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Of this issue of the Street Railway Journal 8500 *copies are printed. Total circulation for* 1907 *to date* 114,650 *copies, an average of* 8189 *copies per week.*

Immediate Municipal Ownership Defeated in Chicago

To all appearances the traction question in Chicago has been settled for a long time to come. The beautiful theories of the advocates of municipal ownership did not appeal to the voters at last Tuesday's election as strongly as did the prospects of relief from the present miserably bad transportation facilities. As a result the voters have declared themselves in favor of progress, rather than of making themselves the subject of experiments by municipal ownership faddists. The traction ordinances were passed with a very comfortable majority, and now, according to the agreements embodied in them, the surface railway properties will be at once rehabilitated.

It is to be hoped that no other American municipality will ever be compelled to go through the experiences of Chicago. For ten years comparatively few improvements have been made in the surface traction facilities. The cars on a considerable number of the lines were ready for the scrap heap years ago. The tracks in most portions of the city are in as bad condition as the cars, and it will be necessary to rebuild them entirely before satisfactory service can be given.

The effects of extending good service over all parts of the city can hardly be anticipated. In the past the majority of the people to whom time and the certainty of reaching business at certain hours were important have been compelled to take up their residence either along the elevated lines or adjacent to the steam roads operating suburban service. The result has been that these sections of the city have been built up and rents and land values have consequently risen abnormally. The extension of adequate service to other sections will no doubt tend to cause an equalization of values throughout the city.

The cost to the city of the traction conditions during the past ten years can hardly be estimated. The continual litigation has been the source of thousands of dollars of expense, but the retardation of the growth and development of the city has of course amounted to a sum much greater. The experience has been dearly bought; but if other cities will profit by the lessons taught, the loss of Chicago may be the gain of other communities.

A Startling Admission

In a recently published letter, President Tuttle, of the Boston & Maine railway system, puts himself squarely upon record as inclined to throw up the sponge on suburban traffic and as ready to pass it over to the trolley lines. He intimates that the suburban traffic as conducted by ordinary railroads does not pay, and that the community is better served by trolley cars. He also emphasizes his belief that in the larger work of railroading electricity is a far more expensive motive power than steam. The position thus taken is curiously self-contradictory, since the trolley lines are undeniably making a profit in carrying passengers, and every suburban line that has changed to electric traction has bettered both its service and its business. If we understand President Tuttle aright, he holds that while short-distance passenger traffic can be handled better by electric power than by steam, freight business is an insuperable obstacle. This may be so, but is the gentleman willing to

put his belief into practice, and would his stockholders back him up in so doing? It has been for years a common practice for railway presidents to meet complaints of bad suburban service by saying that passenger traffic is generally conducted at a loss and is really done as a favor, but do they really believe it? The trolley lines about Boston would doubtless be glad to have the railroads throw up the sponge and quit. They would eagerly grasp the opportunity, but would the railroads really stand by and see them make the most of it? Electric railway men generally believe that they could profitably handle freight if the steam roads would give them a fair share of it. If the latter really believe that electric freight haulage would be at prohibitive cost, why do they so strenuously object to trolley freight franchises and block even passenger lines when they can? It would be amusing if the trolley lines really took President Tuttle at his word and started in to parallel his suburban system for an electric express service.

Safety in Electrical Operation

So much has been said in the daily and technical press in connection with the recent accident on the New York Central Railroad about the relative safety of steam and electrical operation, that it seems worth while to take a general, though brief, review of this important subject. An examination of the statistics of the serious accidents upon the trunk line railroads of this country will show that a large proportion of them are collisions, either head-end or rear-end, which no ordinary precautions seem able to avert. Just why engine drivers disregard danger signals at times is a very singular psychological problem, but nevertheless they do. It sometimes seems as though the mind, strained by long attention, passed into a sort of hypnotic state, in which it became blunted to ordinary impressions or misinterpreted them when received. It may be uncertain whether it was a green or a red light that flashed by, much as one may be in a brown study and forget whether he has or has not locked his desk. But the engineer cannot go back and look, and the real fact often breaks through into full consciousness too late to avert a catastrophe.

One of the common disadvantages ascribed to electrical operation is the lack of independence in the operation of the units, the possibility of a single failure in the system affecting many trains. Although this exists, it brings with it the exceedingly valuable power of instituting an absolute block system in which a train may be prevented from invading an occupied block by actual lack of motive power. So long as trains are run by self-contained and independent locomotives, just so long is it possible for them to be run beyond danger signals at a high rate of speed. The ingenuity of inventors has been exercised for years on absolute safety devices for use under these conditions, but while many of them have been approximately successful none is absolutely so.

With electrical operation every locomotive is dependent on the conducting system for power, and unless this is in a normal condition the locomotive is out of business. If it is necessary to stop a train which has run into danger the feeder switches can be made to do it at once, and, as pointed out by Mr. Murray in this paper last week, such a plan will be employed on the New Haven road. Undoubtedly this plan could be extended, if necessary, to keep dead sections of the working conductor ahead of and behind every train, or cautionary running can be imposed by dropping the working voltage by an amount that would very definitely indicate to the engineer that danger was ahead. If, for instance, the pressure suddenly dropped by a half, even the most blunted nerves would realize that something had happened. It is certainly no small thing to gain the possibility of an absolute and automatic block system in addition to the other and more fully understood advantages of electrical traction.

Something of this gain ought properly to belong to the large interurban systems now in existence, for they are far from being immune from serious collisions. It is on the big, through lines that are coming, however, that the greatest improvements are to be expected. They are upon a scale and with a density of traffic that make a positive block system a necessity. Automatic braking is another easy precaution along the same line of action. The rudiments of such a complete safety system have been well worked out and some of the essential features are already in very successful use. Certain it is that electric operation of railroads gives a possibility of safety precautions far beyond anything yet realized.

Behavior of Motors on Down Grades

The behavior of the railway motor when running at high speeds on down grades is frequently misunderstood, especially among trainmen and others not especially well versed in electrical subjects, however well they may be acquainted with the actual operation of the apparatus. The assertion is frequently made by such persons that under such conditions a car will run faster with the power off than with it on. This evidently is not possible. The direct-current railway motor is of the series type, in which the relation between speed and current approaches an inverse ratio, that is, as the speed increases, the current decreases. But let the speed increase to whatever possible value, the current, although it approaches a zero value, never reaches it. This remains true whether the motor itself is furnishing all the driving power, or part is being obtained from some outside source—in the case under consideration from the action of gravity on the car running down grade. Whatever current is passing through the motor is producing torque and aiding in the propulsion of the car. If the speed is very high, the current and torque may be very small, perhaps not enough to overcome the mechanical friction of the motor; but to the extent that it does exist, it is a help in propelling the car, and must therefore add to the speed. The idea that after a certain speed is reached there is a generator action of the motors is an erroneous one, as this is not possible with a series motor unless the armature connections be reversed with relation to the field.

This "generator action" is often wrongly given as an explanation of the cause of cars sometimes "bucking" or opening their automatic circuit-breakers when running at high speed down grade with the power on. It should be obvious that such an explanation is not correct, from the fact that the same conditions regarding speed, line voltage, etc., do not

always produce this effect. If a careful examination of the motors be made immediately after such an occurrence, evidence will nearly always be found of "flashing over" or arcing from brush-holder to brush-holder or from positive brush-holder to ground in the motor frame. It may be interesting to consider why this should occur most frequently when the car is running at high speed down grade. As the speed of the motor increases, the counter electromotive force increases, and at the same time, as the current decreases, the voltage drop across the fields decreases. Consequently, as the speed increases, the difference of potential between the brushes and between commutator bars increases. With the weak field existing at high speeds, due to the small current, commutation is worse than with a stronger field, and under such conditions, combined with the high peripheral speed of the commutator, the high voltage between brush-holders and that between commutator bars, flashing over is very likely to occur. With the speed further increased by the down grade, all of the conditions tending to cause such an effect are still further increased, so that some apparently trivial additional disturbance, such as the chattering of a brush away from the commutator, a little carbon dust across insulation, or a sudden variation in the line voltage caused by another car on the same feeder throwing off power, may constitute the last necessary factor, under the conditions, to cause the flashing over.

This flashing over of motors on long down grades occurs to a much greater extent on some roads than on others. In some cases it is so common that motormen are instructed always to descend such grades with the power off, while on other roads no attention is paid to the matter, as such trouble is rarely, if ever, experienced. The trouble is most likely to occur in cases where the grades are steep enough and long enough to produce speeds considerably in excess of that for which the motors are designed.

The Copper Situation

In spite of the recent recession in the price of copper stocks, the present situation so far as that metal is concerned is a very sinister one. Without any exceptional demand for copper in the way of new uses, the price of the metal has risen more than 50 per cent above anything that could be called a normal base price and has consistently stayed there. Nothing approaching it has ever been known, although the demand for copper has at times been rather suddenly increased. The causes operating to produce the result are difficult to analyze. There is, of course, immense activity in many lines requiring the use of copper, but one cannot put his finger on any causes that have not been operative before without any such startling results. Some have claimed that great stores of copper are being held for further rise, and that the increase in price has been largely artificial. It is quite possible that there may be a large amount so held, but the situation does not so far bear the earmarks of a successful corner. It looks very much as if the growth of the world's normal demand for copper has reached a point, hastened by several years of great commercial activity, at which the balance between supply and demand is pretty narrow. In other words, the condition is one which makes the price run up at very small cause—natural or artificial. Among the precious metals, platinum has been exposed to similar conditions, with similar results.

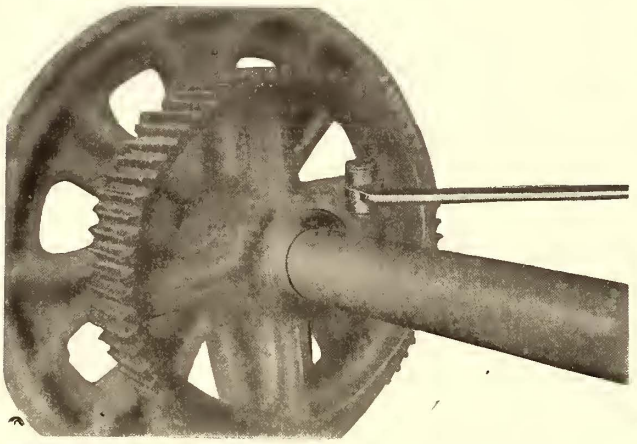
Unless, therefore, copper is more freely mined than now, or the demand for it is checked by the use of substitutes, the price may remain very sensitive to minor causes of fluctuation. Copper is very widely distributed, and many new mines are being opened, which, if they should produce largely, would have a considerable effect upon the market. There is great danger, however, that unless some remarkably rich and accessible mines are developed, the production will remain at a point where manipulation of the market will be too easy. Such a condition would be most disastrous in its effect on the industries that utilize large amounts of the metal, for they could never depend on stable prices. In the electrical industries the possibility that copper might at any time be pushed to 30 cents per pound would be very serious in planning for deliveries. The matter of substitutes for copper, therefore, becomes very important.

For electrical machinery as such no substitute seems to be available, since copper stands alone in its conductivity for unit volume, save for silver, an impossible substitute. But lines as we have time and again noted can very well be made of aluminum. When the basic patents expire in a few years there will be a great reduction of price and the battle with copper will be fairly on. We have before now discussed the use of iron conductors, chiefly as rails. At the present time conditions are not far off in which stranded iron cables may be used for direct-current service at a good profit. Heavy they certainly are, but they are likewise strong and can do good service when the price permits. At one-seventh or one-eighth the conductivity of copper, the economic advantage could be put on the side of iron with a comparatively small advance in copper. In subways and on elevated structures and in conduits filled with insulating compounds iron can even now be used to very good advantage. Certainly between iron for direct current and aluminum for general use there will be a perceptible check to the use of copper. Still more important is the general stiffening of working voltage to decrease the demand for copper. A new line going in at 40,000 volts instead of 20,000 or at 60,000 instead of 40,000 means a great saving with copper around 25 cents per pound. The rise in that metal has queered all calculations based on old prices, and Kelvin's law applied to-day would lead to some unexpected conclusions. Perhaps the rise in price may be of service to the world in revising antiquated methods and putting electrical distribution on a better basis of voltage. In the same way it will at the present rate soon be pertinent to inquire whether machines should not be redesigned. To a certain extent copper and iron are interchangeable in the design, and by extreme care in ventilation it is feasible considerably to reduce the amount of copper required.

The present exigency is hardly enough to produce at once such radical changes, but a continuance of present conditions is bound to bring them about. High voltage in distribution and high output for the copper—these are surely good things to aim at on general principles, and if they are hastened by the present situation one can well afford to view it with some degree of complacency.

SHOP PRACTICE AT HOT SPRINGS, ARKANSAS

Hot Springs, Ark., is located out of the regions where interurban lines throw shop men into frequent communication with each other, and as a consequence the devices and the practice in the shops of the Hot Springs Street Railroad Company possess more originality than is ordinarily found in the shops where the men have frequent opportunity to visit neighboring systems. All of the devices described

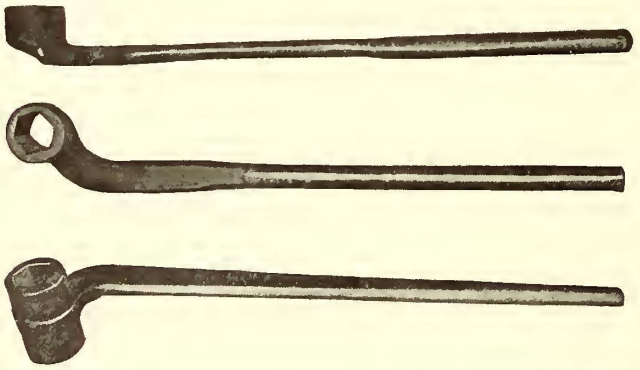


VIEW SHOWING THE APPLICATION OF THE GEAR WRENCH ON THE NUT

herewith were worked out by Edw. Hardin, superintendent of the system, and F. A. S. Williams, master mechanic of the shops.

GEAR WRENCHES

The difficulties of getting at bolts of split gears have been greatly lessened by the use of several special gear wrenches. The design of these wrenches is shown in an accompanying reproduction, while another reproduction shows how one of them fits on a bolt in a most difficult place. Most of the gear bolts may be gotten at with the double-headed wrench, but those bolts used with the Westinghouse No. 101 equipments require both right and left-hand wrenches. Difficulty



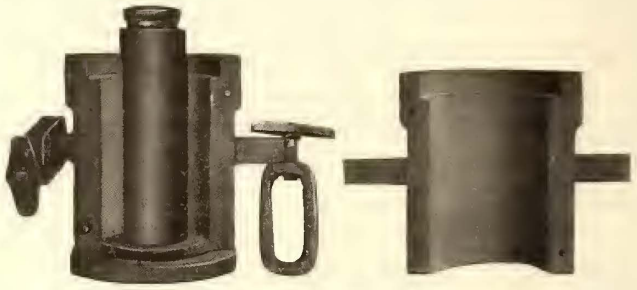
RIGHT-HAND, LEFT-HAND AND DOUBLE-END GEAR WRENCHES

of getting at gear bolts is greater than usual on this system because of the limited space occasioned by the narrow track, the gage being only 4 ft. 4 ins.

BABBITTING DEVICES

Bearings are babbitted in special devices made in the shops. The device for babbitting split bearings consists of a half mandrel bolted to a cast-iron angle. The half shell is held in the proper position and the metal is prevented running out by a heavy cast-iron cover which is clamped to the upright. Dowel pins in the upright assure the cover being placed in the proper position.

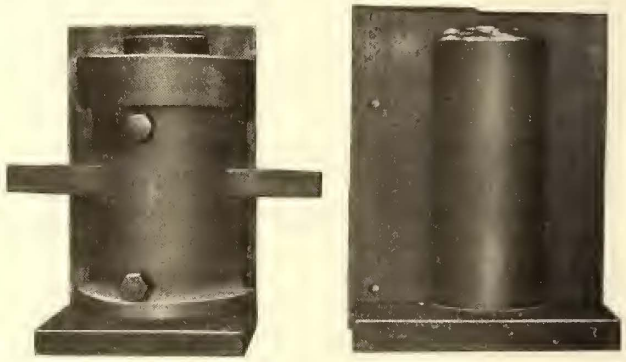
The babbitting device for commutator end bearings consists of a mandrel standing upright in a circular base and around which is clamped two half sections of a heavy cover, containing the brass shell to be babbitted. Bearings of the same general design and diameter, but which differ in length, are babbitted in one device. A reproduction shows



DEVICE FOR BABBITTING COMMUTATOR END BEARINGS

the ring which is placed on the base plate and around the mandrel when the shorter bearings are to be babbitted.

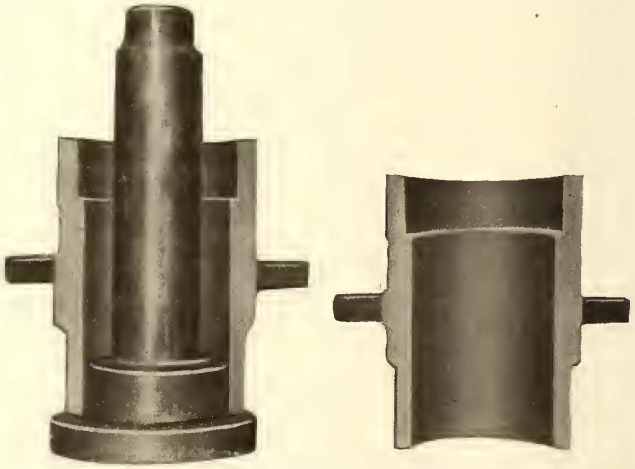
The location of the shop at quite a distance from manufacturing concerns and supply houses is partly responsible for the fact that bearing shells are cast in local foundries and finished in the shop. From seven to eight pairs of split



CONTRIVANCE FOR BABBITTING SPLIT-BEARING SHELLS

bearings and from twelve to fifteen sets of commutator end bearings are turned and finished per day.

Armature and axle bearing wear is very great in Hot Springs, due to the rock underlying the soil being of a



BABBITTING DEVICES: THE RING RESTING ON THE BASE PERMITS BEARINGS OF DIFFERENT LENGTHS TO BE BABBITTED

flinty, gritty nature. It is, in fact, the material from which the Arkansas whetstones are made. Troubles are increased through the fact that the road is narrow gage, and space is so limited between the wheels that there is only about ¼ in. clearance between the wheel and the end of the commutator bearing and other bearings are close to the wheels.

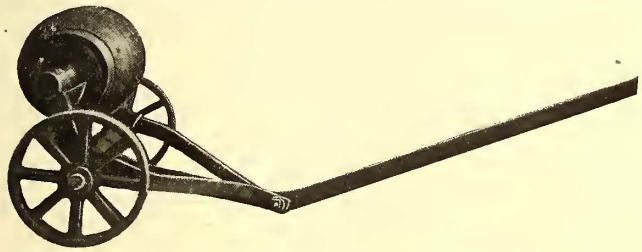
REMOVING AND REPLACING COMMUTATORS

A reproduction shows a device used in removing the commutator thrust collar previous to pulling the commutator. After the two half collars have been placed over the thrust collar they are bolted together and the end of the long screw is centered in the end of the shaft. By turning the screw with a wrench the thrust collar is pulled off.

Commutators are pulled on by a device which resembles somewhat that just described. It consists of two bars held together with rods of such a length that while one bar which has a hole bored in it large enough to fit over the shaft is placed over the commutator end of the shaft the other is held beyond the opposite end. Screwing up nuts shortens the rods and pulls the commutator into position. When putting them on, commutators are wound up with a blow torch before being given the final tightening.

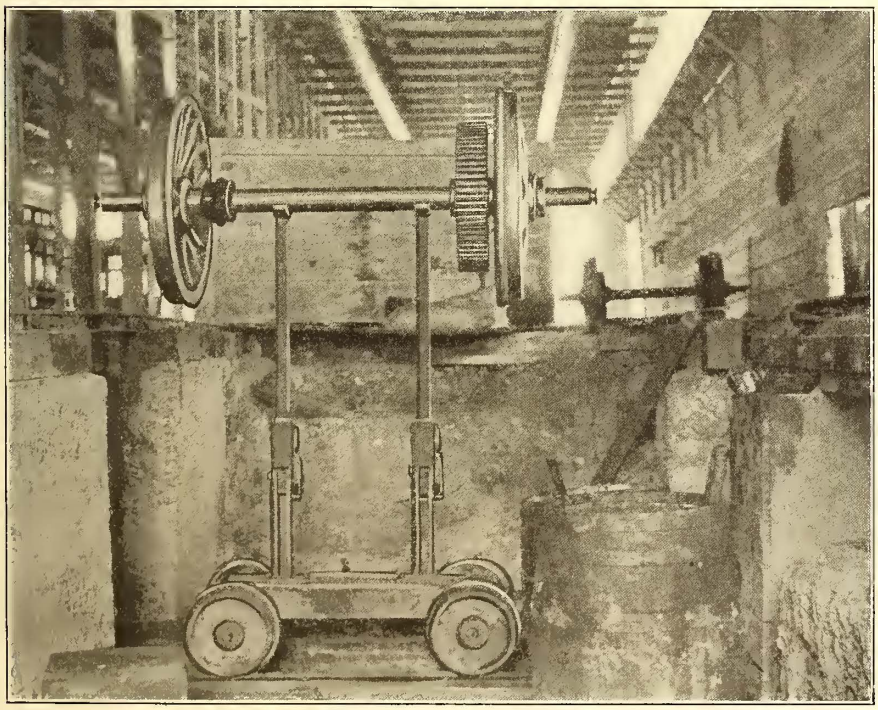
CHANGING ARMATURES

In changing armatures when the hinge pins are not removed it is the usual custom to employ a chain hoist sus-



ONE STYLE OF ARMATURE TRUCK USED IN HOT SPRINGS

pended from a horse inside the car to lower and raise the lower half shell of the motor. This often results in marring the finish of the car more or less in getting the horse in and out of the car, and always results in a great deal of dirt

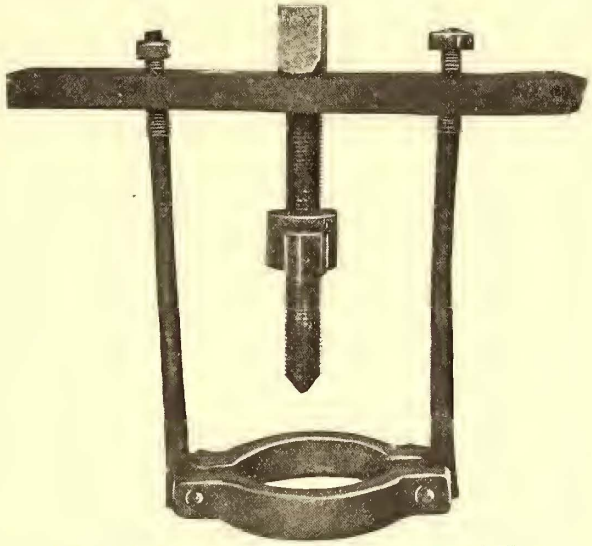


DOUBLE JACK USED IN CHANGING WHEELS

being carried in the car by the workmen. To avoid these objections and to save time, the shell is raised and lowered in the Hot Springs shops by a special bar and a block and tackle, which remove the necessity of any one getting in the car or of lifting the trap doors. The bar is about 2½ ft. long. A hook on one end is engaged in that eye of the lower half of the shell nearest the hinges. The bar extends horizontally under the shell, and under the axle of the car and to its opposite end is hooked the lower block of a tackle. The upper block of this tackle is hooked to a bolt in one of the cross bridgings of the car. The man pulling the rope is in a position where he can see what is required and act accordingly instead of having to be told what to do as when operating a chain hoist in the car.

ARMATURE WAGONS

The shop is well provided with armature wagons and pit jacks, all of which were made in the shop. One type of



APPARATUS FOR REMOVING COMMUTATORS

wagon used is shown in a reproduction. A wagon of this type should be so made that when the handle is lowered the center of gravity of the armature falls on the side of the axle nearest the handle and prevents the wagon tipping up.

CHANGING WHEELS

When wheels are to be changed, the car is placed on the track shown to the right of the accompanying illustration so that the defective wheels are over removable sections of the rails. The end of the car is raised by a jack placed under the center of the truck frame, and the rear of the motor is suspended from a screw-eye which in turn is supported by a long wood bar placed across the car floor. After the sections of the track have been removed the wheels are dropped down to clear the truck by means of two track jacks mounted on a small truck. This truck runs on a transverse track which extends under an adjacent track which has one movable rail section. After the wheels have been dropped the truck is shoved out from under the car and the wheels are raised. This one section of the second track is then removed and the truck is run under this track. The rail section is replaced and the wheels are let down on the track and run off the movable section. The new wheels are then placed on the jack, and after the one rail section has been removed they are carried under the car. The track for the wheel

jack is 54 ins. below the car track rails and is of 22-in. gage. The rams of the two Barret jacks on the truck are extra long and permit wheels to be raised or lowered 44 ins.

TRUCK FOR CARS WITH BROKEN AXLES

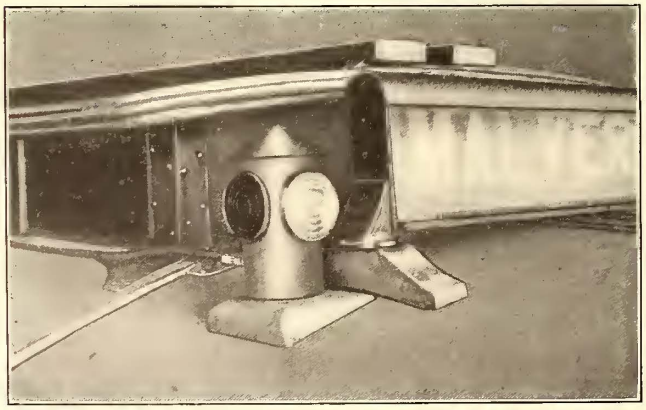
When a car with a broken axle is reported, three timbers and two pairs of small flanged wheels and axles, all of which, when assembled, form a truck, are put in a car and, together with jacks, are hauled to the disabled car. One

LAMP IN RECESS OF CONCRETE PIT

end of this car is then jacked up to raise the wheels of the disabled axle clear of the track, the truck is assembled, is placed under the platform to take the weight, and the car is then returned to the shop under its own power and without injury to the wheels.

PIT LIGHTS

In the construction of concrete pits in the shops, recently,



CAR SIGNAL LAMP WITH REVOLVING COLORED LENSES

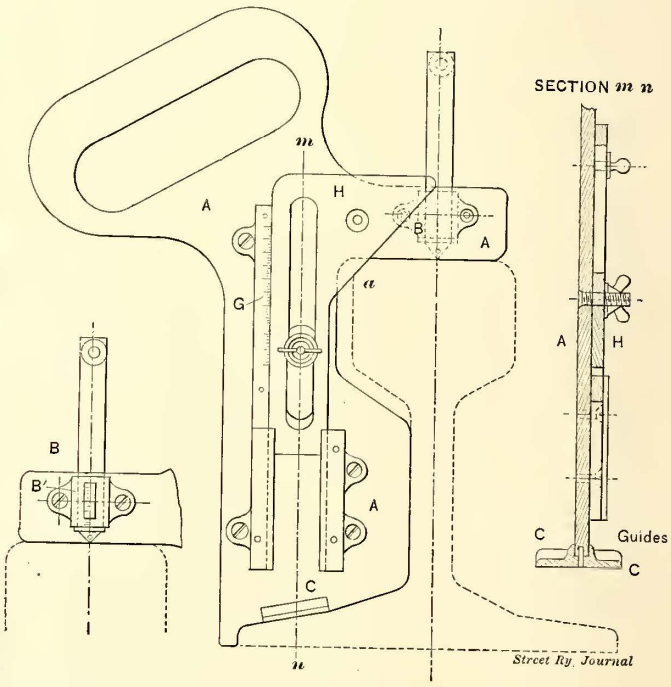
particular attention was given to the question of lighting them. The lights were placed at about 10-ft. intervals in recesses in the concrete immediately under the stringers supporting the rails. The bottom of each recess was slanted in such a manner that the light falling upon it is reflected up against the truck of a car over the pit. In laying the concrete circular loom, ducts were embedded in it for the wires between the lights.

CAR SIGNAL LAMPS

To enable passengers to distinguish the cars of different lines at night, in addition to illuminated signs, colored signals are used. The signal lamp contains four bull's-eyes of different colors and is so placed over an electric light that it may be turned when it is desired to show different colored lights. Three colors, red, green and white, distinguish the cars of the three different lines in the city, while the fourth color, yellow, is used for special cars. Mr. Hardin has applied for a patent on the idea of the revolving lamp.

GAGE FOR MEASURING RAIL WEAR

Messrs. Calvi and Perrot, track engineers of the Metropolitan Underground Railway, of Paris, have recently designed a micrometer gage for measuring the wear of rail heads and gage line. Its construction is shown in the accompanying design, which is reproduced from "Le Genie Civil." The piece *A*, which fits the contour of the base of the rail as well as the side of the web and top of the head,



PORTABLE GAGE FOR MEASURING RAIL WEAR, USED ON THE PARIS METROPOLITAN RAILWAY

is provided with a handle. The vertical wear is measused by the graduated screw *B*, which is threaded in the socket *B'*. The wear at the gage line of the rail is read by means of the sliding plate *H* and the scale *G*. This reading, of course, gives the resultant of the vertical and horizontal wear at this point, but as the incline at the corner of the rail is always at an angle of 45 degs. all readings can be corrected by the same constant. Both scales are provided with verniers. The gage has been found very useful on the Metropolitan Railway, where curves of 150 ft. radius are common and where the radius in some cases is as low as 93 ft.

THREE-PHASE LOCOMOTIVE WITH THREE RANGES OF SPEED FOR THE ITALIAN STATE RAILWAYS

BY BELA VALATIN

One of the objections most frequently raised against the use of the three-phase system of traction on main line railways is that in practical operation it is very often desirable for a locomotive to be capable of running at various speeds, but that three-phase locomotives possess only one main running speed. This latter claim is incorrect. The three-phase motor, like the direct-current motor, has only one running speed for any given draw-bar pull, but with the series parallel connection of direct-current motor or by using the cascade connection for three-phase motors, or by changing the number of poles, locomotives having two main speeds have been constructed. In the majority of cases two ranges of speed meet all practical requirements. It has also been proved theoretically that by a combination of the cascade connection and varying pole methods several ranges of speed can be attained with the three-phase locomotive. This plan, however, is not the only way by which more than two main speeds can be obtained with three-phase locomotives, as the following description of a large railway locomotive having three ranges of speed will show.

Toward the end of 1905 the Italian State Railways ordered from the Ganz Electric Company, Ltd., of Budapest, for their Valtellina line two electric locomotives, one of which was exhibited at the International Exhibition in Milan. These locomotives took the place of two electric locomotives which were taken from the Valtellina road and were put in service on the Simplon tunnel line. These new locomotives, as regards mechanical construction, are similar to those supplied previously by the Ganz Company and now used for the working of the Simplon tunnel, and a full description of them has already been published in these columns.* Electrically, however, they are different, as they have three ranges of speed. Unlike the previous type, which was equipped with two twin-motors and therefore really had four motors, these locomotives have only two motors, one of which has eight poles and the other twelve poles. Both motors are designed for high tension, viz: for 3000 volts at 15 cycles. When one or the other motor alone is in operation the two higher ranges of speed are obtained, while by connecting the two motors in cascade the third range or lowest speed is secured.

The connection of two high-tension motors in cascade presents some difficulties, because under normal conditions the high-tension part of the one motor would have to work on resistance. To avoid this an auxiliary transformer could be used during the starting. In these locomotives, how-

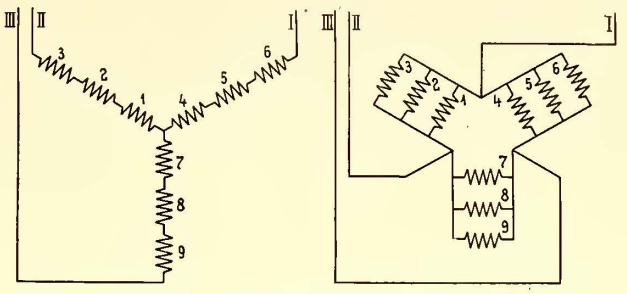
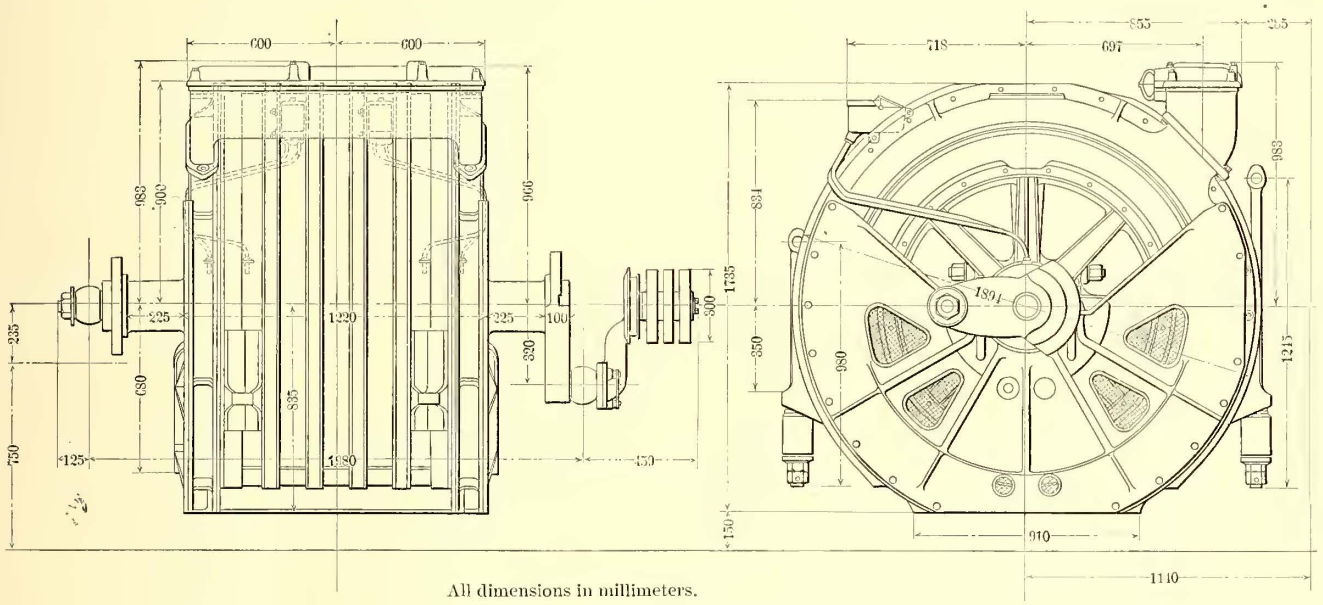


FIG. 1.—DIAGRAM OF CONNECTIONS OF WINDING OF 12-POLE MOTOR



All dimensions in millimeters.

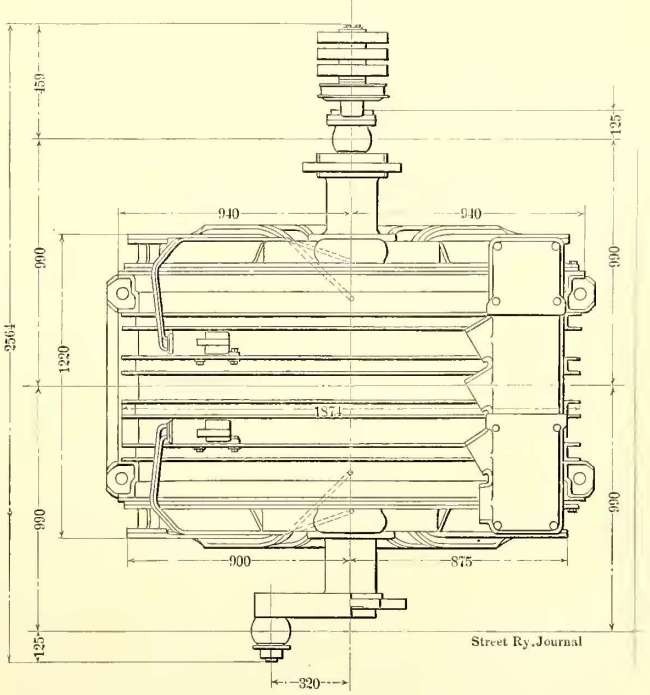


FIG. 2.—PLAN AND ELEVATIONS OF 12-POLE MOTOR

* See Street Railway Journal for Aug. 5, 1905.

ever, a method, proposed by Koloman de Kandó, was adopted, which with large motor sets is more advantageous than that mentioned, especially when frequent stops and starts are made, a condition which would necessitate an increase of the dimensions of the starting transformer.

The new method is as follows: When the two motors are connected in cascade the high-tension winding of the twelve-pole machine is arranged for a potential about one-fifth that of the normal high potential value. This is accomplished by a combination of the stator primary windings of the twelve-pole motor, which has three winding groups per phase, the eighteen ends of the windings being brought out from the motor. Fig. 1 shows the two combinations employed. When the stator primary is used for 3000 volts, the three coils per phase are connected in series and the three combinations of three coils are connected in star, as shown in the left-hand diagram in Fig. 1. For cascade connection of the two motors, the three coils of each phase of the primary of the secondary motor are connected in parallel, and the three combinations are connected in delta as shown by the right-hand portion of Fig. 1. As will be seen by this method, the initial tension of the winding decreases in the proportion of $\frac{1}{3 \times 53}$ or 1 : 5.2. It is possible then, by using 8, 12 or 20 poles, to obtain the three ranges of speed of the locomotives of 64, 42 or 25.5 kilometers per hour.

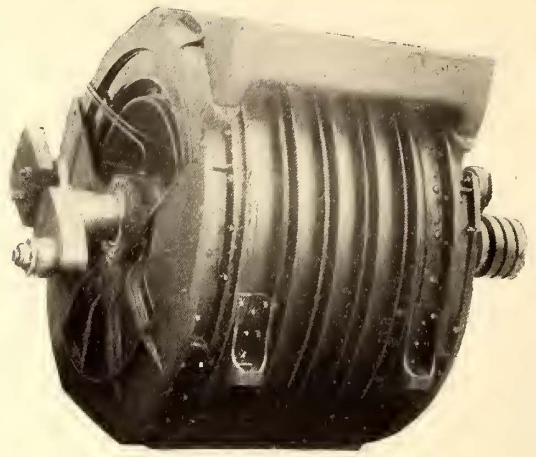


FIG. 3.—12-POLE MOTOR WITH STATOR FOR TWO DIFFERENT VOLTAGES—RATED CAPACITY, 1200 H. P.

As regards capacity, the locomotives at the two higher speeds have the same capacities as the locomotives supplied previously had at full speed, viz: a normal drawbar pull of 3500 kg. At the lowest speed they have the same capacity as the previous locomotives at half speed, viz: a normal drawbar pull of 6000 kg. This normal capacity is based upon

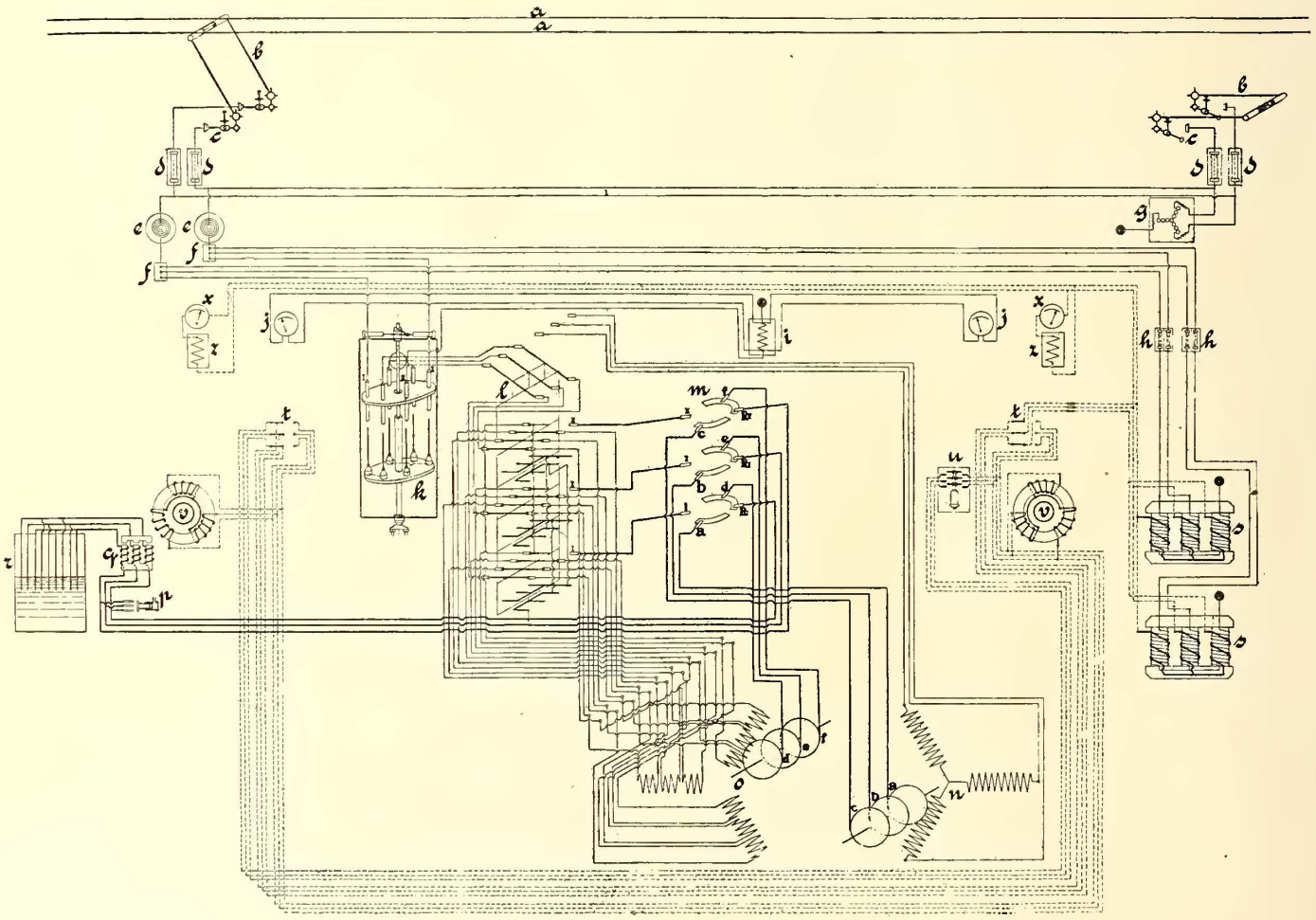


FIG. 4.—WIRING DIAGRAM OF THREE-PHASE LOCOMOTIVE

a—Trolley wires
b—Trolley
c—Trolley cut-out
d—Main safety fuses
e—Choking coil
f—Distributing box
g—Lightning arrester
h—Safety fuses of transformer
i—Shunt for ammeter
j—Ammeter
k—Primary switch
l—Motor commutating switch
m—Speed regulator
n—12-pole motor
o—8-pole motor
p—Short circuiter
q—Automatic governor of the rheostat
r—Water rheostat
s—Transformer
t—Hand switch
u—Switch governor of compressor
v—Compressor motor
x—Voltmeter
z—Additional resistance of voltmeter

the usual ten-hour rating test of the locomotive motors in the laboratory, during which the temperature of the motors does not rise above 60 degs. C. The motors have also a 50 per cent overload capacity for two hours and a 100 per cent overload capacity for a short time.

To provide amply for this overload capacity the motors have been dimensioned larger than called for by the specifications. The output per hour of rated capacity of the eight-pole motor for a rise of temperature of 75 degs. C. is about 1500 B. H. P.; that of the twelve-pole motor 1200 B. H. P.

