an action against a street railway company by a person injured while crossing the track, evidence held to require submission to the jury of the issue as to whether plaintiff was guilty of contributory negligence in failing to again look and listen when crossing the track immediately after a passing car.

3. In an action against a street railroad company for injuries caused by being struck by a car while attempting to cross the track, plaintiff's contributory negligence was not fatal to recovery where it appeared that defendant's servants could have stopped the car in time to have avoided injury to plaintiff had it not been running at a recklessly high rate of speed, in excess of that allowed by ordinance.

4. In an action by one injured while attempting to cross street car tracks, evidence held to require submission to the jury of the issue as to whether failure to stop the car in time to avoid injury to plaintiff was due to the operation of the car at a reckless rate of speed, in excess of that permitted by ordinance.—(Moore vs. St. Louis Transit Co., 75 S. W. Rep., 699.)

NEBRASKA.—Directing Verdict—Street Cars—Collision with Wagon—Evidence—Cross-Examination.

1. A trial court should not instruct a jury to return a verdict for either party where, under the evidence, there is any doubt about the propriety of such action; but, where the duty to do so is plain, it should be performed without hesitation.

2. Evidence examined, and held that a verdict for the plaintiff could not have been sustained in this case on any theory.

3. In a case where a verdict is returned for the defendant, and is the only one which can be sustained, errors assigned by the plaintiff

on account of giving and refusing instructions will not be considered.

4. Bill of exceptions examined, and held that the court did not err in restricting the cross-examination of a witness, and in striking out a part of such cross-examination.—(U. P. Steam Baking Company vs. Omaha Street Railway Company, 94 N. W. Rep., 334.)

instructions given to the jury by the trial court, unless it clearly

NEBRASKA.—Appeal—Harmless Error—Instructions.

1. A judgment will not be reversed on account of the number of instructions given to the jury by the trial court, unless it clearly appears that the party complaining is prejudiced thereby.

2. The giving of an instruction which places the burden of proof to establish some of the facts put in issue by the pleadings on the wrong party is reversible error.

3. It is error to give the jury instructions which contain inconsistent and conflicting paragraphs relating to the burden of proof. Farmers' Bank vs. Harshman, 50 N. W. 328, 33 Neb., 445, approved and followed.

4. A party is entitled to have his theory of his case, as disclosed by the evidence, submitted to the jury under proper instructions; and, where such an instruction is tendered to the court, the refusal to give it is reversible error.—(Omaha Street Railway Company vs. Boeson, 94 N. W. Rep., 619.)

NEW JERSEY.—Street Railroads—Injury to Pedestrian—Contributory Negligence.

1. Plaintiff attempted to cross, on foot, trolley tracks laid in the middle of an avenue with which he was familiar. The time was after 7 o'clock in the evening of Feb. 12. The night was very dark and rainy. He was struck and injured by a trolley car coming from the east. In that direction the avenue was straight for a long distance. The car carried a headlight at its top, and its interior was also lighted. From the configuration of the ground, all the lights of a car thus approaching could be seen for 650 ft. or 700 ft., and the headlight for a much greater distance. He testified that when he started to cross he did not see the car, but before he succeeded in crossing he was struck, though he "stepped as quick as he could." Held that, upon plaintiff's case, his negligence contributing to his injury so clearly appeared that it was error to submit the case to the jury.—(Brown vs. Elizabeth, P. & C. J. R. Company, 54 Atlantic Rep., 824.)

NEW JERSEY.—Fellow Servants—Employment by Agent—Transfer of Services—Consent of Servant.

1. If plaintiff, when injured by the negligence of defendant's servants, was employed and paid by one who in so doing acted as the mere agent of defendant, plaintiff could not recover, as he was a co-servant of those whose negligence caused his injury.

2. If plaintiff, when injured by the negligence of defendant's servants, was employed by one who had a contract to repair defendant's tracks, the question as to whether he had transferred plaintiff's services to defendant with plaintiff's consent should have been submitted to the jury.—(Norman vs. Middlesex & S. Traction Company, 54 Atlantic Rep., 835.)

NEW JERSEY.—Street Railroads—Injury to Passenger—Negligence of Motorman.

1. The motorman of an electric street railway car started his car at moderate speed to cross an intersecting steam railroad consisting of three tracks, after his conductor had gone forward upon the crossing and had used proper care to ascertain that no railroad train was to be expected. While thus proceeding over the crossing at moderate speed, the motorman became suddenly aware of a railroad train rounding a curve near by, and coming toward his car at a high rate of speed, without timely warning by bell or whistle. A collision seemed imminent, and was, in fact, narrowly averted. The motorman, on seeing the danger, instantly applied all power, and increased the speed of his car to the utmost, in order to escape the collision. It was claimed that in the lurch of the street car thereby occasioned a passenger was thrown to the floor of the car and injured. Held, that a verdict attributing negligence to the motorman on these facts cannot be supported.—(Corkhill et ux. vs. Camden & S. Railway Company, 54 Atlantic Rep., 522.)

NEW JERSEY.—Damages—Inadequate Verdict.

1. Where a verdict cannot be declared inadequate, plaintiff cannot have it set aside as too small, though a considerably larger sum would not have been declared excessive.

2. A verdict of $100 to a husband for deprivation of his wife's society, and for expenses necessarily incurred by him because of her injuries, will be set aside as inadequate, the undisputed evidence showing he has paid or is liable to pay considerably more than that for expenses rendered necessary by her injuries.—(Caswell et al. vs. North Jersey Street Railway Company, 54 Atlantic Rep., 565.)

NEW JERSEY.—Injury to Child—Sui Juris—Contributory Negligence—Allowing Case to be Opened.

1. Whether a child seven years old, run over by a street car, was sui juris, and, if so, whether, considering his years, he was guilty of contributory negligence, are questions for the jury.

2. Allowing plaintiff, after closing his case, to open it and introduce evidence, is matter of discretion, and not reviewable.—(Vogel vs. North Jersey Street Railway Company, 54 Atlantic Rep., 563.)

NEW JERSEY.—Street Railroads—Injury to Person on Track—Directing Verdict—Rights in Highway.

1. Plaintiff's driver was driving at midnight a team of horses, attached to a loaded truck wagon, along the public road, upon the left-hand track of defendant's street railway, when he was met by one of the defendant's cars moving on that track. In turning to his right to avoid that car, he drove upon defendant's right-hand track, where another of defendant's cars, approaching from the opposite direction, overtook and ran into the back of his wagon, causing injury. He testified that when he "pulled off" on the right-hand track he looked back, and there was no car in sight, and that no bell was sounded, nor notice given, before the collision. The motorman in charge of the colliding car, in his testimony, made contradictory statements respecting the distance from him at which he first saw the horses "pulling over" on the track in front of him, and admitted that he gave no signal.

Held, that the trial judge properly refused to direct a verdict for the defendant.

2. The right of street railway companies to use the highways by their cars is not superior to the rights of others in the customary use thereof, and it is not an act of negligence, per se, for the driver of a carriage, whether of burden or pleasure, in passing over the public roads of this State where the tracks of an street railway company may be laid, when either met or overtaken by the cars of such company, to keep to the right, upon other tracks of said company, even though such carriage, by turning to the left, might have avoided both meeting, and being overtaken by the company's cars.

3. The defendant was bound to take notice that the law required other carriages or vehicles using the parts of the highway covered by its car tracks, upon meeting its cars coming from an opposite direction, to keep to the right, except it was perilous to do so, and to control its overtaking cars, in anticipation that such other carriages might so turn upon its car tracks, in obedience to the law, at any instant; and it was the duty of the motorman of the colliding car in this case to use reasonable care to observe any vehicle ahead of him, and to govern his car so as to prevent collision. Whether he used such care, or not, was a question for the jury to determine from the evidence.—(Adams vs. Camden & Suburban Railway Co., 55 Atlantic Rep., 254.)

NEW JERSEY.—Street Railroads—Injury to Passenger—Evidence—Non-Suit.

1. A motion to non-suit having been based solely upon the ground of contributory negligence, the question of the absence of evidence of negligence on the part of the defendant is not open for consideration upon error.

2. Plaintiff, while seated in a street car with his arm resting upon the frame of an open window, was injured in a collision between the car and a part of the load of a passing wagon which overhung the side of the wagon and struck the plaintiff's arm. The trial judge instructed the jury, in substance, that, if any part of the plaintiff's arm protruded beyond the line of the car, and but for this fact he would not have been injured, then the plaintiff had failed to establish negligence on the part of the defendant company, and the verdict must be in favor of the defendant. Held, unnecessary for the judge to go further, and charge the jury that the position suggested for the plaintiff's arm evidenced negligence on his part.—(Zeliff vs. North Jersey Street Railway Company, 55 Atlantic Rep., 96.)