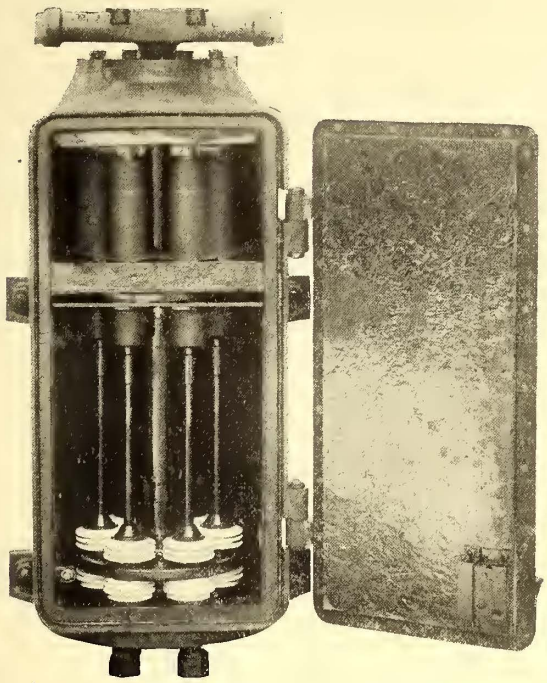


FIG. 5.—PRIMARY SWITCH

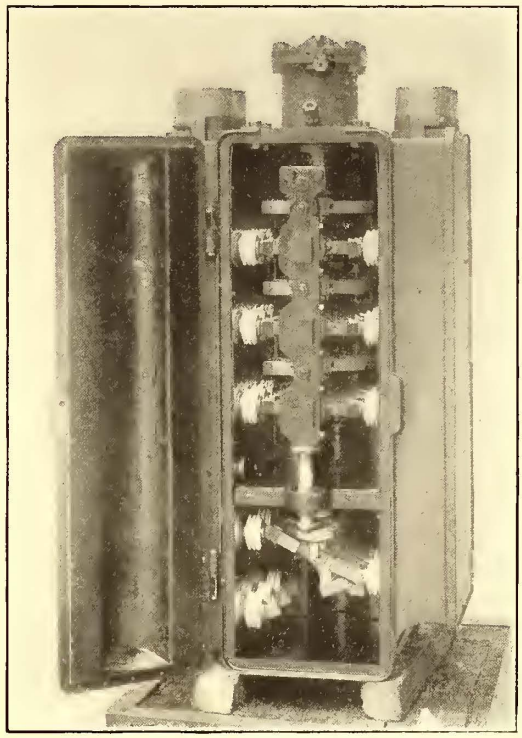
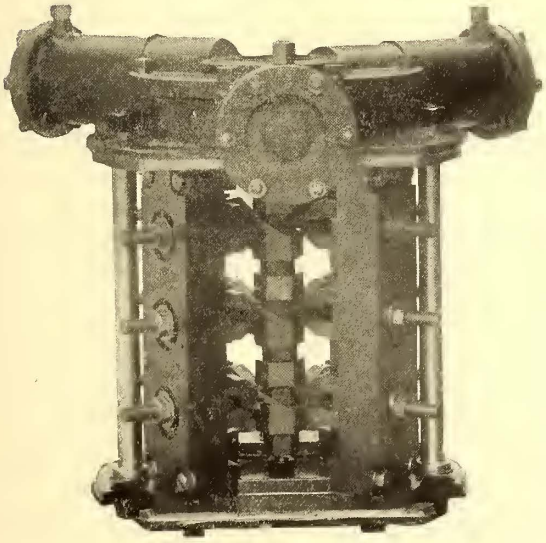


FIG. 6.—MOTOR COMMUTATING SWITCH



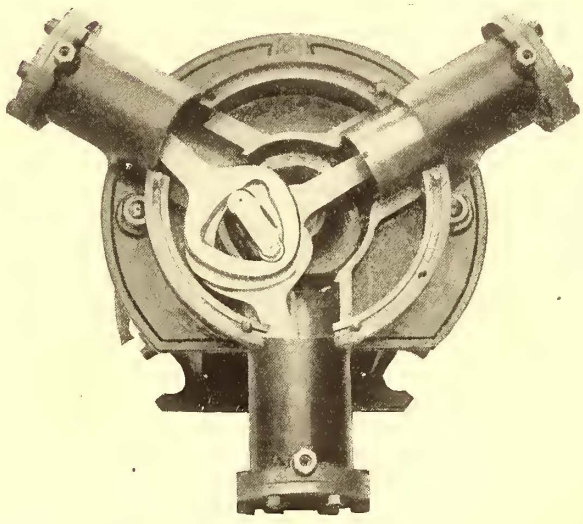


FIG. 7.—SIDE AND TOP VIEWS OF SPEED REGULATOR

The possibility of having three ranges of speed is advantageous in permitting the regulation of power according to drawbar pull and grades and starting with better economy, by reducing the losses in resistances. For this reason the resistances are smaller than with the two-speed locomotive.

The connections described above are equally well adapted for motors provided with an equal number of poles. In this case at full speed both motors can be connected in parallel and a very large motor capacity obtained at full speed. Under ordinary working conditions, however, this arrangement has no particular advantage because high speed is desired only when the tractive effort required is low. Under these circumstances it is better to use only half the number of motors. There are cases, however, when it is very convenient to operate the locomotive at half speed, such as at starting, during switching operations, etc., and in such cases the method of connections mentioned can be employed to advantage.

The motors as shown in Fig. 3 are of similar design to those used on previous locomotives. An interesting difference, however, consists in the fact that the frame is not a steel casting but is made up of steel sheets and U-iron. The slip rings, as in the former locomotives, are located outside the locomotive frame on the crank shaft. The brush holders, which are suspended from above, are protected by a sheet-iron casing opening sideways on hinges. Since every motor is complete in itself and is designed as a normal

three-phase motor, the disposition of the parts can be made to better advantage than with the previous motors, and the output per ton is also higher. The weight of the eight-pole motor is 13.4 tons and that of the twelve-pole motor 11.4 tons.

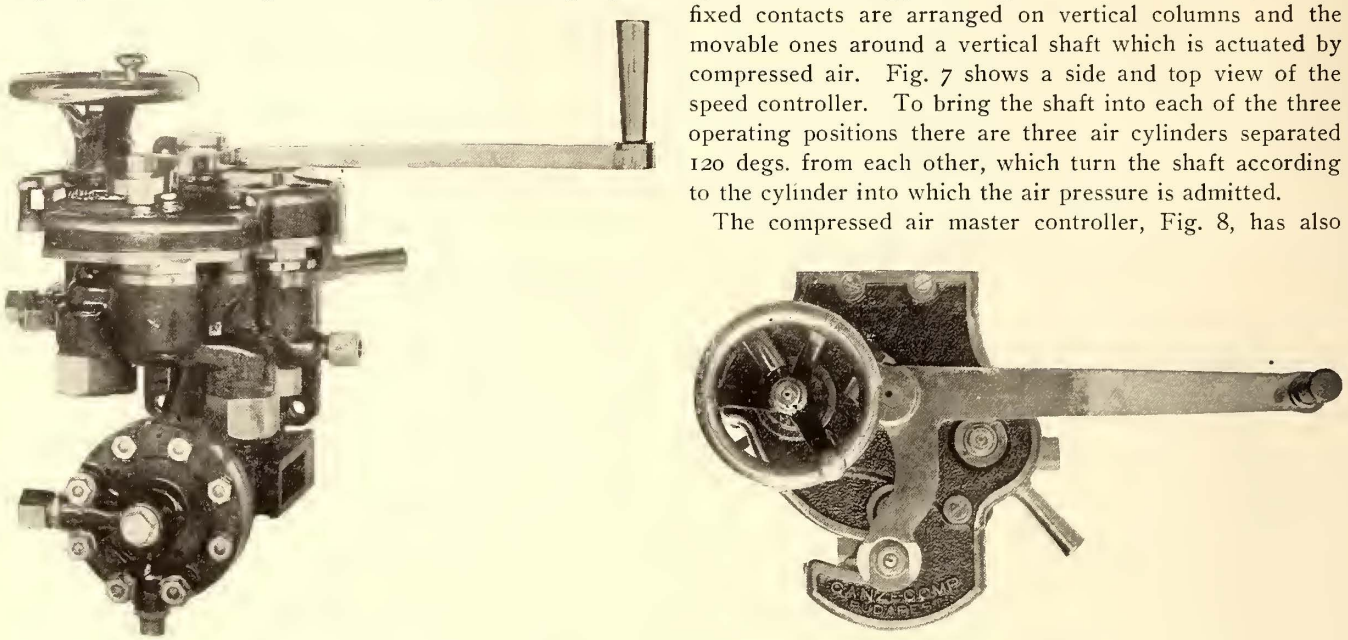


FIG. 8.—SIDE AND TOP VIEW OF MASTER CONTROLLER

As already explained, the stator of the twelve-pole motor is changed at cascade connection from high tension to low tension. For this purpose it is necessary to carry out from the motor eighteen terminals, which in view of the high tension used, requires a particularly careful construction. Fig. 2 is a drawing of the twelve-pole motor, from which the general arrangement of the wire terminals is apparent.

The arrangement of current collectors and regulating and starting apparatus, shown on the wiring diagram Fig. 4, is in general the same as with the previous locomotives. The current collector used is the double-roller, which has given excellent satisfaction in the operation of the Valtellina Railway and which, like the regulating apparatus, is actuated pneumatically. The lightning arresters, air compressor, switch governor, distributing box, etc., are the same as before. The construction of the primary switch, Fig. 5, is the same in principle, but in view of the higher demands upon it some slight changes have been made.

The new apparatus required are the motor throw-over switch and the speed controller, Figs. 6 and 7. The first serves for connecting the windings of the stator of the twelve-pole motor alternately for high or low tension. It is a cast-iron box containing a vertical shaft carrying two sets of knife contacts, leading to the motor windings and to the primary switch and speed controller respectively, and corresponding to the high and low-voltage connections. This shaft terminates in a piston which is actuated by compressed air controlled from the pneumatic master controller. The inside walls of the box are lined with micanite. The speed controller serves to connect the motors and starting resistances with one another corresponding to the three rates of speed. Accordingly three positions are necessary. The fixed contacts are arranged on vertical columns and the movable ones around a vertical shaft which is actuated by compressed air. Fig. 7 shows a side and top view of the speed controller. To bring the shaft into each of the three operating positions there are three air cylinders separated 120 degs. from each other, which turn the shaft according to the cylinder into which the air pressure is admitted.

The compressed air master controller, Fig. 8, has also been altered to correspond to the three ranges of speed. As will be seen from the wiring diagram, this locomotive has only one water resistance, Figs. 10 and 11, whose capacity is greater than previously used. This increase is secured by passing vertical pipes through the water for air circulation and cooling. By the use of this water resistance the current, and consequently the torque at starting, can be kept constant and as high as may be desired. Its operation has been highly satisfactory in continued service through many years.

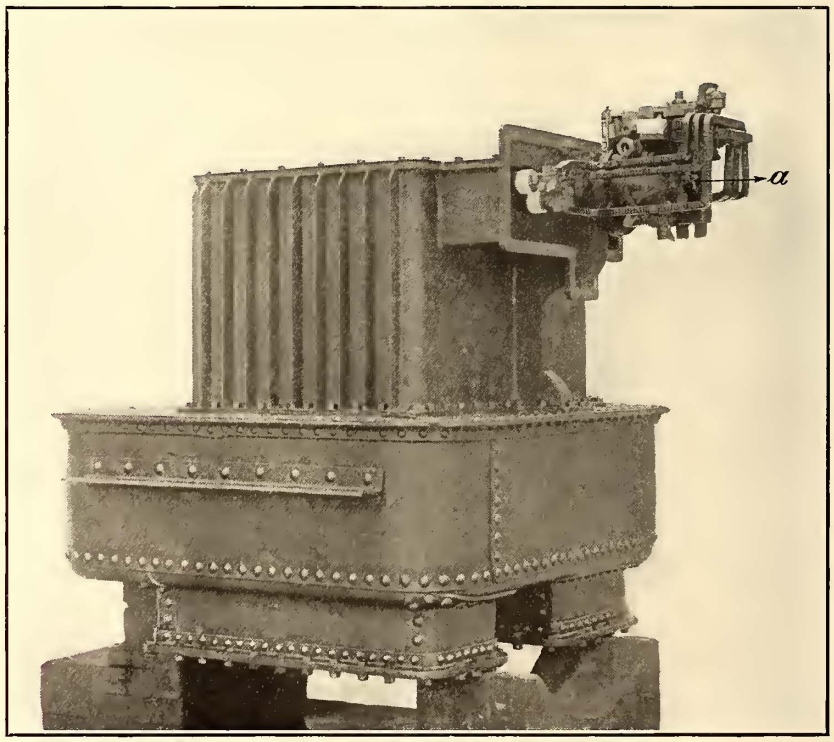


FIG. 10.—WATER RHEOSTAT

In the operation of mountain railways it very frequently

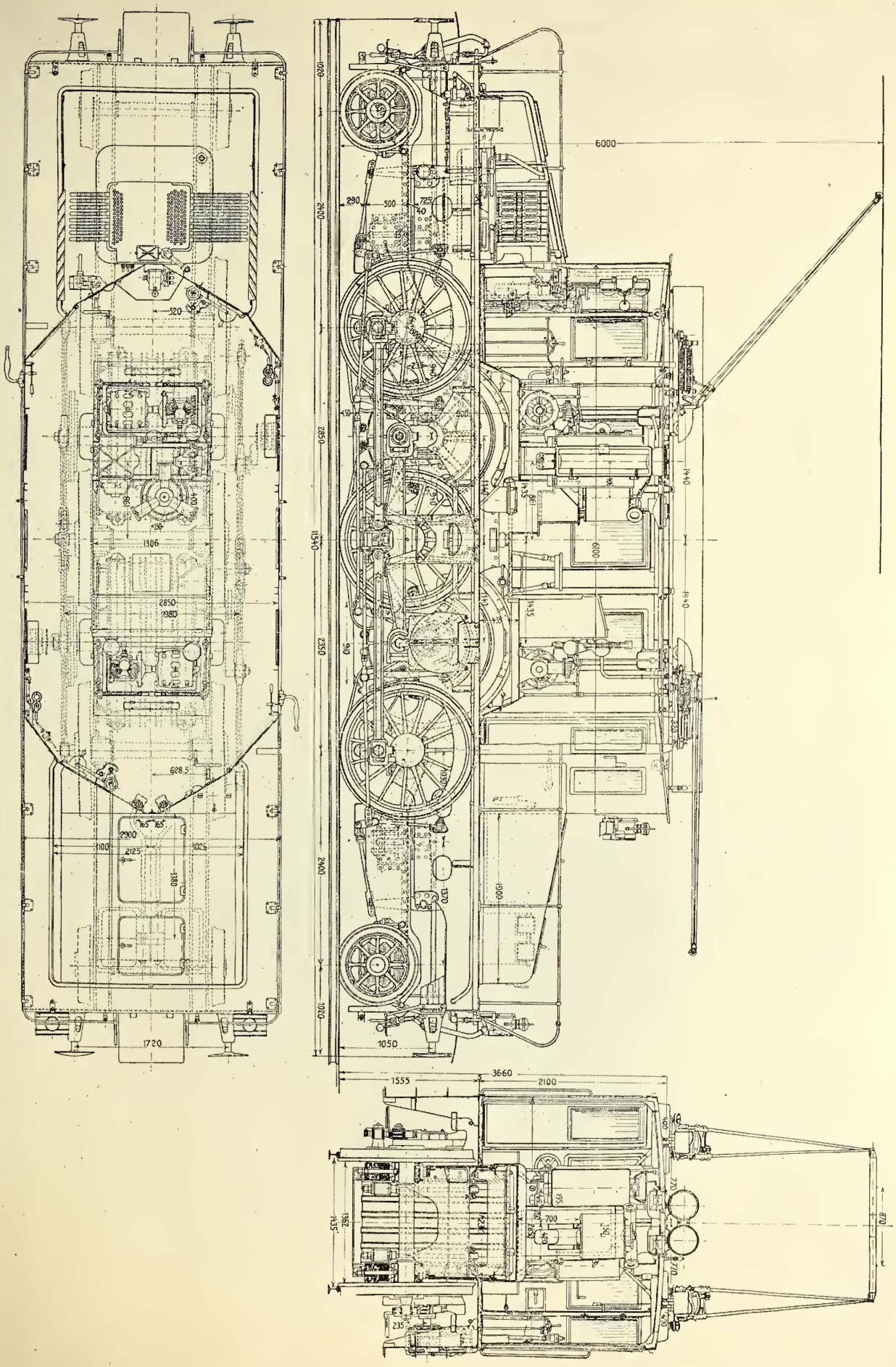


FIG. 9.—LONGITUDINAL AND CROSS SECTIONS AND PLAN OF NEW LOCOMOTIVE

happens that heavy freight trains must be provided with a pushing locomotive in addition to the locomotive at the head of the train. In such cases it is practically out of the question to connect the two locomotives on the multiple-unit system, since all the cars between the two locomotives cannot possibly be equipped with an electric train line. The two locomotives must therefore operate independently of one another and, as with steam operation, be controlled by signals. With the same types of locomotives and with exactly the same driving-wheel diameters an equal distribution of the load between the two locomotives is assured with three-phase current. With unequal driving-wheel diameters, however, the load would be distributed very unequally,

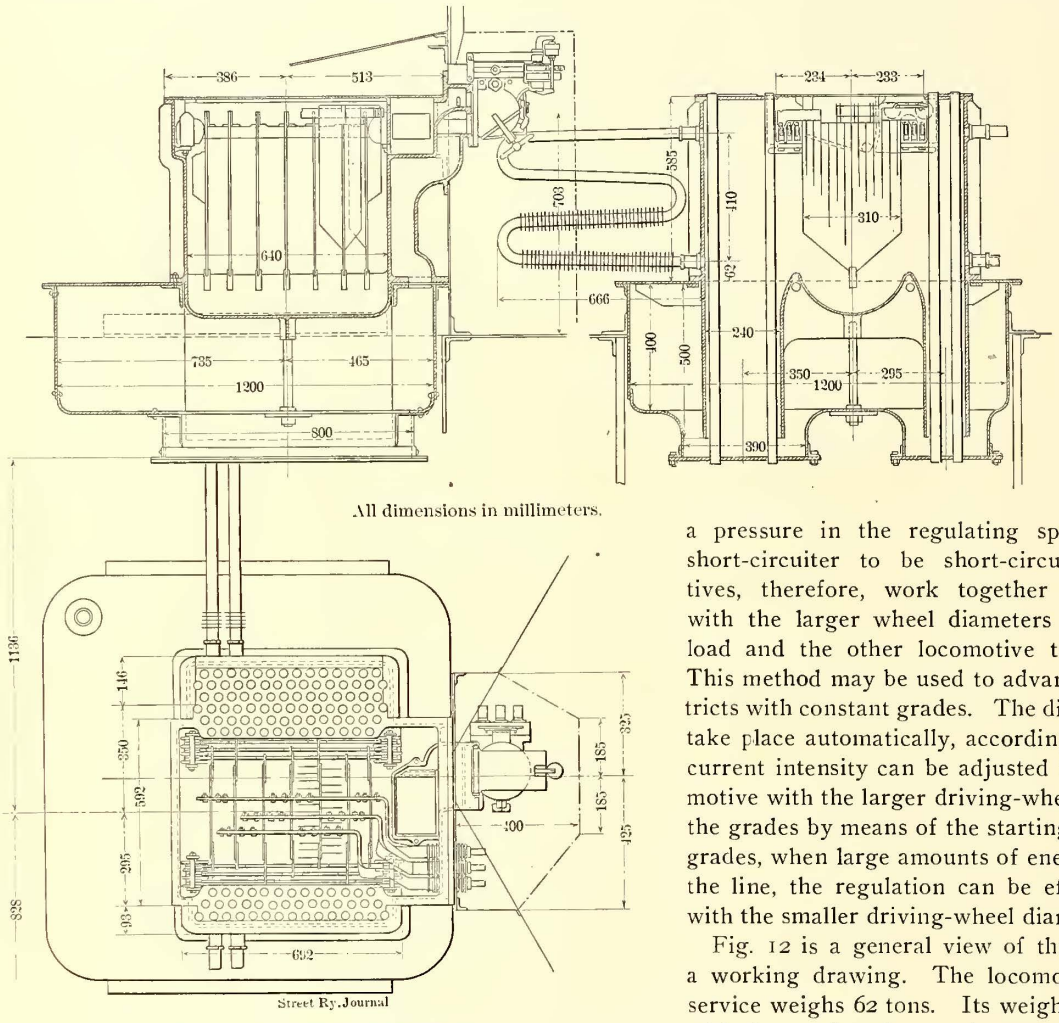


FIG. 11.—WATER RHEOSTAT

owing to the fact that with three-phase motors a slight difference in the speed is accompanied by a great difference in output. Since differences of 2 to 3 per cent in wheel diameters may occur, and since the speed difference of three-phase motors between no load and full load is no more than this percentage, one locomotive in this double service may be fully loaded or even overloaded while the other would run without load or even work as a generator.

To remedy this defect a device has been used with success for the last three and a half years on the motor cars of the Valtellina Railway by which additional resistances provided with steps can be inserted in the rotors. In making up the trains the difference in the wheel-diameters is ascertained, and on the motor cars or locomotive whose wheel diameter is larger, a corresponding step of the additional resistance is inserted, so that at maximum load all motor cars or locomotives are about equally loaded. At other positions on the torque curve the load is not quite equally distributed but, as on all vehicles the load remains below the maximum, this is of no importance.

With the new locomotives, however, a very beautiful distribution of the loads can be secured on account of the use of one main water rheostate instead of the separate resistances. The height of the water in this rheostat depends upon the contraction between the air pressure and an electro-magnet in the regulating head. As many fine subdivisions as desired can be obtained, and so long as the short-circuiter does not short-circuit the secondary parts, every position of the starting lever corresponds to a constant current intensity in the motor and it is possible —by stopping the effect of the short-circuiter—to adjust at will the current consumption of the locomotive to accord with the larger driving-wheel diameters. For this purpose the water rheostat is provided with a smaller lever, shown at *a* in Fig. 10, by means of which the air inlet valve connecting the regulating space with the water space is lifted, so that there can never be such a pressure in the regulating space as would allow the short-circuiter to be short-circuited. The two locomotives, therefore, work together so that the locomotive with the larger wheel diameters is adjusted for constant load and the other locomotive takes the additional load. This method may be used to advantage in mountainous districts with constant grades. The distribution of load can also take place automatically, according to the profile, since the current intensity can be adjusted by the driver of the locomotive with the larger driving-wheel diameters according to the grades by means of the starting lever. On heavy downgrades, when large amounts of energy are being returned to the line, the regulation can be effected on the locomotive with the smaller driving-wheel diameters.

Fig. 12 is a general view of the locomotives and Fig. 9 a working drawing. The locomotive when ready for the service weighs 62 tons. Its weight on drivers is 42 tons, as with the previous locomotives.

A large dam and water power are projected at Hilldale, near Brattleboro, Vt., by the Connecticut River Power Company. The dam will be 26 ft. high with 800 ft. spillway, and it is expected 12,000 hp will be developed. Among those interested are Henry I. Harriman, of Hyde Park, Mass.; Malcom G. Chase, of Providence, R. I.; W. H. Vinton, C. A. Harris and C. W. Dunham, of Brattleboro.

The report of the Rio de Janiero Tramways, Light & Power Company for 1906, shows gross receipts of $5,605,000 and net receipts of $1,550,000. A considerable increase of business is expected as soon as the hydraulic station on the Lagos River is completed. The net receipts for 1907 are estimated at $2,133,000.

COPENHAGEN'S STREET RAILWAYS

Prior to eight years ago there were several street railway lines owned by separate and independent companies in Copenhagen. In 1898 a corporation was organized which combined the entire system, with slight exceptions. The capital stock of the corporation is $2,680,000, and bonds to the amount of $1,408,000, drawing 4½ per cent, were issued and sold. There is also a floating debt of about $884,400. As a condition to granting a franchise, the city government exacts the performance of the following duties:

First, that the fares to be collected should not exceed 10 ore (about 2½ cents), which also should include universal transfers. Second, that the company should pay to the city treasury 6 per cent of its gross receipts. Third, that it should pave and maintain between its tracks and about 2 ft. outside the rails. Fourth, the city reserved the privilege of providing the electric power at an agreed price, out of which the city is making a net profit of about 700,000 kroner ($187,600) per year. Fifth, that the charter should expire in forty years, at which time the entire property should be delivered to the city free of cost and encumbrance.

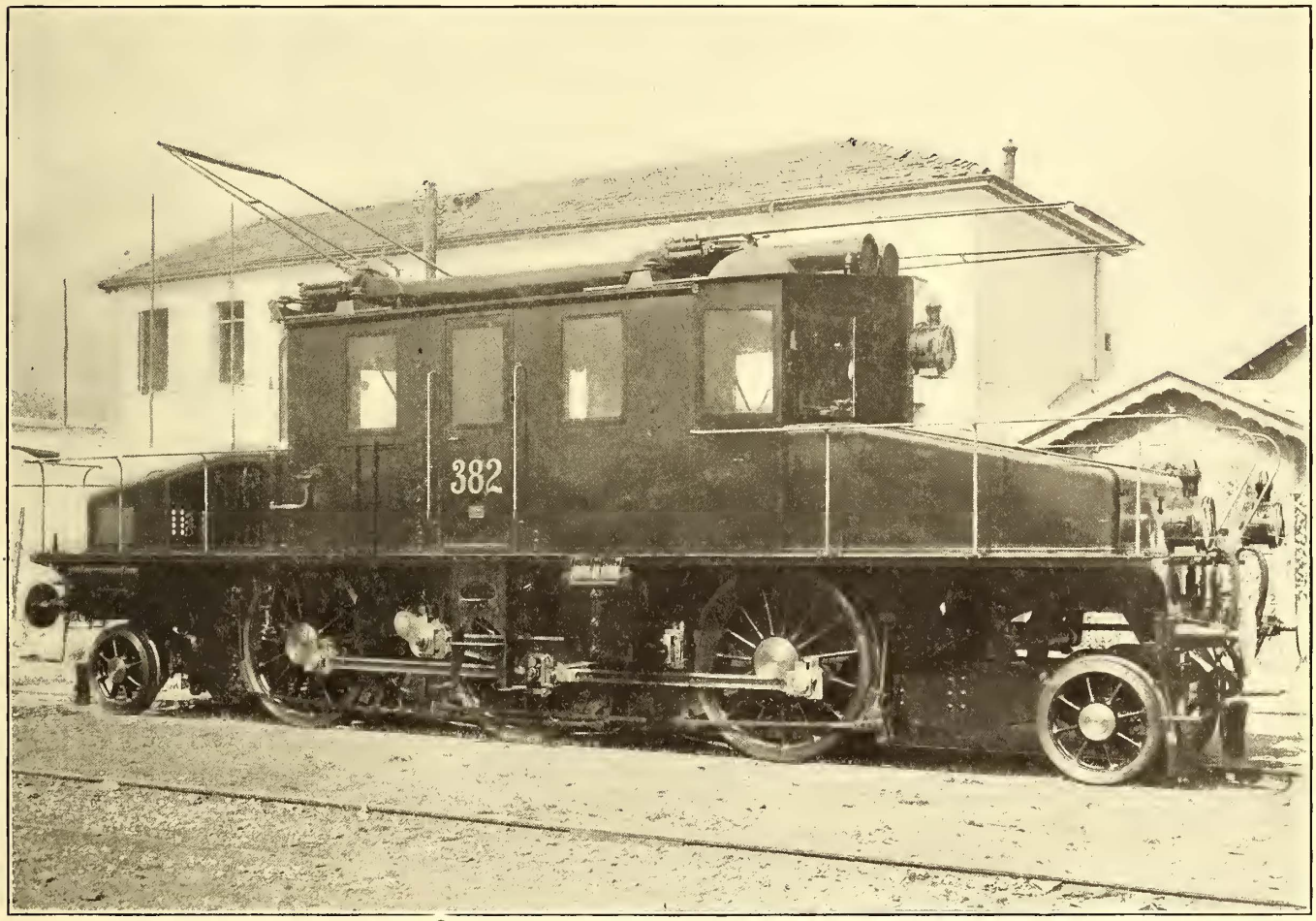


FIG. 12—GENERAL APPEARANCE OF THREE-PHASE LOCOMOTIVE READY FOR SERVICE

The lowest wages for motormen and conductors is about 4 kroner ($1.08) per day, a day being ten hours for the conductor and nine and a half for the motorman. After a period of service the pay is slightly increased, the amount for the year ranging from 1100 to 1500 kroner ($295 to $402). For the ordinary workman the pay is from 1100 ($295) to 1400 ($375) kroner per year.

In addition to this compensation the company provides the clothing for the motormen and conductors. They are allowed one day of rest in six without deduction of pay, and in addition six holidays during the year. Employees of the company remaining in the service twenty-five years are entitled to a pension in case at the end of that time they are unfit for further work. The pension amounts to two-thirds of the yearly wage of the person. In case of illness contracted outside of and not due to the service, full wages are continued for six weeks and half wages for the six weeks following, after which no duty rests upon the company; but the period of such illness is reckoned as a part of the service for the purpose of the pension. If the illness was contracted in the service, the employee receives full wages until recovered. In case of personal injury caused by an accident arising out of and in the course of the employment and incapacity for work results, the company continues full wages until the final consequence of the accident shall have been ascertained or until the employee recovers. In case the incapacity resulting from the accident proves to be permanent, the employee will receive a pension for life equal to about two-thirds of his average wage for the preceding five years. The provision for a widow's pension amounts to about one-eighth of the average wage of the husband for the preceding five years. In case an employee is injured and death results, the law provides that the widow, if there shall be a widow, shall receive 3200 kroner ($858) at once and in lieu of a pension. There are now 1420 employees.

The car-miles in 1898 were 3,797,413, and the income $719,831, while in 1906 the car-miles aggregated 9,771,827 and the income $1,562,492.

A premium is paid to motormen for reduced power used below a fixed standard, the sum of 5908 kroner ($1,583) having been paid to motormen under this arrangement in 1905. The company paid 6 per cent in dividends in 1905.

THE MULTIPLE CATENARY SUSPENSION FOR THE BLANKENESE-OHLSDORF RAILWAY, GERMANY

The Siemens-Schuckert Works, now building a single-phase railway from Blankenese to Ohlsdorf, Germany, have adopted for this line a new form of catenary suspension in which there are two carrier wires beside the trolley wire.

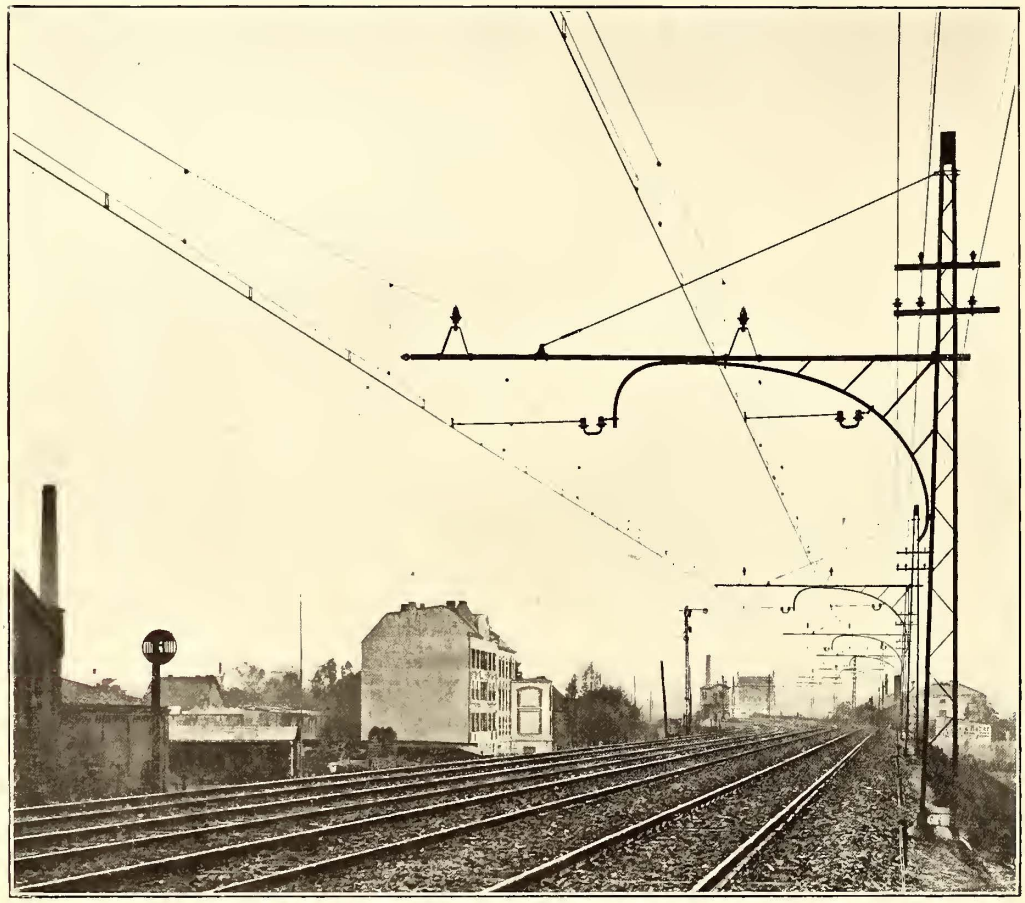


FIG. 1.—ARRANGEMENT OF MULTIPLE CATENARY SIDE-SPAN OVERHEAD CONSTRUCTION ON DOUBLE TRACK

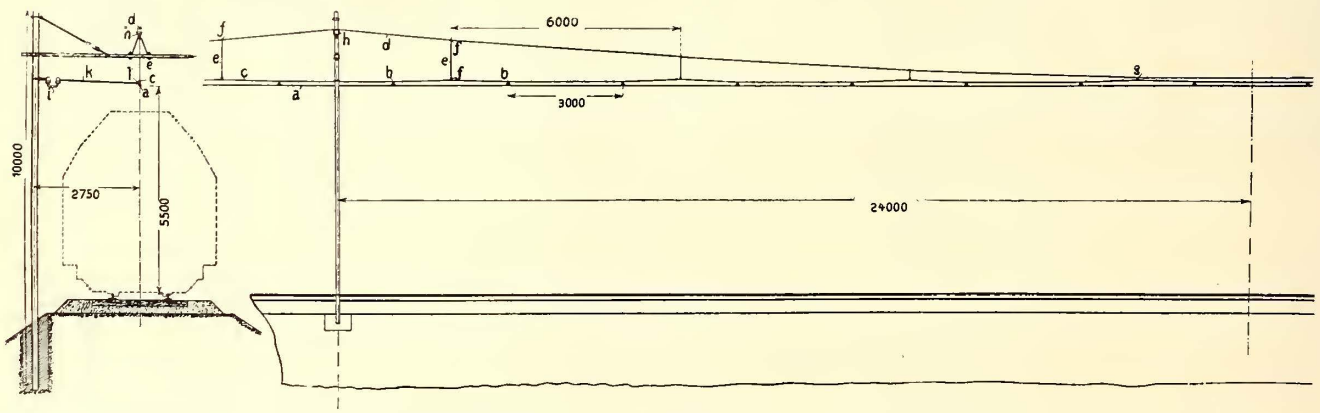


FIG. 2.—END AND SIDE ELEVATIONS OF MULTIPLE CATENARY (ALL DIMENSIONS IN MILLIMETERS)

It will be noted from Fig. 1 that in this case it is used with side poles and double track. The details of this type of catenary are indicated in Fig. 2. The trolley, *a*, is a hard copper wire of 100-sq.-mm section (No. 000) supported at intervals of 3 m (10 ft.) with mechanical clips, *b* (shown in detail in Fig. 3), which are fastened to an auxiliary carrier wire, *c*, placed above the trolley wire and practically parallel to it. The clips grip the trolley wire but have a longitudinal movement along the auxiliary carrier wire. These clips also allow for the upward movement of the trolley wire caused by the pressure of the current collectors, so a flexible suspension is secured which permits good contact between bow and wire. The auxiliary carrier wire, *c*, is of No. 3 wire or 6-mm diameter. It is suspended from the main carrier wire, *d*, at intervals of 6 m (20 ft.). This suspension is made through perpendicular hanger wires, *e*, which are connected with the main messenger cable as well as the auxiliary carrier wire by the special clamps illustrated in the right engraving in Fig. 4. In the middle of the span a different type of clamp, *g*, is used as shown in detail in the upper left part of Fig. 4.

The main messenger cable consists of seven strands of steel wire, giving a total section of 35 sq. mm, or that of about a No. 3 wire. As illustrated in Figs. 1 and 2, it is carried at the poles on an insulator, *h*, with a metal cap to which the hanger wire is screwed (see Fig. 6).

To prevent the side swinging of the trolley wire, the latter as well as the auxiliary carrier are secured by a double pull-off, *i*, of the type shown in Fig. 7, a piece of tubing, *k*, and clamp, *l*. The latter is so constructed that even at these points the trolley wire can rise with the bow pressure. At curves this arrangement is somewhat modified, as the wires are under tension only. Means are provided at definite intervals on all three wires to allow for the effect of changes in temperature.

The advantages claimed for the multiple catenary over the single catenary are as follows: The number of perpendicular supporting wires is only half of what it would otherwise be, affording considerable improvement in the appearance of the line and simpler and easier maintenance of the entire

overhead construction; the use of sliding clamps between the trolley wire and auxiliary carrier permits easy and auto-

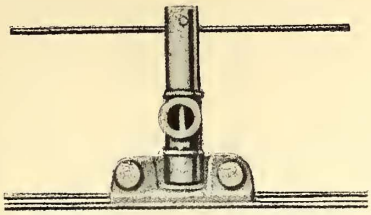


FIG. 3.—CLIP BETWEEN TROLLEY AND CARRIER WIRE

matic equalization of the tension on the former after the line has been installed, and hence less wear. This advantage

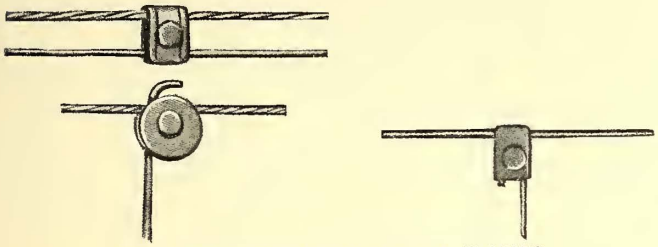
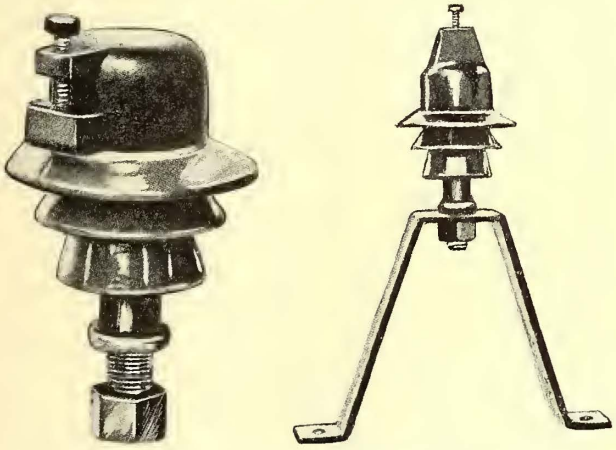


FIG. 4.—DIFFERENT TYPES OF CLAMPS

is claimed to be important on account of the differences in tension which will be caused by changes in temperature.



FIGS. 5 AND 6.—INSULATOR CARRIER FOR MAIN CABLE, AND DETAIL OF INSULATOR

Finally, in case of trolley wire breaks the supporting system is less apt to be affected on account of the sliding of

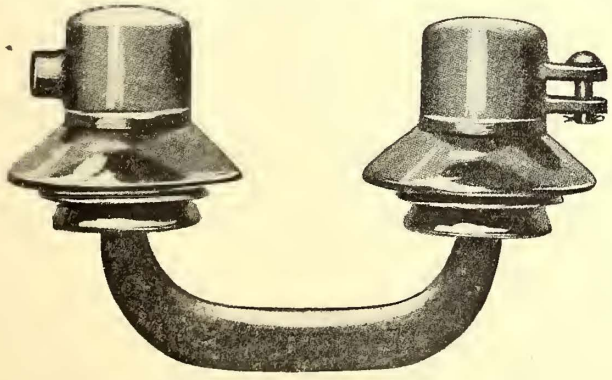


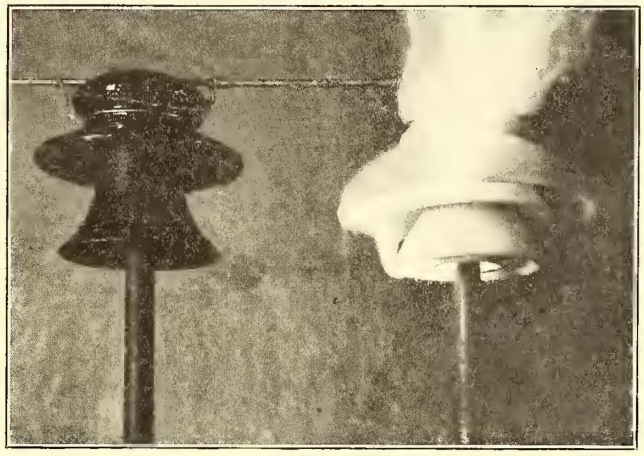
FIG. 7.—DOUBLE PULL-OFF

the trolley clamps on the auxiliary carrier wire of the system.

This type of catenary suspension is now in use on a section 1.3 km (0.8 mile) long of the Rheinuferbahn between Cologne and Bonn, on 26.5 km (16.4 miles) of double track of the Blankenese-Altona-Hamburg-Ohlsdorf line, and on 33 km (20.4 miles) double track belonging to the Rotterdam-Hague-Scheveningen Railway.

HIGH VOLTAGE TESTS ON DIFFERENT TYPES OF INSULATORS

Two articles have appeared in recent issues of this publication* relative to the testing and construction of the Kleinstuber type of Ambroin high-tension insulators made by the Vereinigte Isolatorenwerke Actiengesellschaft, of Berlin-Pankow, Germany. These insulators are not of the multiple-petticoat form commonly used for high-tension work. The ordinary insulator consists of a single bell of Ambroin molded at the top, in which a metal cap is screwed but for very high potentials there is also a disc of insulating material to separate the bell from the cap. To compare this construction with porcelain, the company submitted a number of its insulators for tests by the Reichsanstalt, the official research laboratory of the German Empire. The figures thus secured were then compared with the latest regarding porcelain insulators made in Germany.



AMBROIN AND PORCELAIN INSULATORS UNDER A 40,000-VOLT TEST

The following figures are taken from this comparison:

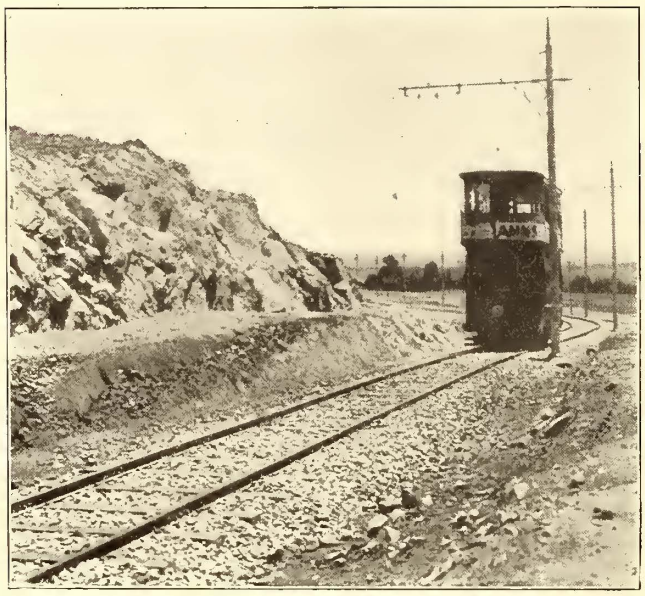
Porcelain Insulators.			Ambroin Insulators.		
Arcing Voltage in Dry Weather.	Arcing Voltage in Wet Weather.	Weight in Grams.	Arcing Voltage in Dry Weather.	Arcing Voltage in Wet Weather.	Weight in Grams.
60,000	29,000	700	56,000	29,000	610
75,000	37,000	1,460	69,000	46,000	740
91,000	44,000	1,850	77,000	54,000	810
93,000	49,000	2,125	83,000	66,000	1,200

The accompanying illustration shows what occurred during a laboratory test. The insulator on the left is of the Kleinsteuber type and the other a delta porcelain insulator. The latter had a maximum diameter of 177 mm., a height of 140 mm, a weight of 1950 grams, and was listed at 3.10 marks ($0.77). The former had a maximum diameter of only 135 mm, the same height, weighed 790 grams, and was listed at 1.65 marks ($0.41). Both insulators were mounted in parallel and connected by copper wire over the caps and between the supports. The test was made at 40,000 volts in an artificial shower. The arcing on the Ambroin insulator is barely noticeable, while the porcelain insulator is wrapped in flame.

*See Street Railway Journal, for August 11, 1906, and January 12 1907

NOTES ON THE JOHANNESBURG MUNICIPAL TRAMWAYS

Electric tramcars started running in Johannesburg, South Africa, on the first section of line completed (little more than a mile and a half in length) in February, 1906, and as fresh track was completed the service was extended, until at the end of the year practically the whole town and district



A SINGLE-TRACK SECTION

A BUSY DAY IN JOHANNESBURG

was served. The present length of the electrically-equipped routes is about 28 miles standard-gage track, and further extensions are already authorized.

Before starting upon its own electrical scheme the Johannesburg Council purchased the old horse tramways, which had a route length of about 12 miles. By adopting almost entirely different routes for the electric traction the Council was able to keep the horse service running until an equivalent electrical service was available. The last of the horse tramways ceased working during August, 1906.

The track is of the usual girder type for paved streets in the city limits, while T-rails are used on the suburban sections which are ballasted with rock. Overhead construction with double 0000 trolley wire is used throughout, and as shown in the illustrations is of both the span and side-bracket type.

A number of the poles were provided with an extra ornamental bracket for supporting arc lamps, while about 200 incandescent lamp posts were erected and 400 of the old gas lamps were converted into electric glow lamps.

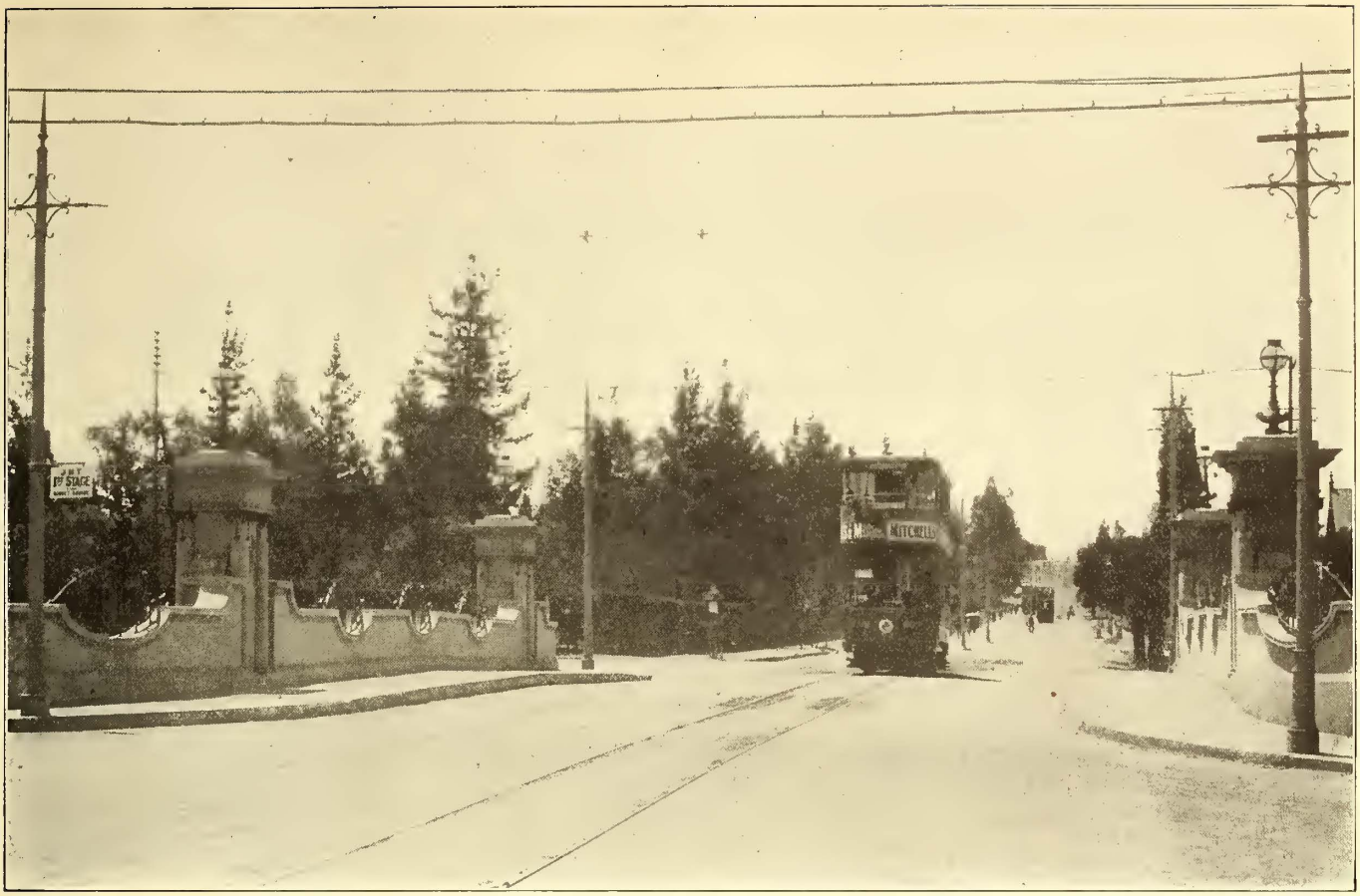
The arc lamps and glow lamps are arranged in twenty groups of nine in series across 460 direct-current mains and except in the case of two circuits each group of lamps is controlled by an automatic switch and fuse in the base of the first lamp post and a switch fuse in the last lamp post.

LOOKING SOUTH IN THE HARRISON STREET SUBWAY

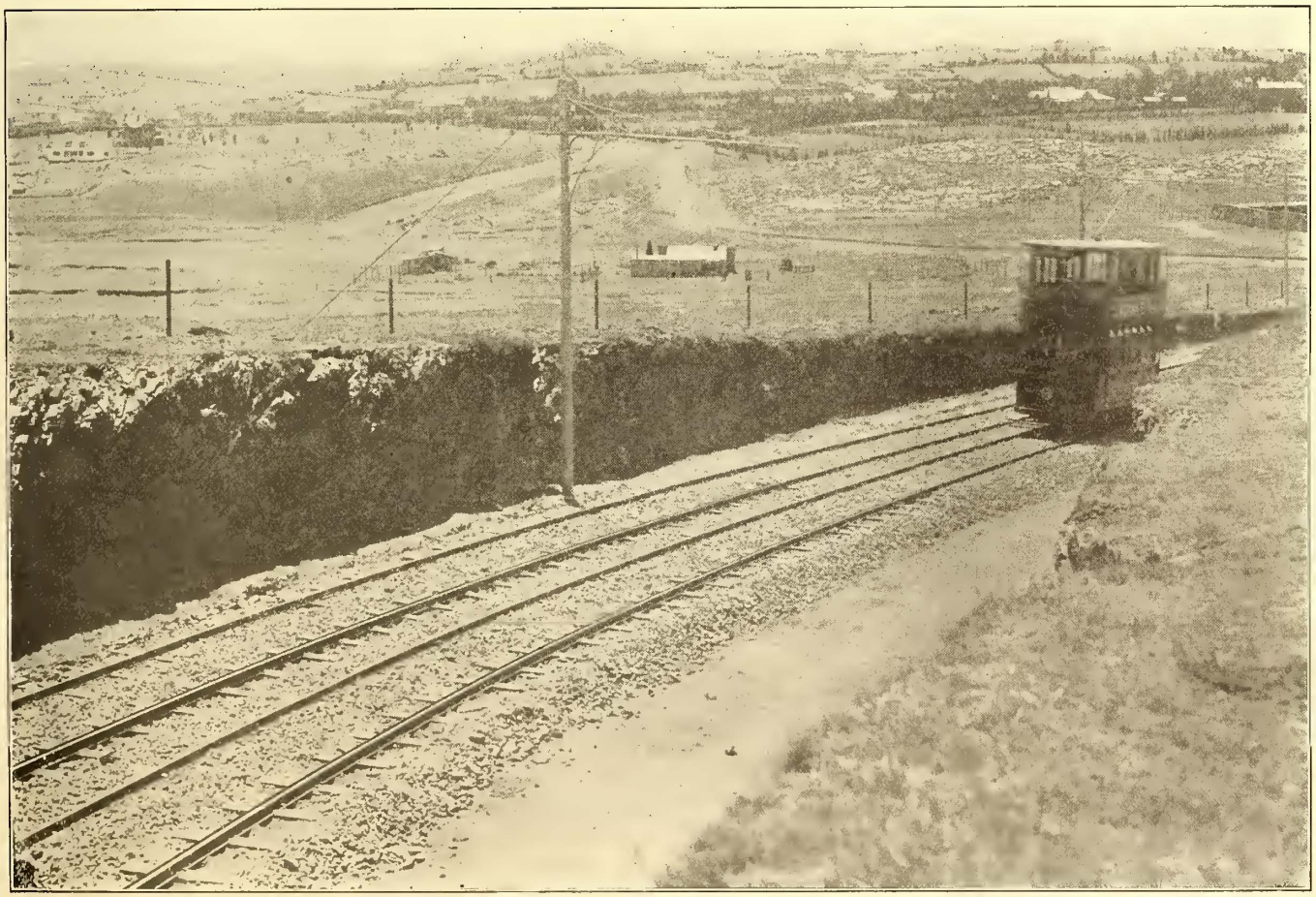
A VIEW IN THE OPEN CUT

The ears used are 18 ins. and 24 ins. long, and made of gun metal. The overhead switches are also of gun metal and are of the mechanical type, provided with an operating cord for working from the ground.

The span wire used for bow string suspensions for side bracket poles and span poles is of galvanized steel made up of seven strands of No. 14 and 12 S. W. G., respectively. The straight line hangers and double and single pull-off are of galvanized iron. For a certain length overhead bare



A VIEW ALONG THE MARKET SQUARE ROUTE OF THE JOHANNESBURG TRAMWAYS



A DOUBLE-TRACK ROCK-BALLASTED SECTION IN THE OUTSKIRTS OF JOHANNESBURG

feeders are run on brackets fixed to the poles. These are guarded by 7-16-in. strand wire erected on brackets above those carrying the feeders. Feeder and section pillars are erected at every one-half mile in accordance with the Board of Trade regulations, and the same are earthed to the rail as in English practice. Each feeder pillar is provided with a portable telephone and a twenty-seven-point switchboard for the main car house exchange.

The first contract for cars comprised 100 of the four-wheel type, of which 60 have cross seats inside and out, and the remaining 40 have the usual longitudinal seats inside and cross seats outside. Eighty out of the 100 cars have been fitted with top covers extending the whole length of the car. They are fitted with roller spring blinds at the sides as a protection against sun and rain, and end screens with doors and windows. Each car carries 24 passengers inside and 34 outside. The over-all width of the body is 7 ft. 3 ins., and the extreme width of the car 7 ft. 5 ins. The bodies are 16 ft. long inside, and the length over the platform is 26 ft. 6 ins. The inside seats are of rattan, while the top seats are of the usual garden pattern.

With a view to insuring ample power and minimizing repairs on motors, each car has been fitted with two 35-hp motors, so that the maximum temperature rise in working is unusually low. The trucks are of the Brill type, and the wheels, which are 33 ins. in diameter, have especially thick steel tires.

The braking arrangements consist of magnetic track brakes combined with wheel shoes energized by the motors. A Peacock hand brake operates on the same wheel shoes as the magnetic brake. The cars are fitted also with the popular English trigger-type lifeguards and folding steps.

Ten double-truck cars have recently been shipped. They have longitudinal seats, top covers and electrical equipments similar in all respects to those on the four-wheel cars. Each of these will carry 30 passengers inside and 44 outside. They are intended for special traffic, such as for race meetings and at lunch time when the traffic demands are extremely heavy.

In addition to the 110 passenger cars, 5 watering and 3 freight cars have been supplied. The water cars are of the single-truck type, and have 1800-gal. tanks, with electrically-driven air compressors giving sufficient pressure to spray the water 25 ft. on each side of the track. The water cars and freight cars have electrical equipments identical with those on the passenger cars.

THE BRICK AND STEEL CAR HOUSE OF THE JOHANNESBURG TRAMWAY SYSTEM

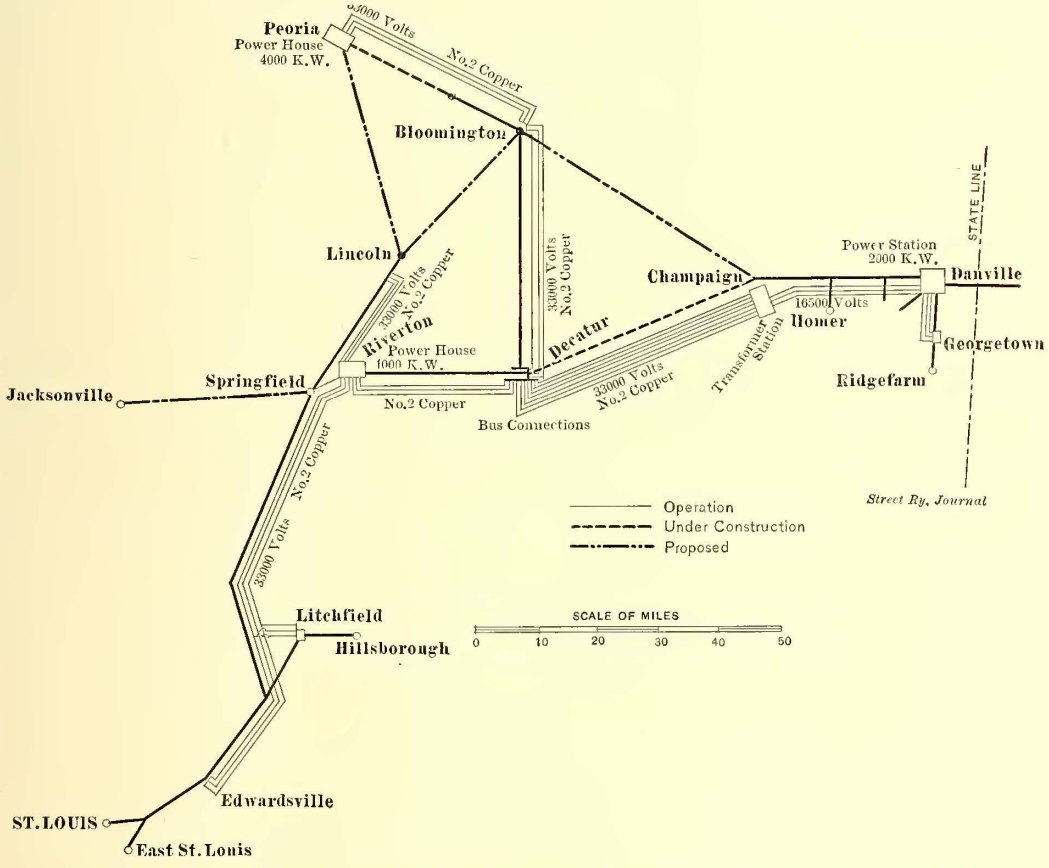
Excepting the bodies of the freight cars (which were made by the Gloucester Wagon Company), the whole of the cars and equipments have been supplied by Dick, Kerr & Company, and were manufactured by them—with the exception of the double trucks, which were made in America—to detail specifications prepared by Mordey & Dawbarn, the consulting engineers to the municipality of Johannesburg.

The overhead equipment was also erected by Dick, Kerr & Company, to the specifications of the consulting engineers. The poles and pole fittings were supplied by Messrs. Blackwell & Company under a separate contract.

The fact that the revenue from the tramways is over 30 cents per car-mile is an eloquent testimony to the appreciation of the tramway service by the public of Johannesburg.

THE ILLINOIS TRACTION SYSTEM—ITS GROWTH AND HIGH TENSION POWER DISTRIBUTION SYSTEM

The Illinois Traction System within the brief period of three years has attained a very prominent place among the interurban systems of the country. It is now operating over 300 miles of road in Central Illinois, and has in the course of construction about 80 miles of additional track. When the new line now partially completed between Champaign and Decatur is finished, the system will possess a through route from Danville to St. Louis, a distance of approximately 220 miles. There is at present a continuous road from Bloomington through Decatur and Springfield to the Missouri metropolis. A probable extension eastward from Danville to the Indiana State line will connect the system with the network of interurban lines covering Indiana and Ohio, from which it is now isolated.



HIGH-TENSION POWER DISTRIBUTION LINES OF THE ILLINOIS TRACTON SYSTEM

During the past year the Chicago, Bloomington & Decatur Railway has been put into operation between Decatur and Bloomington; the Springfield & Northeastern Railway Company began operating between Springfield and Lincoln, and the St. Louis, Decatur & Champaign Railway for a portion of the 41 miles between Decatur and Champaign. The balance of this latter line has been practically completed, and the Peoria, Bloomington & Champaign Traction Company's line connecting Peoria and Bloomington has been constructed.

Other extensions, including the line of the Illinois Western Railway from Springfield to Jacksonville, will doubtless be made during the approaching summer. To afford a satisfactory entrance into St. Louis, it is probable that a $,000,000 bridge will be built across the Mississippi River at St. Louis

The offices of the vice-president and general manager, L. E. Fischer, from which the entire system is managed, are located at Danville. In view, however, of the extensive operations farther west and the extensive territory in which the present development is being conducted, Mr. Fischer has temporarily removed to Springfield. A private car, plainly yet attractively equipped and furnished, serves as a movable office.

In addition to the interurban lines operated by the Illinois Traction System, the system embraces the city lines in Danville, Urbana, Champaign, Decatur, Bloomington, Jacksonville and Peoria; lighting and heating utilities in Danville, Champaign, Bloomington and Decatur, and lighting plants in Urbana, Jacksonville and Granite City.

POWER DEVELOPMENTS ON THE SYSTEM

Plans are being completed for the generation of power for the entire interurban system at three power houses, which will be interconnected by high-tension transmission lines in such a manner that they can be operated in multiple, notwithstanding the fact that some of the lines will carry a voltage of 16,500 and others a pressure of 33,000 volts.

A station containing two 2000-kw Curtis turbines is now being completed at Peoria. Additions are being made to the present plant at Riverton to give this station a rated capacity of 4000 kw. At Danville a 2000-kw generator which was exhibited at the World's Fair is being installed.

High-tension lines of No. 2 copper at 33,000 volts will leave the Peoria power house and, after supplying sub-stations en route will terminate in bus connections at Decatur. The lines from the Riverton power house and those extending east of Decatur to Champaign will also be brought to the same bus-bars at Decatur.

At Champaign will be located a transformer house in which will be installed three 400-kw transformers having a ratio of two to one. The low voltage coils of the transformers will be connected to the 16,500-volt high-tension line from the Danville power house, while the 33,000-volt lines from Champaign will be brought to the other side of the transformer. These transformers will serve simply as a means of tieing the lines together, and no power will be taken from them.

With the completion of the distribution system power generated in the Peoria power house may be used to operate the sub-station at Georgetown, about 125 miles distant. At the present time the Riverton power house supplies the Ed-

wardsville sub-station, about 90 miles distant, and this is probably the longest transmission of current generated in a steam plant in the country.

All of the lines north of Springfield, Decatur and Champaign will be single-phase roads. It is the present intention of H. C. Hoagland, electrical and mechanical engineer of the system, who is developing the transmission system, to operate each of three single-phase roads by one of the phases of a three-phase line from the Peoria power house. The sub-stations on the Peoria-Bloomington line will be connected to one phase, those of the Bloomington-Decatur line to another, and those of the line north of Springfield to Lincoln to another.

ACCOUNTING FOR TAXES

WM. H. FORSE, JR.

There is considerable diversity of opinion, among accountants, regarding the disposition of the item of taxes in preparing railway financial statements. All agree that taxes should be charged to operation during the year for which they are assessed, regardless of the dates when paid, but there is not the same unanimity as to whether taxes should be included in operating expenses or, with bond interest and analogous items, should be deducted from (net) income. The latter method seems to be the most popular, and in a recent published analysis of the Southern Railway Company's annual report a writer comments as follows: "The company lumps operating expenses and taxes together —the reason for this is not known. In some cases, like that of the Illinois Central, whose taxes consist of a 7 per cent tax on its gross earnings, these taxes might be considered as analogous to an operating expense. Usually, however, they are considered like interest on the funded debt, a fixed charge."

In the system of accounting prescribed by the Interstate Commerce Commission, taxes of every character, whether on earnings, valuation of property operated or securities owned, are shown as a deduction from income.

On the other hand, a firm of accountants of national reputation authorizes the inclusion of taxes in operating expenses, and in support of this action makes explanation as follows: "Taxes should be considered as a separate expense account under the heading of general expenses and not as a fixed charge. A fixed charge is properly a guaranteed return on invested capital, being specifically represented (1) by interest on mortgage bonds and (2) by guaranteed interest return on any other class of interest-bearing securities, said interest return being always in the nature of a fixed or guaranteed percentage, such as interest on debentures or interest on certain classes of preferred stock. In conclusion, a fixed charge is any guaranteed interest return on securities issued, which interest must be paid and deducted from net earnings, thereby leaving net profits, out of which net profits regular stock dividends can be paid."

Taxes may be separated, for the purpose of this discussion, into two general classes. The first of these may be, for convenience, termed property tax, consisting of taxes paid on all kinds of property owned, such as real estate used for right of way and other purposes, rolling stock, cash, securities, etc. Broadly speaking, the tax assessed upon property owned is not affected by the fluctuations in the volume of traffic, or, in other words, by the earnings of the property. In this respect it may be likened to the interest on funded debt, which remains constant, regardless of the fact that many trains may be taken off, or rates reduced under compulsion, and earnings thus show wide variations. It may happen, however, that taxes are largely increased this year over those of last year on the same amount of property by reason of an increased rate of taxation.

Operating expenses in detail, and the relation of their total to the gross earnings of a property, comprise tests of the efficiency of the operating staff through comparison with previous like periods; if operating expenses are cumbered with taxes, efficiency is apt to be lost sight of to some extent, when totals only are under consideration.

One accountant meets this theory with the objection that taxes can be influenced by the management in many cases. For example, at Smithtown the company rents a building and its grounds, valued at $5,000, for $40 a month, which is charged to operating expenses. The management decides to buy the property, does so, eliminates the rental payment, and henceforth pays a tax of $100 per year, which is grouped with other "fixed charges" as a deduction from income when it should properly be shown as part of the operating expense.

The writer does not accept this as a final settlement of the controversy for this reason. The company under consideration builds stations at many other places besides Smithtown, and in securing funds for the purpose puts out an issue of bonds, whose interest is thereafter a fixed charge of the company; the increased bond interest lessens operating expenses (rentals) as does the ownership of rolling stock and other property, but there is no thought of treating this additional bond interest as an operating expense.

Another kind of tax is that assessed upon earnings or volume of traffic. This is not materially affected by the method that has been used in financing the property, as is the tax assessed upon property owned, and whether the company owns or leases certain of its property, the amount of the tax is practically the same. In sharp contrast to property tax, earnings affect the amount assessed, and for this reason the tax is similar in some respects to those operating expenses which are sensitive to variation in traffic.

Frequently, however, the tax upon earnings takes a different form from that levied by municipalities and may be a charge per passenger for the use of tracks and stations at terminal points. In these instances, the gross earnings include the tax on terminal charge, which has been actually earned, and when paid as rental the amount is charged against operating expenses. Some accountants object to including this rental with earnings, especially in those States which assess a tax upon gross earnings. It is argued that the State would receive a tax twice upon the same earnings, once upon the earnings of the company owning the terminal and again upon the earnings of the company renting terminal facilities. It does not necessarily follow that the method of accounting shall be changed on that account. The writer is familiar with an instance which occurred in an Eastern State, illustrating the point. It was felt that good accounting required that the total amount earned be included in the gross earnings of the company using the terminal facilities, but for tax purposes the amount paid per passenger for trackage was set out in reports to the State board as a deduction from gross earnings, and as the companies owning and renting the tracks were agreed upon this method of reporting, the State officials allowed the deduction.

POWER STATION COSTS IN LONDON

The London "Engineer" recently published some interesting statistics on cost and output of the Neasden power station which supplies electric power to the trains of the Metropolitan Railway in London. This station was described in the STREET RAILWAY JOURNAL for Aug. 29, 1903. Briefly, the generating equipment consists of four 3500-kw Westinghouse-Parsons turbines operating at 1000 r. p. m. The steam consumption is 17 lbs. per kilowatt-hour at full load and 20¼ lbs. at half load. The vacuum maintained is about 1¼ lb. per square inch absolute. The variations in load are naturally heavy, during the daytime running from about 35 per cent to 175 per cent of normal, and after 7 p. m. from little over 20 per cent up to 100 per cent of normal. The consumption of lubricating oil in the whole station for the four turbo-generators, the exciters, alternator for coal conveyor work, pumps, etc., is under 100 gals per month.

The four turbo-generator sets at present installed are served by fourteen water-tube boilers designed for 200 lbs. pressure and worked at 180 lbs. to 185 lbs., with 180 degs. F. superheat. They were hydraulically tested to 300 lbs. per square inch for one hour. Each has 260 tubes, 18 ft. long by 4 ins. diameter, and two drums, 23½ ft. long by 4½ ft. diameter. This gives each boiler 5730 sq. ft. of heating surface, and its grate area is 100 sq. ft. Their guaranteed evaporative power is 20,000 lbs. per hour each, with 25 per cent. overload capacity; this corresponding to 3½-4⅜ lb. per square foot heating surface. The superheater of each boiler contains 128 tubes, 1½ ins. in diameter, giving 894 sq. ft. of external heating surface. Four banks of economizers serve the fourteen boilers, with a total of 1760 tubes. These deliver the feed at an average temperature of about 275 degs. F. The feed is brought to them from the hot well through feed heaters, which raise the temperature about 100 degs. F., by two compound vertical double-acting steam pumps, each of which is equal to supplying three turbines at full load.

Each turbine is served by a separate barometric condenser, the rising exhaust main being 54 ins. in diameter and 34 ft. in height. Each is designed to condense normally 66,500 lbs. of steam per hour, and will deal satisfactorily with about 60 per cent. in excess of this. The remainder steam, that is to say, the steam that is not carried away as condensed water with the circulating water, and the air are drawn off by a steam-driven "vacuum pump," its two pump barrels being 24 ins. in diameter by 24 ins. stroke, while the one steam cylinder is 10 ins. diameter by 24 ins. stroke, all three being arranged tandem. This pump runs at 100 double strokes per minute, and consumes 55 hp. No auxiliary jet ejector condensers are employed. The circulating pumps are centrifugal, one 18-in. pump to each turbine, delivering 250,000 gallons per hour, or not much short of forty times the weight of steam to be condensed. There is also a 16-in. hot-water pump in each turbine.

There are three duplex cooling towers, each essentially composed of an immense number of timber slats, which baffle and spray the water as it falls through a height of about 20 ft. Each can cool 400,000 gallons per hour down to at least 85 degs. F.

The alternators are three-phase, with 11,000 volts in each phase on a non-inductive load. The normal speed of 1000 r. p. m. gives a frequency of 33 1-3 cycles per second, the machines being four-poled. There are three 100-kw exciters installed. A small 100-kw alternator is run to supply power to various small motors and for lighting the station and yards.

There are in all nine sub-stations. Most of these have in each three 800-kw rotary converters; but two of them have each three 1200-kw, and one of them four 1200-kw rotaries. In all there are twenty-eight sub-station rotaries, of a total normal capacity 25,200 kw. These run at 375 r. p. m., and with 550-600 volts between the outgoing terminals. Each rotary converter is served by three static transformers reducing from 11,000 to about 440 volts.

The conductor rails are of soft steel of a conductivity equal to one-seventh that of copper. They are 100 lbs. per yard in weight, or 10 sq. ins. in sections. They are copper-bonded, with 1½-sq.-in. copper section. The insulators are placed 9 ft. apart.

The present rolling stock comprises twenty-eight trains, each of a total weight of 180 tons plus the passenger load, the passenger seated capacity being 350. The motor cars weigh 40 tons, and the trailers 25 tons each. Each full train consists of two motor coaches and four trailers. The motors are rated at 150 hp, and there are four of these on each motor coach, giving 1200 hp to the full train. This yields an acceleration of 1½ ft. per second per second. There are in addition ten trains of a total weight of 185 tons each, the motor equipment being somewhat heavier in these. The Westinghouse unit switch system of train control is used. Besides these, there are ten locomotives of 1000 rated horse-power each with four motors. These locomotives weigh from 45 to 50 tons, and are capable of drawing 250 tons up a grade of 1 in 40 at 10 m. p. h.

In November last complete systematic tests of the whole generating plant were made. It is unnecessary to give here all the details of these tests. The "Engineer" mentions the following results: The boiler test lasted six hours, the gage pressure being 188 lbs. per square in. and the superheat 150 degs. F. The feed reached the economizers at 160 degs. F., and left them at 253 degs. F. The water actually evaporated was 3¼ lbs. per hour per square foot of heating surface, the coal consumed being 23½ lbs. per hour per square foot grate area. This corresponds to a steaming power of 7.94 lbs. actual superheated steam per pound of coal burnt. Apart from the action of the feed heater and the economizer, which together raise the feed to 253 degs. F., the boiler proper and its superheater have, therefore, an evaporative efficiency of 9.0 lbs. water from and at 212 deg. F. per pound of coal burnt ($7.94 \times \frac{1095.6}{965.7} = 9.0$). Taking the boiler along with the feed heater and economizer, the whole plant has a heating efficiency of $\frac{1263.6}{965.7} \times 7.94 = 10.4$ lbs. from and at 212 degs. F. per lb. of coal. This means 84½ per cent efficiency, since the coal used had 11,980 as its calorific value. The percentage efficiency of the boiler and superheater separately is 73. Deducting 12 per cent of moisture contained in the fuel, the consumption of dry coal per kilowatt-hour was 2.4 lbs. Considering that there was 8½ per cent of ash as well as 12 per cent of moisture in the fuel these results are very good.

The turbo-alternator test was carried out with 184½ lbs. steam gage pressure and 150 degs. F. superheat, the average vacuum pressure being 1¼ lb. per square inch absolute. During a six hours' "full-load" run the actual variation of load was from 1200 to 6000 kw, and averaged 3850 kw. During a subsequent two hours' "half-load" run it varied

from 800 to 3400 kw, and averaged 2175 kw. The actual steam consumption per kilowatt-hour was 18.3 lbs. at full, and 22.2 lbs. at half power; but with the allowance made on account of the above large variation and for other reasons, the full-load consumption is within the guaranteed 17 lbs. per kilowatt-hour. If 85 per cent be taken as the mechanical and electrical efficiency of the combined turbine and alternator, this figure of 17 means 14½ lbs. per kilowatt-hour, or 10.8 lbs. per horse-power-hour of mechanical work done by the steam on the turbine blades.

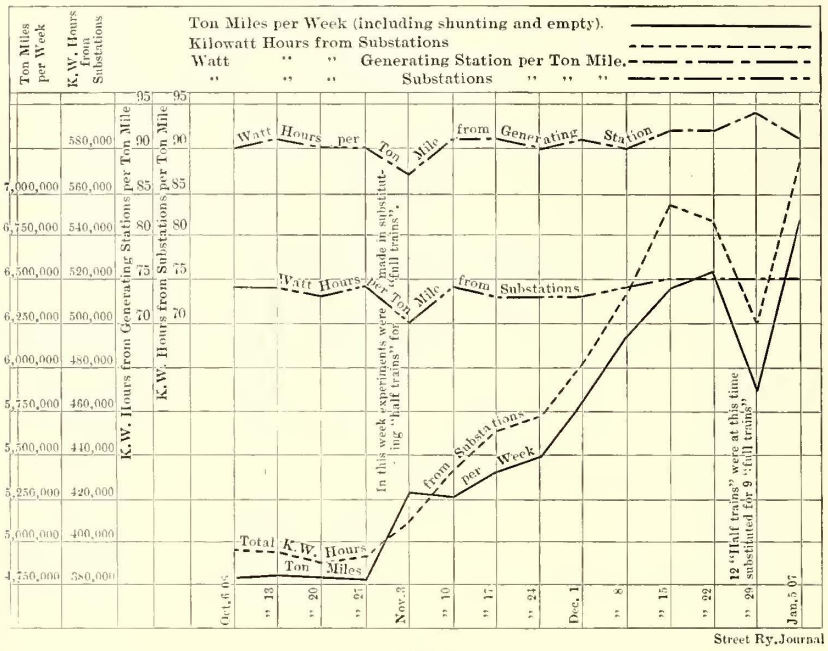


FIG. 1

The principal statistics of the last four months of 1906 are presented in the accompanying four diagrams. For the purpose of obtaining a definite figure for train-miles all the trains have been reduced to equivalent trains of 170 tons weight, although many of the trains are three-car or "half" trains, and also the real weight of a full train approximates more nearly to 180 tons than to 170 tons. In calculating the ton-mileage the passenger load has been neglected. The seating capacity gives a full passenger load of about 20 tons, but as during certain hours there is a considerable standing load, 10 tons of passengers per full train is probably an under estimate of the average. This is 6 per cent of 170 tons, and this ought to be remembered in considering the other figures of the diagrams. For instance, the average energy from sub-stations per ton-mile is 74 watt-hours, but reducing this by 6 per cent, the real figure, taking into account passenger load, is only 70 watt-hours.

The coal consumption includes all banking-up time and losses on economically small loads. The output from the sub-stations is between 82 and 83 per cent of that generated. Of this latter output between 9 and 10 per cent is spent on lighting, machine driving, etc. Thus about 75 per cent of the power generated is used for actual traction work upon the track. It is this last consumption that is given in Fig. 1 as "Consumption per train-mile and per ton-mile from sub-stations." Per train-mile of 170-ton trains the average is 12,800, and per ton-mile 74 watt-hours. Per ton-mile ⅜ lb. of coal is used, costing .0046 cents. The cost in coal consumed varies very uniformly in proportion to the output, while the other costs in this station are low, being only about .016 cent for labor and .001 cent for lubricant and supplies. The total cost thus comes to only .063 cent on the average per ton-mile. Per kilowatt-hour generated the average figures are: 4¼ lbs. coal, costing 0.5 cent; wages, 0.2 cent; supplies, .01 cent; total, 0.71 cent. This figure includes no depreciation or repairs, nor does it cover interest on capital outlay.

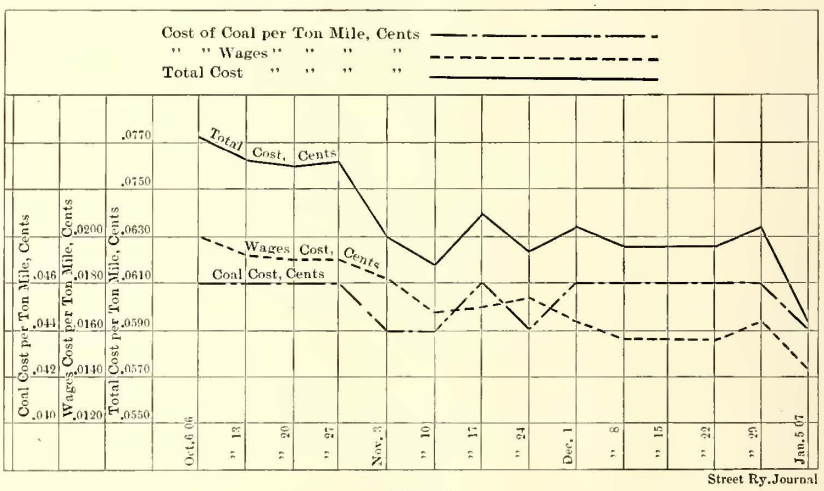


FIG. 2

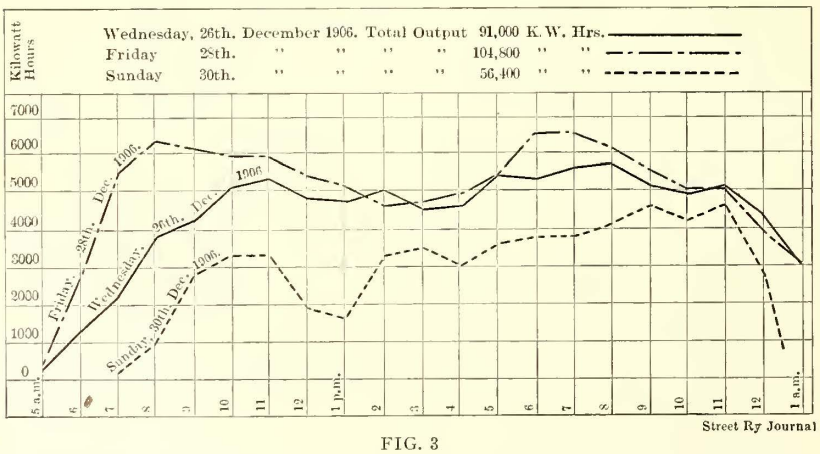


FIG. 3

The installation is fortunate in the fact that the morning and evening demand peaks are not nearly so pronounced as they are on very many electric traction systems. This is shown in Fig. 3, which gives the hourly output throughout three typical days. The Metropolitan Railway is used as a means of business communication right through all the mid-day hours. Also for at least four hours at night there are no passenger trains running, and for three out of every twenty-four hours none of the big turbo-generators is at work. The load factor is thus 42 per cent, reckoned on the normal capacity of the four units installed.

The staff works in three shifts, and over its eight hours

each shift has a low load factor of employment. The three shifts all told of high and low degree number 42 persons, or .0030 of an individual per rated kilowatt. The total number of stokers is 14 to take charge of boilers whose normal duty to evaporate and superheat 280,000 lbs. or 125 tons of water per hour.

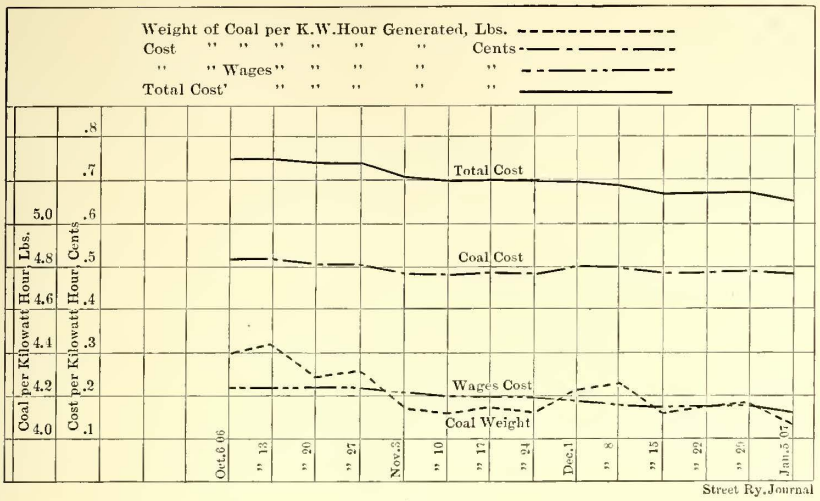


FIG. 4

A CLAIM AGENT'S VIEW OF STANDARDIZATION

The following address on the standardization of street railway equipment from the standpoint of a claim agent was delivered at the March 13 banquet of the Massachusetts Street Railway Association in Boston by Edward O'Callaghan, claim agent of the Boston & Northern Street Railway. It was afterward the subject of a general discussion among the street railway men present, a large majority favoring standardization along the lines advocated by the speaker.

STANDARDIZATION FROM THE STANDPOINT OF A CLAIM AGENT

The adoption of a standard for the construction of car bodies, trucks and electrical equipment has been a subject for deep thought and discussion in this and kindred associations for a long time, and judging by the numerous and ever varying types we see on different roads, the results up to date are not encouraging to its advocates. In taking up this subject, the principal points to be considered are the practicability, the advantages, if any, and the cost. If we are satisfied on the first two, we should not be "phased" by the question of cost, unless we find it disproportionately great. This question, like a great many others of importance in railroading, is largely a local one, as the type which may be very satisfactory in our new Western cities, with wide streets, would be out of the question with us in the East; but taking it as a general proposition, I think it unwise, with few exceptions, to adopt a standard. We want the best, and in this age of progress, when invention and improvement follow one another in rapid succession, we should allow the widest possible latitude in style and dimensions of parts and then choose the most suitable for certain localities.

Considering the subject from the standpoint of the claim agent, the standardization that counts is that which enters into the operation of the car by the conductor and motorman, that which makes their work as uniform as possible, and eliminates every foreseen possibility of confusion or mistake on account of the difference in location or manipulation of the different parts by the men. No matter who built the cars, the location of the controller, air brake, hand brake, gong pin, sand pin, scraper lever, door and step levers, overhead switches, bell cords and register cords, could and should remain uniform, so that a man stepping from one car to another could manipulate the different parts as mechanically as a touch typewritist does the keyboard of the machine.

A great many accidents have happened through lack of this uniformity; for instance, a controller and brake are a certain distance apart, so that a short man can turn both at once. On the next car they are several inches apart and he must operate one at a time, often becoming confused with dire results to the company and himself. The location of the overhead switch, if the controller sticks, is important, and when he wants it he is liable to find it in front, where he can reach it easily and almost instantly, or out of reach overhead so he has to take one of the handles to strike off the connection. Again, when he is approaching a team and it pulls in front suddenly or some careless pedestrian steps in front, he wishes to make an emergency stop. He puts his foot out to operate the sand box and at the same time sets his brake or reverses. He then is liable to discover that the sand pin is differently located than on the other car. The difference in width of cars is sometimes forgotten, so that the side of a truck, part of a load, a temporary fence by day or a warning light by night may be struck, with several claims for damages as a result.

Another trouble which unnerves the motorman when cars are in danger of collision either head-on or rear-end, is the frequency with which one car overrides the other and smashes in the vestibules, owing to the difference in height of platforms and bumpers. With his own life in danger, he is liable to become confused and forget to do the proper thing if he does not actually do the wrong one.

This brings us to the most important part of the whole equipment to standardize; either have the platforms at a standard height, so the ordinary bumpers will surely meet or adopt a standard bumper which will prevent the highest platform from over-riding, and also the lowest from passing underneath. For any company using cars of different heights of platforms, this absence of uniformity is a costly matter. The cost of repairing cars alone is a big item, but back of that, we have the broken legs and bruised spines when passengers are caught, and going still further we have the exaggerated claims for trifling injuries and fake claims where there are no injuries at all. All this is principally on the strength of the damage to the cars, whereas if they had collided with even greater force and no apparent damage was done because the bumpers met squarely, the passengers would not consider it much of an accident; and if any did go into court they could not play on the feelings of the jury by describing the damage done and gaging the force of the blow thereby. Many thousands of dollars have been voted away by juries where the injuries were trifling, simply because of the blood-curdling description of the accident, the smashing, crashing and rending of glass, iron and timbers. I firmly believe that enough money goes in repairs and settlements in one year to standardize the platforms and bumpers of every car in the State.