NEW JERSEY.—Master—Servant's Injuries—Declaration—Sufficiency—General Demurrer—Defects Reached—Motions to Strike.

1. A declaration, for servant's injuries, alleging that it was defendant's duty to use due care in the selection of competent persons to operate its cars, and yet, neglecting its duty, it did not use due care in that behalf, but negligently employed incompetent persons, and so negligently managed a certain car being propelled towards the car upon which plaintiff was, that by reason of said negligence, and by reason of the car being in control of incompetent persons negligently employed by defendant for that purpose, a collision occurred, etc., does not charge defendant as an insurer, but states a good cause of action.

2. A declaration founded on separable demands, some of which are good and some bad, will prevail against a general demurrer, and, since the abolition of special demurrers, an objection thereto must be made on motion to strike out.—(Peter vs. Middlesex & S. Traction Company, 55 Atlantic Rep., 35.)

NEW JERSEY.—Carriers—Street Car Company—Injuries to Passenger—Contributory Negligence.

1. Evidence in action by a street car passenger for injuries examined, and held to show that the accident was occasioned by plaintiff

alighting from the car after it had started, and without notifying the conductor of her intention, and hence not to sustain a verdict for her.—(Lee vs. Elizabeth, P. & C. J. Railway Company, 55 Atlantic Rep., 106.)

NEW JERSEY.—Injuries—Damages—Elements—Exclusion.

1. Plaintiff, who was injured by defendant's negligence, was confined to the house for fourteen weeks after the accident. His place of business adjoined his residence, and, beginning about five weeks after the occurrence, he was able to attend to the most important part of his business without going outdoors. He employed an extra man for four days each week during a period of a year or longer, but admitted that during such time plaintiff was actively engaged in the business of his firm, and was not devoting as much attention as he had previously done to his outside work. Held, that such facts justified the jury in excluding loss of earnings and the wages of plaintiff's employee so hired in ascertaining plaintiff's damages.—(Schreck vs. Jersey City, H. & P. Street Railway Company, 55 Atlantic Rep., 650.)

NEW JERSEY.—Trial—Order of Proof—Evidence—Cross-Examination—Personal Injuries—Excessive Verdict.

1. The order of proof is always discretionary with the trial judge. He may reopen the case on rebuttal if he so wills, if no injury will follow to the defendant by way of surprise or otherwise.

2. An engineer called by the plaintiffs testified that he had made a map of the locality of the accident for the defendant. On cross-examination the defendant produced and the witness identified the map, and stated that it was made from actual measurements made by himself upon the ground, and that it was drawn to a scale. The defendant had the map marked for identification. The defendant did not offer the map in evidence. Upon the defendant's resting, the plaintiffs called for the map, and offered it on rebuttal. The court admitted it. Held, that in this there was no error. Nor was there error in the court's allowing the witness to subsequently testify to pertinent questions as to the map itself, and to locate certain points thereon.

3. Where the verdict is clearly excessive, in view of the character of the injury and sufferings of the plaintiff, when injury and sufferings are the only questions submitted to the jury, it may be set aside.—Foley et ux. vs. Brunswick Traction Company, 55 Atlantic Rep., 803.)

NEW YORK.—Carriers—Passenger—Negligence—Street Car—Question for Jury—Instructions—Anticipation of Danger—Preponderance of Evidence—Negligence—Cause of Accident.

1. Evidence in an action by a passenger on a street car for injury caused by a collision of the car with a truck examined, and held to present a question as to want of care on the part of the street car company for the jury.

2. While plaintiff was a passenger on defendant's street car, as it was turning a corner, the rear of the car collided with a truck, and a trunk fell therefrom against a window of the car, injuring plaintiff. There was no evidence of negligence on the part of the motorman. The court instructed that if the motorman, knowing that the truck was approaching, and about to turn into the avenue, did not use that ordinary care that a man of his position should have exercised, then the plaintiff has established, by what would be known to the law as a "fair preponderance of the evidence," negligence on the part of the defendant company. Held, error, in assuming that the mere turning of the truck into the avenue called on the motorman to anticipate that there might be a collision, though there was room for them to pass safely.

3. The instruction was also erroneous in declaring, as a matter of law, what would constitute a preponderance of evidence to establish defendant's negligence.

4. The instruction also erred in stating to the jury, in effect, that the omission to exercise ordinary care on the part of the motorman would render the defendant negligent, and, by reason thereof, liable to plaintiff, even though such lack of care did not contribute to the accident.—(Suse vs. Metropolitan Street Railway Company et al., 80 New York, Suppl., 513.)

NEW YORK.—Street Railroads—Injuries to Pedestrians—Witness—Cross-Examination—Scope.

1. Where plaintiff claimed that the killing of his infant intestate by one of the defendant's street cars was caused by the negligence of the motorman in not looking ahead, and his failure to stop the car in time to prevent the injury, while defendant claimed that the motorman was looking ahead and that the child ran suddenly in front of the car, so close that it could not be stopped, plaintiff, on cross-examination of the motorman, was entitled to inquire as to his method of operating the car at particular places; the rate of speed at which he ran; his obedience to orders relating to the operation of his car before a schoolhouse within a short distance of the place of the accident; the crossing by people on the street; the application of his brake; statements which he made concerning the accident; what he had testified to on a former trial; and whether or not his present version of the transaction was not different from his previous testimony.—(Willsen vs. Metropolitan Street Railway Company, 80 New York Suppl., 414.)

NEW YORK.—Street Railroads—Injury to Traveler—Assault by Motorman.

1. A boy 14 years old, riding on the front platform of an electric car, was thrown or kicked from the car by the motorman. He walked back a short distance somewhat lamely, and while in the act of crossing the further track was struck by a car, and died from the injuries received. The place was well lighted by electric lights, and the car was well lighted, and about 125 ft. distant, when he attempted to cross the tracks. There was no evidence that he looked or listened, or that he was so injured as to be unable to use his powers of sight and hearing. Held, that the railroad company was not liable for his death.—Binder vs. Brooklyn Heights Ry. Co., 66 N. E. Rep., 406.)

NEW YORK.—Injury to Employee—Assumption of Risk.

1. Plaintiff's intestate was conductor on a street railway, and was killed by coming in contact with a tree near the track. He had been over the road about 160 times as conductor and about fifty trips as motorman, and was familiar with the situation. Held, that, by continuing the employment with the knowledge of the facts, deceased assumed the risk, and it was error to submit the question of defendant's negligence to the jury.—(Drake vs. Auburn City R. Co., 66 N. E. Rep., 122.)

NEW YORK.—Street Railroads—Injury to Child—Crossing Track—Contributory Negligence—Intervening Cause.

1. An action against a street railway company for the killing of a child while attempting to cross the company's tracks, an instruction that, if the jury found the child was guilty of contributory negligence, the question remained whether defendant's driver, by the exercise of reasonable care and prudence, might have avoided the consequence of the child's negligence, was erroneous, where there was no intervening circumstance, and the only issue presented were the negligence of the defendant and the contributory negligence of the child with respect to one set of circumstances.—(Delkowsky vs. Dry Dock, E. B. & B. R. Co., 79 New York Suppl., 1104.)

NEW YORK.—Infants—Wrongful Death—Care Required—Instructions—Capacity of Infant.

1. Where, in an action for the negligent killing of a boy, the court charged that the boy was required to exercise such care as a boy of his age and of good intelligence would exercise under like circumstances, and also such care as others in a like situation would exercise, an instruction that it was his duty to exercise such care as a boy of his age and of good intelligence would exercise under such circumstances, "and deem adequate thereto," was not erroneous, as making the degree of care to be exercised depend on the operation of deceased's mind.

2. An infant over the age of 12 is presumed to be sui juris, and hence, in an action for his wrongful death by being struck by a street car, the same degree of care that is required of an adult should be required of him in the absence of proof as to his mental capacity.—(McDonald vs. Metropolitan St. Ry. Co., 80 New York Suppl., 577.)

NEW YORK.—Railroad Crossing—Threatened Collision—Negligence—Question for Jury—Carriers—Railroad Crossing—Threatened Collision—Negligence—Question for Jury—Contributory Negligence.