The absence of uniformity is still more annoying to the conductor, and is a very liberal contributor to the accident column. The location of bell cords and register cords is something that never seems to trouble the car builders,—any old place seems good enough for them, but it is of great importance to conductors not over the average height when the aisles and platforms are packed and when they have all they can do to reach them even when the car is empty. Many a time the failure to ring a quick bell or three bells to prevent an accident is due to the bad location of the bell cord. In some cars they are set so far back that a short conductor actually walks on the feet of the passengers while endeavoring to reach them, and frequently disturbs passengers' hats in the same manner. This applies with greater force to the register cords, as they are more in use. Again, both cords are sometimes so near together and sag so much between pulleys that the conductor has to puzzle over them for some time before he knows which is which. Some cars have the bell cord above and some below the register cord. We can readily understand that quick, business-like work is out of the question under such difficulties. All this wastes time and keeps the conductor inside the car, when he should be on the rear platform safeguarding his passengers and the company's treasury.

These things are very annoying, and although trifling in themselves they often lead to trouble of a more or less serious nature on account of the extra bother and sometimes the twitting of the passengers. If he happens to be sensitive or not over level-headed, the conductor becomes impatient, nervous and snappy; he gives the wrong change, does not punch transfers right, carries passengers by their destination, or starts his car too quickly. Each mistake adds to his discomfiture, until he is unfit to handle a car.

We will now assume that we have a standard equipment and it is of the utmost importance that it be maintained as such. This is not always as easy as it seems; some employees are careless, and some are actually destructive and abuse everything they handle. The motorman will strain his brakes until they are unfit for use, will mix gong and sand pins, blister the controller fingers by delaying between points, and the conductor will sometimes in an ugly fit deliberately break his bell and register cords. To correct by discipline is difficult, however, for reasons well understood, and the greatest care should be taken to see that all parts are in perfect working order at all times. For instance, the length, width and shape of gong pins and sand pins should be uniform, not everything from a 6-in. square-headed lag screw which stands 1½ ins. over the floor with a sticky thread and so slim that it runs down beside the tapper to a flat-headed 2½-in. pin which is so close to the floor that a little sand will prevent it from working. In the latter case the motorman has to stoop down, pick it up and clean it, during which time he may have an accident. The brake chain should be so adjusted that it will not require three turns where the last car had only required one.

Another injurious result of the absence of uniformity is the effect it has in shaping public opinion. Regular patrons often ride on the platforms, and become more or less familiar with the working of a car and are quick to notice defects and to criticise the management. Often, owing to statements of dishonest employees, they become imbued with the notion that the management and not the employee is to blame for a good many accidents, and even where the employee may be clearly to blame he will lay the blame to some defect which does not exist. The passenger, owing to certain things he had noticed at different times, believes him, hence we find that passenger to prove a poor witness for the company and his neighbor a poor juror.

Carelessness and poor judgment on the part of employees insure a certain number of accidents, and everything possible should be done to confine them to this class by adopting and maintaining uniformity wherever possible in everything that counts in the operation of a car. These standards should apply not merely to local conditions. If general, they would result in a great saving by stopping the destruction of property, the maiming of passengers, and preventing a number of minor accidents by removing "as far as lies in the power of the management" so many contributing causes.

MEETING OF THE UNDERWRITERS' NATIONAL ELECTRIC ASSOCIATION

The annual meeting of the Electrical Committee of the Underwriters' National Electric Association to consider changes in the national electrical code was held March 27-28 at the rooms of the New York Board of Fire Underwriters, 32 Nassau Street, New York. The suggestions of the sub-committee on wiring and equipment of street railway property, including rolling stock, were published on page 451 of the Street Railway Journal for March 16, 1907.

Rule 28, Section b: The committee proposed to amend this section by the use of the following words: "Must not be used when the difference of potential between the two wires under normal conditions is over 300 volts." It was decided not to adopt this amendment, but to add a note in fine print to the code exempting railway circuits from Section b of Rule 28.

Rule 33, Sections c and d: The object sought by the amendment suggested by the committee was approved. A change was made in the wording of each amendment, however, by substituting the word "may" in each case instead of "can." It was thought that the former word expressed permission better than the word "can." The last clause of the amendment to Section c in its original draft read: "The current must be cut out of the building whenever the latter is not in use or the road is not in operation." It was not the intention of the sub-committee to require that the circuits should be cut off when there is an inspector in the building, and it was decided to reword this sentence so as to permit the use of current in the building under these circumstances.

Rule 33, Section e: Clauses 1 and 3 were united so that they read as follows: "Cut-outs and switches must be placed between non-grounded side and lights or motors they are to protect."

The wording of the proposed clause 4 of Rule 33, Section c, was also referred to a committee for rewording. As expressed in the amendment proposed by the committee it would seem to dictate the use of a No. 00 B. & S. gage wire for connecting the lighting circuits to the rail return, whether there is one light or more on the circuit. It was decided to change this wording so as to permit the lighting circuits to be wired under the usual rules and simply grounded to the No. 00 main to the rail return.

On the morning of March 29 a short conference of the association was held as to the advisability of drawing up a code for high-voltage single-phase trolley wire installations, such as those from 3300 volts to 11,000 volts. It was the opinion of the association, however, that it was too early in the art yet to make rulings of this kind.

TRANSPORTATION AT THE JAMESTOWN EXPOSITION

BY E. C. HATHAWAY
General Manager, Norfolk & Portsmouth Traction Company

The problem of handling the millions of people who are expected to attend the Jamestown Exposition, to be held at Sewell's Point on Hampton Roads, Va., this coming summer, is one which will doubtless be of interest to the readers of the STREET RAILWAY JOURNAL, and I shall endeavor to give as concisely as possible our plans for doing this.

There are two trolley lines, both double-tracked, which will operate between Norfolk and the Exposition grounds, viz.: the Norfolk & Atlantic Terminal Company and the Ocean View division of the Norfolk & Portsmouth Traction Company.

The Norfolk & Atlantic Terminal Company, recently acquired by the Norfolk & Portsmouth Traction Company, is a double-track trolley line of standard gage which operates between Norfolk and what is known as "Pine Beach," a summer resort operated by the same company at Sewell's Point, and on from the latter place by ferry to Newport News.

On this line a single-track viaduct across the Norfolk & Western Railway necessitates a wait when two cars have to pass at this point. To avoid this when we are running the frequent schedule which will be necessary during the Exposition, we have gotten from the city a temporary permit to lay certain track connecting the lines of this company with those of the Norfolk & Ocean View Railway Company (formerly the Bay Shore Terminal Company), which was also recently acquired by this company. This latter line also crosses the Norfolk & Western at another point by a single-track viaduct, and it is proposed to run all cars of both companies out of the city and across the Norfolk & Western via the lines of the Bay Shore and return via the lines of the Norfolk & Atlantic Terminal Company. The cars of each company will then return to their own tracks on the other side of the railroad, thus making a loop through which all cars will operate in one direction. This will facilitate the operation of a fast schedule and do away with all chance of accidents at the viaducts.

The Ocean View division of the Norfolk & Portsmouth Traction Company runs from Norfolk to Ocean View and

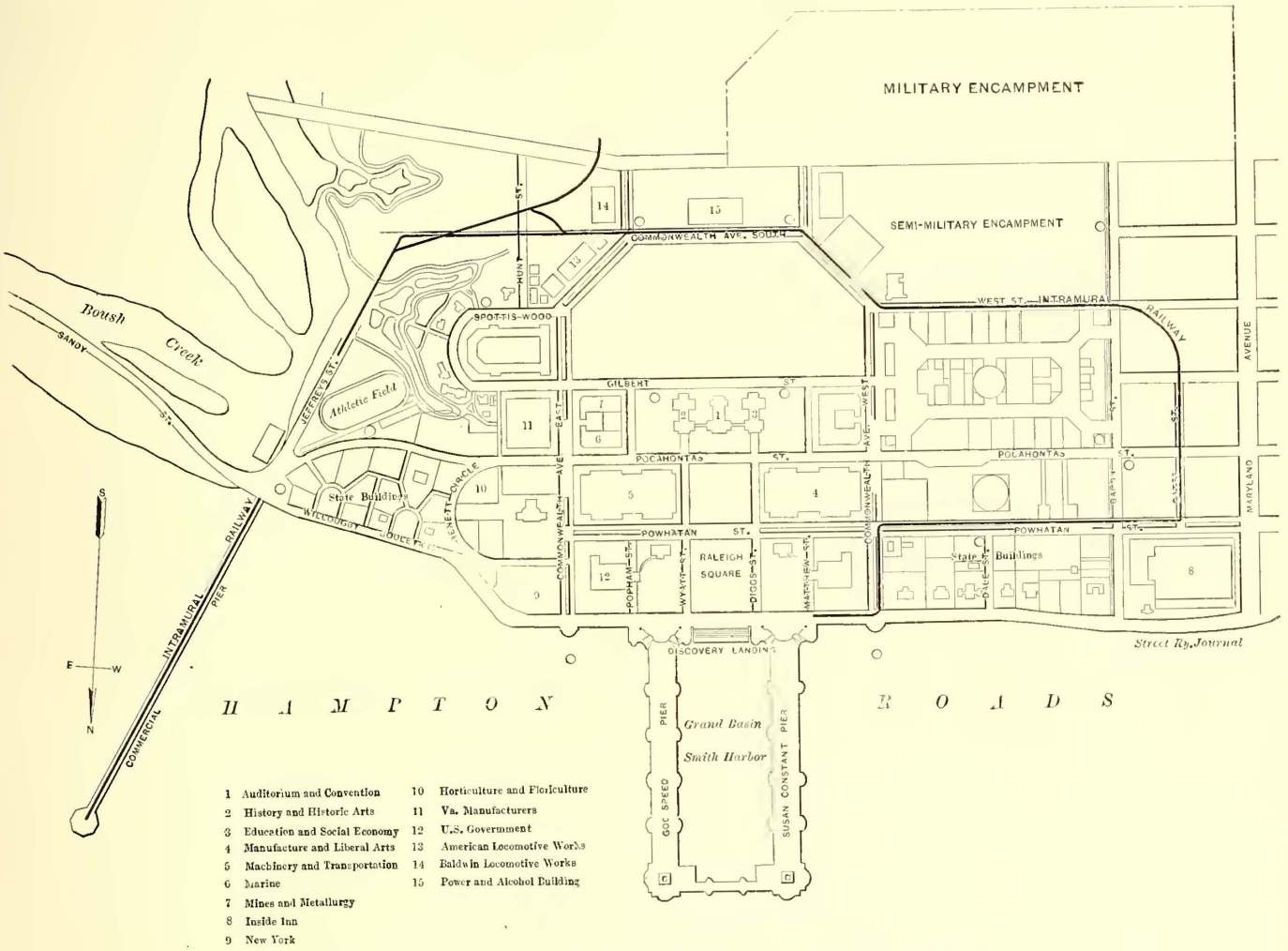


FIG. 1.—PLAN OF JAMESTOWN EXPOSITION, ON HAMPTON ROADS

Willoughby Spit and from there by ferry to Old Point Comfort. We have extended this line from a point just below Ocean View, known as the Government Reservation, across the country on the shores of Willoughby Bay to the Exposition grounds, a distance of about 3½ miles. This road is a double-track line with a 5-ft. 2-in. gage.

The use of these two lines makes practically a four-track line, and as the terminals in Norfolk are at different points, the crowd will be divided in loading.

We have purchased about forty Brill semi-convertible cars and forty open trailers, and these, with the cars we already own, will enable us to run a motor car and trailer over each line every 2½ minutes, and during rush hours every three-quarters of a minute. Counting 250 passengers to the train, this would mean a capacity of 12,000 an hour in each direction.

The terminals at the Exposition grounds are shown on

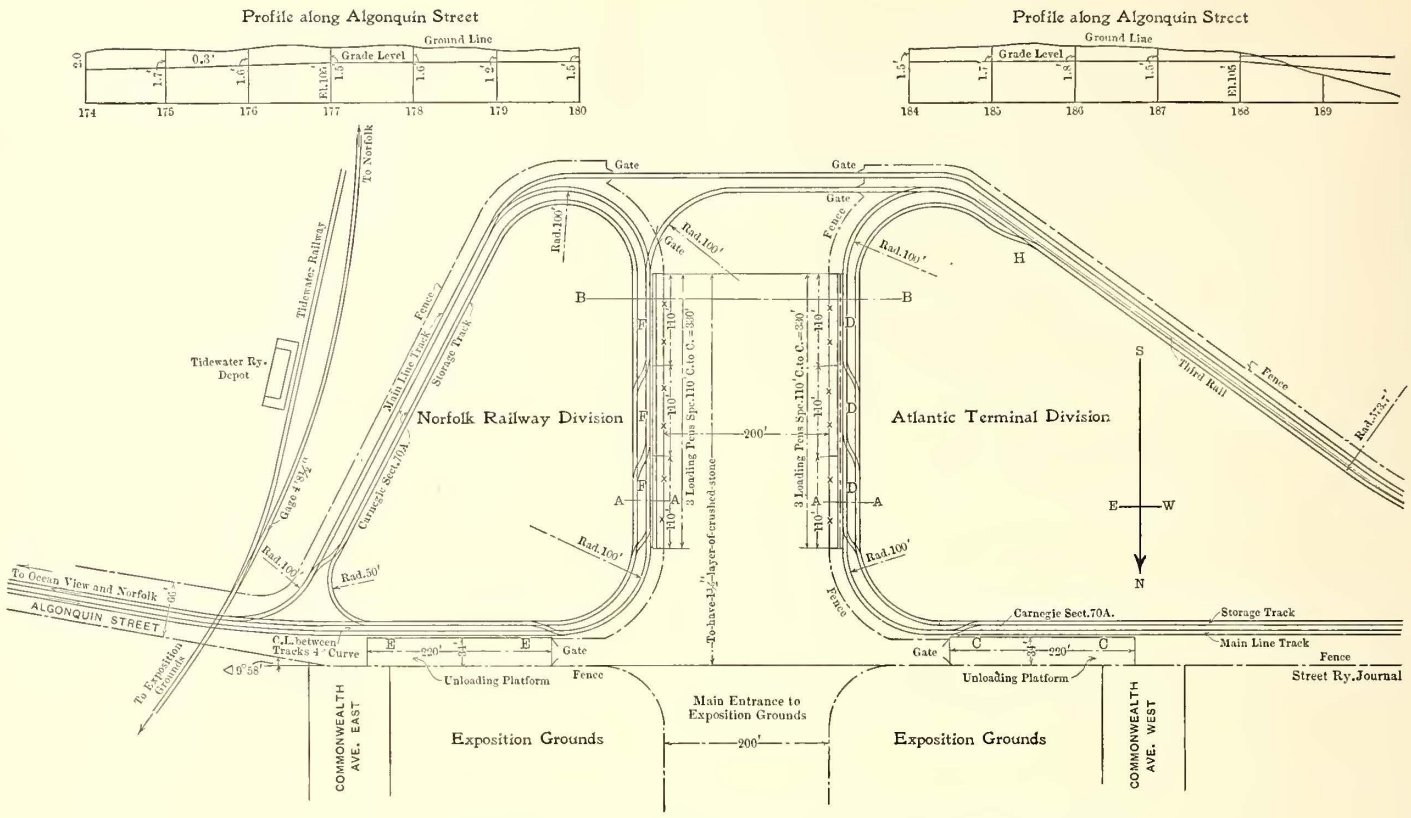


FIG. 2.—PLAN OF TERMINALS AND APPROACH OF ATLANTIC TERMINAL DIVISION

the accompanying map, Fig. 2. The difference in the gage of the two lines necessitates two separate stations.

The Atlantic Terminal cars will come in and unload passengers at the point *C*, continue around to the point *D*, where they will load, go on around the loop and return to Norfolk. The Ocean View division cars will come in on the other side, unload at the point *E* and proceed to the point *F*, where they will load and return around the loop to Norfolk, via Ocean View. As shown on the map there are three cross-overs in front of the loading platforms on each side and frequent cross-overs at other points, to facilitate switching cars for loading and unloading.

On each side are three loading pens each 110 ft. long. Each pen is provided with two gates at about the points marked *x*, and each gate has a turnstile and a ticket-chopper, one man to operate each ticket-chopper and one man to operate each turnstile. Six cars at a time can be loaded at each terminal, and with one gate for each car and

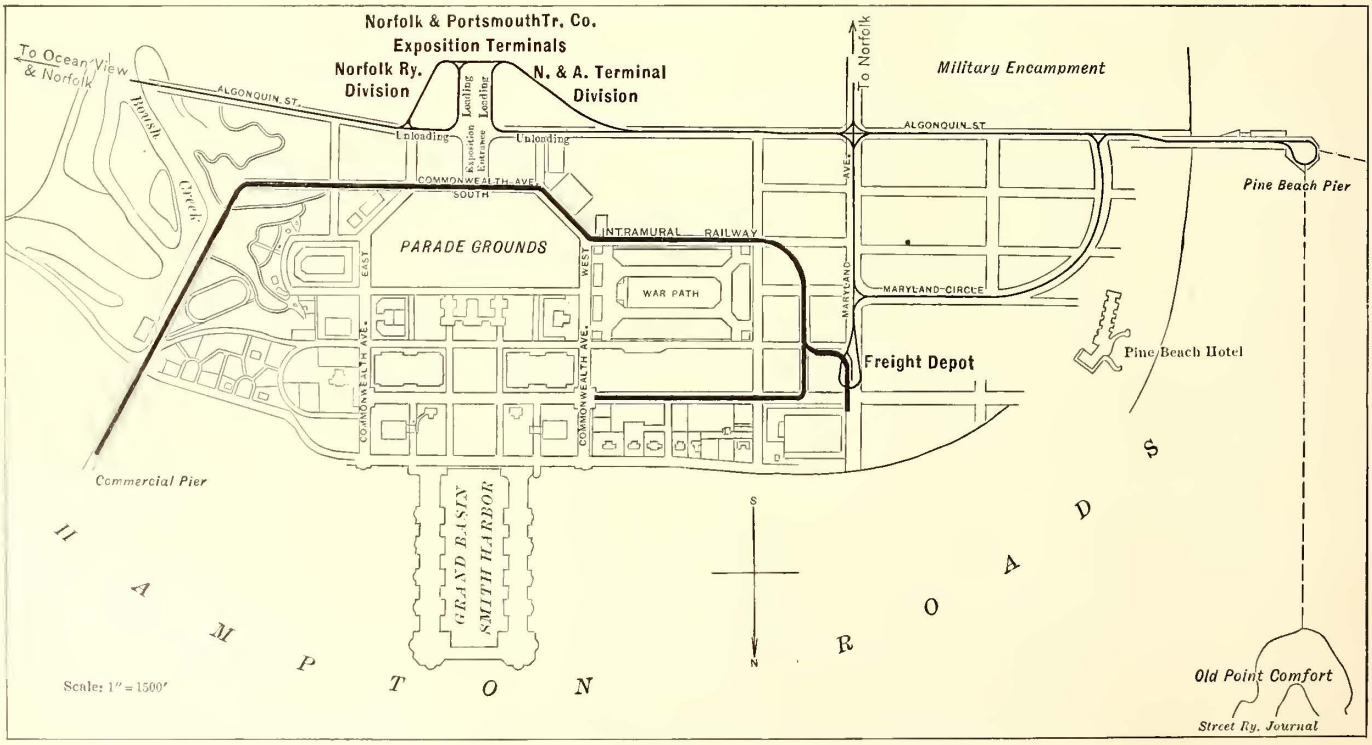


FIG. 3.—GENERAL PLAN, SHOWING TERMINALS, GROUNDS AND INTRAMURAL RAILWAY

the divisions between the pens, there will be little danger of accident in loading cars. It will also be seen from the map that the storage track on the terminal side extends from the point G around to the point H, a distance of over 1400 ft., and on the Traction side the entire inside track around the loop is available for storage for about the same distance.

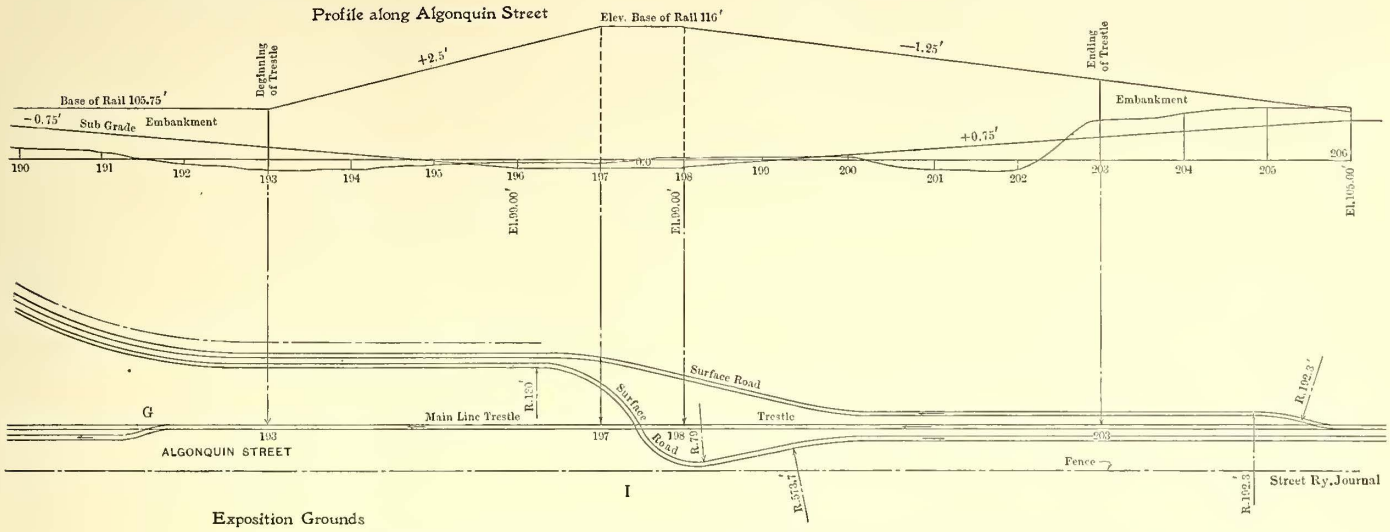


FIG. 2 (CONTINUED).—PLAN OF TERMINALS AND ATLANTIC TERMINAL DIVISION

Where the tracks cross at the point I, one track passes over the other, thus doing away with the danger and delay incident to a grade crossing.

In the space just outside the Exposition gates will be erected booths from which tickets will be sold. It has not been fully decided whether the plaza between the terminals will be paved or covered with crushed stone.

The third rail from the point where the Traction Company's tracks join the Terminal tracks is for the purpose of enabling the cars of the Traction Company to reach the freight station shown on map Fig. 3 and in detail on map Fig. 6.

A smaller terminal station will be located opposite the freight depot, with the same turnstile arrangement. This will be the terminus of the cars operating between the grounds and the company's pier, where various boats be-

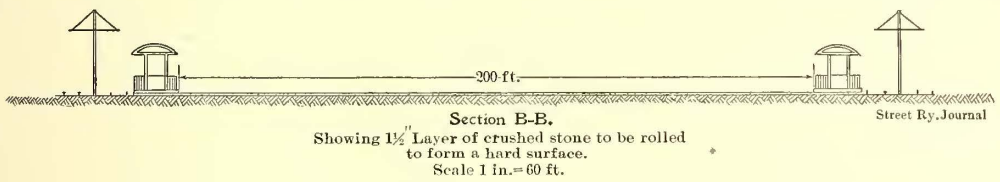


FIG. 5.—SECTION BB OF FIG. 2

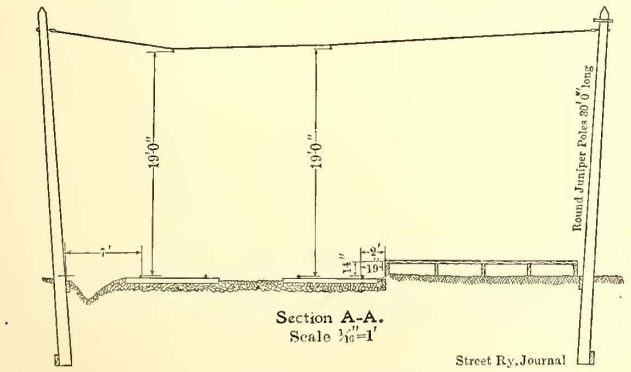


FIG. 4.—SECTION AA OF FIG. 2

sides our own will land, bringing people from Newport News, Old Point Comfort, Hampton and Norfolk.

There will be a cashier's office at the Terminal station and the surplus money taken by the conductors will be turned in at stated intervals during the day. All receipts will be deposited in drop safes at this end and will be taken care of by the treasurer and his staff at the close of each day.

The fare between Norfolk and the Exposition grounds will be 10 cents or two tickets over the Norfolk & Atlantic Terminal division, six tickets for a quarter being sold on both lines. The fare over the Ocean View division has not been fully decided upon on account of the necessity of having three coupons. The distance via Ocean View is

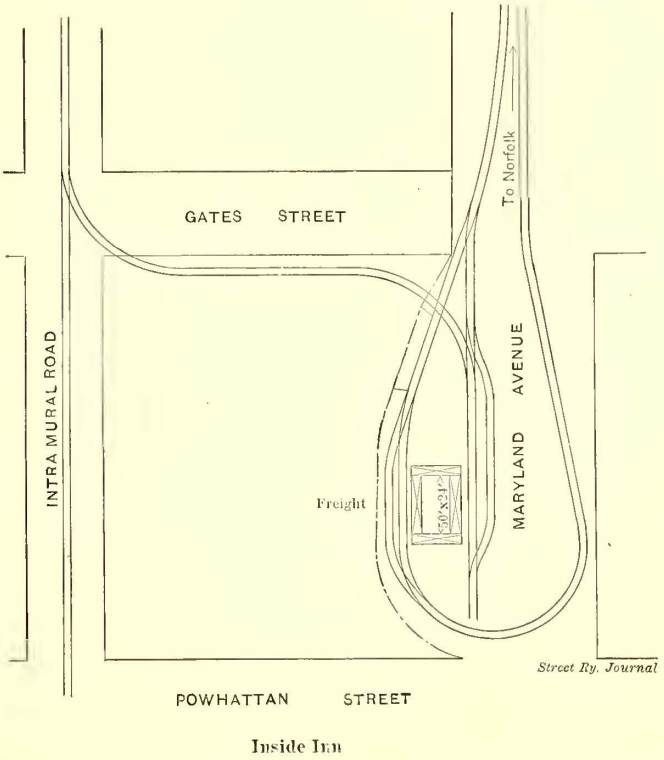


FIG. 6.—TRACKS AT FREIGHT STATION

9 miles and will consume approximately 40 minutes. The distance via the Atlantic Terminal is about 6 miles and consumes 30 minutes.

At the Norfolk end the cars of both companies operate around loops, so that there will be no delays in switching and turning cars.

We have studied every phase of the situation and feel that we have a very complete plan, and with the various steamboat lines which will be operating between Norfolk and the Exposition grounds we shall have no difficulty in handling the crowds.

THE DAYTON MEETING OF THE CENTRAL ELECTRIC RAILWAY ASSOCIATION

The March meeting of the Central Electric Railway Association was held at the Algonquin Hotel, Dayton, Ohio, March 28. It was well attended and the discussion of the papers presented was animated and exceedingly interesting. The morning session was opened by President Nicholl at 11:30. Retiring President Spring took the occasion to welcome his successor, President Nicholl, to the chair and to extend to him the best wishes of the association, and as a token of the esteem in which he was held presented him a bouquet of roses. In a few appropriate remarks President Nicholl thanked the association for the honor conferred upon him and stated that he regretted very much his inability to be at the Indianapolis meeting, at which he was elected. He urged all to attend the meetings and to come fully prepared. He believed none could spend one day every two months to a better advantage than by attending the meetings.

After the minutes of the last meeting had been approved the following paper on "Track Bonding" was presented by Thomas B. McMath, civil engineer of the Indianapolis Traction & Terminal Company:

TRACK BONDING

The earliest track bonding noticed by the writer was the bonding of the old tram rail on wooden stringers. This was done by drilling a ⅜-in. hole in the tram near the end of the rail. The bond consisted of a No. 4 galvanized iron wire; a rivet was started in the hole, about two turns of the wire were taken around the rivet and then the rivet was set. In speaking of this work, some time ago, a statement was made that no pains were taken to get good contact. This is the general opinion of present critics, but it probably was never the case. Frantic efforts were made to pour solder on the wraps of wire around the head of the rivets. The head of the rivet was under the rail and the space required for clearance was obtained by notching the stringer. The end of a rail only was raised during the work of installing the bond so as not to interfere with the service of mule cars which passed over the road every ten minutes. Both the contempt of the mule driver for the new methods of propulsion and the conceit of the expert applying bonds often found ready expression in plain but vivid language.

The next method of bonding, so far as the writer knows, still retained the use of the galvanized iron wire, but the supplementary wire was carried the full length of the track and was connected with each joint bond. Even in this type of bonding an effort was made for good contact, as all wire splices were soldered.

Failure of the bonding during these periods was not hard to explain. The entire track construction was so weak that the impossibility of securing a proper return was chargeable largely to the track as well as the lack in capacity of the bond. At this time, while the tram rail was still in use the 4½-in. girder rail was considered standard construction for horsecar work and was expected to be sufficient for electric cars if it were only bonded.

The channel pin was generally used with wire bonds and was the first efficient terminal. It was first used with galvanized iron wire up to No. 0000.

This type of bonding held its own in popularity and efficiency till driven out by bonds concealed under the angle plates. Its popularity was largely due to the possibility of using old scrap wire from feeders and trolleys as bonds. Its efficiency was due to its easy application by unskilled workmen. Its failure was caused by the ease with which the copper was stolen on exposed track.

With the 6-in. girder rail, however, a much better bond, known as the Chicago bond, was used. Those employed by the writer had a solid No. 0 wire with a large base at the terminal end, and the terminal was threaded. After the terminal was put through the rail a brass nut was put on and pulled tight. The surface of the rail around the hole was milled with a special tool, and a large area of contact was provided by the boss on the terminal which pressed against the milled surface. Special pains were taken for contact, as a strip of solder was introduced under this boss and after heating it with a torch the nut was given an extra turn. Finally the end of the thread was riveted to prevent the nut becoming loose.

The next bond coming under the writer's notice was the No. 00 Atkinson "horseshoe," about 2½ ins. long. This bond was designed to be applied with a single screw compressor, but in reality a large majority were driven in and riveted with a hammer. This bond gave good results on account of its increase in capacity when used on good firm joints. On loose joints, however, its shortness and lack of flexibility soon resulted in the contacts being destroyed. The No. 000 and No. 0000 Washburn & Moen bond known as the Crown bond was next. This bond had a hollow terminal which was expanded after its insertion in the rail by a tapered steel plug driven into the hollow terminal. These bonds proved to be good. The point of failure was generally in drilling a hole of the exact size needed for the terminal, and the limited expansion the plug would give. The result was loose terminals. There are bonds of this description in track at Indianapolis that test fair now after six and seven years use.

The standard bond in use in Indianapolis is a No. 0000 10-in. flexible bond with ⅞-in. compressed terminal. With this type of bond the chief difficulty is the connection of the flexible strand or ribbon wire with the terminal. Each manufacturer claims that his process is the best. But all bonds are subject to the personal errors of the workman in manufacture. Certain heat conditions, together with proper manipulation at the exact moment, are essential to the construction of a good bond. Individual wires which are badly burned or practically cut through in the process of forging are frequently found in all these bonds. I know of no practical test that can be applied to ascertain the conditions at the point where the strands merge into the terminal. If the terminals are sawed open with a hack saw, the condition of the surfaces exposed is no proof of their original condition, as the drag of the saw teeth in a material which flows as readily as soft copper will cover and smooth over irregularities. If the terminal is cut in quar-

ters by a hack-saw down to the flat and these quarters are spread and flattened back by sharp, heavy blows with a hammer, such a test may demonstrate the ductility and hardness of the material and may show some measure of the contact between the ribbon wire and the head in cases where the head was originally a separate piece. For testing the union of ribbon or strand wire with the terminal, the following is suggested: Hold the head of the bond firmly in a vice, then after cutting the strands some 2 or 3 ins. from the head, bend them back against the terminal. Then take the individual wires and separate them from the head by a strong, sharp jerk. This will show, relatively, any reduction in area, brittleness and possible defect at their junction.

Manufacturers do not pay sufficient attention to smooth terminals. Frequently terminals are so rough that an appreciable flow of material under compression will be required to bring cavities into contact.

A serious difficulty in bonding is the drilling of holes in the rail. New twist drills will bore an exact hole, but if they are ground by hand the holes which they bore will not be true. A tool grinder is therefore essential. A Yankee tool grinder in the shop, or one of the portable tool grinders now obtainable, should be used exclusively for bitts. A portable grinder costs about $15 and can be fastened on a hand car, wagon bed or even on a block of wood. In the latter case the grinder is convenient to carry, and when nailed to a pole or a tie, grinding can easily be accomplished.

In one case, after carefully bonding some 3 miles of track the writer found at the end of three months that 15 per cent of the bonds were faulty, and is convinced that defectively ground bitts were entirely responsible for this condition. The original holes were drilled with a Ludlow electric track drill after the track was laid, and the holes drilled dry so that no oil or dust could prevent contact. The bonds were immediately applied with good compression. It was decided that one of the bitts used, due to defective grinding, must have drilled a hole nearly one-eighth of an inch large. The only defective bonds were consecutive along one side of the track, and the holes were all found to be too large.

It is necessary to insist on the use of the tool grinder, as men claim they can grind better by hand. Investigation has shown that all claims of better grinding by hand were due to a wire edge left by the tool grinder which prevents good cutting. The wire edge can easily be removed by the back of a knife blade.

If one man is made responsible for the field grinding he will soon learn the necessary kinks and take pride in doing the work well.

The writer has never personally used a plastic bond. His experience with solders of low melting temperature, and which contain bismuth and mercury, indicate to him that such alloys will granulate and disintegrate in time.

Soldered bonds are a succcess where carefully applied. They give good contact, and are hard to remove. Good track with firm joints are necessary for the success of a soldered bond.

The use of a bond brazed to the rails by means of an electric brazing device gives the best contact that can be obtained. This process of brazing, however, includes the merging of the ribbon wires into a solid mass for a terminal, which is the most delicate part of bond manufacture. The forging of a bond can be entrusted only to a workman of the highest skill. Railway companies will find it difficult to do work themselves with such a machine, unless able to find and keep an operator with the requisite skill.

In Indianapolis there are 40 miles of track with cast-weld joints. These joints have been tested several times for electrical contact, and show well in this respect. Only 1 per cent of open joints have had to be rebonded after five and six years of service.

It is frequently impossible to bond all joints in special work, as the compressor cannot be applied. Long bonds must be used to connect all pieces that would leave open joints. In addition it is best with complicated layouts to use long bonds to jump the entire job of special work. The size and number of such long jump bonds depend on the amount of return current to be carried. Long bonds can be made with terminals spliced and soldered to the wire or cable.

Manufacturers charge more for two terminal ends than for a 30-in. cable bond, which cut in two will provide the desired terminals. The reason for this is a secret of the manufacturer.

The general rule for cross-bonding is to use a cross-bond every 500 ft. and at both ends of all special work. Double track should be bonded across at least every 1000 ft. A bond made 66 ins. long will suffice for both track and devil strip cross-bonding.

Bond testing can be done with very simple instruments. The double voltmeter is sufficient. This is wired to knife-edge terminals. One reading is taken through the joint, the other reading through a similar length of rail. A comparison of the drops shown by each meter will give the relative conductivity of joint and rail. A joint showing three times the resistance of an equal length of solid rail is frequently permitted. Greater resistance indicates that the bond should be renewed. The expense of removing and replacing the pavement, however, frequently prevents proper attention to poor bonds.

It is a slow and tedious job to go over any length of track with a bond tester. Enough attention is, however, not given to the condition of bonding. A bond supervisor should be employed on all roads and he should have no other duties which will prevent his making proper inspection. A good bond supervisor will undoubtedly be termed a crank by construction gangs; if so, this proves his efficiency. A test car for general inspection of bonding would be a good investment for roads of considerable length of track. Such a car has made trips over Indiana and Ohio roads. The car gave the general conditions, but registered more open joints than actually existed, as any break in contact between the wheel of the car and the rails would also register as an open joint. In spite of any local defect missed or non-existing defect registered, the car would show the conditions of bonding for less expenditure per mile than any other method.

DISCUSSION ON TRACK BONDING

The discussion following Mr. McMath's paper was largely confined to the method of drilling holes and to the use of brazed bonds. Mr. Mason, of the Electric Service Supplies Company, thought that oil used in drilling holes got into the steel and was hard to remove. Mr. McMath replied that he had forbidden the use of either water or oil in drilling holes.

G. H. Kelsey, electrical engineer of the Indiana Union Traction Company, said that one bondmaker insisted on using gasoline to remove oil. He believed oil formed a coating of insulation and increased the resistance of the bond.

W. H. Evans, master mechanic of the Indianapolis Traction & Terminal Company, said that there was no question

but that oil was detrimental. He added that the later developments in the production of high-carbon or high-speed steel would permit drilling without the use of oil or water.

Mr. Kelsey wanted some information concerning the brazed bond. He said he had heard that one objection to this bond was that in fusing the terminals the meshes were weakened. He thought this was probably due to improper fusing, but he wanted to know some practical results from brazed bonds.

C. N. Wilcoxson, general superintendent of the Cleveland, Southwestern & Columbus Railway, said that about fifteen months ago he had two short divisions of his road bonded with these bonds. The bonds were installed at a season of the year when wet weather and other conditions prevented the installation of soldered bonds. A recent inspection of the bonds on the different divisions after they had been on fourteen months showed that out of 1200 bonds there were seven defective. Of the seven, five were defective on account of broken strands. The terminals of these bonds were intact and in good order. Two bonds had one terminal loose. He considered the showing a remarkable one. At a later date 500 bonds were placed in brick pavement. The track was in bad condition and it was practically impossible to keep joints tight. Of these 500 bonds an inspection showed 27 defective ones. He thought this a very good showing, considering the condition of the track. He said he would use many more brazed bonds this year. In two years, he added, he had used about 10,000 soldered bonds. His data were not sufficiently accurate to give definite results, but he did not think the failures excessive.

George H. Whysall, of the Columbus, Delaware & Marion Railway, in speaking of the expense of installation of bonds, said that in installing 2000 twin terminal bonds the expense of installation was from 8 to 10 cents. The number that could be installed per day depended somewhat on the temperature. During the installation of the first 1000 bonds considerable trouble was experienced by the breaking of drills. The drills broken were usually those used to bore the two inner holes or the holes next to the end of the drill. He removed the oil used in drilling the holes by the use of a cheese-cloth swab and gasoline. He took exception to Mr. McMath's statements that the drills should be machine-ground. In all his work the drills were hand-ground, and he thought they could be ground more accurately by hand than with a machine. He added that trouble with bonds was usually because the company expected to get the work of bonding done by a section hand rather than by a mechanic.

The next paper on the program, "Car Wheels for Interurban Service," was presented by C. Skinner, master mechanic of the Scioto Valley Traction Company, Columbus, Ohio.

CAR WHEELS FOR INTERURBAN AND CITY SERVICE

I have interpreted this subject to mean, "Wheels for heavy interurban cars, operated over both interurban and city tracks," and in the treatment of the matter at this time I have in mind only the operation of high-speed equipment weighing 40 tons or over per car. I am fully satisfied that in the selection of wheels for this class of service the specifications of the Master Car Builders' Association should be adhered to as nearly as possible. It may be, and in our case was, necessary to reduce the size of the wheel flanges somewhat to operate over city streets. I believe the flange dimensions may be safely reduced to 1⅛ ins. or 1 in. in depth and to 1¼ ins. or 1⅛ ins. through the throat, but I am firmly of the opinion that the 4-in. tread is essential to safe tracking and to obtain proper efficiency in braking with heavy equipment.

Since the introduction of the rolled-steel wheel is comparatively recent, I will not enter into a discussion of the relative merits of this type as compared with the steel-tired wheels which we have in use on all of our motor equipment.

My experience has been that the flangeless brake-shoe is best for service in which heavy cars are operated over grooved rail in city streets, for the reason that the flange wear, always excessive, should not be increased by the use of a flanged shoe. We have demonstrated by practical tests that the wear on the wheel flange by a brake-shoe adhering to the flange of the wheel reduces the possible length of time between tire turnings by nearly 30 per cent. Therefore, in the operation of heavy equipment at high speed with flangeless brake-shoes, we need a fairly wide tread to obtain sufficient braking power.

The question of safety in tracking is an extremely important one. I believe all will agree that no system of inspection, no matter how thorough, can be depended upon to detect a wheel loose and working at the axle fit at just the time it occurs. Therefore, why reduce the factor of safety from this not unusual trouble, especially when we have to meet a condition in operating over city tracks that greatly increases the liability of wheels to loosen on the axle fit? Recognizing the desire and expediency of interurban companies to operate their cars over the tracks of city companies within the limits of municipalities, I believe that in the operation of this same heavy equipment at high speeds outside of city limits, safety must be the first consideration.

Asking your further indulgence, I will give you a brief resumé of the experience of the Scioto Valley Traction Company with the wheel question. This company commenced operation in July, 1904, and until about Dec. 1, 1904, it operated on its own T-rail tracks exclusively, not entering Columbus over the city tracks until the latter date. The records from which data were obtained for this report cover ten 60-ft. passenger cars of this company, weighing 42 tons each and equipped with 36-in. steel-tired wheels, having M. C. B. tread with flange 1 in. deep by 1 1-16 ins. thick through the throat. (This was found to be the maximum size of flange which could be operated over the groove-rail tracks in the city of Columbus.)

The accompanying drawings submitted herewith show the exact wear on flanges of a pair of wheels removed from one of the cars on March 22, 1907; this pair of wheels having been placed under the car Nov. 8, 1906, with tires newly turned to the dimensions mentioned above. The mileage made by this pair of wheels during this interval was 28,000 miles. This wear was, however, somewhat abnormal, as we average about eight months between turnings, or about 48,000 miles.

The first five months of our operation, you will recall, was over T-rail, and I would call particular attention to the fact that during that time our wheel flanges showed no perceptible wear. Since Dec. 1, 1904, or during a period of about twenty-seven months, we have been obliged to remove and turn ninety-three pairs of wheels for no other cause than worn flanges. The distance covered in going in and out of the city of Columbus is 7 miles, about one-half of which is grooved rail with 1¼-in. groove.

In looking at the print you will observe the excessive wear on the inside of the flange. This wear, coming at the

angle it does, shows a very severe wedging tendency, which finds its weakest point at the wheel and axle fit. The inertia from the swaying of the heavy car and climbing the inside of groove where the track is out of alignment makes it very difficult to maintain an immovable wheel at this fit. In less than two months after commencing operation over the city tracks we had a large number of loose wheels, that is, they had moved out of gage on the axles, notwithstanding that it afterward took from 45 to 60 tons hydraulic pressure to move the same wheels in the shops. We replaced these wheels at from 90 to 125 tons pressure, and have been fairly successful in keeping them tight.

Judging from our experience, I should say that wheels for this class of service should be pressed on at about 90 tons, with a minimum of 70 tons. I have handled wheels of the same design on steam railroads for a number of years, using 40 tons as a maximum pressure, with no trouble from loosening.

Although over half of the wheels under the cars covered in this report have been refitted on account of becoming loose, we find it necessary to maintain the most rigid inspection of our wheels. We keep a trained inspector whose principal duty it is to gage each pair of wheels each day a car is in the shops, that is, every alternate day. The spread is measured by a solid immovable gage and a written record is made of the position of the wheels on the axle. This report is turned in to my office, where it is carefully checked with the former records. It is not unusual even now to find a wheel loosened, notwithstanding the enormous pressure at which we put them on.