1. A train approached a grade crossing of a street railway, through the thickly populated district of a village, around a curve where the view was obstructed. The engineer did not ring the bell or sound the whistle, but applied the brakes, so as to barely escape collision with a trolley car. A passenger on the trolley car jumped therefrom to avoid injury and was hurt. Held, that the question of the engineer's negligence was for the jury.

2. A trolley car approached a railroad crossing to within a couple of lengths, when the conductor got off and went forward, looking for trains. He motioned to the motorman to start, and after the car started, evidently becoming aware of an approaching train, motioned again to the motorman to stop, which the latter failed to do. The car crossed the track barely in time to avoid a collision. A passenger on the car jumped therefrom to avoid injury, and was hurt. Held, that the question of the carrier's negligence was for the jury.

3. Evidence in an action by a passenger on a trolley car against the street car company and a railroad company owning an intersecting track, for injuries occasioned by jumping from the street car to avoid a threatened collision with an approaching railroad train, considered, and held to render the question of the passenger's contributory negligence one for the jury.—(Robson vs. Nassau Electric Ry. Co. et al, 80 New York Suppl., 698.)

LONDON LETTER.

(From Our Regular Correspondent.)

Kincaid, Waller, Manville & Dawson estimate the cost of reconstruction of the Perth Tramways at £46,000. In addition to this there has to be added £21,800, the price already paid for the tramways, and along with the engineers' fees and Parliamentary expenses the total cost will be about £70,000. The engineers further recommended that the tramway line be extended on the north side of the city to Dunkeld Road at a cost of £1,500. The report goes on to recommend that the gage should remain the same, but that a number of additional passing places will require to be added. The present concrete under the rails will require strengthening, and the present rails lifted and heavier ones put down. Twelve double-decked cars are proposed. When the extensions that will be necessary at the electric station owing to the reconstruction and the extension of the tramways proposed have been completed, along with the additional extra expenditure that will arise, the reconstruction scheme and purchase of tramways will have involved an expenditure of close upon £100,000.

A new series of trials in connection with the running of the new electrical trains by the North Eastern Railway on the Tynemouth line has been commenced, and will be continued every day until further notice. Since the first trial was run on the Riverside line in September last, electrification has been so rapidly pushed forward that the public are now within measurable distance of seeing this new era in railway traveling definitely established. The third rail placed in each 6-ft. way has been practically laid the whole of the circular tour between Newcastle, Tynemouth, and New Bridge Street. The cables on part of the line to New Bridge Street have not been completed, and the intricate crossings into the Central Station have not yet been rearranged, but in other respects the road has been practically electrified over some 80 miles of single track. Along with the rapid progress of the new system several complete trains of the handsome new rolling stock have been built at the company's works, and it is to test these trains, as well as to familiarize the men who have been selected to drive them, and also to form accurate bases for a time-table, that the present series of experiments were commenced.

Campbeltown's Council and the Kintyre district committee are both inclined to look with favor upon the scheme for the laying of a light railway, or electric tramway, between the capital of Kintyre and Machrihanish. The syndicate which is promoting the scheme estimates that the line will cost between £20,000 and £30,000. Assuming the correctness of this estimate, and taking £25,000 as the probable cost, it is not easy to see how such a line can be worked to a profit. Golf is the only industry of Machrihanish; and people who go there in summer, settle down to the serious business of the place for a month, or a fortnight, or at least a week.

Hewitt & Rhodes, engineers, and the Llandudno & Colwyn Bay Light Railway Company have entered into a contract for the construction of the line from the Northwestern Hotel, Mostyn Street, Llandudno, through Craigydon, to Rhos-on-Sea.

The Leeds Corporation lighting committee proposes to substitute electricity for gas in the illuminating of all tramway routes within a radius of one mile from the junction of Boar Lane and Briggate, opalescent and clear globes to be used for such lighting at the discretion of the superintendent. The tramways committee have given permission for the using of tramway poles in connection with this extension of electric lighting.

At the next meeting of the Holborn Borough Council a statement will be presented respecting the proposal of the London County Council for the electrification of the tramways within the borough. The works committee is of opinion that the overhead or trolley system if far preferable to the conduit system on the grounds of economy and efficiency. The committee will therefore recommend that the board of trade be requested to withhold its approval of the proposal of the London County Council to instal the conduit system.

The highways committee of the London County Council has decided to recommend the Council to accept the tender of J. G. White & Company (Limited), of London, for the reconstruction of electrical traction of the Streatham cable tramways and the construction of tramways in Tooting High Street and Defoe Road. The amount of the tender is £95,005.

Parliament has decided that in the case of the London United Tramways bill the standing orders should not be dispensed with, and the bill, therefore, will not be allowed to proceed. Many comments, favorable and otherwise, have been made on the remarkable character of the demands which the various local authorities sought to impose as the "price" of their assent to the bill, and it was owing to the nature of these demands that the company felt compelled to abandon more than half of its proposals. The company's proposed expenditure on the road and bridge widenings alone amounted to £217,932, but this was not regarded by the local authorities as sufficiently generous, so a further demand for £642,630 was made. The company points out that both these amounts would have to be paid before it could proceed to construct the additional 21½ miles of extensions.

As an example of these demands, the company states that it proposed to construct half a mile of new tramway at Brentford, and in return for this concession the Urban District Council demanded a further expenditure of £520,000. The company intended by means of this link to run electric cars direct into the District Railway stations at Hammersmith and elsewhere, and so set down and take up passengers immediately alongside the platforms. "The outcome of the situation," says Clifton Robinson, the managing director of the company, "is that the great scheme admirably conceived by Mr. Yerkes has been set back two years, and the question now arises whether such a condition of affairs should not be practically considered by the Royal Commission on London Traffic."

The Underground Electric Railways Company, of London, Limited, has given the contract for electric elevators over all the "Yerkes" system of "tube" railways to the Otis Elevator Company, of London. The value of the work is about £350,000, which is the world's record for passenger lift contracts. Three hundred and forty motors have been ordered for this contract from the General Electric Company, Limited, of London, by the Otis Elevator Company, which will be required for 170 elevators to be distributed over three of the Yerkes tubes. These tubes are the Baker Street & Waterloo, the Charing Cross, Euston & Hampstead and the Brompton Road & Great Northern & Strand. A very large amount of the work will be English, though necessarily a few Otis specialties will have to be brought from America.

At a meeting of the electric lighting and power committee of the Liverpool Corporation, held recently, special interest attached to the proceedings owing to the presentation of an important report and recommendation by the consulting electrical engineer, A. Bromley Holmes. This reviewed the financial position of the electric works, and recommended that the price for electrical energy charged to the tramways committee should be increased from the present rate of 1.05d. to 1.12d. per unit, subject to the existing sliding scale to meet variations in the cost of coal. Mr. Holmes supported his recommendation by pointing out that as the Glasgow Corporation entailed a cost of nearly £100,000 last year for 13,000,000 units of energy for tramways, while Liverpool only paid about £80,000 for 17,000,000 units, the charge to the Liverpool tramways committee was manifestly much too low. The increase he proposed would only on the present consumption by tramways add about £4,500 to the £80,000.

The General Electric Company, Limited, of London, gave its annual staff dinner last month and invited a large number of its friends to be present at the Trocadero, where a most excellent dinner was served and an enjoyable entertainment provided afterward. Gustav Byng was in the chair for the first time for some years, as he has had to be absent in Switzerland for a number of years on account of his health. Some excellent speeches were made by Mr. Byng, Mr. Hirst, Mr. Roger Wallace, Mr. Manville, Mr. Max Byng and others, though Gustav Byng had a hard time preventing himself from indulging in his favorite topic of Protection. As an offset, however, against the well-known views of the chairman, each guest was presented with a copy of the "General Electric March," written for the occasion, and which on examination was found to have been "Made in Belgium."

The annual staff dinner of Dick, Kerr & Company, Limited, was held this month in the Holborn restaurant, John Kerr, M. P., in the chair. As the dinner was a private one and extended to only a few of the company's friends, no account will be given of the toasts. Suffice it to say that the toast to the Staff of Dick, Kerr & Company, was able proposed by the chairman and cordially responded to by W. A. Rutherford and Mr. Connor. Later on a special toast was proposed to George Flett, managing director of the company, which was most enthusiastically drunk, all present realizing what an important part he had played in the wonderful success which this company has achieved. The toasts were interspersed with songs and other entertainment and a most enjoyable evening spent.