Some idea of the excessive wear of flanges due to the cause mentioned may be shown by comparison with the life of the same wheel under equipment of equal weight on steam railroads, it being not unusual to obtain a mileage on steam roads of about 200,000 miles between turnings, while our average is 48,000 miles.

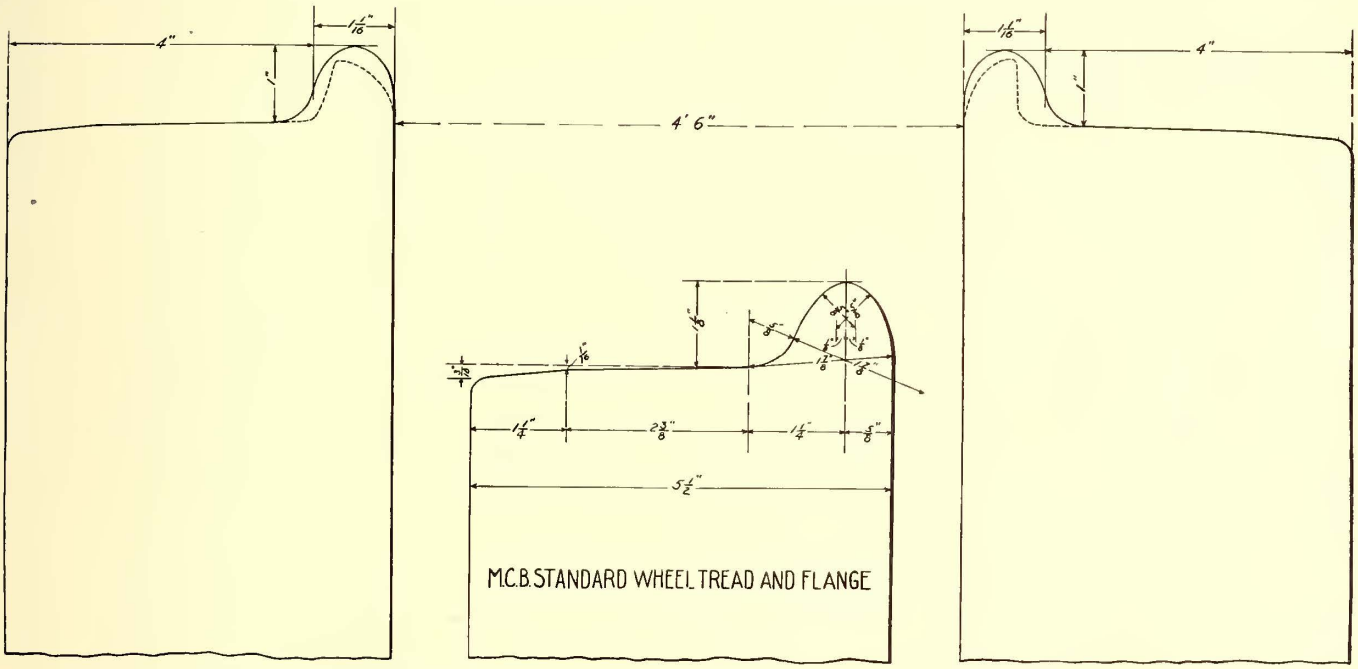
DISCUSSION ON CAR WHEELS

Mr. Whysall thought that the wedging action caused by the wheels riding on the inside of the groove of the rails in city streets was undoubtedly the cause of the loose axle fits experienced by Mr. Skinner. He wanted to know whether or not Mr. Skinner had found any difference in the wear on the flanges of the wheels on the gear side and of the mate wheels.

Mr. Skinner said that he had found the wear about equal. He added that his troubles were increased by the fact that the gage of the city track over which his cars ran varied from 4 ft. 8¼ ins. to 4 ft. 9 ins.

Mr. Whysall said that his experience had been that the greatest flange wear was on the leading wheel nearest the gear. At first he thought this was due to the sanding devices, but the sanders had been changed and the same results had since been obtained.

F. A. Bundy, master mechanic of the Lima & Toledo Traction Company, said that he was not able to get 50,000 miles out of a pair of wheels because of the rapid wear of the wheel adjoining the gear. Recently he had not been turning a full flange on worn wheels. Instead, the sharp flange is partially turned out of the wheel worst worn, and the wheel is then put on the rear axle and on the side opposite the gear. He is now turning the wheels on the gear side of the forward truck a little larger, so as to offset the tendency to wear. He did not know whether his trouble was due to the condition of the track or to the fact that his cars were operated in one direction only. The trouble was experienced with two styles of truck.



WEAR ON INTERURBAN STEEL-TIRED WHEELS CAUSED BY RUNNING OVER GROOVED RAIL IN COLUMBUS, OHIO

Mr. Skinner said that his cars were operated in both directions. He got from 160,000 to 170,000 miles out of 2½-in. tires.

Mr. Kelsey said he believed one cause for the wearing of wheels was the condition of the side bearings. He said there is no question but that a roller center bearing would help matters.

Mr. Evans thought Mr. Bundy's wheel troubles were due to the type of rail and largely owing to too close gage on curves. He said that the importance of mating wheels was not fully appreciated. Often the mating of wheels was given over to men who did not take sufficient care. He said that wheel-makers sometimes employed boys 10 or 12

years of age to do the taping. He thought that a difference of one-eighth of an inch in the tape measurements in taking the circumference of wheels should be the limit in mating them. He urged the use of a tape rather than calipers in getting the diameter of wheels, saying that he knew nothing better for taking measurements than the M. C. B. standard tape. He had followed the plan of making the wheel having a thin flange a little larger to throw the strain on the mated wheel. He said it was important that the wheels should be mounted at equal distances from the center of the axle. This place could be located by a punch mark at the center of the axle. It was unfortunate, he said, that the traction companies had not agreed on a rail which would tend to reduce the wheel wear.

Mr. Skinner, in reply to a question by Mr. Bundy, said that his wheels were not key-seated on the axles.

At the conclusion of the discussion, on a motion by Harrie P. Clegg, president of the Dayton & Troy Electric Railway, a vote of thanks was extended to those presenting the papers and to those taking part in the discussion.

AFTERNOON SESSION

At the opening of the afternoon session the president announced the appointment of several committees, after which the following paper on "Trolley Wheels" was read by M. M. Baxter, electrical engineer of the Western Ohio Railway Company, Lima, Ohio:

TROLLEY WHEELS

We have many trolley wheels to-day to test out on our many different roads, for each style of road must have its particular wheel. At this time we will consider the wheel for the interurban car. Much time and expense can be saved by a railroad company by using a wheel built for its particular service; hence, it pays to test them thoroughly.

When testing a new wheel we should not only keep the car-mile record of wheel, spindle and bushing, but a record of complaints from the conductors. We should learn if the wheel held to the wire and if it ran quietly. We should examine the wheel when it came off test and learn whether it met with accident or if it was entirely worn out. Examine the spindle, lubricant, bushing and flange of wheel. See if the wheel wore true. It also pays to keep a complete record of every wheel used. This can be done with little cost by the car house man who looks after the trolleys. Let him stamp each wheel and keep a record of the date when it went in and out of service, giving the number of the car on which it was placed. This record can be completed by the man who takes care of the car mileage. If a record of all wheels is kept we will not allow some of them to lie along the right of way for boys to pick up and sell; we will get them to our own scrap pile. Very often where an extra pole and wheel are carried on a car the train crew in their haste make quick repairs and get their car back on time after a trolley wheel accident, will throw the old pole and wheel on the ground, expecting the work-car crew to pick it up some day. If this record is kept we will know if the wheel manufacturer is keeping his product up to standard. If we learn of some other road giving the same service as our own who claim good results from a trolley-wheel test, we will know if we care to try their wheel. Many delays on the road from trolley-wheel trouble can be done away with by having a good man to inspect wheels. This inspection should be done every day or after every 500-mile run. Much attention should be paid to the contacts and collecting springs of wheels. These contacts and springs should be kept clean and in good shape so that the current will not depend upon the spindle for a path to the trolley pole. If it does the lubricant will soon dry out and the spindle or hub will be ruined. Oftentimes a wheel is condemned when the real cause of trouble may not be in the wheel. This cause may be in the trolley stand or the adjustment of the wheel in the harp. To have the life of a wheel increased where a double trolley is used and where the wheel has a tendency to wear only on one side instead of in the center, adjust the trolley stand so that it will swing freely, but not too freely, for the high-speed road cannot make time with a too sensitive trolley stand. The pressure of the wheel on wire should be watched closely.

DISCUSSION ON TROLLEY WHEELS AND CLINCH EARS

The discussion following this paper developed into a comparison of wheels of different makes and the care taken of them. General Manager Whysall, of the Columbus, Delaware & Marion, said that the average run of the Kalamazoo wheel, with graphite bearing, one lubrication a day, had been 2200 miles on that road, but with two lubrications a day they had run as high as 6500 miles. However, he thought the time and trouble in lubricating a second time is worth more than the cost of the wheels. The Hensley wheel, he said, averaged from 3000 to 3500 miles. The poles carried a tension of 40 to 45 lbs., with trolley 19 ft. above the rail. During the past winter considerable trouble had been encountered by the wire breaking and the tension was reduced to between 35 and 40 lbs. Since this has been done the trolley does not keep to the wire.

Mr. Mason, of the Electric Service Supplies Company, stated that the trouble with the wheels was that they were not properly lubricated, and he thought that particular attention to this point would result in better service.

The new Holland wheels, used on the Western Ohio, Mr. Baxter said, had worn on one side, but when supplied with a roller bearing stand this objection disappeared. Other members stated that this appliance would increase the life of any wheel now in use.

F. A. Bundy, master mechanic of the Lima & Toledo, made the statement that oil in graphite bushings destroyed the qualities of the graphite and defeated the purpose for which the bushing was intended. This idea was endorsed by a number of other members who had experimented with them. He also said the average life of trolley wheels on his road had been 3200 or 3300 miles for the past six months, but before that time he could not get even 3000 miles out of them. Mr. Bundy thought that the electric railway men should become educated to the bow trolley or some other appliance that would do away with wheels. He suggested that a shoe with a contact of at least 6 ins. be used. If aluminum could be utilized for this purpose, Mr. Bundy said, he thought such a scheme would be successful, as the metal is light and greater contact could be secured than with a heavier metal. Regarding the tension of trolley poles, Mr. Bundy suggested that a pressure of from 40 to 50 pounds is sufficient to break the retriever or damage some other portion of the mechanism. He said that from 30 to 35 lbs. with a roller-bearing base is sufficient to hold the trolley wheel to the wire and will be found more satisfactory than a greater tension.

There was some discussion on the clinch ear and the liability of the wire breaking at the ear. One member stated that on a road 65 miles long this style of trolley had been used and no breaks had occurred at the ear, but in all cases they occurred 10 or 12 ft. away. Another speaker took just

the opposite view, and said his experience with trolley lines erected with the small clinch ears showed practically all breaks at the ears.

E. C. Spring stated that the alignment of the wire has much to do with the wear of the trolley wheel. The Hensley wheel, he said, had given good service on his road, as is attested by the fact that he had just placed an order for the second dozen poles in the past five years. He had had no breaks in the wire, except at the sleeve, soldered sleeves being used. Mr. Whysall replied that keeping the track in alignment is as important as the wire, and that he was afraid that many failed in this respect. Usually a track is either out of surface or alignment. A deviation of ⅜ in. at the track means much more at the wire 19 ft. above.

Mr. Kelsey, of the Union Traction Company, said that he had had some experience with the No. 18 Kalamazoo wheel with graphite bushing. He thought many engineers make the mistake of using wheels that are too heavy. Poles and wheels should be as light as consistent with the use to which they are subjected. He favored the graphite over a solid bushing, because the pounding of a worn graphite wheel is less marked than with the solid brass. Mr. Kelsey made a good point in stating that many trolley wheels are burned out by forcing the current through the bushing which is covered with oil. The oil acts as an insulator and forms an arc which soon destroys the wheel. Some of the faults that are placed upon the wheels may be due to this instead of defects in the wheel or its manufacture. Mr. Kelsey said he hoped the bow trolley would soon show itself on the roads in this section. The only danger that he could see in the adoption of that plan is in the wear on the trolley wire. The speaker discussed the Clark splice for trolley wires and said that the only trouble he had ever had with them is in their turning out of their position when some distance from a support.

R. C. Taylor stated that he had been using the Holland trolley wheel and had also purchased a supply of the Hensley wheels. Some of them had shown a mileage of 5000. In this connection Mr. Whysall said he had tried a sliding bow for a trolley, but that all the appliances he had used would melt like ice in the sun.

On the Rushville line in Indiana, A. A. Anderson stated that they had been getting 5000 miles out of a bow trolley with an aluminum contact. The results, he thought, would be better in voltages up to 6600 and 11,000. This type of trolley has not proved successful on d. c. systems, because of the wear at the point of contact. To prevent wear on the bow, grooves were cut lengthwise in it to hold the oil. There is no perceptible wear on the wire.

F. W. Shelton stated that there are 20 miles of catenary construction on the Fort Wayne & Springfield line and that the bow trolley will be used as soon as the track is in condition, the ordinary trolley being now used. The difference in expansion in the messenger and trolley wires should be given close attention in order to get the latter tight enough.

George S. Davis described a malleable-iron wheel which had given 11,000 to 12,000 miles on a Pennsylvania road. It was 6 ins. in diameter and had a copper bushing lubricated by rawhide strips which carried the oil from a reservoir. Mr. Bundy said that he had gotten 8000 miles service from a cast-iron wheel, operating with four 90-hp motors, and that the wheels did not wear out at the hub. He believed that if unbalanced wheels were cast in metal molds they would all be absolutely alike and would answer the purpose better than a milled wheel, and save machining.

After this discussion, the chairman announced the following paper on "Car Inspection," by Lee M. Jacques, master mechanic of the Fort Wayne & Wabash Valley Traction Company, Fort Wayne:

CAR INSPECTION

Car inspection, as applied to street railway and interurban service, is to be considered as one of the most important points with which the electric railway men have to contend. It should be considered from several different standpoints, viz.: safety to the public, maintenance of proper schedules and economy in maintenance of equipment. Proper inspection is the greatest insurance, both to ourselves and the public, and the only way in which a satisfactory degree of safety can be assured.

As regards maintenance of proper schedules, inspection greatly reduces the liability of cars failing while in service and lessens the chances for the public to express opinions regarding the poor service that electric railways maintain for the different city and interurban lines. This also has a tendency to make the public, in general, think that electricity is not as reliable as steam when used for the purpose of transportation.

When inspection is considered from an economical standpoint, as regards the maintenance of equipment, the old adage that "a stitch in time saves nine" is expressly applicable to the maintenance of electrical apparatus. Inspection of electric cars should be carried on like that of locomotives on steam lines and not as a railroad car or coach, because each individual car has its own motive power, a small defect in which may cause serious trouble and much expense and delay. Accidents, such as burning out of controllers and derailments caused by broken flanges, etc., with proper and thorough inspection at frequent intervals can generally be avoided.

At the present time, especially in the East and Middle West, electric lines handle daily many more people than the steam railroads; therefore we should be equal, or superior, to them as regards inspection and maintenance of equipment and have facilities by which each car could have thorough inspection at frequent intervals.

On many of the city lines cars are allowed to run several days without complete inspection. This generally is owing to the crowded condition of shops and pit rooms, as many of the older city lines are still using the same shops, or portions of them, that were used in horse-car days. As these shops are centrally located in a majority of cases, floor space and pit rooms cannot be obtained owing to the excessive price of adjoining grounds; consequently, the cars cannot all be run over the pit each night but have to be divided to permit alternate inspection, several nights or days sometimes elapsing before all the cars have been inspected. This explains, to a large extent, why so many cars fail while in service, interrupting schedules and giving great dissatisfaction both to the management and public.

Another point to be considered is that most of this work has to be done at night when it is necessary to use torches or extension lights while inspecting all parts under the cars, and an inspector is much more liable to miss defective parts than he would in daylight. Most street railways as well as other industries do not think night work can be carried on as economically as in daytime. This is true to a great extent, but, with only the few extra cars and limited room that most city lines have, an additional night force with a competent and wide-awake foreman and inspector seems to be the only remedy.

We believe the inspector should be jointly responsible with the foreman for the condition of the equipment and the proper manner in which repairs are made. He should be thoroughly familiar with the different types of equipment he is required to inspect, and it should be his duty to examine carefully each car underneath as soon as it arrives over the pit. If conditions warrant he should complete the inspection of the controllers and car bodies afterward to allow pit room for the next car. After completing his work he should report on a blank form furnished for this purpose. He should also know that the work has been done before the car is allowed to enter service and promptly report to his foreman any errors made in repairs.

Shop conditions should also be carefully considered. When building new shops is it not well to remember the fact that, although not so centrally located, considerable advantage would be gained by having plenty of room for storage, repairs and inspection?

Another important fact quite likely to be overlooked is the facilities for complete inspection. This would mean that the cars would pass over the pit each night and be allowed time enough for the inspector to go over them thoroughly. Both inspection and repairs would be greatly facilitated if one or two pits are so located that cars can be passed over them; those found in good condition being taken to a place for storage and those needing attention to a pit room for repairs. This arrangement would also save much time in shifting defective cars to where they can be repaired.

Interurban shops and car houses are generally located in small towns where land is not so expensive, but unless the shops are very modern conditions are much the same as with cities, as the buildings in most cases are too small to accommodate the increase in equipment that the business now demands. In other words, the present large equipment now used for interurban service has outgrown the shop facilities. However, as these cars are less in number and not so closely scheduled, there is much better chance to give them necessary inspection.

At the present time, with the high speed that is required of these cars, their frequent and careful inspection is of the greatest importance as there are many defects that would not only delay schedules but might result in serious accident and loss of life. Inspection of interurban cars should be carried on in the same manner as with the smaller equipment, only, of course, more time would be required.

In addition to shop inspection each night, I would suggest that the motorman could be of great service if given the proper schooling by being put through a practical shop course and knowing where he would be likely to find the defects and the best manner to correct them. On most interurban lines the schedule allows considerable time to lay over at the end of each trip, and if the motorman was required to inspect and do light repairs he would soon become quite proficient in this respect. He, of course, should provide himself, or be provided, with suitable overclothes and tools for this work. Work of this kind might be the saving of many delays and avoid possibly serious accidents caused by broken or sharp flanges, loose tires, etc., which can readily be detected in daylight. If motormen were placed on the same level, trained and held as responsible as locomotive engineers are in steam railroad service, there would be many less accidents and schedule failures than there are now. This inspection should be the motorman's duty as well as the handling of his car; however, his defect report to the shop men should in no way interfere with their inspection.

Many roads contend that it is not necessary for motormen to know too much about electrical equipment, but simply to teach them to cut out motors, replace fuses and brushes and do other minor repairs. There are some good arguments in favor of this, especially in city service, as they are quite likely to attempt to make repairs of which they have little knowledge and thus both delay schedules and damage equipment; but in interurban service more time could be given to their training and more shop experience so that they could soon be able to detect many small defects that are now overlooked. At the end of the run, providing the schedules permitted a lay-over, as most of them do, he could make a thorough inspection of all parts of his car that can be easily reached without having it over the pit. Many times a motor brush will stick in the brush-holder, break, loosen, etc., all of which can be easily detected. The damage to commutators, brush-holders, etc., thus avoided, would greatly reduce repair bills in many cases. There are also many other light repairs, such as tightening loose bolts on the trucks or brake rigging easily accomplished. Frequently the loss of a cotter pin in certain parts of the brake rigging will cause the loss of a pin and the result is that the car has no brake. This is generally found out at a point where a stop is very essential, and the newspapers do not fail to publish a detailed account of the "failure" of the air brakes.

By using a thorough system of car inspection each time the car comes to the shop, and having motormen thoroughly competent to inspect and make light repairs at the end of each trip, the cars would not be liable to get in an unsafe or dangerous condition. On the contrary, we would have the best possible safeguard against any liability of accident, either to the public or equipment, thereby saving the claim and mechanical department financially to a great extent. In other words, the more frequent and thorough the inspection by thorough and competent men, the less the liability to damage suits and the more economical the service.

DISCUSSION ON CAR INSPECTION

During the discussion on Mr. Jacques' paper, Mr. Bundy remarked that when the cars did not get far from the car houses he did not believe it well for the motorman to know too much; but motormen on interurban cars should have enough ability to get the car into the shops in an ordinary case of breakdown. Some motormen, he said, would take more interest in making repairs on the road if it were not for soiling their uniforms, which they are compelled to pay for. There would be a different tendency if the men were provided with overalls. He was a strong advocate of overalls for motormen, saying that with them the men would be dressed more in accordance with their work.

E. C. Spring, in discussing this paper, said he did not believe that it is necessary to have the motormen trained to make repairs, thus scattering the shop all along the line. Motormen, he said, should be dressed in a proper manner, and they are usually not prepared to do this work, even if they know how. Under his system the conductors make a report of all troubles and complaints every morning to the general superintendent. These reports are handed in, no matter whether there is anything to say or not, and the men are thus trained to make it a part of their duty, so they will not forget or neglect it. The monthly report of the superintendent of motive power shows the condition of every car on the road and acts as a check upon all other reports that are made during the month. Another thing, he said, motormen, by working on a car, may disarrange some experiment which the shop foreman is trying, or may act in some other way to undo what has already been done.

Difficulty in securing experienced men, Mr. Spring said, had induced him to employ bright farm hands. They are placed in the shop for a few weeks and learn all about the cars and how to handle them. When they go out on their first run they are able to keep full control of the car under all circumstances. Because they have received their instructions from men who have the interest of the property at heart they learn the business well. The experiment had proved a success and they have a number of good men from the farm on the line now. Mr. Spring said that they now had a class, consisting of the foreman and fourteen men, taking a course in the Electrical Institute of Chicago, and that they were making good progress in the studies.

J. L. Adams, manager of the Indiana, Columbus & Eastern, said that the men who make reports should have a good knowledge of the cars on which they report. His conductors and motormen are required to make a report to the foreman each day and this report goes to the manager.

That it is necessary to educate the men who do the work on the road was the opinion of Mr. Evans, of Indianapolis. Motormen should come up through the ranks, he said. Farmers may run a car in a few days, but they know little more than to turn on the current and set the air. As to dress, motormen may be respectably clothed in washable suits that make a better appearance than some of the shabby uniforms occasionally seen. In Indianapolis men are scarce and the companies are almost compelled to take any laboring men that can be had. They are given a drill of a few days in the shop before they are allowed to have anything to do with the cars. The question of inspection, Mr. Evans said, is becoming more and more important all the time. Men, to make competent inspectors, must go through a course of preparation that will fit them for the position.

Mr. Whysall objected to the idea of requiring motormen to wear overall suits so that they may do repair work about the cars. A motorman's job is not a dirty one, he said, and the men should keep themselves clean and neat. If they keep themselves looking that way, their cars will have the same appearance. The management in most cases is responsible for the appearance of its trainmen, and careful attention should be paid to it. Mr. Whysall thought that the men should be able to look after their cars, and if they are not, they should have a little shop training. They may carry overalls or clothing of some kind to use in case they must do work of that kind. The cars of the Columbus, Delaware & Marion run 360 miles a day and the men do not have much time for inspection.

After a man has been in the service for some time and then brings a car into the shops without knowing what is the matter with it, there is something wrong, said C. B. Clegg. The training of motormen depends largely upon the willingness of the car-house foremen to give information. They would often become well informed if all troubles were explained to them. Some foremen hold themselves above instructing the men, while others drill them in such a manner that they are able to handle many troubles that come up on their runs. Mr. Clegg said he liked the rule that prohibited passengers from riding in the vestibule, but that it is often necessary to allow them to do so or leave them on the road when the cars have heavy runs.

Mr. Evans was of the opinion that it is about time that clothes cease to cut the figure they do in the maintenance of electric roads. Interurban trainmen, he said, may keep themselves very neat in washable garments, but he would not apply the same ideas to the men who operate city cars.

Mr. Skinner stated that in the three years the Scioto Valley Traction Company has had its road in operation they had never had an armature on the pole pieces. The men inspect the cars at each end of the line, more for safety to passengers than anything else. The men look after the wheels, as well as other parts of the car, and if they do not understand what to do in case they find anything wrong they telephone the shop for instructions. The company operates seventeen motor cars which average 450 miles a day. Only experienced steam railroad men are employed, and they are required to ride over the road for two or three weeks to learn the track thoroughly. Then they are put into the shops to learn all they can about the cars. As an examination, a car or motor is taken to pieces and the men are required to put it together. If they fail, further training is given them. They are taught all about resistance points and how to prevent rough acceleration on the road. Mr. Skinner was asked a number of questions as to how he could secure railroad men at the salary electric railway companies are able to pay. He said that they were able to get men who preferred the work to steam railroading, even if the salaries are less, and some are taken who have for one reason or other been dropped by the railroads, but their records are always carefully scanned before they are employed. They do not employ men who have been discharged for criminal negligence or anything else that would make them undesirable.

REPORT AND DISCUSSION ON EXPRESS COMPANIES

Chairman Anderson, of the committee on express companies, said that the members had not been able to make sufficient investigations of the question to render a report at this time, and asked that the matter either be referred to another committee or further time granted. The association instructed the committee to continue its investigation and report at the meeting in May.

Manager Whysall, of the Columbus, Delaware & Marion, gave the members some information regarding the operation of the Wells-Fargo Express Company over its lines. He said that the company had not been able to get into Columbus directly over the steam lines, and made a contract with the electric road with that end in view, as well as for the purpose of handling local express matter. The business is handled on the tonnage basis by the railway company, but in estimating the tonnage the value of the goods is also taken into consideration. He did not feel at liberty to go into detail regarding this feature of the contract, with the exception of stating that the more valuable goods counted as greater tonnage than the ordinary run of shipments. On local business the railway company receives one and one-half times the local freight rate on express shipments and on foreign business, that is, business originating on other roads the rate is the same as the local freight rate. The operatives of cars used exclusively for express business are paid by the Wells-Fargo Company, but where a car is used jointly by the railroad and express companies, each pays half the expenses of operating it. He considered the tonnage basis the more satisfactory way of handling the express business, as the remittances are received in from thirty to sixty days. On a commission basis, it might take six months at times to get the accounts made up and receive remittances. The clerical work would be greater and the expenses would be higher than on the plan the company is now doing the business. The valuation of all articles is trusted to the express company, under the plan now in use, and the management has had no cause to feel that everything is not done in a fair manner.

Chairman Taylor, of the committee on car lighting, asked and was granted further time to make a report. President H. A. Nicholl asked the members to be prompt in responding to all inquiries made by the committees, as this is the only way in which they will be able to secure information upon which to base their reports.

MISCELLANEOUS MATTERS

The following report of J. C. Staats, chairman of the committee on insurance, was adopted by a unanimous vote:

During the past two years extensive investigations have been made, relative to the best plans for promoting the interests of traction companies and electric light and power companies, along lines of insurance. As a result of these investigations, the American Railway Insurance Company, of Cleveland, Ohio, has been incorporated and organized with a capital and surplus of $500,000. The officers and directors of the company are composed of men representing railway, light and power companies, and the business of the company will be confined exclusively to these interests. In addition to the American Railway Insurance Company, there have been incorporated the Traction Mutual Insurance Company and the Electric Mutual Insurance Company. These companies will co-operate with the American Railway Insurance Company. In the opinion of your committee, all of the members of the Central Electric Railway Association may be profitably consolidated into one organization to the extent, at least, of the insurance of their properties against destruction or damage by fire. We approve the plan of insurance adopted by the above named companies and recommend the earnest co-operation of every road connected with the Central Electric Railway Association.

(Signed) Henry N. Staats, Chairman,
Harrie P. Clegg,
H. J. Davies.

Chairman Evans, of the committee on standards, said that particular attention to this matter would be given this year and many subjects recommended by the national association would be taken up.

The next meeting will be held in Indianapolis at the usual time in May.

CORRESPONDENCE

CAR HEATING AND VENTILATION

Cedar Rapids, Ia., March 22, 1907.

Editors Street Railway Journal:

In designing a system of heating and ventilating for cars, one of the most important points to consider is the proper circulation of the heated air and its subsequent removal. Heating and ventilation are closely connected, and should be planned at the same time. Indirect radiation must be used, in part at least. In cold weather the fresh air must be warmed to a higher degree of temperature than that at which we wish to maintain the temperature at the breathing line.

Efficiency and economy of car heating and ventilation depend upon the proper location of the inlets and outlets. If a large volume of air is brought into a car and allowed to escape without proper circulation, as will be the case in upward ventilation, but very little benefit will be derived. The fresh air should be taken in above the top of the car through an intake duct, carried down to the bottom of the car, thence upward through the heating coils and into the compartment at or near the ceiling. Here it will spread out and as it cools will gradually descend. The foul air should be removed at the floor into a duct and taken up to the atmosphere. The intake pipe should always be open toward the fresh air currents, and the outlet should open in the opposite direction. The intake and outlet should be automatic and adjust themselves to conform to the different air currents, thus insuring against fluctuation and strong drafts in the car. This would give a combination of the exhaust and pressure system, acknowledged to be the best method in use. When the car is standing it would be a gravity system and there would be some ventilation, varying with the difference of the temperature outside and inside of the car.

It is not practical to remove the foul air through grates in the floor. The tendency of warm air is to rise, and as the outside air is colder, the foul air will not pass downward. An opening can be made in the vent pipe to be used in warm weather, but should always be closed in cold weather. One inlet and one outlet will suffice for a car containing fifty to sixty people. In figuring the amount of air required, it is the number of people and not the size of the compartment that must be taken into consideration. Twenty-two cubic feet per person per minute will maintain a standard purity of 10 parts CO_2 in 10,000.

The car should be made as tight as possible. Double windows are of advantage and will soon save their cost in the fuel or electricity used for heating the car. The windows should always be kept closed, and the doors as far as possible. A fan would be of benefit only when the car stopped, or when running slow. It would be of no advantage when the car was running at a reasonable speed.

Cars will never be properly ventilated until the apparatus is automatically controlled. Hand regulation of monitor sash is bound to be intermittent. Moreover, it is inseparabe from cold drafts down on the passengers and the volume of air fluctuates according to the cross winds, the number and size of the openings. Perfect ventilation of cars can be accomplished automatically when 31 ins. x 31 ins. of floor space is allowed for the apparatus, and not before. In the early days of ventilating school buildings, it was thought that the room required by the heating and ventilating flues, could not be afforded. That idea has passed away. The modern architect is perfectly willing to allow the space required, and car owners should be willing to do the same.

It is no more difficult to ventilate a car than to ventilate a building. In fact, a car would be the easier of the two, and the expense would be much less in proportion.

E. R. Swan.

THE MECHANICS OF HIGH-SPEED CARS ON CURVES

New York, April 2, 1907.

Editors Street Railway Journal:

For a number of years the writer has had occasion to board a railway train at a station located upon a curve. In striking this curve even at the reduced speed required to come to a full stop, it has been observed that on icy mornings the presence of a film of ice between the ties and the rails permitted the outer rail to shift bodily outward as the forward wheel of each truck encountered it. By this action the spikes were gradually bent backward into the wood and loosened. The same action has since been observed during rainy weather when a film of moisture supplied the necessary lubricant.

Several prominent steam railway engineers, in reply to my letter on the subject in the "Engineering News," some weeks ago, have written that they have observed similar action with hard wood ties in dry weather, since the ham-

mering of the rail on the ties had produced a slippery surface upon the wood.

It is thus evident that the elaborate calculations made recently by several able engineers are clearly incorrect in the assumption of a certain amount of friction between the rail and tie at different elevations. This friction, instead of being a constant at each speed and elevation, is a variable under weather conditions, and is affected by the polish of the wooden surface; and this variable may at times be reduced to practically zero, leaving the entire stress to be exerted in shearing the spike heads. It is, therefore, evident that at high speed public safety demands the use of a tie-plate with projecting webs parallel with the rail on its upper and lower surfaces, engaging respectively the wood of the tie and the outer edge of the rail base. In these days of unreasonable anti-railway sentiment and legislation it would be a wise action on the part of railway engineers to adopt this simple but effective protection at all main-line curves.

Another matter of very great importance on curves of high-speed electric roads has been entirely overlooked by the engineers, as far as is shown by their published calculations. This is the fact that the rapidly rotating armature of an electric motor tends to maintain itself in its line of motion and resists very strongly any attempt to swerve it in any direction from that line. Any one who used an electric pen, whose armature weighed less than 2 oz., will remember that when running at full speed the pen would force itself out of any hand which attempted to swing it rapidly with the elbow as a center. The amount of force due to the gyroscopic action of this light armature would amount to several pounds when swung rapidly. This scheme has been successfully used recently for steadying gunboats in a heavy sea.

It is evident that the speed of rotation, weight of armature and speed of forward advancement are the factors which determine the amount of this gyroscopic action. The bodily displacement of both rails and ties at curves on high-speed electric roads which has recently been observed is accounted for by this action.

In one case it was reported that with a 96-ton electric locomotive on a curve of 2 degrees 30 minutes at a speed of 75 m. p. h., with an elevation of outer rail calculated for 60 m. p. h., the entire track with ties shifted perceptibly on the gravel ballast, while at practically the same speed no such effect was produced by a steam locomotive of about the same weight.

The writer feels that it is the duty of engineers in charge of high-speed electric roads to determine definitely the value of this factor so that it may thereafter be accurately taken into account in all curve calculations. This can easily be done by allowing ample end play of the armature shaft and adjusting a dynamometer to take the thrust towards the outer side of the curve, thus registering the gyroscopic action of the armature at various speeds and various amounts of super-elevation of outside rail.

It would also be interesting to apply a dynamometer on the outer rail at or near the entrance to a curve, moving outward a few of the spikes so that the rail could move, say, ⅛ in. against the dynamometer, which could be set so as to register the amount of tangential force exerted at different rates of speed and of super-elevation. This would give a basis of absolute fact for use in subsequent calculations, where now an assumed factor is used whose value is shown by recent events to be an unknown quantity.

Harold P. Brown.

LIGHTNING PHENOMENA AND LIGHTNING ARRESTERS

The regular March meeting of the American Institute of Electrical Engineers, held March 29, 1907, was devoted to lightning phenomena and the protection against lightning. Lightning phenomena in electric circuits was discussed by Dr. C. P. Steinmetz. Protection against lightning and the multi-gap lightning arrester were treated in a paper by D. B. Rushmore and D. Dubois; while Prof. E. E. F. Creighton described some new principles in the design of lightning arresters.

Messrs. Rushmore and Dubois believed that from the standpoint of protection of the system from static disturbances, whether external or internal, the grounded star transformer connection with overhead ground wire offers the best conditions and is in general to be recommended where the choice is not determined by other conditions. Due to its apparent simplicity, the horn lightning arrester has of late received considerable attention. It is in reality an emergency device and serves as a weak point in the system which is the first to rupture when the voltage increases to a dangerous value. In general the discharge of horn arresters without resistance will throw synchronous apparatus out of step and necessitates starting up the system again. A flaming arc in air, such as occurs on the horn arrester discharges, is a possible source of disturbance much worse than the original one. Practically complete protection can be obtained for wood pole transmission lines by the use of an overhead ground wire in connection with a lightning rod and horns for protecting the insulators. What is known as the water-jet arrester has been used abroad to some considerable extent and it has apparently obtained in certain localities a reputation which is difficult to justify. Its only function can be that of a high resistance connected permanently to the line, and in this case it has the advantage of being self-repairing if ruptured by discharge.

A considerable portion of the paper by Messrs. Rushmore and Dubois was devoted to the multi-gap lightning arrester. As is well known, the essential elements of this arrester consist in a number of cylinders between line and ground and line and line, small air-gaps being left between the cylinders. When voltage is impressed across the arrester the potential gradient is not uniform along the cylinders because the charging current which passes between the adjacent cylinders depends not only upon the electrostatic capacity between the cylinders, but also upon the capacity to ground. Thus the potential gradient is considerably steeper at the high-voltage end of the arrester. At a certain voltage across the arrester the potential gradient between the first and second cylinders is sufficient to break down the dielectric between them, the potential of the second cylinder, being connected to the first by an arc, then rises and a breakdown occurs to the third cylinder and so on until the arc has passed entirely across the arrester. The line current then flows across and the potential is distributed uniformly along the cylinders; the maximum potential difference is less than in the case of the initial breakdown, so that the arc may become ruptured. In the actual lightning arresters much depends upon the choice of the alloys used for the cylinders. The current is carried across the gap by a stream of metal vapor coming from the cathode. If the metal vapor forms at a low temperature the temperature of the arc will be low. Unfortunately the metals, having low boiling temperatures, do not hold their form well under the electric arc. It is necessary, therefore, to use alloys rich in these metals. The metals of higher boiling

points cannot evaporize while those of low boiling point are present, and thus the cylinders retain their form without affecting the temperature of the arc. By properly designing the resistance used in series with the arrester, the arrester can be made to protect equally well at any frequency.

The paper by Prof. Creighton described a new form of liquid electrode lightning arrester.

The discussion was opened by Dr. F. A. C. Perrine, who disagreed with the presentation of the case of the horn arrester. The proper use for this arrester is as an extra precaution against surges which would probably destroy any other type of arrester and leave the apparatus without protection during the continuance of the storm. Experience has shown that where horn arresters are used in parallel with multi-gap arresters the high frequency disturbances discharge harmlessly over the multi-gap arresters; while the low periodicity surges pass over the horn arresters. He stated, as his opinion, that in the present state of the art, leaving out of consideration the recently described electrolytic arrester, the best protection is found in a combination of the horn and multi-gap arresters. In the electrolytic arrester there is found a new type of protective apparatus. The formation of an actual arc in the electrolyte seems very important indeed to its proper performance. The electrolyte arrester seems to be objectionable in that the arc formed within the arrester would probably rapidly evaporate the electrolyte and the cells would require considerable watching.

Farley Osgood related some actual experiences with 60 miles of 30,000-volt transmission circuits feeding power to three sub-stations in which 60-cycle rotary converters are used. Resistances in series with the gaps of multi-gap arresters were tried but discarded, and subsequently resistances were placed in shunt with the gaps. After some experimentation the proper value was found for the shunted resistance and the arresters have proved successful. Light discharges pass across them without any difficulty whatsoever; moderate discharges pass with very little difficulty, while very severe discharges cause the cylinders of the arresters to weld together, which, of course, puts the arresters out of service. It has been found that discharges occur more frequently from line to line than from line to ground. The record for 1906 shows that there has been no interruption of service, although twenty discharges have been noted. Choke coils have been found very effective. A twenty-turn coil seems to answer all purposes very well. The worst operation condition which has been met has been due to short circuits to ground. More apparatus is destroyed during short circuits to ground than at any other time. The liquid arrester seems to be well suited to protect the system against trouble due to grounding of the line.

P. H. Thomas stated that the multi-gap arrester with shunt resistance, leaving out of account the electrolytic arrester for the present, seems to be the most promising protective device now available. He expressed the opinion that the art of protection against lightning is now so far advanced that it is unnecessary to be annoyed by the shutting down of the plant, such as is occasioned when a horn arrester discharges. In discussing the tests reported by Prof. Creighton, Mr. Thomas called attention to the fact that it is important to consider the source of power. It is not safe to draw any conclusions as to the general non-arcing quality of an arrester when oscillographs taken during the tests showed that 200 amps. drawn through the arrester decreased the electro-motive force from 2000 to 200 volts.

V. G. Converse called attention to the fact that when fuses are used in series with the horn arrester, a single stroke does not leave the system unprotected, because it is possible to employ repeating fuses so arranged that when one fuse blows a switch drops and connects in a second fuse, a third, fuse, a fourth fuse, and so on. The Ontario Power Company during the whole of last season observed only one discharge from the generators at the power station, but there were numerous discharges from the lines across the insulators. Experience has shown that a lightning disturbance seldom travels more than four or five line spans before it will pass to ground by way of a tower.

D. Dubois explained that multi-gap arresters are so designed that when a discharge occurs the current from the generator is limited by the higher series resistance to about one-sixteenth of an ampere, which causes such a drop in the resistance rod that there remains a drop of only about 80 volts across each gap. This voltage is so low that the arc is promptly ruptured.

William McClellan reported the results of some observations made upon multi-gap lightning arrester equipments used on 11,000-volt trolley circuits, which tended to show that such arresters are destroyed when the disturbances are heavy and frequent. The electrolytic arrester possesses most excellent characteristics in that it acts exactly like a safety valve. When the station supplying the power is equipped with large generator capacity, so that a short circuit sustained for a considerable time will not cause a shut-down, horn arresters can be used to advantage. When extra insulation is placed on the end turns of transformers and powerful insulators are used on the line, the equipment is designed to take care of a certain increase in voltage, and it does not seem necessary to adjust the lightning arresters to discharge every time the voltage rises a small amount above the normal.

Ray P. Jackson explained that in the type of electrolytic arrester used by him he did not consider the current on discharge to be limited by the counter-e. m. f. effect. There seems to exist a dielectric film, which after it has been punctured is capable of resealing itself when the voltage drops below a certain value. It acts like a valve with a spring behind it. Concerning the horn arrester, it may be stated that its virtues consist chiefly in its mechanical characteristics. It is comparatively simple and cheap and can be placed out of doors. It will prove an excellent device for use in series with an electrolytic arrester for limiting the dynamo current to a small value.

H. C. Wirt remarked that the only disadvantage possessed by the electrolytic arrester resides in the liquid. It seems, however, to represent the solution of the lightning arrester problem. He submitted some data regarding the operation of the shunt resistance type of multi-gap arrester on a 33,000-volt system installed at Joplin, Mo. Although much trouble was experienced with the series-resistance type of arrester, almost perfect results have been obtained with the shunt resistance arrester subsequently used.

Dr. C. P. Steinmetz, in replying to the objection raised against the employment of a fuse in a shunted resistance arrester, stated that when the fuse blows the system remains protected equally as much as though the fuse had initially not been installed. The use of the fuse provides a closer protection for most of the time and under most of the conditions than would be permissible if the fuse were not there. The conditions are in no respect analogous to those existing when a fuse is inserted in series with the horn type of arrester.

PENNSYLVANIA RAILROAD COMMISSION REPORTS UNFAVORABLY ON ROAD MOTOR CARS AS AN AUXILIARY IN AMERICAN PASSENGER SERVICE—ALSO REPORTS ON RAIL MOTOR CARS

Last fall the Pennsylvania Railroad appointed a committee of officials, composed of C. M. Sheaffer, superintendent of passenger transportation; R. N. Durborow, superintendent of motive power, and A. E. Buchanan, chief clerk to the general passenger agent, to visit Europe for studying general railroad conditions, and the operation of road and rail motors, especially with reference to the possible adaptability of the American use of road motor cars as auxiliary to the regular passenger service. This committee has just submitted its reports to the general manager.

The road motor report says:

"The road motors for passenger service are simply automobile omnibuses of various types, the cost varying from $3,000 to $5,000, some of them having double decks, and in many cases small compartments for the accommodation of luggage and parcels. Machines of this character have been introduced to a greater of less extent by the following railways: London & Northwestern Railway Company, Great Western Railway Company, London & South Western Railway Company, Great Eastern Railway Company, Caledonian Railway Company.

"Frequent road motor service has been established at points where there are villages not located on the railways, but with sufficient population to warrant the service, also from stations on the main line, as well as from the terminus of one branch line to that of another. These motors are operated on advertised schedules, at a maximum speed of 15 m. p. h. The routes covered range from 3 to 20 miles in length, and the tariff rates for passengers, luggage and parcels are published, no distinction being made as to class. A storekeeper in each village is employed as the agent for the company.

"The established schedules are maintained with a fair degree of regularity; the service is well patronized, and is appreciated by those depending upon it. However, your committee failed to find, at any of the places visited, very much enthusiasm expressed in regard to the road motor proposition from a railroad standpoint, some of the railway officials stating that they did not consider this character of service a proper function of a steam railway company. In some cases negotiations were under way with independent automobile omnibus companies to take over and operate the road motor service; and, further, we failed to find any road motors in operation or contemplated in connection with any of the Continental railways.

"The Great Western Railway of England, on account of the numerous small towns and villages adjacent to its lines, is the largest user of road motors, owning eighty-four machines and operating them on forty-four established lines. We inspected the service between Slough and Stoke-Poges, a distance of 10 miles the round trip. The car used was equipped with a four-cylinder gasoline engine of the Milnes-Daimler type, and had a carrying capacity of twenty persons. Steam road motors have been tried on this line, but were unsuccessful on account of boiler troubles, and they have been abandoned. The London & South Western Railway has four steam road motors of the Clarkson type, which are considered quite unsatisfactory.

"The Great Eastern Railway has eighteen motors—four Daimler, two Wolsely, two Thornycroft, and ten built by themselves. The cars have double decks and each seats thirty-eight persons. The Caledonian Railway of Scotland has two road motors in service a few miles from Glasgow, between Clarkson and Eaglesham, a distance of 8 miles. It was noted that wherever steam has been used for the operation of road motors they have proven unsatisfactory, and that gasoline machines are the most successfully operated, those of the Milnes-Daimler type predominating.

"From our personal observation and the information obtained as to the conditions existing under which road motor service has been established and operated in Great Britain, and with our knowledge of the general condition existing in the territory traversed by our line, it is the opinion of your committee that the establishment of this character of service as an adjunct to our railway passenger business is not worthy of any serious consideration at this time, and it is our judgment that the same cannot be successfully or profitably operated, on account of the general bad condition of the roads, severe climate and the territory not at present covered by trolley lines being so sparsely settled as to make such service unnecessary and unwarranted."

The report on self-propelled railway cars says:

"Rail motors, costing from $8,000 to $10,000 each, have been introduced to a greater or less extent by all principal railways of England; also by several on the Continent, as follows: Great Western Railway; London & North Western Railway; London, Brighton & South Coast Railway; London & South Western Railway; Great Central Railway of England; German Government Railways (Saxony); Italian State Railways; Paris, Lyons & Mediterranean Railway; Paris & Orleans Railway Company.

"In some cases these rail motors have entirely displaced the steam passenger service on branch lines, but are generally being used for supplementary service in connection with other trains.

"The rail motor car is in charge of a guard, who issues tickets and collects fares, besides performing necessary duties in connection with the handling of luggage and parcels. He also keeps the necessary train records. The car is equipped with a small compartment on the rear platform in which is placed a throttle connection with the boiler, the necessary brake apparatus and whistle, which permits it to be operated from either end, making it unnecessary at any time to turn the car. The design and construction of the car is such as to make it unsuitable for shifting purposes. On lines where motor cars are operated the freight train service is performed by a regular locomotive.

"It appears that where rail motor service has been established travel has increased to a considerable extent. Within itself, the service is not remunerative, but the expense would seem to be warranted when its value as a feeder in creating additional long-distance travel from the main line steam trains is considered.

"Operating officials of roads on which this character of service has been established were rather enthusiastic as to its possibilities. The mechanical officials, however, were not favorable to it. It was admitted that there is a slight saving in fuel, but it is claimed that this is more than offset by the increased cost of maintenance and the loss of service while undergoing repairs.

"On the Continent, while this service is in actual operation to a limited extent in Germany, France and Italy, railway officials still consider it to be in an experimental stage.

"We inspected the Great Western Railway motor service from Southall to Ealing, both stations being suburban to London. The speed ranged from 20 to 45 miles an hour. The driver said the car was capable of 50 m. p. h. The car

ran smoothly, without noticeable vibration, and had been in successful operation for three years. The London & North Western Railway operates a rail motor line on its Oxford branch from Bicester to Oxford. The London, Brighton & South Coast Railway has two gasoline motors in service at Brighton. Each car is equipped with two 30-hp Daimler motors suspended from the frame. Noise and vibration were noticeable while these cars were standing with the motors running. There was also a very disagreeable odor from the gasoline.

"The London, Brighton & South Coast Railway has small detachable steam locomotives at Brighton, which are attached to trailers. Local officials said this service was more satisfactory than by the gasoline cars. The London & South Western Railway has fourteen steam rail motors from its Marylebone Station, London.

"German railways, under government management, have been experimenting with rail motors two years, using for purposes of comparison a Serpollet car (steam, with coal fuel), a Milnes-Daimler car (gasoline), and an accumulator car (storage battery), also a small locomotive and coach. We were told that the experiment so far showed the steam locomotive and coach to be the most economical and successful.

"With the benefit of this experience the committee is of opinion that the installation of self-contained motor cars for passenger service on certain branch lines largely depends upon the gradients, the possibilities for increased travel and the possible saving from a reduction in the train crews. A small tank locomotive and car, equipped for operation in either direction without turning, commends itself as the most elastic adaptation of the rail motor which came under our observation and appears to be in the line of future development abroad."

In connection with the foregoing reports it is interesting to add that the Nov. 5, 1904, issue of the Street Railway Journal contained a comprehensive article by Philip Dawson on "The Use of Independent Motor Cars on Railways" which described quite fully some of the cars mentioned in the report. Since then other articles have been published in this journal on prominent types of European motor cars. The auto-bus subject from a commercial standpoint was discussed in an article in the Nov. 17, 1906, issue by H. Vellguth on "The Operating Costs of the Modern Auto-Bus."

ELECTRICITY IN OTTOMAN ASIA

On Feb. 7, in the presence of the governor-general of the province and the general in command of the fifth army corps, besides other civil and military officials, notables of the city, and foreign consuls, the new electric street car and street lighting service in Damascus were formally handled over by representatives of the Ottoman government who had come from Constantinople for that express purpose to the Societé Ottomaine Impériale des Tramways et d'Eclairage Electriques de Damas. At first the street car service will cover only the distance from Salhyeh to the Meidan, some 5 miles through the city from suburb to suburb. Cars were to commence running on March 14, on which day the Ottoman fiscal year begins. Electric lights have been installed, and Damascus is now being lighted by 1000 electric street lamps, for which the municipality pays an annual rental of 3000 Turkish liras ($13,200). Besides these, the company has put in more powerful lights in the Grand Mosque, in the public squares, and in the Serail. Private electric lights will soon be introduced in shops and residences. The installing company is Belgian. Some of the electrical supplies and apparatus have been imported from Germany, France and England, but all cars, motors, dynamos, etc., have been bought in Belgium. American manufacturers have apparently paid no attention to this opportunity of securing preliminary vantage ground. Concessions for electric light and street railway undertakings have been granted corporations in Damascus, Beirut, Aleppo, Smyrna and Salonica.

ACCIDENTS IN GERMANY

The following interesting classification of the accidents occurring during January, 1906 and 1907, on the street railway lines belonging to the German Street and Interurban Railway Association has been prepared by the secretary of the association. This association includes practically all of the electric railway companies in Germany:

Character of Accident.	1907.	1906.
Fatalities	2	2
Accidents involving disability for more than 13 weeks	75	15
Accidents involving disability for less than 13 weeks	314	274
Total	391	327

Day of Accident.

	1907.	1906.		1907.	1906.
Sunday	29	22	Thursday	49	58
Monday	69	38	Friday	61	53
Tuesday	69	48	Saturday	62	52
Wednesday	54	51	Not recorded	8	5

Time of Accident.	1907.	1906.
Between 12 midnight and 6 a.m.	29	30
Between 6 a.m. and 12 noon	145	112
Between 12 noon and 6 p.m.	118	117
Between 6 p.m. and 12 midnight	89	62
Not recorded	10	6

NEW PUMP COMPANY

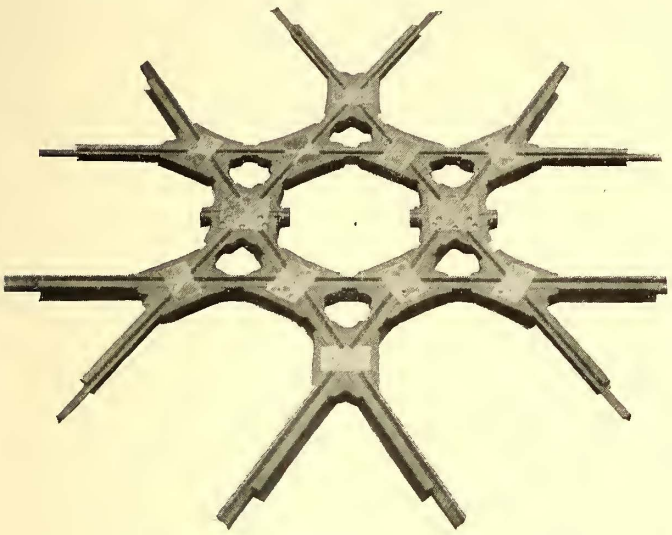
The Alberger Pump Company, of New York, has been organized to manufacture and sell centrifugal turbine pump machinery of all capacities and for operation against any head, either steam power or electrically-driven. The steam turbine has taught the great principle of dealing directly with rotary motion, and the managers of the Alberger Pump Company are convinced that future progress in pumping lies along this line.

The officers, management and works of the new company are identical with those of the Alberger Condenser Company, and in order to provide for this business a large addition to the Alberger shops is now in progress. The equipment will consist of special tools for this particular class of work, together with elaborate testing apparatus.

The Indiana, Columbus & Eastern has purchased a handsome parlor car, with observation vestibules and buffet, built by the Cincinnati Car Company, and it will be put into the limited service on the Columbus, Newark and Zanesville division.

THE HOBOKEN TURNTABLE

In connection with the large turntable at the Hoboken terminal of the Public Service Corporation of New Jersey, described by Martin Schreiber in the STREET RAILWAY JOURNAL for March 23, it may be interesting to add some further points furnished by the New York Switch & Crossing Company, the builder of this turntable. It was impracticable to build the table crossing in one piece on account of its great size and the danger of breakage during transportation. As shown in the accompanying view, it was necessary to make the joints through the hard centers, because the latter are so numerous that there was not room to fish-plate without doing this. The hard centers are made of hammered steel and are held in place with six 1-in. vertical bolts through each center, with the heads countersunk. Babbitt was then poured into the counter-sunk holes to finish, as shown.

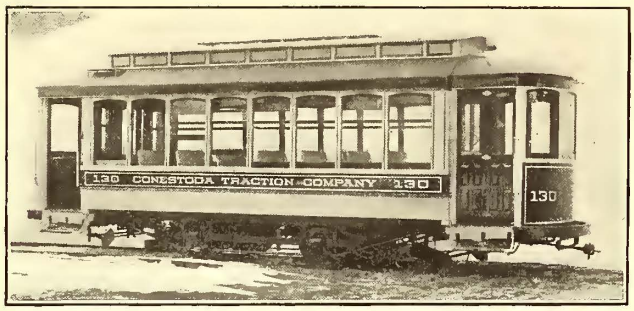


THE SPECIAL WORK FOR THE TURNTABLE

As mentioned in Mr. Schreiber's article, the table was installed because there was not room enough at the ferry slip to allow loop operation. A compromise was effected by putting in the table and so arranging the tracks that cars need only be turned through an angle of 120 degs. Continued operation has demonstrated this turntable to be far more successful than was anticipated under the disadvantageous conditions at this terminal.

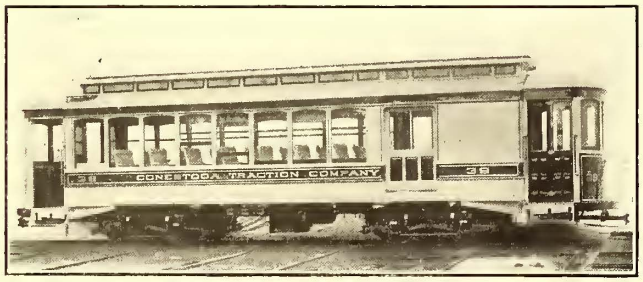
SEMI-CONVERTIBLE CARS FOR CONESTOGA TRACTION COMPANY

The Conestoga Traction Company, of Lancaster, Pa., which is a very large user of the grooveless-post semi-convertible cars, has just received a number of Brill combination passenger and baggage cars for use on an interurban branch of the system and four single-truck cars for city service. In addition, the company will shortly receive from the same builders five 40-ft. baggage and express cars. The semi-convertible feature in these interurban cars permits a greater width of aisle and seating space, coupled with the inviting high-back seats with head roll with adjacent arm rests. The interiors, which are of cherry, are stained a mahogany color and harmonize nicely with the robin's egg blue tint of the ceilings. A single sliding door separates the two compartments. The baggage compartment is fitted with the usual accessories, including seats which can be folded up when not in use. The truck used is the 27-G1 with a wheel base of 4 ft. 6 ins., which is the standard double-truck for the road; each of the cars carries four motors. The length of



EXTERIOR OF SINGLE-TRUCK CAR FOR LANCASTER

car over end panels is 31 ft. 8 ins.; over crown pieces, 41 ft.; length of baggage compartment, 9 ft. 2 ins.; width over sills, including sheathing, 7 ft. 10½ ins.; over posts at belt, 8 ft. 2 ins. Readers of this paper are familiar with the single-truck type of grooveless-post semi-convertible referred to. The treatment of the interiors in the last lot



EXTERIOR OF PASSENGER AND BAGGAGE CAR FOR LANCASTER

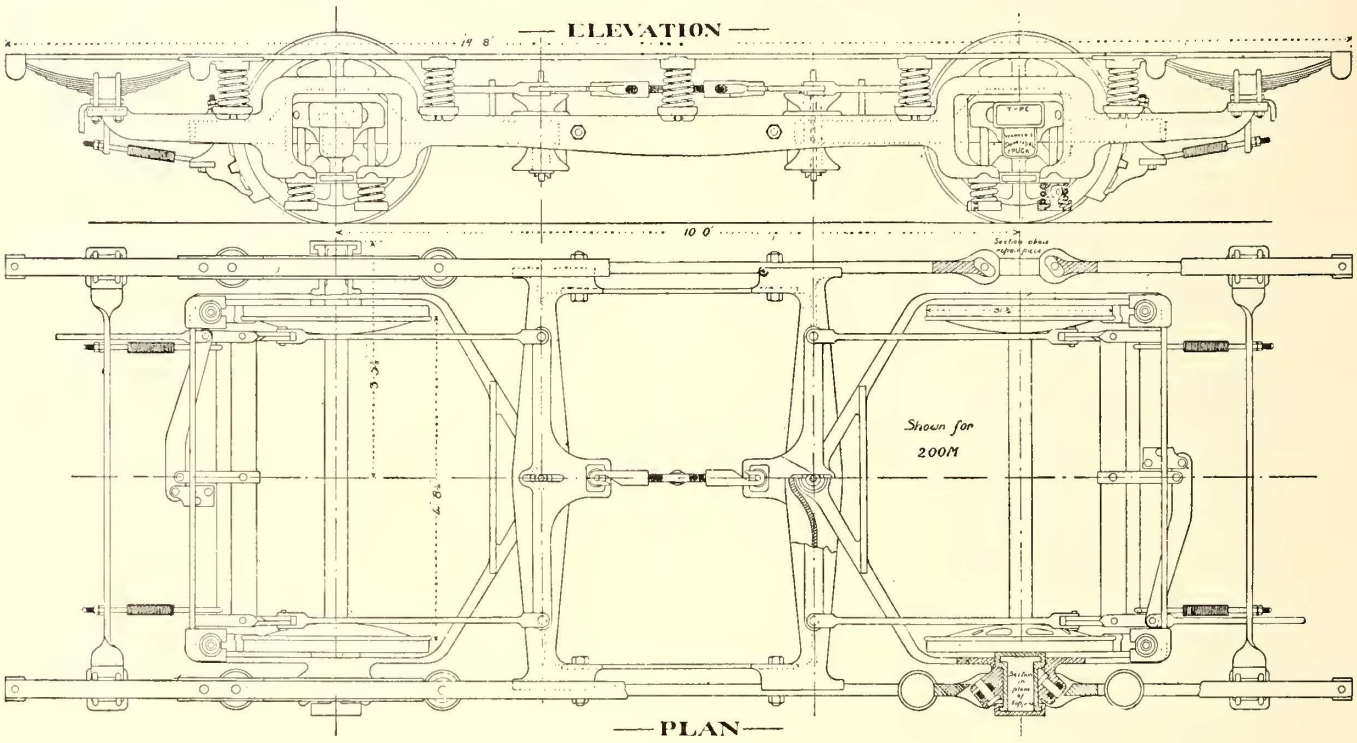
ordered is similar to that adopted in the combination cars, and the seats, while not having high backs, are also of Brill make. The cars measure 20 ft. 8 ins. over the end panels and 30 ft. 1 in. over the vestibules. The width over the

INTERIOR OF COMBINATION CAR FOR LANCASTER

sills, including the sheathing, is 7 ft. 10½ ins. The truck used is the No. 21-E with a wheel base of 7 ft. The car company's track scrapers are used at both ends of the single-truck cars and both types are fitted with its specialties.

A NEW RADIAL TRUCK

As noted previously in these columns, the subject of radial trucks is one which has received much attention abroad. Of the countless attempts that have been made during the past sixty years to produce a perfect steering control for railway wheels, one of the latest is the method devised by J. S. Warner, of Westminster, Eng., as the outcome of his experience with American truck makers. The term used by German engineers, "single axle bogie," or by the French, "pivotal axle," is preferred by Mr. Warner to the term "radial truck," at least for four-wheel cars, since perfect radial action with four-wheel cars is a remote possibility.



PLAN AND ELEVATION OF RADIAL TRUCK

As will be seen by reference to the plan, Fig. 1, the motors are pivoted at points between the axles. The whole car then hangs on links each about 1 ft. in length, there being two to each axle box. The result of this arrangement is a peculiar movement illustrated by Fig. 2, the upper view representing what would be seen by a person on the inside of the curve.

Through the enterprise and courtesy of H. E. Blain, of the West Ham Tramways, England, some twelve months' regular service has been run with the Warner method applied to one end. The result of this trial is claimed to show that even without the control of alignment springs no overswing results, while on straight track the car body preserves an unusually comfortable dead straight riding. An important claim for this truck is that the traction is reduced not only by the absence of oscillation obtained by the longer wheel base, but about 5 to 10 per cent less tractive resistance is secured than with any other truck by the extremely delicate accommodation to the track sinuosity. Fig. 3 is a view of the actual gear.

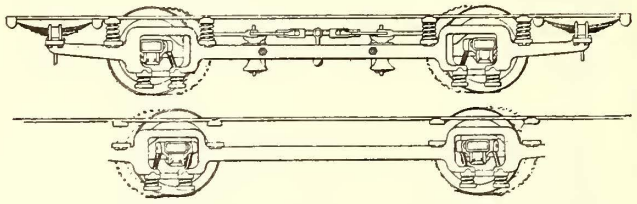


FIG. 2.—VIEWS ILLUSTRATING THE RADIAL MOTION OF THE TRUCK

Links have been used with a purely transverse swing giving an approximation to this result, but the steering effect given by the Warner truck around the slightest irregularity gives a valuable freedom from flange friction reducing it probably by one-half. Since flange friction for straight tramway track and single trucks is never equivalent to less than 30 per cent of total traction current, the claim that 5 per cent less current is used seems a modest one. It is said that the riding of the car is absolutely free from side-to-side jolting and that a reduction in flange wear is observed which must mean at least an equal reduction in rail wear. A double truck on the same principle is now being designed by the same maker.

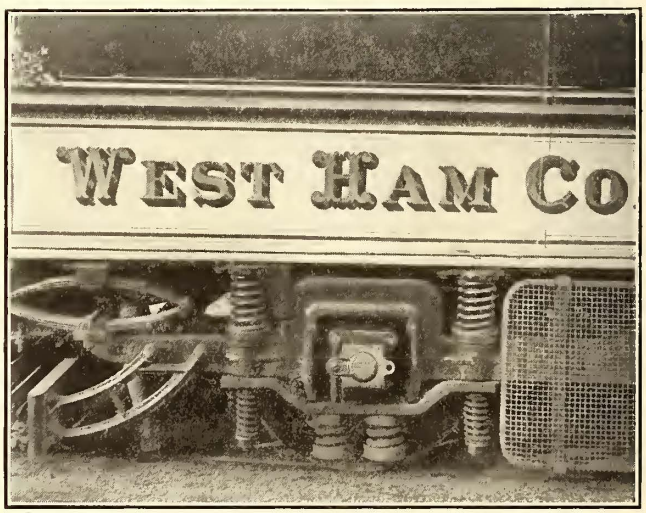


FIG. 3.—RADIAL TRUCK GEAR USED ON WEST HAM TRAMWAYS

One of the double-decked cars mounted on this truck is of 10-ft. wheel base with a 22-ft. body and an over-all length over the fenders of 35 ft. This size of car has hitherto been mounted on two maximum traction trucks. In this case not only is there appreciable economy in traction resistance, but the simplification of brake mechanism with the absence of four pilot wheels, axle boxes and two axles will greatly reduce maintenance charges, while the traction will be the maximum available from the given weight of car.

Twelve months' running has shown that the wheels give 30 per cent greater wear; that is, a steel-tired wheel running 60,000 miles ordinarily will do 90,000 miles with this radial truck.

GASOLINE-ELECTRIC SYSTEM FOR COMMERCIAL VEHICLES

The British Thomson-Houston Company, of Rugby, England, has developed a gasoline-electric mechanism for propelling vehicles in which the transmission is entirely electrical. Differential gears are eliminated by using two motors, which also allow the speed to be varied by the series-parallel method. The generating equipment consists of an automatic regulating d. c. generator directly coupled to a gasoline engine. The generator is designed to maintain a constant load on the equipment at a constant speed of the engine, irrespective of the varying load demands of the vehicle. In other words, the product of volts and amperes of the output is at all times constant, for as the amperes load demand increases the volts correspondingly decrease, so that the load and, therefore, the speed of the engine remain unaltered. This result is obtained automatically by a suitable arrangement and design of the windings, and without the use of moving contacts. The generator is coupled to a 35-hp engine and is normally rated at 15 kw, 850 r. p. m., 65 to 130 volts, but is capable of withstanding heavy overloads. It has removable aluminum covers, which completely protect it from dirt and water.

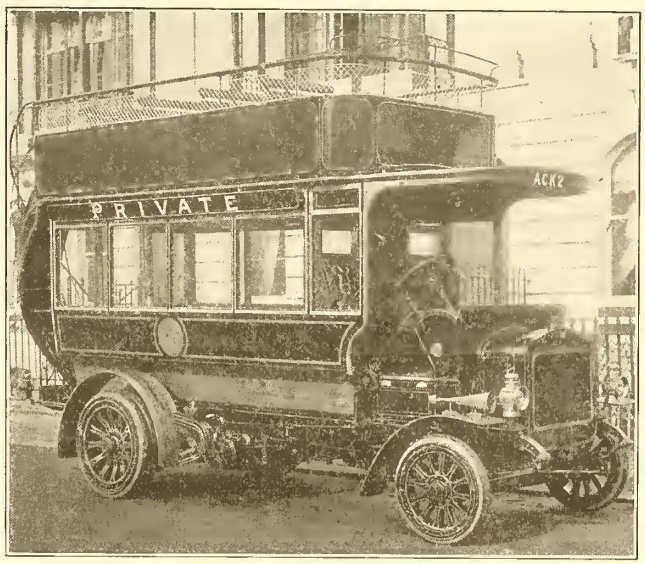


FIG. 1.—GASOLINE MOTOR CARS

Each motor is designed for a constant input of 7.5 kw at from 500 to 1400 r. p. m.; the e. m. f. varying from 65 to 130 volts; it is a series-wound machine. The two motors are capable of propelling a vehicle having a gross weight of 7 tons up grades exceeding 14 per cent.

The system of control is extremely simple. To the right of the driver, in the position usually occupied by the change-speed lever on a gear-driven vehicle, the "operating box" is mounted. This is coupled through a chain to the controller proper. The latter is located close to the motors and generators to reduce the length of the connecting cables to a minimum. The controller provides two forward speed points corresponding to the series and the parallel connection of the motors, and one reverse speed point with the motors in series.

In the operating box is mounted a small resistance and control switch, electrically connected in circuit with the generator field coils. A pedal is coupled to both the engine, governor and to the control switch, so when the pedal is fully depressed the engine is governed to run at 400 r. p. m. and at the same time the switch is moved to insert in the generator field circuit a resistance sufficient to reduce the main volts to practically zero. No current, therefore, flows through the motors and the vehicle is stopped. On releasing the pedal the first movement cuts the resistance out of the generator field circuit, causing sufficient current to flow to the motors to start the vehicle, which will continue to run slowly, the engine remaining governed at 400 r. p. m. On entirely releasing the pedal the governor is "held up," allowing the engine speed at once to increase to 850 r. p. m., and the vehicle will accelerate to its full speed. The engine speed is prevented from exceeding 850 r. p. m. by the restraining influence of the generator, which exerts for all conditions of load a limited but definite load demand.

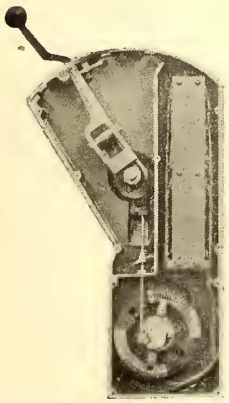


FIG. 3.—INTERIOR OF CONTROLLER

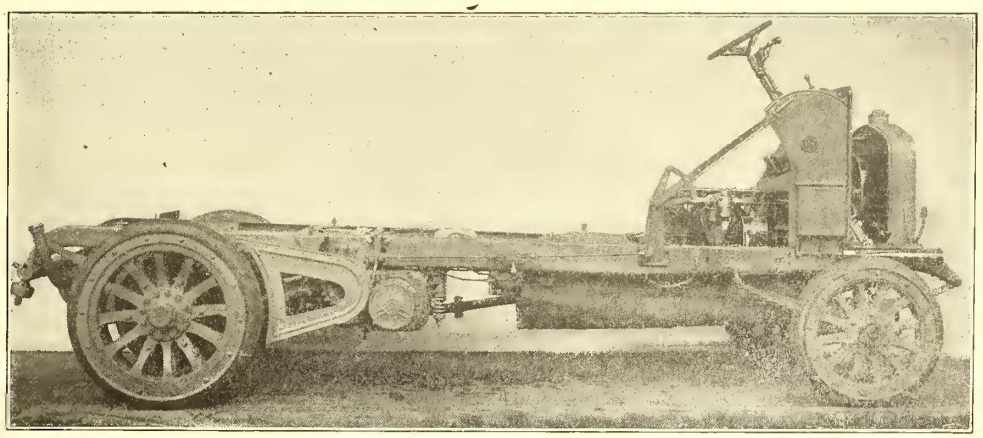


FIG. 2.—CHASSIS OF GASOLINE ELECTRIC VEHICLE

That the motors may exert the necessary additional torque in ascending a grade, the generator automatically supplies the required increase of current, but at a proportionately lower voltage. Thus the torque on the engine, and therefore its speed, remains unaffected whatever the grade may be, and this is brought about without any hand regulation by the driver.

It should be observed that no main resistances are used to regulate the vehicle speed; there is, therefore, no power wasted in such resistances. The extra field circuit resistance mentioned is quite small, and under no condition absorbs more than 25 per cent of the power of the engine, and during normal running is cut out of circuit altogether. An additional feature of the control is the stopping and restarting of the vehicle without operating the controller, and therefore without breaking the main circuit, thereby eliminating any possibility of sparking at the controller contacts. The vehicle is started with the motors in parallel, that is, with full speed connection.

The controller is operated only for reversing and in climbing grades exceeding 5 per cent, when better results may be obtained by running on the first forward series position. On the other hand, however, no damage can occur to the equipment if the driver neglects to change the speed.

A feature in the control which tends to economy in fuel is the arrangement whereby the driver is obliged to reduce the speed of the engine to 400 r. p. m. when the vehicle is standing, thus preventing the practice of racing the engine with the vehicle stationary. For cases where it is necessary to travel long distances at reduced but constant speeds, and it is not convenient to regulate by the pedal, a hand lever is provided which independently controls the engine speed and allows the pedal to be released.

Under certain circumstances, as for example, when climbing steep grades, it is desirable to accelerate the engine speed for short periods to obtain the maximum power. This is provided for by running the hand lever to the field circuit switch in correct sequence, so that, after the hand lever has been moved to a position corresponding to a normal engine speed of, say, 850 r. p. m., a further movement inserts a portion of the field rheostat, which changes the load demand

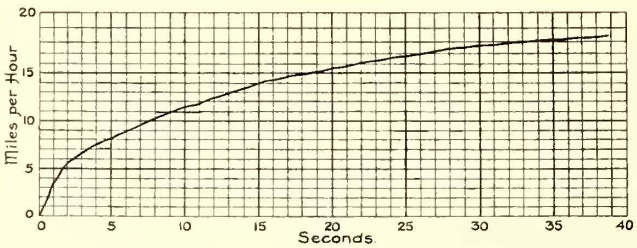


FIG. 4.—ACCELERATION CURVE ON A LEVEL MACADAM ROAD

of the generator and permits the engine to increase in speed, thereby delivering to the generator, and thus through the motors to the road wheels, its maximum available power. By this means full advantage can be taken of the additional power that may be obtained by running the gasoline engine for short periods above normal speed.

In the control system here described, the acceleration is both smooth and rapid; it is also automatic and does not depend on the skill of the driver, as is the case when a clutch and gear-box are used. A driver who has been taught to steer can immediately drive a vehicle fitted with this system as efficiently and economically as one who has had long training and experience.

On referring to the description of the control it will be seen that to stop the vehicle the generator volts are reduced to zero. Conversely, it follows, that in restarting, the volts start from zero and increase to their maximum in regular progression as the vehicle accelerates. This insures a perfectly smooth starting effort, and no shock can result at starting due to a careless or inexperienced driver releasing the pedal too suddenly. The action of releasing the starting pedal fully opens the engine throttle valve, and the engine at once attains its normal speed of, say, 850 r. p. m. The generator load prevents the engine exceeding this speed; the latter is, therefore, developing its full power, which is converted by the generator and delivered to the motors in the correct proportion of volts and amperes corresponding to the speed of the vehicle at that particular moment. As the vehicle continues to accelerate, this proportion continually varies automatically, the amperes decreasing and the volts increasing, the product of the two resulting in a constant quantity representing the full power of the engine. The engine is, therefore, developing its full power at a constant speed during the whole of the acceleration period, and the resultant rate of acceleration is limited solely by the power of the engine, and not by the skill of the driver. As soon as the starting pedal is released, the acceleration becomes automatic, and the maximum available power is delivered to the road wheels without any loss due to the slipping of the clutch or reduced engine speed. Fig. 4 shows an acceleration curve taken from a record made by a Boyer speed recorder on a 24-hp vehicle fitted with the above-described system, weighing 6 tons with its load. The maintenance of the electrical equipment is practically limited to brush renewals, which form a very small item. The general maintenance of electrical machinery is well known to be small, and the design of these equipments has been carefully considered with a view to reducing maintenance to a minimum. The smooth starting effort will effect a considerable saving in maintenance on tires, chains and transmission gear generally. It is impossible to subject the engine to sudden shocks, and these, therefore, cannot result in broken crank shafts, as is often the case with the clutch and gear-box drive.

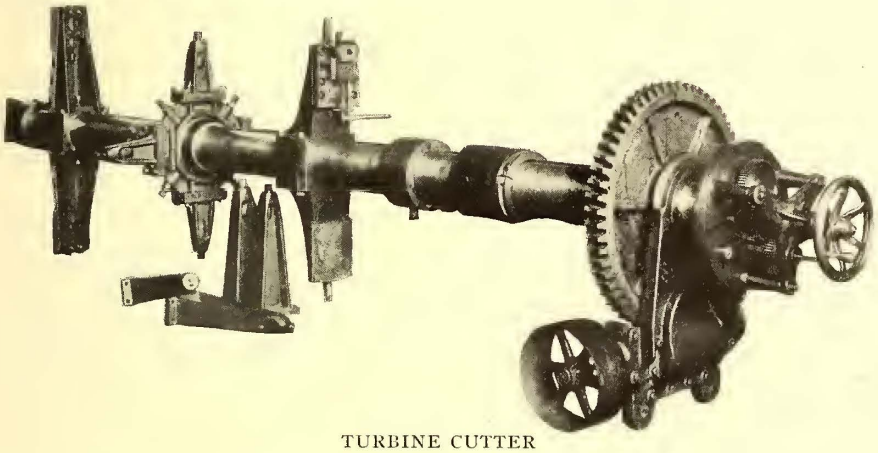
The efficiency of the equipment has been demonstrated by comparative tests with gear-driven vehicles. From the results of these tests it is claimed that a higher average speed can be maintained on a given route, with a given number of stops, and with less fuel consumption than with a gear-driven vehicle of similar type and of equal power and weight. This is due in the first place to a more efficient transmission and, secondly, to the absence of a definite relation between the engine speed and the speed of the vehicle, which renders it possible when running on a good, level road to run the engine at a comparatively low speed and yet maintain a comparatively high vehicle speed.

BORING MACHINE FOR TURBINE CYLINDERS

The illustration on the next page shows a portable boring bar, 10 ins. in diameter and 27 ft. long, recently brought out by H. B. Underwood & Co., of Philadelphia, for the boring of turbine engine cylinders, for cutting the grooves in each cylinder for blades, and when the latter are inserted for truing them up. If the blades need grinding, it can be done while the bar is in place. The bar is made of a good quality of solid steel, "forged." The driving gearing is an accurately cut worm and screw of the Albro Hindley type. The feed attaches on the end of the bar and has three different feeds. To change from one to the other, a sliding shaft is

used. The large hand wheel shown is for feeding by hand when starting cuts and for changing the position of the cutterheads quickly. When feeding this hand wheel is held stationary by blocking or any convenient way of holding.

The boring bar is fitted with three cutter heads. The larger ones are made in halves to enable them to be placed on the inside of the cylinder, the spider or steady rest having different lengths of arms with adjusting screws also made in halves for the same reason. The small one is placed in the cylinder and the bar is slipped through it. The feed screw is in one side of the bar; on this screw is placed the feed nut that does nothing but feed the tools into the cut. On the opposite side of the bar is a proportionate keyway that carries the key for receiving the side thrust of the cut. As it is long and of sufficient size it makes an easy guide and receives the strain on the feed nut. The thrust for taking car of the thrust of the screw while driving the cut into the metal is of high grade hard bronze with many grooves into it. These grooves fit into corresponding grooves in the screw, making a very substantial bearing and



TURBINE CUTTER

thrust for the heavy duty required in deep and heavy cutting.

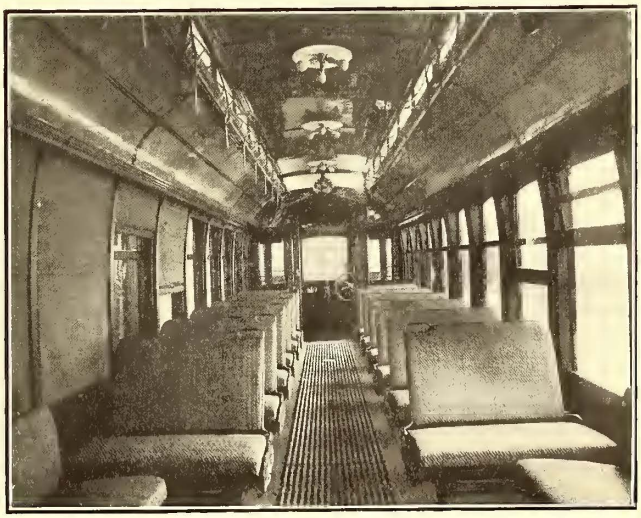
The reason for making two arm cutterheads in two pieces is the duty for which the machine was designed; that is, the turbine cylinders are cast in sections of various diameters, —the two end ones have the engine shaft bearings. They are machined before putting together, rough bored, and the flanges faced; then bolted together, making a long cylinder of different diameters. In one of the cylinders there is a manhole. After the bar has been placed through this long cylinder and the bar bearings are placed and accurately adjusted in the outer shaft bearings, the cutterheads and the center bearings are passed into the cylinder through the manhole and placed together on the bar preparatory to boring and grooving. After the boring is done each cylinder has several grooves (⅜-in. x ⅜-in.) turned into the bore. For doing this a very complete slide rest that holds the grooving tool is used. It is shown on the upper end of the cutterhead. On the lower end of the same cutterhead is shown a place to attach a grinding wheel, if necessary. The small solid cutterhead shown is for smaller boring and cutting grooves. The tools on all the cutterheads are arranged to be set by the workmen inside. The steady bearings are easily set by the workmen both as to position and tension on the bar. With the increase in size of engines and the general use of floor plates the demand for special portable tools has greatly increased and there is now a decided call from some of the large stations and engineering establishments for portable machines that are easily handled.

MORE SEMI-CONVERTIBLE CARS FOR DALLAS

The type of the grooveless-post semi-convertible car shown in the accompanying illustration is one of six of a duplicate order furnished recently by the American Car Company for the Dallas Consolidated Street Railway Com-

CAR WITH EXTRA LONG PLATFORMS FOR DALLAS

pany, which is under the management of Stone & Webster, of Boston. The cars will be operated on the busiest city lines, and to facilitate the handling of passengers and provide adequate standing room, extra long platforms, 6 ft. in length, are used. These platforms are supported by four wooden knees which extend back to the body bolster and the knees are reinforced by angle-iron with the angle-irons of the center knees reaching 4 ft. back of the body bolsters. The folding platform doors are controlled by the Brill automatic door device. The seats of the car corners are longitudinal and accommodate four passengers each. A feature of the car is the arrangement which makes it possible to raise the windows to any desired height. The interiors are finished in cherry with maple ceilings. Four clusters of three lights each having frosted globes are placed along the center of the dome and the lighting circuit is controlled by a switch located over the door at one end of the car. Length over end

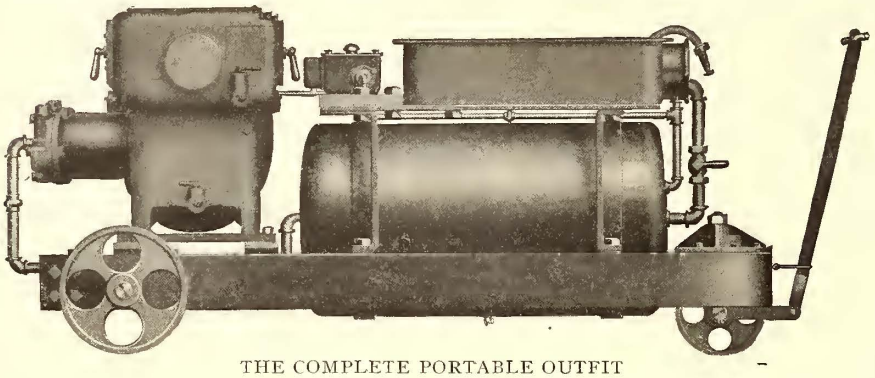


INTERIOR OF CAR FOR DALLAS

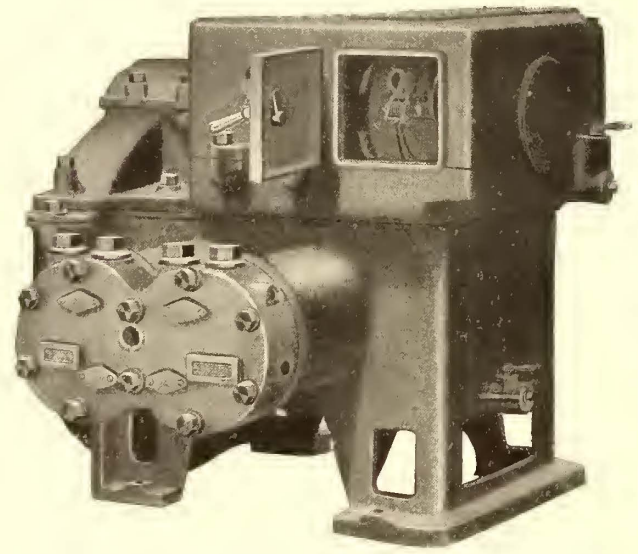
panels, 28 ft.; over vestibules, 40 ft.; width over sills, including sheathing, 8 ft. 4 ins.; size of side sills, 4 ins. x 7¾ ins.; center crossings, 4½ ins. x 5½ ins.; end sills, 5¼ ins. x 6⅞ ins. The trucks are of the Brill No. 27-G type with a 4-ft. wheel base; two motors are used per car of 50-hp capacity each.

A NEW TYPE OF PORTABLE AIR COMPRESSORS

In the car houses, power plants and trackwork the uses to which compressed air can be employed are almost innumerable. It is particularly useful in blowing out motors and generating apparatus, and can often be advantageously employed in driving pneumatic drills, riveters and other air-operated tools. The larger shops and power houses are usually piped for compressed air from a stationary compressor, but often in a small shop such an installation introduces a greater expenditure than is deemed advisable. In other instances the range of territory over which it is desired at times to use compressed air would, with a stationary compressor outfit, necessitate a great deal of underground piping. Under such conditions a portable compressor outfit is highly desirable.



THE COMPLETE PORTABLE OUTFIT



THE COMPRESSOR AS MOUNTED ON THE TRUCK

To satisfy the demand for a compact, self-contained and stoutly-constructed portable compressor outfit, the National Brake & Electric Company has designed a type which will appeal to purchasers desiring a convenient and durable appliance. The outfit comprises a compressor, an automatic type-N generator and necessary piping, an air gage and reservoirs, and a combined switch and fuse, the whole being mounted on a substantial angle-iron frame supported on wheels. The front wheel is hung in a pivoted fork made of cast steel, and the outfit is drawn around by means of a wrought-iron tongue. The compressor is exceptionally narrow, the parts being so disposed as to waste no space on the truck. The width of the outfit over all is only 29¾ ins. This readily permits it to be taken through doors and openings in shops and factories of much smaller size than the average.

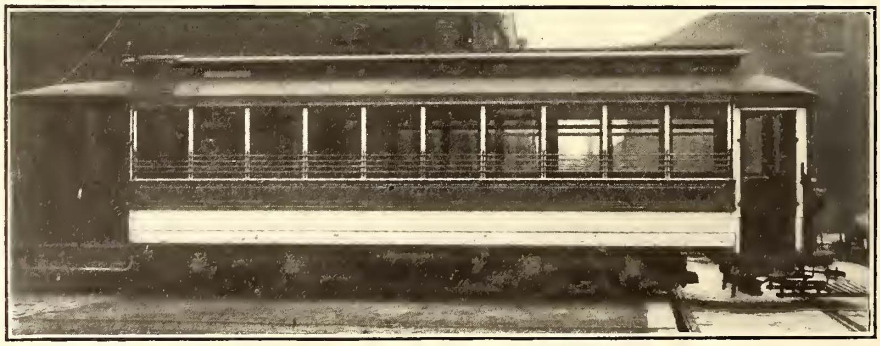
The air compressor furnished with the portable outfit is the National Standard new and improved, in which one of the many distinctive features is the construction of motor and compressor as entirely separate and self-contained units. This compressor was described at some length in the Street Railway Journal, Sept. 8, 1906. The governor, supplied with portable compressor outfits, is a standard type-N oil pneumatic, which has fully demonstrated its absolute reliability and adaptability to the hardest kind of service. This governor was described in the Street Railway Journal for Oct. 13, 1906.

The reservoirs furnished with all sizes of portable outfits are of cold-drawn seamless steel. They are 18 ins. in diameter and 33 ins. long. The compressors are made in sizes ranging from 11 cu. ft. to 50 cu. ft. of free air per minute.

NEW CARS FOR THE LOUISVILLE RAILWAY COMPANY

Fifty new cars have just been received by the Louisville Railway Company, and the company has placed an order with the St. Louis Car Company for fifty 28-ft. car bodies, equipped with St. Louis Company's No. 47 trucks and four G. E-80 motors, to be delivered between April 15 and May 15, 1907. These cars are duplicates of car No. 1000, of which an illustration is presented herewith. These cars have a short vestibule platform on the front and large open platform on the rear. The inside finish is of mahogany with bronze fittings. There are ten rattan upholstered seats on each side. The sash covers and ventilator sash are supplied with locks, so same can be fastened in cold weather.