The Lancashire & Yorkshire Railway and Dick, Kerr & Company, Limited, have every reason to congratulate themselves on the success which they have achieved in having ready for service the first electrically operated trains in Great Britain for main line railway work. Full details of this great work will be found on another page. A large number of gentlemen connected with the technical press and the electrical engineering profession made a trip to Liverpool recently for the purpose of inspecting the electrified section of railway between Exchange Station, Liverpool and Southport, together with the power house at Formby and one of the sub-stations at Birkdale. The trip was a most successful and enjoyable one in every way, thanks to the courtesy of J. F. A. Aspinall, general manager of the Lancashire & Yorkshire Railway, and his staff, and the usual hospitality of the staff of Dick, Kerr & Company. The electric train ran to Southport without a hitch at the rate of about 60 miles an hour, and the working of the whole system, including the power house, was perfection itself.

ANNUAL REPORTS FROM BERLIN AND HAMBURG

The recently issued annual reports of Germany's greatest two street railway systems—the Grosse Berliner Strassenbahn and the Hamburger Strassen-Eisenbahn—show an encouraging traffic development which is typical of the large European cities and nearly all German street railways. That the business situation in Germany is enjoying steady improvement is shown by the fact that since April, 1903, the income of the Berlin company has increased 6.24 per cent and of the Hamburg company 8.37 per cent. One disagreeable feature of this additional traffic, however, to the companies, is the abnormal increase in the use of commutation tickets, which amounted to 13.4 per cent in Berlin and 15.1 per cent in Hamburg. It is estimated that if all the passengers were to use commutation tickets the companies' operating expenses would be almost double the income. At present 18.5 per cent of the paid traffic is carried at commutation rates in Berlin and 18 per cent in Hamburg.

The increase in car kilometers was 4 per cent in Berlin and 5 per cent in Hamburg, which is very satisfactory considering the additional traffic handled. In Berlin the revenue per car kilometer, which had suffered a gradual reduction since the electrification of the system, increased for the first time, namely, from 10 cents to 10.25 cents (40 pfg. to 41 pfg.). In Hamburg the increase per car kilometer began a year earlier, namely, from 8.2 cents to 8.4 cents (32.9 pfg. to 33.7 pfg.), and the income per passenger (except commuters) increased from 2.9 cents to 2.92 cents (11.62 pfg. to 11.7 pfg.).

It is well known that the Hamburg company is one of the very few privately-owned traction corporations which has not adopted the policy of giving a 2.5 cent (10 pfg.) fare within the city limits. In Hamburg the fare to the city limits is 5 cents (20 pfg.) and runs up to 11.25 cents (45 pfg.) on the suburban extensions. This plan permits a much better service than is possible with lower fares, and has been followed by most of the municipal lines, who have therefore not found it necessary to readjust their rates to a higher level—a process which is now the order of the day on both German and French street railways. In Berlin, where everybody pays but 2.5 cents (10 pfg.) fare, there has been no increase in the income per passenger.

What would an American railway company say to a fare of only 2.5 cents for any desired distance up to 13 miles (20 km), with universal transfers and when the franchise expires (say in twenty-five years after electrification) to surrender to the municipality for nothing its track and overhead construction and perhaps even its power stations and rolling stock; and in addition, to pay during the life of the franchise up to 10 per cent of the gross earnings and 50 per cent of whatever surplus remains after the payment of a 5 per cent or 6 per cent dividend? And further, as in some cases, to be obliged to purchase power from the municipality at 3.75 cents (15 pfg.) per kw-hour when it could generate its own power for 1.5 cents (6 pfg.) per kw-hour at most? The Berlin company is comparatively fortunate in paying 2.25 cents (9 pfg.) per kw-hour. The Hamburg company pays 2.5 cents (10 pfg.) in Hamburg proper, and in the suburb of Altona up to 3. 75 cents (15 pfg.). It is true that the municipality bases these charges upon power delivered to the trolley wire—but is that an equivalent? The effect of this policy on the development of street railways in Germany has been disastrous. All 2.5 cent (10 pfg.) lines, and especially those under municipal ownership, have carefully avoided building extensions, no matter how needful they were for the benefit of the community.

But to return to the subject of the Hamburg and Berlin companies, both corporations, like most German roads, have followed the policy for a long time of using their increased earnings for the betterment of their lines rather than in paying high dividends. The Berlin company has been paying an 8 per cent dividend for the last two years instead of 7½ per cent as formerly, while in Hamburg the dividend rate has been 8½ per cent for the last four years. Large sums have also been transferred to sinking funds, so that when the franchises expire and the railways become the property of the respective municipalities the former owners will have the full value of their lines in cash.

Both companies have given large amounts for the benefit of their employees, the Berlin and Hamburg companies spending respectively amounts equal to 6½ per cent and 6 per cent of the wages paid to their employees. It is probable that in no country but Germany do such peculiar conditions obtain relative to employees' benefits and pensions. The compulsory contributions required by the government cover insurance against sickness, invalid and old-age insurance, and insurance against accidents to employees. In addition, however, the companies make voluntary contributions in the form of maintaining a benefit fund for indigent employees, and also a pension fund.

Both companies have also always endeavored to purchase competing lines. In Berlin the company has succeeded in securing control of all the important electric surface railways in the city, with the exception of a line over 11 miles (18 km) long, which is operated by the municipality at an enormous loss. Beside this line, however, there are 8 miles (13 km) of elevated and underground lines, a municipal steam line which crosses and girdles the city and finally the omnibus companies, which do an enormous business.

Beside the Hamburger Strassen-Eisenbahn-Gesellschaft, Hamburg has another privately-owned railway. This second company is known as the Hamburg-Altonaer Centralbahn-Gesellschaft. It operates a single line about 5 miles (8 km) long which runs through the middle of Hamburg and Altona. It is considered the best-paying line in the empire, its business amounting to $38,400 (160,000 marks) per km., while the larger Hamburg company and the Berlin company must be satisfied with $18,240 (76,000 marks) and $28,800 (120,000 marks) per km, respectively. This fortunate line has remained independent. The city of Hamburg owns a competing steam line, but there are no omnibuses.

The annual report of the Grosse Berliner Strassenbahn presents the following figures: Passengers carried in 1903, 312,410,000, and in 1902, 294,800,000, an increase of 5.97 per cent; gross earnings from passenger business, $6,933,158.88 (28,888,162 marks) in 1903 and $6,525,985.44 (27,191,606 marks) in 1902, an increase of 4.08 per cent; revenue per car kilometer increased from 10 cents to 10.25 cents (40 pfg. to 41 pfg.); gross earnings from all sources, $7,085,082.96 (29,521,179 marks) in 1903, against $6,630,480 (27,627,000 marks) in 1902; total expenses in 1903, $3,817,340.88 (15,905,587 marks), against $3,681,210.48 (15,318,377 marks) in 1902; expenses in 1903, 53.88 per cent of gross earnings, against 55.41 per cent of gross earnings in 1902. It will be noted that the percentage credited to expenses has decreased after having gradually risen for several years. Up to the present time the company has given most of its attention to the electrification and extension of its system, but it will now have the opportunity to devote its energies to internal improvements. Undoubtedly the operating expenses will continue to decrease when all the cars have been equipped with wattmeters.

A large expense item is that caused by the conduit branch of the system. Although it is only 1.8 miles (3 km) long, the cost for repairs in 1903 was fully $19,920 (83,000 marks)! The greater part of the expense is caused principally by the rapid deterioration of the asphalt along the track. The total number of employees was 7841. The amount paid out for labor in 1903 was 46.03 per cent of the total expenses, and in 1902 was 45.73 per cent. The system has been increased only 1.2 miles (2 km), exclusive of turn-outs, sidetracks, etc.

The rolling stock consists of 1289 motor cars (916 single-truck cars and 373 double-truck cars, the latter including 51 convertible cars); 882 trailers, including 575 closed cars (of which 119 have top seats and 70 are convertible) and 307 open cars; and 66 horse cars. There are also 16 tower wagons for repairs and inspection, 71 track-salting cars, 5 cars for carrying money, 15 lowrys, 4 sprinklers, 12 fire engines, and vehicles for transporting material. Of the motor cars, 518 are arranged for trolley and conduit systems.

In 1903 the company instituted on all lines headways of 7½ minutes and 15 minutes. It is necessary to have a headway of 25 seconds with a 2.5 mile (4 km) radius of the common center from which the lines start so that the above schedule can be maintained. The car-kms run in 1903 included 53,300,000 motor car-kms and 16,860,000 trail car-kms—an unfavorable proportion for German city traffic. The low number of trail car-kms is due in large measure to the action of the municipal authorities who do not permit trailers to cross prominent boulevards like "Unter den Linden." The cost of a trail car-km is about one-half that of a motor car-km. The accident list for 1903 shows that 13 people were killed, 184 seriously injured and 1397 slightly injured, the greater part of whom were hurt through their own negligence. The expenses in connection with these casualties amounted to $52,878.96 (220,329 marks).

The Hamburg company, although doing but one-third the business of the Berlin company, ranks next to the latter. The Hamburg system covers over 96 miles (155 km) of streets and has in all 183 miles (300 km) of track. The rolling stock consists of 558 motor cars (50 double-truck), 439 trailers and 29 sand, salting and repair cars. The company also owns the largest car-building shops on the Continent. It has for several years past turned out 500 cars annually for other companies. The total number of employees was 3550, of whom about 550 worked in the car shops. The traffic personnel received $615,740 (2,566,000 marks) in wages.

The gross earnings, including the car business, for 1903 were $2,867,368.80 (11,947,370 marks), against $2,652,869 (11,053,621 marks) in 1902. The total operating expenses in 1903 were $1,941,335.52 (8,088,898 marks), including $5,899.92 (24,583 marks) for accident payments. The surplus for the year was $826,033 (3,858,471 marks). In 1902, the total number of car-km was 30,846,936. and in 1903, 32,409,924, including 23,655,454 motor car-km, 8,659,497 trail car-km and 94,972 horse car-km. The average income per train-km was 11.5 cents (46.2 pfg.) in 1903, against 11.1 cents (44.5 pfg.) in 1902; per car-km, 8.4 cents (33.7 pfg.) in 1903, against 8.25 cents (32.9 pfg.) in 1902; and per passenger, 2.9 cents (11.7 pfg.) in 1903, against 2.8 cents (11.62 pfg.) in 1902. All the motor cars have been equipped with wattmeters.

LEGAL VICTORY FOR ELECTRICS IN NEW YORK

The Court of Appeals has affirmed the right of the Auburn & Syracuse Railroad Company to extend its line from Skaneateles to Syracuse, N. Y., without a permit from the State Railroad Commission. The plaintiff in the litigation now ended was the New York Central Railroad. The suit was brought to restrain the Auburn-Syracuse Company from operating the section of its road from Skaneateles to Syracuse, on the ground that the extension had been made without the authority of the Railroad Commission. The issue which the New York Central presented to the court in this case was largely of a technical nature. Back of it was the more sweeping and far-reaching proposition of the Central that under the general railroad laws of the State the construction of parallel railroad lines is inhibited save under the stress of public necessity, to be duly certified by the Railroad Commissioners. It is on this plea that the Central has endeavored to block the construction of interurban electric railway lines paralleling its own roads, and the technicality raised against the Auburn & Syracuse Company was simply a means to that end.

EXTENSIVE CUBAN ELECTRIC RAILWAY PROJECT

The Cienfuegos, Palmira & Cruces Railroad & Electric Power Company, which was organized last fall for the purpose of constructing some 40 miles of electric traction system and lighting a number of towns in Southern Cuba, has decided to considerably enlarge its plans. In all nearly 90 miles of electric railway will be built.

Four and a half miles of track will be constructed in Cienfuegos, one of the most flourishing seaport towns in Cuba, where at present there are no tramways of any description. The line will run from there to Caonao, thence over a private right of way to Palmira, Horringuero and Cruces, then on to Ranchuelo, and from there to Santa Clara. There will be a branch, also over a private right of way, from Caonao eastward 15 miles through Los Guaos to Cumanayagua. From the harbor of Cienfuegos to Caonao there will be a second line on a private right of way built to carry freight exclusively. All the lines will be standard gage. Owing to the number of sugar and coffee plantations along the proposed route the company expect to do a very large freight business.

The power plant, which will have a capacity of upwards of 10,000-hp, will be located about 26 miles from Cienfuegos at Hanabanilla, where the Hanabanilla Falls, which are known as the Niagara of Cuba, are situated. It is proposed to divert the Rio Negro by closing a subterranean passage through which it discharges its water southward toward Trinidad. By this means its entire discharge will be added to the Hanabanilla. The available head will then be nearly 700 ft.

Bruno Diaz, a Cuban tobacco leaf merchant, is president of the company. The capital has been subscribed by Cubans and Germans. Cornelius C. Vermeule, 203 Broadway, New York, who has just returned from Cuba, is the consulting engineer of the company. T. W. Bennett is the chief engineer. He is expected to arrive from Cuba this month. Contracts for equipment will be awarded inside of three months.

BRAZILIAN ELECTRIC TRACTION PROJECT

An extensive electric traction system is to be built in Santos, a Brazilian seaport town of about 10,000 inhabitants, located some 35 miles from Sao Paulo. James Mitchell, general manager of the Sao Paulo Tramway, Light & Power Company, Ltd., is primarily interested in the project.

SCALE FORMATION IN BOILERS

That nearly every water used for producing steam contains solids which form boiler scale, is well known, but it does not appear to be so well known how scale is formed, or what chemical reactions take place to cause the formation.

These solids may be classed separately as sulphates and carbonates. The carbonates consist of calcium carbonate and magnesium carbonate, both of which are held in solution by reason of their excess of carbonic acid. From about 180 degs. F. to the boiling point and above this the excess of carbonic acid is driven off, and the carbonate of lime, or magnesia, robbed of its solvent constituents. An exceptionally high temperature is not necessary to effect this separation, and it is for this reason that carbonates are found deposited in feed-water heaters and economizers, as well as at the point where the feed-water enters the boiler.

The carbonates when existing in water without calcium sulphate being present form a porous accumulation, varying from a crystalline to amorphous formation, and even occurring as a fine powder. The latter is more often the case when the feed-water contains in solution a considerable quantity of sodium chloride (common salt).

Calcium sulphate (plaster of paris), which is held in solution by nearly every natural feed-water, and especially in England, is not precipitated at the comparatively low temperature mentioned. In an experiment made in the laboratory of the Geo. W. Lord Company, of Philadelphia, a water heavily saturated with calcium sulphate was heated to a temperature producing 10 lbs. of pressure, but no precipitation was caused of the calcium sulphate.

Some authorities claim that the separation, or the change of the calcium sulphate from solution to suspension, takes place on the surface of the water in the boiler. If this were a fact, the calcium sulphate scale would accumulate in those parts of a boiler nearest the water surface. The contrary, however, is the case, as scale of this nature invariably forms at the parts of the boiler which are exposed to the highest temperature. It is for this reason that the Geo. W. Lord Company claims that the actual separation from a certain quantity of water takes place the minute that quantity of water is changed into steam, and that this change occurs at the point where the heat is transmitted through the iron of the boiler into the water.

When a molecule of water reaches a sufficiently high temperature to become steam it forms a minute globule and rises through the water to the surface, where the slight coating of water covering the globule breaks. At the point where this globule is formed, that is, at the heating surface, there being nothing to hold the calcium sulphate either in suspension or solution, it must separate, and form a very small crystal. If the ebullition of the water permits it to do so, it will adhere to the iron at the point where it had its origin, or it may be carried by the circulation until it finds something to which it can adhere. The scale which is formed of calcium sulphate alone is very hard, but a formation of this kind is rare, the great majority of scales consisting of the three substances mentioned, as well as other mineral and vegetable substances. These latter substances, which are held in suspension instead of solution, become part of a body of scale only mechanically; that is, they become part of a scale as sand becomes part of mortar when mixed with cement. The cementing substance in scale is first of all calcium sulphate; magnesium and calcium carbonate being secondary.

From the very nature of scale-forming substances their accumulation is a source of trouble to the engineer and expense to owners of plants. The problem is a rather difficult one, as not only does each source of water vary greatly in the scale-forming solids, but each individual source varies from time to time. One can readily see, therefore, that the analysis of a single gallon of water does not give much information, but the analysis of a sample of scale does give complete information, as each represents the residue after the evaporation of large quantities of water. The company, therefore, contends that if a sample of scale is divided and separated into its various ingredients, chemical treatment can be undertaken successfully. Without such determination, however, it is an impossibility to provide reagents which on the average can be assured to give satisfactory results.