The Cincinnati Car Company, of Cincinnati, has recently booked orders for equipment as follows: Five double-truck semi-convertible cars for the Eastern Pennsylvania Railway Company, of Pottsville, Pa.; five 33-ft. closed cars for the Camden Interstate Railway Company, of Huntington, W. Va.; five 30-ft. closed car bodies for the Consolidated Railway Company, of Bridgeport, Conn., and six 18-ft. single-truck cars and three 45-ft. interurban cars for the Sheboygan Light & Power Company, of Sheboygan,



TYPE OF CAR BEING PUT INTO SERVICE AT LOUISVILLE

SMALL DIRECT-CURRENT GENERATORS FOR EXCITER AND OTHER PURPOSES

A complete line of direct-current generators ranging from 1½ kw to 17½ kw has lately been developed by the General Electric Company. The machines are designated as type CQ and embody the compact cylindrical construction which has been found dso satisfactory in the CQ and C R motors. They are especially applicable as exciting units for alternating-current generators or as direct-current generators for small power plant purposes where a low capacity belt-driven generator is suitable.

The bearing heads are so constructed that the machines can be installed on floor, wall, or ceiling, thus adapting generators to crowded locations. Other constructive features also deserve mention. The field and armature coils are form-wound and removable, and both receive an insulation practically impervious to water. The field coils are held by the flanged tips of the steel pole-pieces, which are seated firmly in the field frame by bolts passing through the frame and secured with nuts. The armature coils are held in toothed slots on the core and extend beyond the end flanges, being firmly banded to prevent vibration or movement. This form of winding gives a large radiating surface for the conductors and so keeps the temperature rise very small. The bearings are arranged with ring oilers and, as has been mentioned, can be adjusted for wall or ceiling installation by turning the bearing heads through 90 to 180 degs. Carbon brushes, sliding in finished box guides, are firmly held against the commutator by adjustable individual springs. The generators will operate sparklessly from no-load to full-load without shifting the brushes. These CQ generators are compound wound for 120 to 125 volts and from 240 to 250 volts full load.

A further development of the CQ generator is the balancer set for the regulation of three-wire systems.

FIRE ON TUNNEL SITE

A fire early Wednesday morning, April 2, destroyed the temporary framework covering the area at Church and Cortland Streets, New York, where the proposed twenty-five-story terminal for the McAdoo terminal is being built, and will, it is unofficially reported, delay the work about a month. Operations are carried on here all day, and some of the men at work are reported to have had narrow escapes from injury in reaching the street.

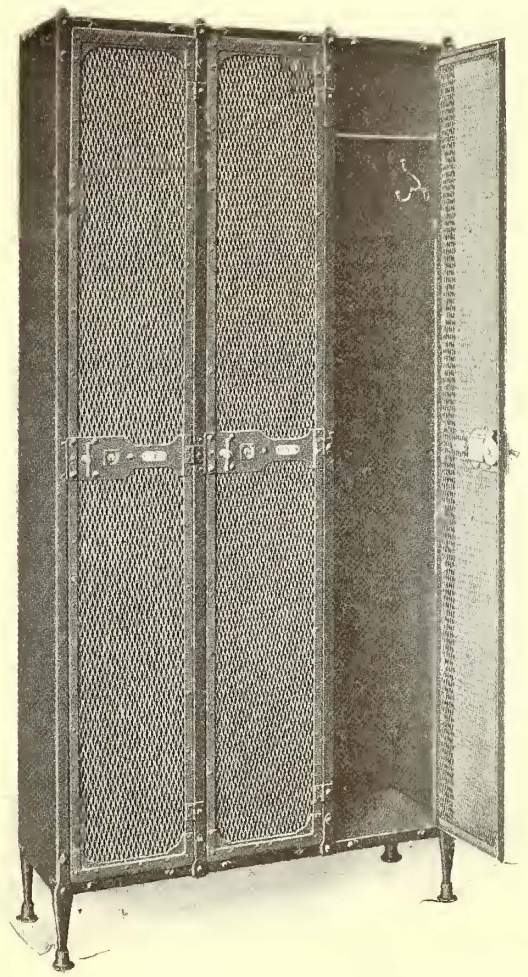
A NEW AIR COMPRESSOR FOR CONTINUOUS SERVICE

A water-jacketed cylinder head has been designed for the new type of compressor for intermittent service recently put on the market by the National Brake & Electric Company, illustrated and described in the Street Railway Journal for Sept. 8, 1906, which permits the compressor to be operated continuously where proper water connections are made with the head. By the circulation of water in the head the valves and those parts of the compressor subjected to the greatest heat are kept comparatively cool with continuous operation of the compressor.

With the water-jacketed compressor there is furnished a water governor which automatically cuts off the circulation of water whenever the compressor is shut down. This governor is very simple and reliable, and eliminates the danger of running the machine without water which might result from neglect to turn the water off after the machine has been stopped. The water-jacketed types of compressors are made in sizes varying from 15 cu. ft. to 35 cu. ft. per minute, and are particularly adapted for stationary installations in power houses and electric railway shops.

STEEL LOCKERS FOR THE MEN

Lockers have come to be an indispensable part of the street railway equipment. The shop, the power station and the employees' club that pretend to order cannot be without them. The extension of their use beyond these limits depends largely upon the methods of management of the different systems and the individual requirements. Lockers make for order, and afford just the protection that is needed. For the trainmen they are especially valuable, as the men can go and come from the car house when they so desire in civilian dress, and often when their runs are irregular are saved the trouble of going home before reporting for duty. A line of steel lockers, especially adapted to street railway use, is offered by the Narragansett Machine Company, of Providence, R. I. Both the single and double-tier type are made. Expanded metal or perforated sheet steel doors may be had, the expanded metal door being especially attractive, considered esthetically. From the standpoint of construction the lockers embody those features that make for strength and durability. The partitions, backs, tops and shelves are of sheet steel, folded and reinforced, and secured



STEEL LOCKER WITH EXPANDED METAL DOOR

by bolts inside the locker only. There are no raw edges to injure the person or clothing. Each locker is a unit, and the cabinets may be made any size and can be readily added to or taken from to suit changed conditions. A variety of locks is offered.

LONDON LETTER

(From Our Regular Correspondent.)

The new tramway system of the Dumbarton Town Council, referred to last month as forming one of the connecting links in an extensive system of tramways from the Lanarkshire coal fields to the banks of Loch Lomond, has now been opened for traffic. The tramways have been constructed by the Electric Supply Corporation, of London, who were the promoters of the company, and on their invitation a party of local gentlemen were invited to inaugurate the system in the usual way. Luncheon was served at the Lesser Borough Hall, Mr. Scott Moncrief, the London manager of the Electric Supply Corporation, presiding. It was intimated in one of the speeches that a new Dumbarton Borough and County Tramways Company was being formed with a view to extending the line to Dalmuir and Balloch.

Last month reference was made to the undue importance which the London County Council Tramways were given in the recent elections at that time in the immediate future. The elections have since taken place, the Progressives suffering a complete defeat, and those of the Moderate party securing a very large majority. Doubtless the warnings that have been sounded for some time back by well-known financial authorities on the tremendous amount of money being spent by the London County Council on tramways and other enterprises have had their effect, the benefits being largely forgotten in the financial alarm. The work of the tramways, however, will have to go on, as many contracts have already been made, and the work, of course, cannot be stopped. It is fairly sure, however, that the London County Council's electric power scheme will fall to the ground, as it is not considered at all probable that the Moderate party will proceed with that ambitious scheme. Time and cool judgment will doubtless eventually decide that some working arrangement between the already existing companies is all that London at present needs, and not the establishment of enormous new power houses at an expenditure of millions sterling of capital, the success of which would be entirely problematical. A report on the working of the southern system of tramways has recently been issued by the highways committee of the London County Council, in which it states that during the past year under review, 183,512,421 passengers were carried, being 83,000,000 more than were carried on the southern system during the year 1899-1900, when the Council first commenced the working of the lines. The report calls attention to a number of the difficulties which the Council is still encountering, and mentions the congestion of the service around the Elephant and Castle. During the first year of the working of the lines, the average number of cars passing that point was about 4000 a day, whereas, now, it has increased to about 5500, even though it has been relieved, to some extent, by taking certain of the Greenwich services via Kennington. The battle of the London County Council with the outlying boroughs as to the system to be used in future is also by no means completed, and the Islington Borough Council has recently advised the London County Council that it declines entirely to allow any overhead trolley system in their borough, so that the electrification of certain of the lines of tramways in the northern portion of London is at a standstill. The Council has recently ordered another lot of 300 electric cars, the car trucks being supplied by Mountain & Gibson, of Bury, who have already supplied a large number of trucks in London. While on the subject of London's tramways, it may be interesting to note that Mr. A. L. C. Fell, manager, has perfected a brake, designed to prevent such accidents at the one at Highgate. The invention is in the nature of a hand attachment to the present magnetic brake, so that if for any reason the current operating the magnetic brake should fail, the brake can still be applied to the rails by means of hand power. It will also be possible for the motorman to apply this brake by hand power at the top of any gradient, so that the brake will be acting as a constant retarding force all the way down the hill, the magnetic action of the brake being only used to bring the car to a standstill, or in an emergency.

An interesting decision has just been made by the Nottingham Corporation Tramways committee. A considerable portion of its overhead construction was erected on the center-pole type and the committee has now decided to remove a number of these center poles and put up span-wire construction. This will obviate, to a large extent, the obstruction in the streets to traffic by means of these tramway standards. Mr. Aldworth, the tramways manager, explains that, in addition, he believes the span-wire system makes for greater economy, as the trolley passing under span-wire construction is not subject to such hard usage as it is in center-pole construction, where the suspension of the trolley wire is much shorter and more rigid. The Nottingham tramways have been, during the past year, considerably extended, and the eastern part of Nottingham is now linked up to the remainder of the city, which will afford great convenience to residents, as narrow streets for some years precluded all possibility of getting tramways to that portion of the city. The County Council, however, vigorously tackled the situation and has made a number of important street widenings and improvements to accommodate the tramways.

The select committee of the House of Lords, which has been for some few days considering the bill promoted by the Birmingham City Council to extend the tramways system to Harborne, about which there has been so much dispute in that city, have given its decision against the bill, so that this important suburb of Birmingham will be without a tramway system at least for some years. There appears to have been great diversity of opinion, but the wealthier classes living in Harborne who were afraid that if tramways were extended to their select suburb it would result in a lot of cheap houses being put up, have won the day. The bill was naturally opposed also by the London & North-Western Railway Company, whose records show a considerable falling off in other parts of the city, owing to the large business which the Birmingham tramways are doing. It is stated that the weekly average of passengers using the tramways is 1,200,000, and it is estimated that the gross takings will amount to £260,000 for the year, with a surplus of at least £40,000 a year.

The Birmingham tramways committee report that, after many conferences with representatives of King's Norton and Northfield Urban District Council, an arrangement has been come to for the working by the Corporation from Jan. 1 last, to Dec. 31, 1927, of the Moseley and King's Heath tramways, and from July 1, 1911 (when the company's lease expires) until Dec. 31, 1927, of the Pershore road and Bristol road tramways, and also of any new tramways within the district of the King's Norton Council which may be physically connected with the tramways of the Corporation. The Corporation is to work the traffic and maintain the electrical equipment, and will receive from the Council 4d. for every car-mile run. The Council is to provide electric current, to maintain the track, and to pay to the Corporation a sum representing depreciation on the cars apportioned to the mileage run in their district. The Corporation is to pay over to the Council all receipts in respect of fares taken within the latter's district.

The annual report of the London United Tramways, which has recently been published, shows gross receipts amounting to over £327,000, and a net revenue of over £144,000. After paying dividends on debentures and preference shares, the company have been able to declare a dividend at the rate of 3 per cent on the ordinary shares. This is, of course, not entirely satisfactory, as this company used to pay a much larger dividend than this, but Sir Clifton Robinson points out that considerable portions of the line are not yet earning money. The directors take, however, a favorable view of the situation, and expect shortly to be able vastly to increase the earning powers of the company. It is expected that by mid-summer their lines will be connected with those of the London County Council at Tooting and Summerstown, and that the new portion of the line from New Malden, Raynes Park and Wimbledon will then be able to be put in operation.

The recent board of trade inspection of the Torquay tramways, which we understand was quite successful, possesses peculiar interest as they have been equipped on the Dolter surface-contact system. The trial car had on board Major Pringle, R. E., and Mr. A. P. Trotter, the inspectors; Mr. H. Jarvis, a director of the National Electric Construction Company, by whom the tramways have been carried out; Mr. E. A. Mitchell, chief engineer to the Dolter Electric Traction Company, for whom they have been laid; Mr. H. Lancaster, general manager, and a few others interested in the work. The total distance traveled by the car was about 8¼ miles, and the routes traversed comprise the whole of the completed portion of the system except the Babbacombe road section, from Torwood Street to St. Marychurch Townhall.

The South Lancashire Tramways Company has obtained the consent of the Swinton and Pendlebury District Council to the

making of junctions at Swinton and Pendlebury, between the company's system and that of the Salford Corporation. In its letter the company stated that the object of the proposed junction is the provision of a through service to Manchester. The Council has acceded to the application, on certain conditions, among which it is specified that no agreement shall be entered into between the South Lancashire Company and the Salford Corporation, whereby running powers shall be given or obtained, without the approval of the Council.

The York and District Tramways bill, the promoters of which sought powers to run tramways in the city of York, has been withdrawn. In the meantime the Corporation has decided to purchase the existing tramway company's system, and apply either by bill or light railway order for powers to work it.

Approval of the proposal to electrify the railways of the Isle of Wight is recommended by a committee of the County Council, as a result of a conference between delegates of public bodies and the United Electrical Construction Syndicate, Ltd. The scheme includes express services and fuller local services by single cars, with stopping places at all cross-roads. The proposal also includes 30 per cent reduction in fares and a considerable increase in the number of trains.

The Paisley & District Tramway Company, which, in the summer of last year extended its line from Paisley to Barrhead, intimates that it intends to apply to Parliament for power to make a further extension as far as Thornliebank, the object in view being to establish a connection with the Rouken Glen, which is also reached by the Glasgow Corporation Tramways. The Corporation is deeply interested in the extension now proposed, because about half of the new line would traverse territory which the Corporation seeks to include within the boundaries of the city.

The Manchester Corporation Tramways committee has decided to retain in support of its Parliamentary bill Mr. Balfour Browne, K. C., Mr. Lewis Coward, K. C., and Mr. G. Rhodes. Four petitions have been presented against the bill, one each on behalf of the Earl of Ellesmere and Earl Egerton, the Cheshire County Council, and the Stretford District Council. With regard to the proposals for inter-running of cars on the Manchester and Salford systems, no decision has yet been reached. The committee is awaiting reports from the general managers of the two systems. The scheme suggested by Manchester is based on the arrangement in vogue with the Oldham Corporation. Under this the conductors of the cars are supplied with the tickets of each local authority, and within the respective areas passengers' fares go to the controlling authority, a weekly balance being afterwards made between the Corporations.

A meeting of the executive committee of the Municipal Tramways Association was held at the Manchester Corporation Tramways offices recently, after which the members were entertained to dinner by the Manchester tramways committee. Alderman Wainwright (chairman) presided, and members of the tramways committee also present were Alderman Bowes (deputy chairman), Alderman McCabe, and Councilor Stewart, The company further included Mr. J. M. McElroy (president of the association), Mr. J. Aldworth (vice-president), Mr. J. B. Hamilton and Mr. A. Baker (past presidents), Mr. P. Fisher, Mr. J. Lancaster, Mr. C. J. Spencer, Mr. Mozley and Mr. A. R. Fearnley (secretary). Alderman Linsley, Councilor Barnes, Mr. G. W. Holford (general manager Salford tramways) and Mr. L. Slattery. An address was presented during the evening to Mr. J. M. McElroy, general manager of the Manchester Corporation Tramways, honorable secretary and treasurer of the Municipal Tramways Association, 1902-06, president of the association this year. In this document the members of the association offered their sincere thanks for the excellent services Mr. McElroy has rendered to the association since its inception.

Clacton, in Essex, has successfully opposed the offer of the Clacton & St. Osyth Light Railways Company to introduce a system of electric tramways. The plea of the opponents at the inquiry was that Clacton is a quiet place, that its visitors are now attracted by the calm and restfulness of the town, and that the introduction of tramways would spoil the reposeful character of Clacton, and drive away not a few of its customary health seekers.

The Town Council of Stirling has received intimation that the negotiations for the acquisition and electrification of the tramway line from St. Ninians through Stirling to Bridge of Allan had terminated, for the present at any rate, without result. The negotiating company made a provisional purchase of the undertaking last August, and reached a working agreement with Stirling Town Council. The County Council, however, insisted that the whole track within its jurisdiction should be blocked between the rails, as well as for a space on either side, and this demand, coupled with other provisos, was regarded as too onerous by the company.

Mr. Graham Harris, the arbitrator appointed to decide the dispute between the Leyton Urban Council and the North Metropolitan Tramways Company as to the amount to be paid by the Council for the company's works, which are situated in Leytonstone, has issued his award. The portion of the company's system situated in Leyton and Leytonstone was compulsorily acquired by the Council. The Council contended, however, that it was not required to purchase the works, which did work for the whole system, except so far as they were necessary to the portion which it had acquired. This contention has been upheld by the arbitrator, who awards the company £19,168, as against the £73,442 demanded.

On the kind invitation of Thermit, Ltd., the British branch of Th. Goldschmidt, of Essen Ruhr, Germany, the inventors and producers of alumino-thermic welding, a large number of gentlemen, some connected with the tramway industry, but most of them with the shipping industry, the Board of Trade and Lloyds, paid a visit to the works of the Thames Iron Works, in London, to witness a demonstration of welding by the thermit process of a fracture of the stern post of a large steamer. Thermit welding, as applied to tramway rails, needs no introduction in these columns, as it is now being used extensively all over the world, the Thermit process having established a most extraordinary record in its rapid adoption and success. It is of interest to mention the fact that this process is entirely suitable for the welding of fractures of large steel frames or castings, such as used in marine work for the stern post of steamers. The demonstration was extremely interesting. Dr. Hans Goldschmidt himself was present, along with Mr. Stutz, the general manager of the London office, and many of the staff from various countries of different companies engaged in this business. An old stern post which had been fractured had been erected in a part of the yard, and when the visitors arrived the mold had already been fixed in place, the stern post in the immediate vicinity of the mold and the mold itself being subjected to considerable heat, preparatory to the introduction of the thermit. Dr. Goldschmidt read a description of the experiment about to take place, and after the visitors, about 150 in number, had been provided with blue glass, through which to look upon the molten metal as it runs from the crucible into the mold, about 200 pounds of the special material was placed in the mold, fired in the usual way. In about a minute's time the whole material had run into this mold and the process of welding was in operation. This took place about 11:30 in the forenoon, and, after luncheon, about 3 o'clock in the afternoon, the molds were entirely removed, when a beautiful clean weld was exposed to view. The experiment was successful in every way, and it only remains for Lloyds' inspectors to make such tests of the complete joint as they may desire.

A. C. S.

LIST OF BOOKS ON CEMENT AND CONCRETE

The Book Department of the McGraw Publishing Company has just issued a leaflet containing a list of all of the recent works on cement and plain reinforced concrete. An effort has been made to make this complete, and it contains the names of some books which have been put on the market only within the last few days.

The McGraw Publishing Company has also issued a leaflet and list of books on steam turbine engineering.

COLLINS COMPANY SECURING BIDS FOR MATERIAL

The Collins Construction Company, 92 LaSalle Street, Chicago, Ill., which has secured the contract for 65 miles of electric railroad from Canton to Youngstown, is now taking bids on all classes of material and equipment needed for the complete construction and equipment of the road, consisting of concrete work, trestle work, drain pipe, steel bridges, ties, steel rails, rail-joints, frogs and switches, boilers, turbine generators and accessories, power-house building, car house and shops, poles, brackets, trolley-wire transformers and all accessories for the complete overhead work; passenger coaches, freight motors and motor equipment. The estimated cost of construction and equipment is $2,000,000.

THE CLEVELAND SITUATION

The plan of Mayor Tom L. Johnson, as divulged at a mass meeting in Cleveland on Wednesday of last week, to confine his scheme of 3-cent fare within the city limits, opened the eyes of some of the friends who have been staunch advocates of his theories. Up to that time the Mayor had been very careful never to mention the limit of possibilities for the 3-cent ideas that he has entertained, but through skilful questioning by President Horace E. Andrews, of the Cleveland Electric Railway Company, he made the admission, which is considered by many a confession of his inability to do what he has promised. Mr. Andrews had figured upon operating the entire system upon whatever fare might be adopted, feeling that the zone idea had been exploded long ago, but according to what the Mayor said, that is what he has been counting on all the time. He said he would not even entertain the idea of giving Collinwood a 3-cent fare on the holding plan, even if the village should be made a part of the city, nor would he allow any of the other outlying villages anything less than a 5-cent fare, unless their contracts with the Cleveland Electric specifically provide for it, or that it could be proved that the cost of carrying passengers is less than that. He said he did not believe in operating the lines outside of the city at the expense of those living in the city. Their people must pay a higher fare and allow the people in the city to pay just enough to make the company self-sustaining. The stand the Mayor explained seems to sustain the points made in the report made by Mr. Du Pont to the City Council, in which he said that the franchises in the outlying villages are worthless after the grants to the connecting lines within the city limits expire. Whether or not the report was submitted to the Mayor for his approval before it was read to the City Council, its contents seem to coincide with his views.

East Cleveland and some of the other villages have contracts with the Cleveland Electric Railway Company by which they are to have whatever rate prevails in the city, no matter what that may be. Under the leasing plan they would be able to force the leasing company to honor this franchise contract, and Mayor Johnson said that he would not interfere where such contracts exist. The line that reaches East Cleveland also goes to Euclid Beach, a popular resort which is largely patronized by both city people and visitors. Although a long run, this line does a heavy business through the summer and must make money for the company. The Mayor said he did not know what view he would take of the question regarding its fare. The owners of the resort are taking an interest in this matter.

At the meeting Wednesday, Mayor Johnson appointed a committee, with himself as chairman, to consider the communications of Presidents Andrews and Du Pont, and to suggest ways and means of getting together at the meeting to be held Saturday afternoon. This committee held a meeting or two, but no suggestions were made that would reduce the width of the gulf between the two companies. The later meeting really resulted only in a passage of words between the Mayor and Mr. Andrews and Messrs. Andrews and Du Pont. The Mayor attempted by a series of questions to induce Mr. Andrews to go into detail and give data from which he arrived at conclusions, but his questions were parried until finally Mr. Andrews said that the data collected were for the information of himself and Mr. Du Pont in their negotiations, and that they were not to be made public unless a settlement was arrived at. Then the Mayor started out with some information that proved to be data regarding the road and asked Mr. Andrews if there were any objections to giving it to the Council members for their consideration. Mr. Andrews repeated what he had said before, to the effect that the data are the company's private matter and were intended only for himself and Mr. Du Pont, and were not, under the agreement, to be given out. He said he did not propose to furnish ammunition for campaigns against the company later on. Mayor Johnson claimed that the stand taken by the company would block any further negotiations, as the Council had nothing upon which to base an offer, to which Mr. Andrews replied that he had supposed the negotiations were between his company and the Municipal Traction Company, and he could not see what good such information to the Council would be.

At the meeting on Wednesday, City Solicitor Baker presented Mr. Andrews with a list of sixteen questions, the answers to which, he said, would enlighten Council upon the matter. Following are the questions, with the answers formulated by Mr. Andrews and read before the meeting:

1.—It is claimed that in Chicago 20 per cent was added to the actual value of the physical property of the street railroads as compensation for contractors' profits, brokerage, interest during construction and engineering charges. This is the so-called Chicago plan.

In Cleveland it was suggested that one-ninth of the aggregate value of the physical property and franchises should be added and the sum so arrived at capitalized to be redeemable at one-tenth which is equivalent to 21 per cent additional to the actual value of the physical property and franchises together. This is the so-called Cleveland plan.

In your determination which of the plans did you use, or did you use both?

Answer: In Mr. Du Pont's communication to the Council, under date of Jan. 10, he stated that the Municipal Traction Company would be willing to make a contract with the Cleveland Electric Railway Company for the operation of its properties similar to the contract between his company and the Forest City Railway Company. That contract provides, as stated by him, for the payment as rent of "the equivalent of 6 per cent interest upon the stock of the company, issued at not less than 90 cents on the dollar and redeemable at $110 a share." He stated that the stock of that company represented the "physical and construction value of the property." The items mentioned in the first paragraph of this question are a necessary part of the cost of the construction of every street railroad, and were certainly included in the "physical and construction value" of the property of the Forest City Railway Company, against which $100 of stock of that company was issued for every $90 of cost. For this reason they should be included in the reproduction value of the Cleveland Electric Railway Company and, as the proposition is that a contract be made with the Cleveland Electric Railway Company similar to the contract made by Mr. Du Pont's company with the Forest City Railway Company, one-ninth should be added to this reproduction value, including the items mentioned. For these reasons the items mentioned were so included, and to the value so ascertained one-ninth was added in exact accordance with Mr. Du Pont's original proposition.

2.—Did you base franchise value upon estimated profits per passenger or per car-mile?

Answer: Per car-mile.

3.—Did you take average earnings upon the entire system or average earnings upon the several lines in finding the franchise values?

Answer: Average earnings upon the entire system.

4.—What percentage of the gross receipts did you assume as net earnings?

Answer: Forty.

5.—What rate of interest was deducted from net earnings as interest on physical property before capitalizing for franchise value?

Answer: Five per cent.

6.—In determining the franchise value, did you use the present worth of future profits?

Answer: Yes.

7.—What rate of interest did you use in determining present worth?

Answer: Five per cent.

8.—What rate of annual increase did you assume?

Answer: Eight per cent compounded. This is the rate of increase in earnings in the past four years, and in the past twelve years.

9.—From what date did you estimate franchise value?

Answer: July 1, 1907. (This date should be Jan. 1, 1907, as that was the date agreed to in determining physical values).

10.—Are your franchise values based on the assumption that the franchises in Central and Quincy Avenues have expired?

Answer: Yes.

11.—What date of expiration did you fix for the so-called cable road grants outside of Glenville, including St. Clair, Superior and Payne?

Answer: Jan. 5, 1910, for St. Clair; and Jan. 26, 1910, for Superior and Payne.

12.—What date of expiration did you assume for the Woodland Avenue and West Side grants?

Answer: Feb. 10, 1908. The company believes, however, that the grants run to a later date.

13.—What dates of expiration did you assume for the Euclid and Prospect Avenue lines west of University Circle?

Answer: July 13, 1913. The company claims, however, that its rights do not expire until after that date.

14.—What date of expiration did you assume for Detroit Avenue, west of Highland Avenue?

Answer: Sept. 5, 1924. The contract with the Rockport Plank Road Company, referred to by Mr. Baker at the Council meeting on the 27th, was not included, nor was it included in our valuation of the physical property.

15.—What value did you give to outlying franchises after the expiration of the inside connections?

Answer: The present worth of the net earnings per car-mile, after deduction of interest upon the value of the physical property, as stated in my answers to questions 2 and 3, in exact accordance with the method of franchise valuation suggested by Mr. Du Pont.

16.—What method did you use in ascertaining the franchise value of the outlying grants after the expiration of the inside connections?

Answer: My answer to question 15 answers this.

In the course of the questioning, Mr. Andrews said that he thought for a while that they would certainly reach an agreement, or at least an agreement upon values, if they had been let alone. The Mayor demanded to know what the expression meant. Mr. Andrews did not answer definitely, but intimated

that if others had not had so much to do with it, he and Mr. Du Pont would have gotten along better. During the discussion Mr. Du Pont several times denied that he had used certain methods and agreed to certain rules for arriving at results. Each of the men intimated that the other had not been fair in some of the statements made.

With all his ingenuity at persuasion and questioning, the Mayor endeavored to get President Andrews to say what he thought would be a fair value on the property for leasing purposes. Mr. Andrews replied that he could see no reason for making a price to the Council, but that if negotiations in good faith are desired he is willing to continue them. He said he had not taken the matter of price up with the directors of the company, but only matters that came up at former meetings had been discussed.

At the meeting on Wednesday, Mr. Du Pont presented a letter, in which he criticised the report made by Mr. Andrews to the City Council on Monday evening. In answer to this, Mr. Andrews handed the following communication to the City Clerk at Wednesday's meeting:

Mr. Du Pont's letter of the 27th, I wish to reply to in several particulars:

1. As to my not giving him a copy of my letter of March 25 to your Honorable Body, I received a letter from Mr. Du Pont late Sunday evening, enclosing a copy of a communication that he said he expected to send to you. The Council met at 7 o'clock the next evening. Mr. Du Pont left the city on Sunday. I learned, upon inquiry, that he did not return to Cleveland until after the Coucil meeting. I therefore had no opportunity to send him a copy of my communication to you in time for him to consider it before your meeting.

2. As to the adoption of what is referred to as the "Chicago rule" for the appraisal of the physical property. In Mr. Du Pont's communication to you of Jan. 10, in which the negotiations were suggested, he said: "The present contracts by which the Municipal Traction Company operates the lines of the Forest City Railway Company are upon the basis that the Municipal Traction Company shall pay as rent the equivalent of 6 per cent interest upon the stock of the company, issued at not less than 90 cents on the dollar, and redeemable at $110 a share; the stock of that company representing only the physical and construction value of the property.

"I am directed by the directors of the Municipal Traction Company to say that it would be entirely willing, on behalf of the public, to make similar contracts for the operation of the Cleveland Electric Railway Company's properties, the rent to be fixed by a careful determination of the value of the physcical property and the present worth of the unexpired franchises of the Cleveland Electric Railway Company, adding to that sum one-ninth thereof, and upon the sum so derived paying as rent quarterly at the rate of 6 per cent per annum."

The Municipal Traction Company pays 6 per cent upon the face value of the stock of the Forest City Railway Company, issued at 90 cents on the dollar; this representing the "physical and construction value" of the property of that company. The "construction value" undoubtedly included all the expenses of engineering, superintendence of construction, cost and use of tools, lawyers' fees, expenses of obtaining consents of property owners, court costs, carrying charges, etc. All these items were, of course, included in the 90 cents, one-ninth of which was added, bringing the value of the property up to the face value of the stock, and upon which value 6 per cent dividends are to be paid. If the city shall elect to purchase the property it is to pay the Forest City Railway Company or the Municipal Traction Company 10 per cent additional, the redemption of the stock being $110 per share. He said to you that his company would be willing to make a similar contract with us. The cost of reproducing our property at present market prices of material and labor was to be determined by him and me, and this cost, of course, should properly include legal expenses, carrying charges, the use of tools and everything that goes into the cost of constructing a street railway.

Depreciation, proportioned to length of time each item of property has been in use, was to be deducted from this total cost, the depreciation to be figured on the legal and advertising expenses, etc., as well as on the cost of labor and material. To this depreciated present value one-ninth was to be added, just as it was added to the physical and construction value of the Forest City Railway Company's physical and construction value. The "Chicago rule" was used, not to determine the amount of the bonus, but to determine the amount that should be included in the value of the physical property. In the Detroit valuation report prepared by Prof. Bemis some years ago, 22 per cent was added, representing the items above referred to.

3. As to the value of the franchises: He says that I never told him how I arrived at the value of the Cleveland Electric Railway Company's franchises. I arrived at it by a method suggested in every particular by himself, and, at the time, I stated I thought his plan was equitable, and could suggest no improvement, and that it was acceptable to us, and I gave him the complete data, in writing, as to the duration of franchises, length of track and number of trips, by which he could reach a value by the same method and check the result that I might obtain. If he completed a calculation on this basis the result must have coincided with the result reached in our office, as I made no changes whatever in the method suggested by him and taken down stenographically by Mr. Davies, and used the rates of interest and percentages of operation arrived at after considerable argument on both sides. I did not suppose that we had reached a complete disagreement as to the basis on which the value of the franchises of the company should be calculated until I received his letter of March 13, which was accompanied by a printed argument in which he assumed a physical property value to which we had not agreed, and which did not contain all the items of value, and adopted a method of calculation of franchise values that had not only not been agreed to by me, but was very different from the plan that he had suggested, the plan that he had used in his valuation of Chicago franchises, and the only plan upon which I have made any calculation of franchise value.

For the company I entered into this negotiation with good faith, and am willing to resume it in the same spirit, but as the methods of valuation were suggested by Mr. Du Pont, and especially those for the valuation of fraichises, it is difficult to reconcile with the good faith that ought to control such negotiations the present refusal to abide by the results so reached.

At a public meeting in the Council chamber Tuesday forenoon, March 5, Mayor Johnson expressed his determination to exclude from any agreement between the Cleveland Electric Railway Company and the Municipal Traction Company a clause binding the latter to a fare not to exceed 3 cents in the city and 5 cents outside the limits. All along it had been expected that this would be one of the conditions of the contract and the officers of the Cleveland Electric Railway Company had understood the matter in that light. The Mayor was willing to give the Cleveland Electric Railway Company a twenty-five-year franchise at the rate of seven tickets for a quarter as security in case the Municipal Traction Company failed to pay the interest on the value fixed, or to keep the property in proper condition, but that is all. Even then he wanted the Council to be the judge as to whether the proper care was taken of the property.

Further questioning on the part of President Andrews, of the Cleveland Electric, brought out the fact that the Mayor wanted the Municipal Traction Company's fare regulated by action of the City Council, with the idea that, if it was found that the system could not be operated on a 3-cent fare, a change to a higher fare could be made. But the Mayor made it appear, as far as possible, that he wanted the matter thus arranged so that the Council might reduce the fare, if the business produced a surplus.

A committee appointed by the Mayor at a former meeting, consisting of his honor, as chairman, City Solicitor Baker, and Councilmen Koch, Biesinger, Pfahl, Argill and Haserodt, made a report at this meeting which recommended that an offer be made to the Cleveland Electric Railway Company to lease its property on the basis of 6 per cent on a valuation of $60 a share, redeemable at 10 per cent in advance of this. The report referred to a number of lines, whose franchises expire within a few years, as being of little value, and the committee, it seems, considered the franchises in suburban towns as without value after the franchises of the connecting lines had expired. In order to make matters easy for the holding company, the committee suggested that the company should be paid 3 per cent on the valuation fixed for the remainder of this year, 4 per cent next year, 5 per cent the succeeding year, and 6 per cent thereafter.

The report of the committee was adopted, with the understanding that Councilmen voting for its adoption were not binding themselves to support the holding plan. The Mayor explained that whatever plan was adopted should be submitted to the people for their approval, but it is not believed that he desires to have anything submitted to the people. Since he has been forced to admit that the change may result in 3-cent fare and may not, the idea will probably not be so popular and people may conclude that it is better to be sure of the seven tickets for a quarter, as offered by the Cleveland Electric, than to run the risk of having the Municipal Traction Company charge any fare it may see fit, if so desired by the administration.

President Andrews stated that the company could not operate the system on a 3-cent fare, and that he expected the Municipal Traction Company to fail, if the offer is accepted. For that reason the company would probably be willing to accept the offer, with the provision that the fare be limited to 3 cents. Mr. Andrews said he would bring the city's offer before his board of directors, but he made no offer to the city in any way. He made it clear, however, that the offer would not be accepted unless the limitations mentioned as to fare were placed in the lease. He offered to test the flat 3-cent fare, but the Mayor refused this. Mr. Andrews then said he has spent half a million dollars making tests and that he was not anxious to make this one.

TRACTION WINS IN CHICAGO

Frederick A. Busse, the Republican candidate, was elected Mayor of Chicago at the election on Tuesday, April 2, having a plurality of 13,121 votes over Mayor Edward F. Dunne. The ordinances settling the street car question were carried by a larger majority. The vote on this question was 165,846 for, and 132,720 against.

The issues of the campaign have been largely based upon the improvement of the local traction systems, as previously mentioned in the Street Railway Journal. Both parties agreed that present conditions are intolerable, but differed as to the best method of revising them. The Democratic Party, headed by Mayor Dunne, stood for immediate municipal ownership through condemnation of the street car property if the result could not be obtained in any other way. The Republican Party favored ordinances which were recently passed by a Democratic City Council over the veto of Mayor Dunne. These ordinances provided for twenty-year franchises for the street car companies, the city retaining the right to purchase the systems for $50,000,000 plus the amount to be spent for immediate rehabilitation of the lines, six months' notice being necessary of the city's intention to acquire the property. The ordinances also provide for universal transfer throughout the city, a 5-cent fare, and 55 per cent of the net profits of the companies to be paid to the city.

NEW YORK FRANCHISE VALUATIONS

The valuations of the public franchises held in New York City, by the State Tax Commission for the special tax provided for by law, are increased $105,375,700 this year. The valuations placed on the various franchises under the Brooklyn Rapid Transit are increased over $16,000,000. In the tentative assessment, the latter increase was $20,000,000. Against this the officers of the Brooklyn Rapid Transit vigorously protested. The result was a reduction of nearly $5,000,000. In all, in New York City, the increase exceeds $100,000,000. What the tax receipts from these sources will be, however, cannot be determined until it is known what tax rate the legislature will impose. Should it be equal to that of last year, the tax sums paid by these franchise holders will be increased nearly $400,000.

MICHIGAN COMMISSIONER RECOMMENDS THAT ELECTRICS BE PLACED UNDER STATE JURISDICTION

In presenting his report to the State, the Railroad Commissioner of Michigan says in part:

"At the last session of the legislature, a law was passed authorizing the Commissioner of Railroads to require the construction of fencing along the lines of electric railways, and also providing for the construction of farm crossings across such tracks. This was certainly a step in the right direction, but there does not seem to be any good reason why electric interurban railway lines should not be brought fully within the jurisdiction of the Commissioner of Railroads, and the control of said law, to the same extent that railroad lines operated by companies organized under the general railroad laws are now controlled. These electric railway companies have become a very important factor in the carrying trade in the State, and the building of such lines should certainly, under all circumstances, be encouraged. I would, therefore, recommend that the law under which this class of companies is organized be either repealed and the companies required to reincorporate under the general railroad laws, or that such law be so amended as to become fully as effective as the general law. At the present time electric railway companies are not required to make any report to this department and only make a very incomplete and unsatisfactory report to the Secretary of State. It certainly seems very important that the general public should be enabled to inform themselves regarding the actual condition of these corporations, and I would therefore most earnestly recommend that you request the legislature to enact a law which will require electric railway companies to make complete annual reports to the Commissioner of Railroads in about the same form that is now used by the steam railroad companies in making their reports."

TOLEDO, WABASH & ST. LOUIS COMPANY INCORPORATED

The Toledo, Wabash & St. Louis Railroad Company has been incorporated at Augusta, Me., with a capital stock of $6,000,000, and the following Toledo men as officers: Clarence D. Whitney, president; George G. Metzger, vice-president; J. P. McAfee, treasurer; S. L. McAfee, secretary. Riggs & Sherman, of Toledo, will be the engineers. It is said this is a further development of the Toledo & Defiance Railway Company, which was incorporated a few weeks ago. In fact, the Ohio company is to be a holding company. Burr Brothers, of New York, will underwrite the stock of the company, while the Carnegie Trust Company will act as transfer agent, and the Columbia Trust Company as registrar. The Toledo & Defiance Railway Company will secure the right of way, franchises, and all other concessions. The construction work will be done in sections, the first being that between Toledo and Defiance. After that the line will be continued westward. No bonds will be issued, it is said, and no preferred stock. The road will thus stand upon its own foundation. President Whitney is an old steam railroad man, having been traffic manager of the Clover Leaf system. The road will pass through Fort Wayne, Indianapolis, Terre Haute and some other smaller cities of the Hoosier State and will be as nearly an air line as possible. Following this comes the report that the Toledo & Indiana, which has plans for an extension from Bryan to Waterloo, Ind., will build on to Fort Wayne, where it will connect with the Union Traction Company's line. Through traffic arrangements with this company and the roads owned by the McKinley syndicate in Illinois, a through route to St. Louis will be formed. Possibly a number of gaps will have to be closed up, but the Union Traction Company's lines and those of the McKinley syndicate in Eastern Illinoise are now connected. The gaps will then occur between that point and Southern Illinois. The syndicate is now building a line from Alton on the Mississippi River to Jacksonville, in the Central part of the State.

DECISION IN THE MEMPHIS LOW FARE CASE

Sustaining the validity of an ordinance seeking to compel the Memphis Street Railway Company to sell tickets at the rate of six for 25 cents, and declaring that the extended franchise which the company has been claiming since Nov. 20, 1905, is of no legal value, Judge Pittman has decided the damage suit for $2,000 of William G. Byrne against the Memphis Street Railway Company in favor of the plaintiff. Attorneys for the defendant immediately filed notice of appeal. The opinion is elaborate, and sustains the position taken by the plaintiff's attorneys, which is that the ordinance of 1895 was not a contract for the reason that the Legislature of the State of Tennessee had expressly and unequivocally declared that no taxing district should make any contract of any description, except in writing, to be signed by a majority of the fire and police commissioners and a majority of the Board of Public Works. Attorneys for the defendant contended that a decision adverse to the defendant would mean that the franchise of the Illinois Central Railroad, involving about $15,000,000; the Union Railway Company about $4,000,000, and the Memphis Street Railway Company involving $5,000,000 or $6,000,000 would be declared invalid. This view of the situation was not held by Judge Pittman, except with regard to the Union Railway Company, which he declared might be involved.

Isadore Newman & Son, who control the majority of the stock of the Memphis Street Railway company, have issued the following statement:

"Before we became interested in the Memphis Street Railway Company our attorneys reported favorably on the franchise. The franchise provides for a 5-cent fare for a continuous ride, but reserves the right to the city to request the company to sell eleven tickets for 50 cents. The ordinance stipulating six tickets for 25 cents was passed some months ago during political turmoil.

"The company will appeal the decision rendered March 28. We are most confident that the higher court will sustain the rate of fare provided in the franchise, for the franchise constitutes a contract between the city and the company.

"We are advised that no other question as to the franchise is involved in this decision."

WESTERN KENTUCKY PROJECTS

Tillman Bethell, of Henderson, Ky., is enthusiastic over the prospects of the building of two electric railways from Evansville, Ind., into Kentucky territory, both of which will penetrate rich coal and mineral lands, as well as rich agricultural territory. One of the lines will be from Evansville through Henderson to Uniontown. The other line will be from Evansville to Owensboro. It is the aim of the promoters to build the Evansville and Uniontown line first. In this project Mr. Bethell has enlisted the assistance of A. G. Crutchfield and W. W. Cooper, of Henderson County, who are leading business men of their section of the country.

"It is the aim to build a track 5 miles up the river from Evansville," said Mr. Bethell, "and cross the Ohio River at Towhead Island, which lies on the Kentucky side. We can bridge the river at this point for considerably less than $1,000,000. The two lines will then diverge from the bridge on the Kentucky side, one going east to Owensboro and the other west to Uniontown. Both lines will cover a distance of about 25 miles from the river to their termini. The roads can be built cheaply, as they will traverse a comparatively level scope of territory. The Evansville and Uniontown road will tap coal fields that are most excellent in quality. The Owensboro line will tap beds of mineral, especially fire clay."

All of the rights of way have not been obtained, but he says that will be an easy matter. Mr. Bethell is one of the oldest business men in Western Kentucky. For many years he was engaged in the steamboat business, but for the last twenty-five years he has been engaged in farming and other businesses.