THE ABUSE OF TRANSFERS IN CLEVELAND—LOW-FARE TICKETS ABOLISHED

As heretofore intimated in these columns, the plan voluntarily adopted by the Cleveland Electric Railway at the time of its consolidation with the Cleveland City Railway, of giving universal transfers on all lines, has been found very unsatisfactory, owing to the flagrant abuse of the privilege. Some time ago the company decided that it would be necessary to institute more stringent rules relative to the use of transfers, and as a first step in this direction has recently required passengers to ask for their transfers when they pay their fares, instead of securing them at transfer points. This change reduced the number of transfers somewhat, but did not do away with the practice of circling the city on one fare, as it was then possible to secure a transfer on a transfer on the Wilson Avenue crosstown line, which intersects more than half the lines in the city.

Before the universal transfer system went into effect about 8000 transfers per day were issued on the Wilson Avenue line. Lately, however, on days when traffic has been heavy as many as 25,000 transfers have been issued. A careful investigation was made, and it was discovered that a large percentage of the passengers were systematically swindling the company. At some crossings there was open trafficking in the slips. Two inspectors of the company stationed at St. Clair Street and Wilson Avenue one day recently negotiated for sixty-eight transfers in one hour, while another inspector of the company, stationed at Central Avenue, where conditions are somewhat similar, secured fifty-eight transfers in one hour. It is even stated that saloonkeepers near the corner of St. Clair Street and Wilson Avenue increased their trade by selling beer for 4 cents if the purchaser turned in a transfer, and by giving a transfer with beer for 5 cents. This was rendered possible by the fact that there are numerous large factories in this district which operate both night and day shifts. In the evening the night men coming on would ask for transfers and a few minutes later they would be handed out to day men going home.

As a result of investigations of this kind extending over several weeks, the company became convinced that it was being swindled out of thousands of fares, not only in the manner described, but through the practice of pleasure-seekers who are enabled to ride continuously for one fare. A new rule, which went into effect last week, provides that transfers on transfers will not be given on Wilson Avenue; in other words, transfers from this line will be given only to those who pay cash or ticket fare. It seems quite probable that the company will institute further modifications of the universal transfer system, as it is claimed there are other portions of the city where it is possible to swindle the company by securing transfers on transfers.

Another important change by the company is the return to its old plan of selling eleven tickets for 50 cents, instead of six for 25 cents, as it has been doing since the consolidation. This action was taken at a meeting of the directors of the company, held Monday, March 22. President Andrews has made a statement to the public in which he intimates that the lower fare and universal transfers were adopted as an experiment to test the claim that lower fare would stimulate business and increase the earnings of the company. The experiment has cost the company an actual loss in earnings of approximately $200,000 in eight and one-half months, while the operating expenses have increased during that time, owing to the increased cost of wages, power station equipment, rolling stock, electrical equipment and fuel. It had been hoped that some settlement of the street railway question would be effected between the company and the city, but there is at present no evidence of a disposition on the part of the city to make such an adjustment, hence the company finds it necessary to restore the rate of fare established by the ordinances under which it is now operating.

As a matter of fact, Mayor Johnson has taken another tack in the campaign to secure lower fares in the city. The latest plan is to request the State Legislature to pass laws giving cities the right to regulate street railway fares. At its last meeting the City Council adopted a resolution petitioning the Legislature to enact a law on the subject mentioned. The action of the Mayor is taken to indicate that he does not expect the courts to decide the McKenna ordinance as being constitutional. This ordinance established a zone within which the Cleveland Electric Railway Company was required to grant a three-cent fare.

The color line as ordained by the City Council of San Antonio, Tex., was drawn on the street cars for the first time in that city on March 15. The negroes resented the innovation by boycotting the cars.

TWO INGENIOUS COMBINED FARE REGISTERS AND SERVICE INDICATORS

As is well known, the Ohmer Fare Register Company, of Dayton, Ohio, has manufactured registers of various sizes for registering and indicating, separately, different classes of fares collected, and printing a record of each class at the finish of each half-trip, together with the register number, trip number, day and date, and the badge number of conductor. The Ohmer Company now has added to these two new machines, known as the No. 5 and No. 6, for use, exclusively, on city lines. United States and foreign patents have been issued for both of these machines.

The No. 5 register is arranged to register and indicate, separately, three or four different classes of fares, and at the end of each half-trip it prints a record of each fare collected, registered in its own specific class, and it also prints a record showing the total of all the fares collected on each half-trip, irrespective of the class. Besides printing the month and the day, it prints the time in hours and minutes that each car is put into service, the time in hours and minutes that both the conductor and the motorman take and leave the car. The time in hours and minutes is printed at the termination of each half-trip. The direction in which the car moves is also printed, as "Up" and "Down," "East" and "West," etc. If the car should be an extra, the record will print "Extra"; if a special or chartered car, the record will so indicate. It also prints perfectly the condition of the weather, and makes a notation of other miscellaneous data as may be desired to record. The detailed list includes the following: Extra, Special, Chartered car, Hot, Cold, Rain, Snow, Hail, Sleet, Fair, Baseball, Circus, Work train, Late, Accident, Collision, Off track, Motor impaired, Fuse out, Wires down, Washout, Railroad blockade, Railroad crossing, Passenger put off.

The No. 5 machine is so complete in its operation that with its use the ordinary trip slip used by conductors may be dispensed with, and all data pertaining to the service by the conductor be recorded and indelibly printed with this ingenious machine. This printed report cannot be tampered with nor removed, save by the inspector or car starter in authority, who removes the statement in duplicate at the end of the car run. One copy of this record is sent to the treasurer or auditor of the company, or, if desirable, the conductor may be permitted to remove his own record, in which case the inspector would remove the duplicate record showing all the totals for the entire day by one or several conductors. The No. 5 register, with all its accomplishments, is simple in operation, and is stated to be no more complicated than the other registers made by the company.

The Ohmer Fare Register Company's No. 6 register is similar to the No. 5 in most respects, with the exception that it has a limitation for two kinds of fares, and is particularly designed for large city properties collecting universal 5-cent cash fares and transfers only. Both registers are arranged for operation with cord or rod, and the operating devices to either can be attached to the ordinary register rods.

THE REPORT OF THE AURORA, ELGIN & CHICAGO RAILWAY

The annual report of the Aurora, Elgin & Chicago Railway Company, presented to the stockholders of the company by President L. J. Wolf is very complete, giving a general review of the work of the company since the line was placed in operation, and telling of the difficulties of operation that have been successfully overcome and the outlook for the future. The entire road is now in complete operation, and when entrance to Chicago is secured over the lines of the Metropolitan West Side Elevated Railroad, a determined effort will be made to capture the commuter business now handled almost exclusively by the Burlington, Northwestern, St. Paul and Great Western Railroads. The branch of the Aurora, Elgin & Chicago from Elgin to Wheaton was opened on May 26, 1903, and the prediction that the gross earnings would double was verified. The earnings of the Aurora-Chicago branch from Sept. 1, 1902, to Feb. 1, 1903, were $78,216. The earnings of the entire property from Sept. 1, 1903, to Feb. 1, 1904, were $160,262. (Miscellaneous earnings for January, 1904, were estimated to be the same as those of December, 1903.) During the winter 1902 the earnings of the company suffered severely from interruptions of service due to snow and sleet storms, but modifications of the equipment made the service of the past winter even more efficient than that of the competing steam lines. For 1902 the earnings by months were as follows: September, $21,450; October, $18,895; November, $16,663; December, $11,205. For the first five months of 1903 the earnings were: January, $10,001; February, $9,002; March, $14,706; April, $16,265; May, $28,010.

CHICAGO UNION LOOP OFFER.

The Union Elevated Railroad Company has made an offer to the city of Chicago whereby increased compensation to the city is provided for if an ordinance is passed which will put aside all questions as to the validity of the Union Loop franchises, which the city recently attacked in the courts. The following are the principal items in favor of the company in the proposed agreement:

Dismissal of the suit by the city attacking the validity of the franchise for the Van Buren Street line because frontage consents were purchased.

Approval of all lines as at present constructed.

Extension of the franchise of the Northwestern elevated, north of Wilson Avenue.

Extension of the platforms of Loop stations.

Extension of the Northwestern elevated platforms at Kinzie Street, with the privilege of constructing two tunnels to the Northwestern Railroad depot.

The privilege to elevate the tracks at Lake Street and Fifth Avenue on the Loop, to eliminate the crossing of elevated tracks at the same grade.

Altogether, 5420 ft. of platform on the Loop is elevated. This, of course, includes platforms already in place. This, together with elimination of delays caused by the grade crossings at the entrance to the Loop, should increase the capacity of the Loop to provide for traffic for several years to come.

PERSONAL MENTION

MR. FREDERICK STARBAUGH has been appointed master mechanic of the Ohio Central Traction Company's shops at Galion, Ohio. He was formerly with the Western Ohio Railway at Lima.

MR. W. P. HAZEN, for some time chief engineer of the Central Market Street Railway, of Columbus, Ohio, has resigned to become chief engineer of the Cincinnati, Georgetown & Portsmouth Railway, of Cincinnati.

MR. FRANK COPELAND, bridge engineer for the Columbus, Delaware & Marion Railway, of Columbus, Ohio, has resigned to take up a similar position with the Joliet, Plainfield & Auror Railway, which is now in course of construction in Illinois.

MR. ARTHUR C. RALPH, retiring general superintendent of the Boston & Worcester Street Railway, was entertained at a banquet at Marlboro (Mass.) March 11, by seventy-five of his former employees. Mayor Frederick R. S. Mildon and other city officials were present and spoke. Mr. Ralph was presented with a handsome Knights of Pythias watch-charm. His headquarters formerly were in Marlboro.

CAPT. ROBERT McCULLOCH, who was recently elected vice-president and general manager of the St. Louis Transit Company, is expected to assume his new duties within the next few days. Capt. McCulloch's resignation from the Chicago City Railway Company was to have become effective March 15, but the officials of that company requested him to continue with the company until arrangements were made for his successor.

MR. M. E. McCASKEY has been elected second vice-president and general superintendent of the Pennsylvania & Mahoning Valley Railway Company, of Youngstown, Ohio. For the past two years Mr. McCaskey has been superintendent of the New Castle division of that company. Before going with this company he was superintendent of the Pittsburg & Birmingham Traction Company and superintendent of construction of the Pittsburg, McKeesport & Greensburg Railway Company. He has been in street railway work for twenty-two years, and earlier in his career was connected with roads in Rochester and Buffalo.

MR. OSCAR T. CROSBY, of Washington, D. C., the distinguished electric railway engineer and explorer, delivered a very interesting lecture on March 23 before the New York Electrical Society upon his recent trip to Turkestan and Thibet. Mr. Crosby with one friend, a French officer, crossed the western portion of Thibet, entering that largely unexplored region from the frontier of Chinese Turkestan and emerging in India. The expedition was one of great hardship, owing to the natural difficulties presented, but Mr. Crosby had the satisfaction of visiting a large region hitherto untrod by the foot of civilized man, of correcting some previous opinions as to its geography and topography and of adding greatly to the scientific knowledge on Western Thibet.

CAPT. ALEXANDER R. PIPER has been appointed to the position of general superintendent of the American Railway Traffic Company, which was organized in the interest of the Brooklyn Rapid Transit Company for the purpose of transporting freight over that company's lines and assuming the city ash handling contract. Capt. Piper formerly was Second Deputy Police Commissioner of New York, and prior to that was superintendent of final disposition of the Street Cleaning Department. Capt. Piper is about forty years old and a graduate of West Point. He has served in the Eighth and later in the Second Infantry. Under General Miles he was in several Indian campaigns, and in May, 1898, he was appointed captain in the volunteer service. He served in Porto Rico and about five years ago he was retired on account of the loss of his arm.

MR. MILLARD B. HERELEY, an interesting interview with whom is given elsewhere in this issue, is a recent acquisition to the field of street railway management, having been appointed general superintendent of the Chicago Union Traction Company last November. His appointment was remarkable in that prior to that time, he had no direct connection with the operating department of the company, although in his work as traffic manager of the same company, for three years previous investigating conditions, he had an excellent opportunity to become familiar with the work. Mr. Hereley's success in winning the co-operation of his employees and reducing accidents, is referred to in the article just spoken of. He declares, however, that the guiding hand of General Manager Roach, and the support given by Receivers Fetzer, Eckels and Sampsell, have enabled him to make much of the progress he has been credited with in his new position. Conductors and motormen of the company express themselves as having a keen interest in Mr. Hereley's welfare, and as having confidence that they will always receive fair treatment at his hands, relations in the past having been such as to justify this confidence.

M. B. HERELEY

MR. WILLIAM S. TURNER, of J. G. White & Company, has just returned to New York from Auckland, New Zealand, where he has been since 1901 installing an electric tramway plant for J. G. White & Company, Ltd., of London. The line is owned by the British Electric Traction Company, has 30 miles of track and was described in the Street Railway Journal for Sept. 26, 1903. Mr. Turner is one of the pioneer builders of electric railways in this country, having been engaged in this work since 1888. He is a graduate of Cornell University and received from that institution in 1886 the degree of M. S. The same year he entered the employ of the Westinghouse interests, for whom he installed a number of electric lighting plants, among others an alternating plant at Carbondale, Pa., one of the earliest of its kind. The following year he joined the forces of the Edison Electric Light Company, at New York, and assisted in designing and supervising a portion of the early lighting system of that company in New York. In 1888, in connection with Mr. J. Lester Woodbridge, he formed the firm of Woodbridge & Turner, engineers and contractors, whose business was continued as the Woodbridge & Turner Engineering Company until 1895. Some of the electric railway plants installed by this company were that at Salem, Mass., the first electric railway in New England, a portion of the West End system in Boston, Hartford, Augusta, Nashville, Chattanooga, Quincy, Ill., Providence, Portland, Me., and Chester, Pa. Between 1896 and 1899 Mr. Turner was engaged in New York as an independent consulting engineer, but in the latter year he joined J. G. White & Company, for whom he supervised the installation of a number of railway plants, among others, the Elizabeth & Plainfield Street Railway and certain of the suburban lines of the Washington Traction & Electric Company, also a three-phase, high-tension lighting system for the Long Island City Electric Lighting Company. Mr. Turner left Auckland last fall, after the completion of his work in that city, spent the winter in London and arrived in this country March 19. He has been a member of the American Institute of Electrical Engineers since 1887.