SERVICE IN MILWAUKEE

At the hearing recently before the Wisconsin Railroad Commission some interesting facts were given regarding street railway operation in Milwaukee by C. N. Duffy, auditor of the Milwaukee Electric Railway & Light Company. Mr. Duffy said that during the month of February, the Milwaukee Electric Railway & Light Company carried 7,134,180 passengers and operated its double-truck cars 916,890 car-miles, or all told offered a capacity of 38,509,380 car-seat miles. Of this car-seat mileage, only 18.53 per cent was used. Mr. Duffy is quoted as saying: "There were only 7.78 passengers carried to a car-mile. Out of 397 cars possessed by the company, 372 cars were put in service. That is, out of a car capacity of 100 per cent during the month, 93.7 per cent were in use. No other road in the United States can show such a record. It must be remembered that when the last seventy-five cars were put in service, thirty-five old cars had to be taken off. This left only about forty new cars for service improvement. Taking 5.20 to 6.20 at night as the busiest time of the day, if 372 cars are put in service, and only average sixty passengers to the car, it means that 22,320 passengers are carried in 1 hour, or 372 in 1 minute. Three hundred and seventy-two cars an hour means six cars in 1 minute and 1 car in every 10 seconds. I think the capacity of the streets is about reached. You might do something with an increase of car capacity, but you could not increase your transportation capacity."

TRANSFER OF MANAGEMENT OF WORCESTER LINES

A transfer of management of street railway lines controlled by the New York, New Haven & Hartford Railroad, by which Francis H. Dewey, president of the Worcester Consolidated lines, becomes general head of the roads in this section of the State, is announced. President Charles S. Mellen, of the New Haven Road, has resigned the presidency of the Worcester & Southbridge and Worcester & Blackstone Valley Roads, and Mr. Dewey has been elected president of each of those lines. The Worcester & Webster and Webster & Dudley Railways, which are controlled by the New Haven Road, have been leased to the Worcester & Southbridge Company, and both the Blackstone Valley Road and the enlarged Worcester & Southbridge system will be operated from Worcester in connection with the Worcester Consolidated, which is also one of the New York, New Haven & Hartford Railroad properties. E. G. Cornett will be general manager of all these lines.

A. B. Potter, who has been superintendent of the Worcester & Webster, Worcester & Southbridge and Webster & Dudley, has been transferred to the Stamford, Conn., lines of the New York, New Haven & Hartford, and J. W. Anderson, superintendent of the Blackstone Valley Road, will be in direct charge of the enlarged Worcester & Southbridge.

THE NEW YORK CENTRAL ACCIDENT

On March 27 the grand jury in New York City handed down three indictments, charging manslaughter in the second degree as the result of the New York Central accident of Feb. 16. The parties named are the railroad company, Vice-President A. H. Smith, and General Superintendent I. A. McCormack. The presentment states that the disaster was undoubtedly due to the excessive speed. It refers to the fact that the electric locomotives run with greater smoothness than steam locomotives, and consequently men not experienced with them almost invariably underestimate their speed. The jury believed that the engineer of the wrecked train had not received sufficient instruction to enable him to form a judgment of any value as to the speed at which he was running his train.

CALIFORNIA STORM AFFECTS TRACTION PROPERTIES

The severe rainstorm and floods which visited California the week of March 17, resulted in considerable damage to traction properties in the central valleys and crippled the service to a considerable extent in San Francisco. At Orrville the entire town was flooded, and the losses to the Northern Electric Company's railway lines and bridges were very heavy. No trains could be operated for several days, the service between Chico, Orrville and Marysville being suspended on account of the tracks being submerged.

In Berkeley the Key Route train service was blocked for a few hours by a washout. In San Francisco the United Railroads were compelled to depend on its two city power plants, Bryant Street and North Beach, as the power house and transmission service of the California Gas & Electric Corporation was temporarily crippled. Many of the car lines were demoralized for several days.

MEETING OF THE NEW YORK STATE ASSOCIATION

The New York State Street Railway Association has decided to hold its annual meeting at Bluff Point, Lake Champlain, June 25 and 26. A committee of arrangements has been appointed, consisting of E. S. Fasset, C. Gordon Reel, F. V. Green, H. N. Ransom, H. S. Bradfield. Requests for hotel reservations should be made to E. S. Fasset, general manager United Traction Company, Albany, N. Y. It is announced by J. H. Pardee, secretary of the association, that no spring meeting of the body will be held.

STRIKE AT MONTGOMERY

The motormen and conductors employed by the Montgomery Traction Company, of Montgomery, Ala., are on a strike, because the company refused to recognize the union, which was organized a few days ago. Wednesday, March 27, all the cars were run into the car house by the men and for about 2 hours there was not a car running. About sixteen men remained with the company. This was enough to put cars on the road, and with the help of the superintendent and several other employees at the car house about ten cars were run during the afternoon. When the cars came to the car house Manager Ragland made a short talk to the men, telling them the position of the company, saying it did not propose to recognize the union, and those who wanted to remain under those conditions could do so, the others could call and get their money. Nearly all walked out.

The St. Joseph Valley Traction Company, of Elkhart, Ind., which operates with gasoline-motor cars a line from Middlebury, Ind., to Angola, Ind., about 47 miles, has made a mortgage to William P. Knickerbocker, of Elkhart, as trustee, to secure $700,000 bonds, due in 1919. The road was projected to extend from Angola via Middlebury to South Bend, 80 miles. The St. Joseph Valley Railway was organized to build the 28 miles from La Grange to Angola.

EMBANKMENT SUBWAY HEARING IN BOSTON

A legislative committee hearing relative to the proposed subway in Boston from Park Street to the Back Bay Fens district via Beacon Hill and the Charles River Embankment, was held on March 27. Interest centered in the opposition to the project as indicated by various property owners in the Back Bay and by counsel representing parties solicitous lest the work interfere with the attractiveness of the Common. The Boston Elevated Railway Company also appeared in opposition to the plan.

President Bancroft stated that there is now invested, either by by the Boston Elevated Railway Company or the city of Boston, $60,000,000 in rapid transit projects. The company is committed to an investment of $30,500,000 more, of which $10,500,000 is for rapid transit subways in Cambridge; $9,500,000 for the Washington Street tunnel; $8,000,000 for the Forest Hills elevated extension and enlargement of platforms for eight-car trains, and $2,500,000 for surface line and other improvements. To meet the interest, dividend, taxes and subway rental charges on this capital, $1,500,000 extra earnings per year would be required. General Bancroft contended that in view of these capital requirements it would be inadvisable at this time to embark in the Back Bay subway enterprise. The building of a subway for surface cars at the east of the Washington Street tunnel is a matter for consideration in the early future, as is the possible relief of the traffic congestion at Sullivan Square terminal by a proposed elevated extension to Malden and Medford.

When the Cambridge subway is built the present traffic on the Boylston Street tracks of the present subway should be materially relieved. Fifty-one cars per hour are now run into this subway from Cambridge, and thirty of these can be withdrawn. When the Washington Street tunnel is completed, the latter part of next year, forty of the sixty-eight Huntington Avenue cars per hour can be deflected through Dartmouth, Chandler and Tremont Streets to the south portal of the Tremont Street subway, including twelve Berkeley Street cars. In other words, eighty-two cars per hour out of the present 225 can be withdrawn, making a reduction of about 36 per cent. As yet no definite plan is in consideration for a subway connection between Park Street and the South Station, but this is a natural line of travel which will probably be established in time.

REPORT ON STEEL CARS BY PENNSYVANIA COMPANY'S COMMITTEE

Covering a comprehensive plan for substitution of all steel for wooden passenger cars on the Pennsylvania Railroad system, a report has been completed by a special committee to which this important matter was entrusted. Within the next three years it is proposed to buy and construct 2000 all-steel passenger cars. This marks a complete change in all existing standards of passenger equipment and entrance into an entirely new field and involves a tremendous cash outlay. This year it is the purpose to build about 200 steel passenger cars. About fifty cars will be built in the Pennsylvania Railroad shops at Altoona. What the Pennsylvania Railroad management is aiming for is to have sufficient all-steel passenger equipment for every train which will be operated into the New York tunnel terminal system.

THE NEW HAVEN'S PROPOSED BERKSHIRE LINES

In the issue of the Street Railway Journal for March 30, brief mention was made of the plans of the New Haven Company for trolley extensions and improvements in the Berkshire district. It is now learned that from the southern terminus of the Berkshire system at Canaan, Conn., a line will extend clear across Massachusetts from south to north, with numerous lateral branches, tapping districts, many of which have had no improvement in transportation since the days of Massasoit and King Philip's War. A section of the system for which early construction is planned is that running north from Canaan to Great Barrington, where it will join the line already in operation running north from the latter city. There will be a spur running from this new line southwest ot South Egremont, and just before it reaches the Massachusetts line a branch will be thrown to circle through a territory which has now neither trolleys nor steam lines. Running eastward to Clayton, it will then turn north through Ashley Falls to Hartsville. Another loop of this same line, leaving it near Ashley Falls, is to swing eastward through Southfield and New Marlboro, then back to Hartsville. From that point it is run back to the main line near Great Barrington. East of this wide developing loop a line, beginning at Montville, is to run southeast through West Boston and New Boston, down into Connecticut, to connect with the Hartford lines.

From Great Barrington there is now in operation a trolley line which runs through Van Dusenville, Pittsfield and North Adams to the northern boundary of the State at Williamstown. The plans for new construction provide for numerous branches of this line. From East Lee a long line is to run eastward through the valley of the Westfield River, which will thus be connected with the outside world for the first time, to Huntington. From this point a line to Springfield is already in existence, so that if the Legislature approves of President Mellen's proposal the Berkshires will have electric connections not only with Springfield, but also with Boston, Hartford, New Haven and New York. Further north on the main line comes the spur to Mount Greylock, the highest point in Massachusetts. From the present terminus at Williamstown a line is already under construction to Bennington, Vt., which when finished will open to that city Northwestern Massachusetts, which, on account of the indirect connections, has heretofore been difficult of access from that point.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS NOMINATIONS

The board of directors of the American Institute of Electrical Engineers has selected the following nominees for the forthcoming annual election: President, Henry G. Stott, New York; vice-presidents, L. A. Ferguson, Chicago; W. C. L. Eglin, Philadelphia; J. G. White, New York. Managers, P. H. Thomas, New York; B. G. Lamme, Pittsburg; H. W. Buck, New York; Morgan Brooks, Urbana, Ill. Treasurer, Geo. A. Hamilton, New York; secretary, Ralph W. Pope, New York.

AUDITORS ORGANIZE IN OHIO, INDIANA AND MICHIGAN

The auditors of the interurban railway of Indiana, Ohio and Michigan have organized an association, known as the Central Electric Accounting Conference, and Ira E. Guthrie, of Columbus, Ind., auditor of the Indianapolis, Columbus & Southern Traction Company, has been elected secretary. The plans of the association for holding meetings and conducting business are not announced.

BOSTON & WORCESTER COMPANY SECURES CONVICTION OF PERJURER

James J. Barkus, plaintiff in a $5,000 personal injury suit in the Superior Court at Worcester, March 27, against the Boston & Worcester Street Railway Company, after he had been cross-examined by Guy Murchie, counsel for the company, was ordered to be arrested by Judge F. A. Gaskill on the charge of perjury, and held in $1,000 bail for the May term of the Superior Criminal Court. Barkus has appeared as plaintiff in injury cases before, and it is alleged that some of his answers to the questions of the counsel for the Boston & Worcester Street Railway Company were far away from the truth.

Frank B. Hall, counsel for Barkus, said after court:

"As soon as this evidence about Barkus came out, I immediately conferred with the court, and told the judge I was satisfied that Barkus had deceived not only counsel, but the doctors."

A SAN FRANCISCO OFFICE FOR THE STREET RAILWAY JOURNAL

The national character of the Street Railway Journal's circulation is emphasized again by the opening this week of another office for the special convenience of its friends in the Far West. The new office is in San Francisco and will be under the management of Herbert Booth King, who is well known on the Pacific Coast. The San Francisco address is 701 Atlas Building, 604 Mission Street. Copies of this paper and of the books and other publications of the McGraw Publishing Company will be carried in stock and on file for the convenience of friends upon the Pacific Coast who wish to purchase or consult technical literature.

ANNUAL REPORT OF THE BERLIN STREET RAILWAY

The annual report of the Grosse Berliner Strassenbahn, covering operation for the year 1906, reveals such a prosperous condition of affairs that despite the losses due to winter breakdown of the conduit system, the directors recommended a dividend of 8 per cent on over $25,000,000 capital as against 7¾ per cent for 1905.

The number of passengers was 364,100,000, equal to an increase of 3.88 per cent over 1905; the passenger revenue was 34,632,051 marks ($8,658,013), or an increase of 4.13 per cent; the car mileage was 51,381,653, an increase of 2.38 per cent, while the gross receipts per car-km increased from 41 pf. to 42 pf. ($.164 to $.168 per car-mile). The total receipts from all sources were 35,174,338 marks ($9,293,584), and the operating costs 18,968,847 marks ($4,742,212), or 53.93 per cent of the gross receipts as against 54.68 per cent in 1905.

Owing to a general increase in wages and shortening of the conductors' working time, the labor account rose over $120,000, making a total of 11,554,877 marks ($2,888,719). The company also gave 657,371 marks ($84,343) for employees' pensions, sick and death benefits, legal aid, society, etc.

The trackage of the company was increased from 506.8 km (314.2 miles) to 511.9 km (317.3 miles).

STREET RAILWAY PATENTS

[This department is conducted by Rosenbaum & Stockbridge, patent atorneys, 41 Park Row, New York.]

UNITED STATES PATENTS ISSUED MARCH 12, 1907

846,481. Brake; Van Buren Lamb, New Haven, Conn. App. filed Oct. 6, 1905. Provides a brake-shoe so constructed that when it becomes partially worn it may be detached from the brake-head and attached to the wearing face of a new shoe so that the material thereof may be completely used up.

846,516. Means for Attaching Rails to Ties; William C. Smith, Minneapolis, Minn. App. filed Dec. 21, 1906. The base flanges of the rail are slotted to receive bolts which pass diagonally downward into the ties.

846,524. Rail Joint; William P. Thompson, Lansdowne, and Samuel G. Thomson, Altoona, Pa. App. filed Aug. 30, 1906. A splice bar for rails having a freely depending flange extending below the base of the rail, said flange gradually decreasing in thickness toward its lower edge.

846,528. Air Brake System; Walter V. Turner, Wilmerding, Pa. App. filed Aug. 1, 1903. An air brake system in which there are contained an air pump, main, supply, and application reservoirs connected therewith. Supplies air under pressure from two reservoirs to operate the exhaust mechanism of the train pipe, by admitting air from the application reservoir to the exhaust mechanism.

846,533. Electric Controller; Ferdinand Volk, Pittsburg, Pa. App. filed Sept. 29, 1906. A controller of the type in which motor reversals are secured by movements of the handle to opposite sides of a central position. Has a detent to prevent overthrow in either direction.

846,626. Controller for Electric Motors; Frederic Schaefer, Wilkinsburg, Pa. App. filed Feb. 20, 1906. Designed to regulate electromotive force and circuit connections for starting and operating alternating-current motors. Has a sectionally-wound transformer coaxially disposed in the controller casing and segments symmetrically disposed thereabout in such a way as to require only a very limited number of contact fingers. The length of the connecting leads and the number of the contact members is also reduced to a minimum, and as the transformer is rotatably mounted in oil it may be reduced in size and weight.

846,707. Composite Brake-Shoe; Daniel O. Ward, Oak Park, Ill. App. filed Jan. 22, 1906. Has a back plate without marginal enclosing partitions provided with one or more projecting inserts upon its short side, in combination with a body positioned upon the back, arranged about and secured to said inserts and means for securing said shoe in position.

846,724. Means for Attaching Rails to Metallic Ties; Jacob F. Bowman, Artesia, N. M. App. filed Dec. 8, 1906. A clamp for holding rails to metallic ties. Is similar to the clamp used for holding work on a planer bed.

846,755. Brake Shoe; John J. Newbaker, Steelton, Pa. App. filed Dec. 5. 1905. A brake-shoe consisting of a body portion having corrugated rear faces and provided with projecting tongues spaced apart to provide an intervening recess.

846,764. Switch; William R. Thompson, South Norwalk, Conn. App. filed April 21, 1906. A form of signal operating switch adapted to be secured above a trolley wire and engaged by the trolley wheel in passing. Has a pneumatic time mechanism so that the duration of the signal current is constant for all speeds of the passing cars.

846,779. Signaling Apparatus; Clarence W. Coleman, Westfield, N. J. App. filed Oct. 12, 1905. Relates to signal systems of that type in which liquid carbonic acid gas is used as the motive force. The present patent relates particularly to details of the pistons for moving the semaphores.

846,799. Track construction; James W. Leahy, Jersey City, N. J. App. filed Dec. 20, 1906. Track construction for tunnels. Has cross-ties embedded in a concrete bed, shoes at the end of each tie, longitudinal runways bolted to the shoes, and tracks secured by the runways.

846,862. Metallic Railway Tie; Edward C. Potter, Chicago, Ill. App. filed Nov. 24, 1906. A cast metal tie having its central section of deep and narrow form while its end portions are flat and perforated to receive the track bolts.

847,073. Rail Joint; James S. A. Hunt, Mattie, W. Va. App. filed Feb. 28, 1906. Railway joint or chair having side or fish-plates connected at the center with an integral bridge, which constitutes a small rail section intermediate the ends of the usual rails.

847,105. Signal; William H. Parrish, Jr., Nashville, Tenn. App. filed Nov. 3, 1906. A semaphore apparatus having lamps of different colors, arranged in the quadrant of a circle. Four quadrant shutters move angularly to expose different lamps under the influence of electromagnets in the signal circuit.

847,110. Railroad Tie; Joshua H. Price, Cleveland, Ia. App. filed Nov. 21, 1906. A hollow metallic tie having a core of concrete and means for attaching the rail to the tie.

847,157. Signaling Apparatus; Harold G. Brown, West Ealing, London, and Ernest DeM. Malan, Highgate, London, England. App. filed April 4, 1905. The locomotive is provided with a row of depending shoes or tappets, which contact with special plates adjacent to the track rail. The purpose is to complete different annunciator circuits in the locomotive cab.

847,163. Trolley; Thomas Cope, McKees Rocks, Pa. App. filed Nov. 17, 1906. In place of the usual trolley wheel there is provided a V-Shaped shoe having balls inserted in recesses in its face which contact with the trolley wire.

847,170. Trolley Stand; Harry E. Eastman, Richmond, Va. App. filed Jan. 5, 1906. The pole is pressed against the wire by a spring, the faces of which can be released by a detent. There is a link connection from the pole to this detent so that the spring is released in case of excessive upward movement of the pole.

847,187. Railway Rail Joint; William H. T. King, Dallas, Tex. App. filed Nov. 6, 1906. Details of construction of a locking key which passes through two adjacent bolts of a rail-joint.

847,259. Car Replacing Frog; Leon Pluard, Chicago, Ill. App. filed Oct. 10, 1906. The bottom edge of the frog is sharply serrated so as to firmly bite the lower flange of the rail so that the frog will not slip off when replacing the wheel. Has specially formed grooves and channels in the upper face for the same purpose.

847,289. Signal Device for Street Cars; Harry H. Miller, St. Louis, Mo. App. filed July 30. 1906. A device to prevent passengers alighting from a street car, being struck by a car approaching from the opposite direction. A signal bell and an alarm flag is displayed by circuits completed by the motorman when he sees the car from the opposite direction approaching.

BANQUET OF NEW ENGLAND STREET RAILWAY CLUB

The New England Street Railway Club held one of the most successful dinners in its history, its seventh annual, at the Somerset Hotel, Boston, on the evening of March 28. About 350 members were present, and speeches were made by John I. Beggs, of Milwaukee, president of the American Street and Interurban Railway Association; Hon. George Tate Blackstock, K. C., a leading member of the Canadian bar, of Toronto, and Rev. Dr. Willard Scott, of Worcester. The new president of the club, Henry C. Page, of Springfield, presided, and Guy Murchie, one of the attorneys of the Boston & Worcester Railway Company, of Boston, was toastmaster.

President Beggs congratulated the New England club upon its membership, which President Page had announced as having reached 645, and referred to the valuable work which these territorial organizations could accomplish. He also mentioned the trip recently made by members of the National Association to Norfolk and Atlantic City to find a place suitable for the next meeting. The American Association, he said, was so large that only a few cities in the country had accommodations for its annual conventions. It would have been pleased to hold its next meeting in Boston, but it was found impossible, because the only hall of sufficient size in Boston was not available within thirty days of the time when the meeting must be held.

Mr. Beggs then urged a broader policy in the relations of the corporations and the municipalities. He said: "It takes courage to stand up against such denunciation of corporations as we are now hearing. I ask of our law makers and our officials a square deal in order that we may be able to give a square deal in return. I am not one of those that excuse altogether the corporations from responsibility for bringing upon ourselves this denunciation. The game has been played too much under the table. It is high time the cards were shuffled and dealt above the table."

He declared that the street railway service of the country was more important than the passenger service of the steam railroads, for the numbers of people carried, he said, were far greater. He considered the street railway business the greatest business in the country to-day, and said it was growing faster than any other.

Mr. Blackstock was introduced as the leader of the Toronto bar and made a strong and eloquent speech, dealing mainly with the relations between the United States and Canada, commercial and otherwise. He touched upon the history of reciprocal relations since the time of the Civil War and said that the abrogation of the reciprocity treaty by this country at the close of the war, and American legislation since, had taught Canada to depend upon herself. Cut off from American markets Canada had sought and found them elsewhere. In fact this experience had developed in his country the spirit of absolute independence. Nevertheless, there is, and always has been, a feeling in Canada that the business relations between the two countries should be improved.

The address of Rev. Dr. Scott was upon the value of comradeship and accomplishment, but had its humorous side as well, and he kept the company laughing with good stories and jokes.

Seated at the head table also were the following named guests:

Hon. James F. Shaw, B. V. Swenson, Hon. Andrew F. Gates, Hon, E. P. Shaw, D. L. Prendergast, Russell A. Sears, A. E. Potter, L. S. Storrs, Charles D. Wyman, Samuel Higgins, Edgar van Etten, Frank Barr, W. F. Ray, Robert S. Goff, J. H. Goodspeed, C. F. Bancroft, Horace B. Rogers, H. H. Crapo, J. H. Neal, E. E. Potter, Paul Winsor, Hugh M. Wilson, Henry W. Blake, Robert Miles Standish, J. W. Lester, Charles F. Libby, E. A. Newman, D. F. Sherman, T. E. Byrnes, C. H. Persons, E. G. Connette, A. P. Langtry, G. L. R. French.

The committee in charge of arrangements consisted of: Charles C. Peirce, chairman, Boston; E. P. Shaw, Jr., South Framingham, Mass.; M. C. Brush, Newtonville, Mass.; Henry C. Page, Springfield, Mass.; Frank A. Barbey, Boston.

The reception committee consisted of: M. C. Brush, chairman, Newtonville, Mass.; Horatio Bigelow, Norwich, Conn.; John E. Bradley, Worcester, Mass.; Charles S. Clark, Boston; J. T. Cunningham, New York; George C. Ewing, Boston; William W. Field, Cambridgeport, Mass.; E. L. Janes, Boston; C. E. Learned, Boston; L. H. McLain, Melrose, Mass.; F. M. Nellis, Boston; W. G. Meloon, Portsmouth, N. H.; E. T. Millar, Concord, N. H.; E. A. Newman, Portland, Me.; H. E. Reynolds, Boston; W. E. Robertson, St. Albans, Vt.; Frank J. Stone, Boston; C. A. Sylvester, Newtonville, Mass.; C. N. Wood, Boston; W. D. Wright, Providence, R. I.

The regular business session of the club was held in the afternoon of March 28 at the Somerset. There was only one ticket and the gentlemen whose names were mentioned in the Street Railway Journal for March 23 were elected. The new officers are:

President—Henry C. Page, general manager Springfield Street Railway Company, Springfield, Mass.

Vice-presidents: Massachusetts—M. C. Brush, vice-president and general manager Newton Street Railway Company, Newtonville, Mass.

Connecticut—Horatio Bigelow, superintendent New London lines Consolidated Railway Company, Norwich, Conn.

New Hampshire—J. Broodie Smith, vice-president and general manager Manchester Traction, Light & Power Company, Manchester, N. H.

Vermont—F. H. Foote, general manager St. Albans Street Railway Company, St. Albans, Vt.

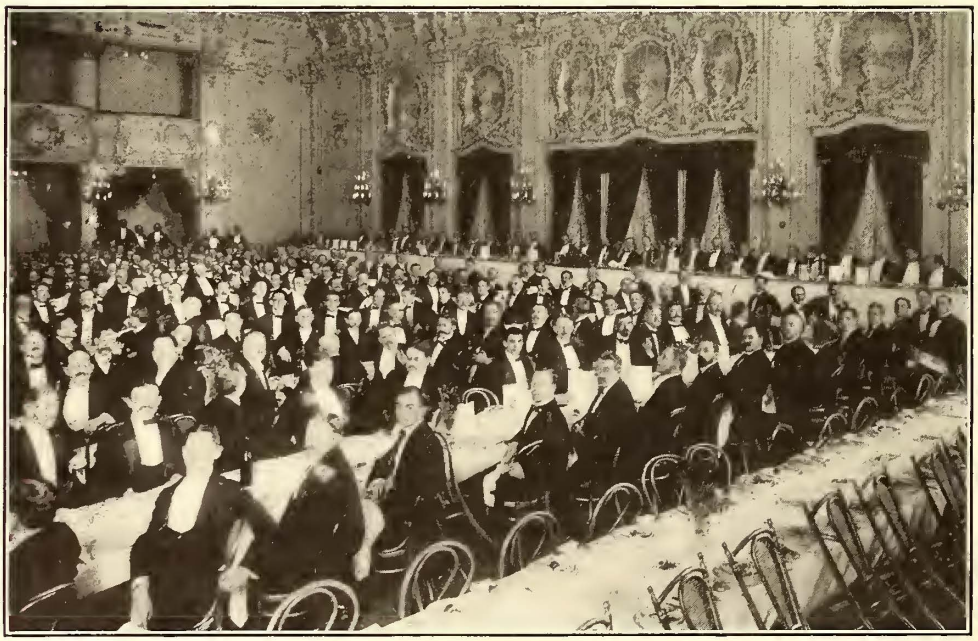
Rhode Island—D. F. Sherman, president Providence & Danielson Railway Company, Providence, R. I.

Maine—E. A. Newman, general manager Portland Railroad Company, Portland, Me.

Secretary—John J. Lane, editor "Street Railway Bulletin," Boston.

Treasurer—N. L. Wood, street railway supplies, Boston.

Executive Committee—Paul Winsor, chief engineer motive power and rolling stock Boston Elevated Railway, Boston; W. D. Wright, master mechanic the Rhode Island Co[illegible]dence, R. I.; C. H. Hile, assistant to vice-president Boston Elevated Railway, Boston; John F. McCabe, purchasing agent Worcester Consolidated Street Railway, Worcester; E. A. Sturgis, superintendent of equipment Boston & Northern and Old Colony Street Railway Companies, Boston; Charles C. Peirce, manager railway department General Electric Company,



BANQUET OF NEW ENGLAND STREET RAILWAY CLUB

Boston; George C. Ewing, railway department Westinghouse Electric & Manufacturing Company, Boston.

Finance Committee—Henry C. Page, Springfield; John W. Corning, electrical engineer Boston Elevated Railway, Boston; E. P. Shaw, Jr., general superintendent Boston & Worcester Street Railway, South Framingham, Mass.

A biographical notice and portrait of Mr. Page appear in the next column.

PRESIDENT TUTTLE SAYS LET THE ELECTRICS HAVE THE SUBURBAN BUSINESS

President Tuttle, of the Boston & Maine Railroad, in a letter to Charles S. Hoyt, of Winchester, expressed the opinion that the solution of the suburban railroad lies in letting the electrics care for all the traffic. In addition to this he also set forth other opinions which are best expressed by himself in his letter, which is appended:

"Replying to your communication of the 6th inst., your suggestion that this company equip its line between Boston and Stoneham with electricity instead of steam power is an easy one to make, but in the present state of the art the substitution of electricity for steam power in general railroad service has not passed beyond the experimental stage and is not yet sufficiently in use anywhere to demonstrate its practicability or feasibility. It is true that the New York Central and the New York, New Haven & Hartford are completing plans for handling their passenger traffic to and from the Grand Central Station in New York by electrically equipped trains, but as there is no freight traffic handled by either of these roads to and from the Grand Central Station, the problem is not with them as difficult as it would be if they were undertaking to provide electric power for handling all the road's traffic, both passenger and freight.

"In so far as the matter has yet been worked out the details of operating expenses are necessarily incomplete, but there is good reason for the belief that because of electric operation—as compared with that of steam locomotives—it is very much greater, but how much no one can tell.

"Again, in the past fifteen years the introduction of rapid transit by electric railways, which gives greater convenience to suburban travel than can possibly be furnished by steam railroads, has so diminished the volume of steam railrod suburban traffic that it is, upon the whole, now becoming a question whether there is any profit at all derivable by the steam railroads from the carrying of short-distance suburban travel, at the existing low rates charged therefor; and, not only the Boston & Maine, but railroads carrying similar traffic everywhere, are fast coming to the belief that the surrender of this kind of travel to the street railways and interurban trolley lines will be, from every point of view, the best solution of the problem.

PERSONAL MENTION

MR. J. A. PIERCE has resigned as superintendent of traffic of the Mexico Electric Tramways, Ltd.

MR. H. H. VREELAND, president of the New York City Railway Company, has been elected a director of the Electric Storage Battery Company, of Philadelphia.

MR. C. A. ALDERMAN has resigned his position as chief engineer of the Cincinnati Northern Traction Company to become connected with J. G. White & Company, of New York. Mr. Alderman has had an extended electric railway experience and has occupied many positions of trust and responsibility. For the past two years as chief engineer of the Cincinnati Northern Traction Company his work has included the reconstruction, straightening and placing on a private right of way of the old electric road between Cincinnati and Dayton. Last year Mr. A' had charge of the construction from Lima to es, of the Lima and Toledo line. Previous to his connection above with the Morgan-Dolan-Schoepf syndicate, he was for eight years chief engineer and manager of the Great Northern Construction Company, which built the Appleyard lines in Wisconsin and Ohio, and a part of the Tucker-Anthony lines in Ohio.

MR. WALTER S. SWAN, prominent in commercial and financial circles in Boston, and a director of the Boston Elevated Railway Company, is dead.

MR. RICHARD E. DANFORTH, a portrait of whom is presented herewith, is the vice-president and general manager of the Rochester Railway Company, of Rochester, N. Y. His appointment as general manager of the railway department of the Public Service Corporation of New Jersey to succeed Mr. Albert E. Stanley was mentioned last week. Mr. Danforth's electric railway career has been one of continuous promotion since his graduation from Cornell University some sixteen years ago, and has included service with the railway system of Buffalo, the Lake Shore Electric Railway Company and the Rochester Railway Company. He has served on the executive committees of the Street Railway Association of the State of New York, and in 1905-06 was president of that body. Owing to the extent of the system of the Public Service Corporation, Mr. Danforth's duties will call for the widest exercise of those executive qualities which have been such a characteristic of his previous work, and have contributed so greatly to the success of his administration elsewhere. Mr. Danforth expects to take charge of his new office on May 1.

R. E. DANFORTH

MR. EDWARD C. NICHOLS, vice-president and general manager of the South Side Elevated Railroad Company, of Chicago, died Thursday, March 28, of pneumonia after a short illness. Mr. Nichols was only thirty-seven years old.

MR. FRED IKES, of Rushville, Ind., has been appointed chief engineer of the Indianapolis & Louisville Traction Company, with headquarters at Scottsburg, where he has located with his family to superintend the installing of machinery.

MR. HENRY C. PAGE, the newly-elected president of the New England Street Railway Club, is well known in street railway circles, having been engaged in electric traction work for many years. He is about forty-three years of age. About twenty-two years ago went to work for the Lynn & Boston Street Railway, and served for three years as conductor. He was then rapidly promoted and finally placed in complete charge of the schedule arrangement and car dispatching of the company. He made such a success of this, that when the Boston & Northern Street Railway Company was formed, taking over many lines, he worked up in the management of the road until he became general superintendent, having charge of 450 miles of track. His particular success on this road was his handling of the employees, and his arrangements of the schedules.

H. C. PAGE

About four years ago he took the position of general manager of the Berkshire Street Railway Company, at Pittsfield, Mass., where he was very successful in the management of the road. He remained there until June, 1905, when the Consolidated Railway Company secured the property, as well as the Springfield Street Railway, when he was appointed general manager of the latter system. This position he holds at the present time.

TABLE OF OPERATING STATISTICS

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

Company.	Period.	Total Gross Earnings.	Operating Expenses.	Net Earnings.	Deductions From Income.	Net Income, Amount Available for Dividends.
AKRON, O. Northern Ohio Tr. & Light Co.	1 m, Jan., '07	125,191	79,581	45,610	41,339	4,270
	1 " " '06	114,968	76,856	38,112	39,947	†1,835
BINGHAMTON, N. Y. Binghamton Railway Co.	1 m., Jan., '07	22,080	13,663	8,417	7,973	444
	1 " " '06	20,471	12,476	7,995	7,376	619
	7 " " '07	185,081	96,952	88,129	54,260	33,869
	7 " " '06	174,007	88,209	85,798	50,765	35,033
CHAMPAIGN, ILL. Illinois Traction Co.	1 m., Feb., '07	262,363	*147,204	115,159	.....	.....
	1 " " '06	212,272	*116,554	95,717	.....	.....
	2 " " '07	541,441	*311,937	229,503	.....	.....
	2 " " '06	449,320	*243,243	206,077	.....	.....
CHARLESTON, S. C. Charleston Consolidated Ry., Gas & Elec. Co.	1 m., Feb., '07	52,478	35,080	17,398	13,402	3,996
	1 " " '06	50,793	32,624	18,170	12,708	5,461
	12 " " '07	654,391	414,445	239,946	157,100	82,846
	12 " " '06	614,963	372,608	242,355	157,042	85,313
CHICAGO, ILL. Aurora, Elgin & Chicago Ry. Co.	1 m., Jan., '07	88,893	56,168	32,725	26,492	6,233
	1 " " '06	80,259	51,269	28,989	24,450	4,539
	7 " " '07	789,700	419,999	369,701	183,187	186,514
	7 " " '06	712,452	376,061	336,390	171,093	165,297
Chicago & Milwaukee Elec. R.R. Co.	1 m., Feb., '07	52,777	29,546	23,231	.....	.....
	1 " " '06	36,593	21,050	15,543	.....	.....
	2 " " '07	115,409	63,038	52,370	.....	.....
	2 " " '06	80,037	43,744	36,293	.....	.....
CLEVELAND, O. Cleveland, Painesville & Eastern R.R. Co.	1 m., Jan., '07	18,032	*10,330	7,701	7,213	489
	1 " " '06	15,858	*9,118	6,740	6,678	62
Cleveland & Southwestern Traction Co.	1 m., Feb., '07	44,707	28,823	15,883	.....	.....
	1 " " '06	39,718	26,981	12,737	.....	.....
	2 " " '07	94,265	58,428	35,837	.....	.....
	2 " " '06	86,285	54,531	31,754	.....	.....
DALLAS, TEX. Dallas Elec. Corp'n.	1 m., Jan., '07	87,324	*71,165	16,159	16,550	†391
	1 " " '06	78,327	*51,355	26,972	14,939	12,033
	12 " " '07	1,032,132	*718,953	313,179	187,257	125,922
	12 " " '06	946,046	*578,917	367,129	182,554	184,574
DAVENPORT, Ia. Tri-City Ry. & Lt. Co.	1 m., Dec., '06	157,239	92,587	64,652	32,124	32,528
	1 " " '05	144,535	82,777	61,758	.....	.....
	9 " " '06	1,251,507	752,597	498,910	243,138	255,773
	9 " " '05	1,091,693	692,580	399,113	.....	.....
DETROIT, MICH. Detroit United Ry. Co.	1 m., Jan., '07	463,735	*293,330	170,405	97,962	72,443
	1 " " '06	417,831	*250,234	167,597	92,242	75,355
	12 " Dec., '06	6,121,940	*3,718,622	2,403,319	2,118,273	285,045
	12 " " '05	5,169,639	*3,041,523	2,128,117	1,675,794	452,323
Detroit, Jackson & Chicago Ry.	1 m., Feb., '07	27,194	*21,945	5,249	15,012	†9,763
DULUTH, MINN. Duluth St. Ry. Co.	1 m., Jan., '07	59,484	33,603	25,881	17,575	8,306
	1 " " '06	54,424	33,722	20,702	17,536	3,166
EL PASO, TEX. El Paso Electric Co.	1 m., Jan., '07	37,043	*28,702	8,341	4,469	3,873
	1 " " '06	27,347	*19,753	7,594	3,749	3,845
	12 " " '07	401,352	*285,352	116,000	47,935	68,065
	12 " " '06	292,444	*195,637	96,807	43,720	53,087
FT. WAYNE, IND. Ft. Wayne & Wabash Valley Tr. Co.	1 m., Jan., '07	91,178	54,795	36,383	.....	.....
	1 " " '06	80,145	47,731	32,414	.....	.....
	12 " Dec., '06	1,109,193	676,846	432,347	364,232	68,115
	12 " " '05	949,498	580,832	368,665	317,859	50,806
FT. WORTH, TEX. Northern Texas Tr. Co	1 m., Jan., '07	74,953	*46,096	28,857	10,138	18,718
	1 " " '06	53,535	*36,385	17,150	9,942	7,208
	12 " " '07	875,553	*556,862	318,691	119,778	198,913
	12 " " '06	670,462	*400,904	269,559	118,965	150,594
GALVESTON, TEX. Galveston Elec. Co.	1 m., Jan., '07	25,548	*16,540	9,008	4,167	4,841
	1 " " '06	19,350	*13,967	5,382	4,167	1,216
	12 " " '07	321,334	*194,053	127,281	50,000	77,281
	12 " " '06	269,090	*177,680	91,410	45,000	46,410
HOUGHTON, MICH. Houghton County St. Ry Co.	1 m., Jan., '07	15,945	*15,637	307	3,959	†3,652
	1 " " '06	14,832	*13,347	1,485	3,899	†2,414
	12 " " '07	230,358	*148,546	81,812	47,037	34,775
	12 " " '06	166,224	*167,136	†912	44,149	†45,060
HOUSTON, TEX. Houston Electric Co.	1 m., Jan., '07	50,094	*33,228	16,866	7,795	9,071
	1 " " '06	43,077	*30,137	12,940	8,173	4,766
	12 " " '07	598,368	*382,837	215,531	92,941	122,590
	12 " " '06	525,820	*321,539	204,281	105,289	98,992
HUDSON, N. Y. Albany & Hudson R. R. Co.	1 m., Dec., '06	27,125	*19,370	7,755	7,292	463
	1 " " '05	25,241	*20,018	5,223	5,000	223
	6 " " '06	199,169	*143,586	55,583	43,750	11,833
	6 " " '05	193,738	*143,225	50,513	30,000	20,513
KANSAS CITY, MO. Kansas City Ry. & Lt. Co.	1 m., Jan., '07	479,022	238,018	241,004	147,519	93,485
	1 " " '06	427,330	213,977	213,353	136,289	77,065
	8 " " '07	3,851,643	1,896,741	1,954,902	1,165,135	789,767
	8 " " '06	3,471,369	1,688,557	1,782,811	1,095,186	687,625
LEXINGTON, KY. Lexington & Interurban Rys. Co.	1 m., Feb., '07	35,267	24,680	10,587	.....	.....
	1 " " '06	30,509	23,062	7,447	.....	.....
	2 " " '07	75,033	51,816	23,216	.....	.....
	2 " " '06	68,316	49,764	18,552	.....	.....
MILWAUKEE, WIS. Milwaukee Elec. Ry. & Lt. Co.	1 m., Feb., '07	283,927	150,234	133,693	90,466	43,227
	1 " " '06	257,206	126,301	130 905	86,095	44,811
	2 " " '07	593,435	313,313	280,122	184,516	95,606
	2 " " '06	535,358	265,918	269,440	170,311	99,128
Milwaukee Lt., Ht. & Tr. Co.	1 m., Feb., '07	48,675	25,235	23,440	29,447	†6,008
	1 " " '06	40,872	17,907	22,966	21,953	1,013
	2 " " '07	102,211	53,060	49,151	59,638	†10,487
	2 " " '06	85,787	37,748	48,039	43,691	4,348
MINNEAPOLIS, MINN. Twin City R. T. Co.	1 m., Jan., '07	456,837	243,097	213,740	115,258	98,482
	1 " " '06	407,865	205,519	202,346	109,708	92,638
MONTREAL, CAN. Montreal St. Ry. Co.	1 m., Jan., '07	271,956	189,498	82,459	40,165	42,294
	1 " " '06	238,230	158,830	79,400	37,090	42,310
	4 " " '07	1,083,992	705,921	378,072	159,173	218,898
	4 " " '06	957,599	616,134	341,465	102,838	238,628
NORFOLK, VA. Norfolk & Portsmouth Tr. Co.	1 m., Jan., '07	147,789	91,817	55,973	.....	.....
	1 " " '06	123,831	78,577	45,254	.....	.....
PHILADELPHIA, PA. American Rys. Co.	1 m., Feb., '07	192,829	.....	.....	.....	.....
	1 " " '06	178,094	.....	.....	.....	.....
	8 " " '07	1,894,378	.....	.....	.....	.....
	8 " " '06	1,737,651	.....	.....	.....	.....
PLYMOUTH, MASS. Brockton & Plymouth St. Ry. Co.	1 m., Jan., '07	6,195	*5,835	361	1,732	†1,371
	1 " " '06	5,736	*5,794	†58	1,745	†1,803
	12 " " '07	112,234	*70,935	41,300	21,842	19,458
	12 " " '06	102,742	*70,672	32,070	21,119	10,952
ST. LOUIS, MO. United Railways Co. of St. Louis	1 m., Feb., '07	764,680	*548,479	216,201	231,324	†15,123
	1 " " '06	713,664	*463,041	250,623	231,991	18,632
	2 " " '07	1,591,017	*1,126,349	464,668	462,866	1,802
	2 " " '06	1,495,453	*954,409	541,044	464,046	76,998
SAVANNAH, GA. Savannah Electric Co.	1 m., Jan., '07	45,442	*30,613	14,830	11,687	3,142
	1 " " '06	49,618	*31,863	17,755	10,904	6,851
	12 " " '07	607,039	*377,796	229,244	135,244	94,000
	12 " " '06	594,514	*354,283	240,231	128,045	112,185
SYRACUSE, N. Y. Syracuse R. T. Ry.	1 m., Jan., '07	97,179	53,647	43,532	24,619	18,913
	1 " " '06	86,060	49,591	36,469	21,758	14,711
	1 " Feb., '07	90,478	51,608	38,870	25,100	13,770
	1 " " '06	79,350	44,349	35,001	22,092	12,909
	2 " " '07	187,657	105,255	82,402	49,719	32,683
	2 " " '06	165,410	93,940	71,470	43,850	27,620
TAMPA, FLA. Tampa Elec. Co.	1 m., Jan., '07	43,994	*31,153	12,841	960	11,881
	1 " " '06	37,840	*20,410	17,430	.....	17,430
	12 " " '07	475,377	*290,701	184,675	2,383	182,292
	12 " " '06	418,464	*238,642	179,821	19,829	159,992
TERRE HAUTE, IND. Terre Haute Tr. & Lt. Co.	1 m., Jan., '07	76,472	*50,325	26,147	14,844	11,303
	1 " " '06	59,831	*39,150	20,681	10,417	10,264
	12 " " '07	839,803	*480,047	359,756	164,639	195,117
	12 " " '06	643,344	*423,480	219,863	123,873	95,990
TOLEDO, O. Toledo Rys. & Lt. Co.	1 m., Jan., '07	170,684	*99,039	71,645	44,168	27,459
	1 " " '06	159,053	*83,148	75,905	42,290	33,615