W. S. TURNER

TABLE OF OPERATING STATISTICS

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

Company	Period	Total Gross Earnings	Operating Expenses	Net Earnings	Deductions From Income	Net Income, Amount Available for Dividends
AKRON, O. Northern Ohio Tr. & Light Co	1 m., Feb. '04	56,884	34,154	22,729	22,667	63
	1 " " '03	54,701	32,414	22,287	22,226	61
	2 " " '04	116,491	71,252	45,239	45 134	105
	2 " " '03	113,488	67,257	46 231	43,192	3,039
AURORA, ILL. Elgin, Aurora & Southern Traction Co.	1 m., Feb. '04	33,132	21,999	11,132	9,133	1,999
	1 " " '03	30,023	18,913	11,105	9,216	1,889
	8 " " '04	10,087	184,339	125 748	73,507	52,240
	8 " " '03	287,154	165,929	121,225	72,730	48,495
BINGHAMTON, N. Y. Binghamton Ry. Co.	1 m., Feb. '04	15 864	10,982	4,882	------	------
	1 " " '03	15,371	40,487	4,884	------	------
	8 " " '04	160,815	85,985	74,830	------	------
	8 " " '03	148,406	85,539	62,867	------	------
BUFFALO, N. Y. International Trac. Co.	1 m., Jan. '04	296,970	201,389	95,581	136,703	†41,122
	1 " " '03	291,490	166,051	125,440	129,195	† 3,756
	7 " " '04	2,471,735	1,366 166	1,105,569	933,147	172,421
	7 " " '03	2,215,179	1,165,705	1,049,474	903,750	145,725
CHICAGO, ILL. Chicago & Milwaukee Elec. Ry. Co.	1 m., Feb. '04	18,047	10,582	7,463	------	------
	1 " " '03	10,645	5,817	4,827	------	------
	2 " " '04	37,034	21,397	15,638	------	------
	2 " " '03	22,680	12,388	10,292	------	------
Metropolitan West Side Elevated R. R. Co	1 m., Feb. '04	172,656	------	------	------	------
	1 " " '03	168,831	------	------	------	------
	2 " " '04	346,896	------	------	------	------
	2 " " '03	343,626	------	------	------	------
South Side Elevated R. R. Co.	1 m., Feb. '04	130,978	------	------	------	------
	1 " " '03	128,348	------	------	------	------
	2 " " '04	266,759	------	------	------	------
	2 " " '03	262,635	------	------	------	------
CINCINNATI, O. Cincinnati, Newport & Covington Light & Traction Co	1 m., Jan. '04	99,320	*59,899	39,421	21,412	18,009
	1 " " '03	94,212	*57,937	36,275	20,986	15,288
CLEVELAND, O. Cleveland & Southwestern Traction Co	1 m., Feb. '04	27,456	22,499	4,957	------	------
	1 " " '03	25,235	17,459	7,776	------	------
	2 " " '04	55,307	45,056	10,251	------	------
	2 " " '03	52,183	37,073	15,110	------	------
Cleveland, Painesville & Eastern R. R. Co	1 m., Feb. '04	27,456	------	------	------	------
	1 " " '03	25,235	------	------	------	------
	2 " " '04	55,307	------	------	------	------
	2 " " '03	52,183	------	------	------	------
DETROIT, MICH. Detroit United Ry	1 m., Feb. '04	288,346	*205,928	82,418	89,788	†7,370
	1 " " '03	285,683	*177,106	103,577	81,048	27,529
	2 " " '04	599,787	*432,031	167,756	177,354	†9,598
	2 " " '03	606,828	*373,044	233,784	162,205	71,579
DULUTH, MINN Duluth Street Ry. Co.	1 m., Feb. '04	41,883	27,754	14,129	11,445	2,684
	1 " " '03	39,747	26,923	12,824	10,161	2,663
	2 " " '04	87,426	56,548	30,878	22,820	8,058
	2 " " '03	83,435	52,837	27,598	20,340	7,258
FORT WORTH, TEX. Northern Texas Traction Co	1 m., Feb. '04	35 333	22,807	12,527	9.333	3,193
	1 " " '03	25,797	15,017	10,780	9,018	1,762
	1 " " '04	72,964	48,275	24,688	18,667	6,022
	1 " " '03	55,747	31,330	24,417	17,952	6,466
GRAND RAPIDS, MICH. Grand Rapids Ry	1 m., Feb. '04	52,100	30,513	21,587	------	------
	1 " " '03	47.468	26,923	20,545	------	------
HANCOCK, MICH. Houghton County St. Ry. Co	1 m., Feb. '04	14,430	12,921	1,508	3,080	†1,572
	1 " " '03	13,140	12,267	873	2,929	†2,056
	12 " " '04	190,694	123,495	67,199	35,084	32.115
	12 " " '03	173,307	115,300	58,006	31.575	26,431
HARRISBURG, PA. Central Pennsylvania Traction Co	1 m., Feb. '04	34,634	35 529	†895	------	------
	1 " " '03	32,734	34,692	†1,958	------	------
	2 " " '04	70,792	63,868	6,924	------	------
	2 " " '03	71,086	52,224	18,862	------	------
HAZLETON, PA. Lehigh Traction Co	1 m., Feb. '04	9.570	9,797	†227	------	------
	2 " " '01	19,587	17,595	1,992	------	------
HOUSTON, TEX. Houston Electric Co.	1 m., Jan. '04	27,437	20 604	6 833	7,154	†321
	1 " " '03	31,049	19,753	11,296	6,250	5,046
	12 " " '04	412,512	273,415	139,097	85,560	53,536
	12 " " '03	367,438	216,412	151,027	75,000	76,027
LONDON, ONT. London St. Ry. Co	1 m., Feb. '04	9,316	9,532	†216	2,049	†2,265
	1 " " '03	10,716	7,684	3,032	1,920	1,112
	9 " " '04	133,464	88,162	45,283	20,716	24,587
	9 " " '03	126,132	74,915	51,217	18,803	32,414
MILWAUKEE, WIS. Milwaukee El. Ry. & Lt. Co.	1 m., Feb. '04	240,724	135,565	105,159	71,734	33,425
	1 " " '03	218,906	115,351	103,554	68,087	35,467
	2 " " '04	500,138	275,116	225,021	146,453	78,568
	2 " " '03	463,375	244,753	218,621	139,185	79,436
MINNEAPOLIS, MINN Twin City Rapid Transit Co	1 m., Feb. '04	313,359	159,752	153,607	72,198	81,409
	1 " " '03	282,601	140.450	142,151	60,900	81,251
	2 " " '04	644,771	316,254	328,517	142,218	186,299
	2 " " '03	594,439	289.025	305,414	121 800	183,614
MONTREAL, QUE. Montreal St. Ry. Co	1 m., Feb. '04	168 685	131,420	37,265	16,941	20,325
	1 " " '03	141 800	108,803	32 997	15,716	17,281
	5 " " '04	937,822	618 258	319,564	85,788	233 775
	5 " " '03	845,589	533,379	312,210	81,706	230,503
OLEAN, N. Y. Olean St. Ry. Co	1 m., Feb. '04	6,401	3 826	2 574	2,438	137
	1 " " '03	5,316	2,859	2,457	3 896	†1 439
	8 " " '04	68,665	32,774	35 892	18,533	17,354
	8 " " '03	47,256	25,142	22,114	12,756	9,359
PHILADELPHIA, PA. American Railways	1 m., Feb. '04	93,675	------	------	------	------
	1 " " '03	81,713	------	------	------	------
	8 " " '04	945,215	------	------	------	------
	8 " " '03	811,617	------	------	------	------
ROCHESTER, N. Y. Rochester Ry. Co	1 m., Feb. '04	109,752	68,809	40 942	26,220	14,722
	1 " " '03	96,464	49,529	46,935	25,371	21,564
	2 " " '04	223,206	139,674	83,531	52 345	31,186
	2 " " '03	198,376	104 049	94,327	50,957	43,370
SAN FRANCISCO, CAL. San Francisco, Oakland & San Jose Ry.	1 m., Jan. '04	30,049	14,247	15,801	6,912	8,889
SAO PAULO, BRAZIL. Sao Paulo Tramway, Light & Power Co., Ltd	1 m., Feb. '04	118,000	39,000	79,000	------	------
	1 " " '03	99,319	36,014	69,305	------	------
	2 " " '04	241,354	77,512	163,142	------	------
	2 " " '03	201,906	62,033	139,873	------	------
SAVANNAH, GA. Savannah Electric Co.	1 m., Jan. '04	39,735	24,947	14,788	10,563	4,224
	1 " " '03	38,522	25,532	12,990	9,583	3 407
	12 " " '04	520,987	307,114	213 872	120,306	93,566
	12 " " '03	485,593	272,539	213,054	115,793	97,261
SEATTLE, WASH. Seattle Electric Co	1 m., Jan. '04	189,813	137,880	51,933	23,187	28.746
	1 " " '03	174,066	138,503	35,563	23,443	12,120
	12 " " '04	2,112,474	1,497,282	615,191	280,119	335,072
	12 " " '03	1,916,110	1,364,313	551,797	264,119	287,678
SYRACUSE, N. Y. Syracuse Rapid Transit Co	1 m., Jan. '04	67,171	42,541	24,630	20,296	4,334
	7 " " '04	489,614	288,496	201,118	133,002	68,116
	7 " " '03	433,108	236,622	196,486	163,175	63,311
TACOMA, WASH. Tacoma Ry. & Power Co.	1 m., Jan. '04	40,810	33,091	7,718	7,771	†53
	1 " " '03	34,833	26,914	7,919	7 356	563
	12 " " '04	499,564	351,306	148,258	107,550	40,708
	12 " " '03	446,578	337,221	109,357	80,701	28,656
TAMPA, FLORIDA. Tampa Electric Co.	1 m., Jan. '04	24,987	17,917	7,070	2 028	4,942
	1 " " '03	22,579	13,516	9,063	1,970	7,093
TERRE HAUTE, IND. Terre Haute Elec. Co.	1 m., Jan. '04	41,188	29,867	11 322	9,530	1,792
	1 " " '03	33,535	25,564	7.971	6,542	1,429
	12 " " '04	481,904	316,386	165,517	90,372	75,145
	12 " " '03	338,324	264,494	73,830	76,466	†2,630
TOLEDO, O. Toledo Rys. & Lt. Co.	1 m., Feb. '04	124 037	*71 951	52,086	41,590	10,496
	1 " " '03	115,148	*61,114	54,034	39,564	14,470
	2 " " '04	261,554	*145,908	115,647	82,902	32,745
	2 " " '03	240,642	*123,512	117,130	79,022	38,108
YOUNGSTOWN, O. Youngstown-Sharon Ry. & Light Co.	1 m., Feb. '04	36,065	*22,310	13,755	------	------
	2 " " '04	73,012	*46,156	26,855	------	------