Street Railway Journal

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STREET RAILWAY PROGRESS IN ST. LOUIS

St. Louis has always played an important part in the development of the electric railway industry of America, both in the manufacture of street railway cars and other supplies, and in progressive operating practice. In the first ten years of the electric railway in St. Louis a public policy which was liberal in the granting of franchises, combined with considerable rivalry among competing lines, made the development very rapid, not only as regarded the building of new mileage, but also in the improvement of rolling stock and all the details of street railway service that tend to the public comfort. As time wore on consolidations gradually took place until the St. Louis of recent years, as the visitors to the convention of 1896 found it, had seven systems of street railway, each one of which included a number of small companies. These systems were the Lindell Railway, the National Railway (Chicago syndicate), the Southern Electric Railway, the Union Depot Railroad, the Missouri Railroad, the Peoples Railway, and the St. Louis & Suburban Railway. Since the convention of 1896 consolidations have been gradually going on, until all but the last named system have been consolidated, and are now operated by the St. Louis Transit Company. The St. Louis & Suburban Railway remains as a distinct system, together with its allied suburban lines, which are operated under one management and as if belonging to the same company.

An article of this kind, dealing with present progress, would not be complete without reference to some of the past improvements in electric railway practice that found their origin or much of their early support on the St. Louis roads.

VIEW OF LOOP AT THIRD STREET AND WASHINGTON AVENUE, LOOKING WEST ON WASHINGTON AVENUE, ST. LOUIS

The long double-truck car, with cross seats and center aisle, gained its first great popularity in St. Louis, and events since that time have shown that in this regard St. Louis led what was to become a very general practice.

The first cast-welded track ever laid was put down in St. Louis in November, 1894, and the success of the 2 miles then laid led to the laying of a great many miles the following season in St. Louis, as well as elsewhere. The spring of 1894 saw the laying of considerable electrically

welded track, which experiment led up to the trial of cast welding the following fall.

In 1893 the first large railway generators direct-connected to Corliss engines were turned over in the Cass Avenue & Fair Grounds Railway plant. These are soon

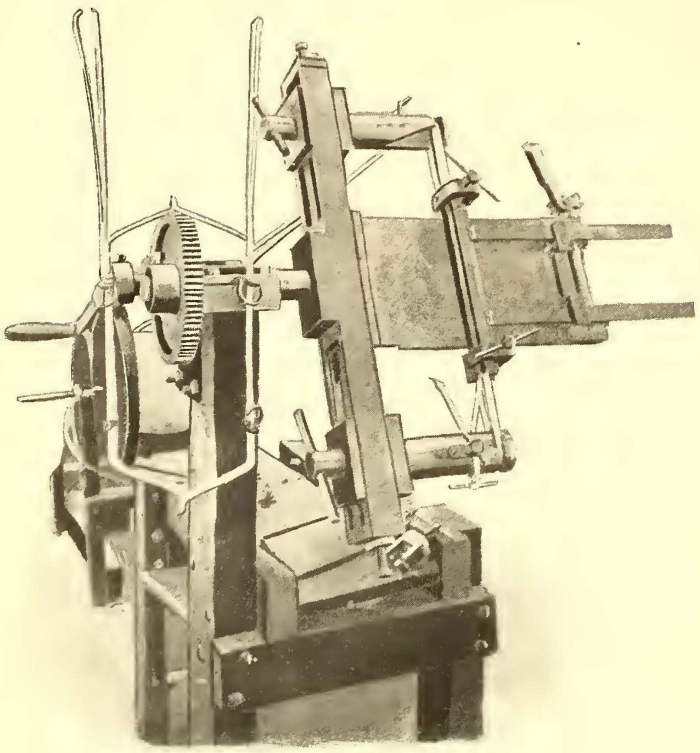


FIG. 1.—ARMATURE COIL WINDER FOR G. E. 57 MOTORS. GENERATOR COIL WOUND AND SET FOR SPREADING

to be taken down and used in the new power house of the St. Louis Transit Company on the north side.

In the matter of street railway supplies the St. Louis street car builders have always furnished an important proportion of the street cars in both this and foreign countries. Nor has it been behind in car wheels, boilers, engines and miscellaneous supplies. Taken altogether, St. Louis can not fail to be a field of interesting study from a street railway man's standpoint.

Previous to the consolidation already mentioned of some five or six different managements under the control of the St. Louis Transit Company there was considerable difference in the methods of management and operation, made necessary by the operation of several distinct properties.

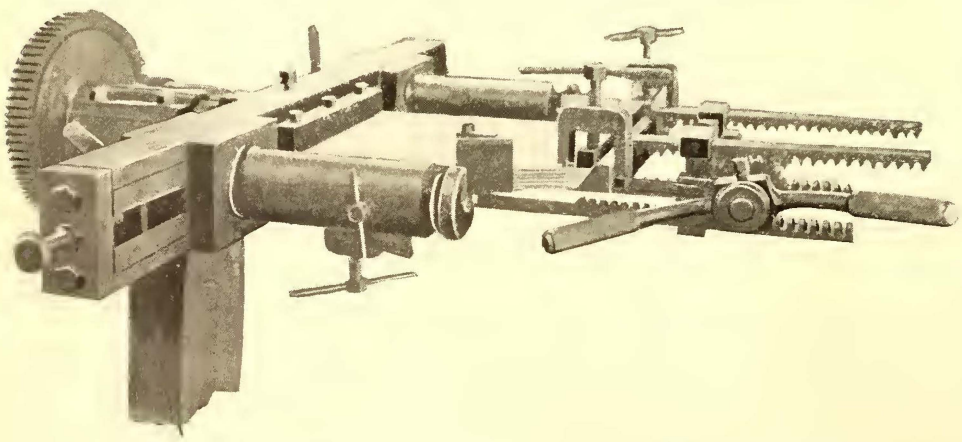


FIG. 3.—ARMATURE COIL WINDER FOR G. E. 57 AND OTHER MOTORS, SHOWING DETAILS OF RACK AND PINION, DIES, ADJUSTMENTS, ETC.

It will be interesting to note some of the changes that have been brought about by the new state of affairs that has resulted from the consolidation and change of management.

THE ST. LOUIS TRANSIT CO.

The more important of the changes, brought about by the consolidation of these various properties into one, may be summed up briefly as follows: The building of two large power houses to replace six small power houses previously supplying the system; the establishment of an up-to-date armature repair department, fitted with labor-saving appliances and employing economical methods, comparing favorably with the best electrical factories; the modification of rolling stock toward certain uniform standards; doing away with the numerous small car rebuilding and repair shops, each complete in itself, and the assignment of some

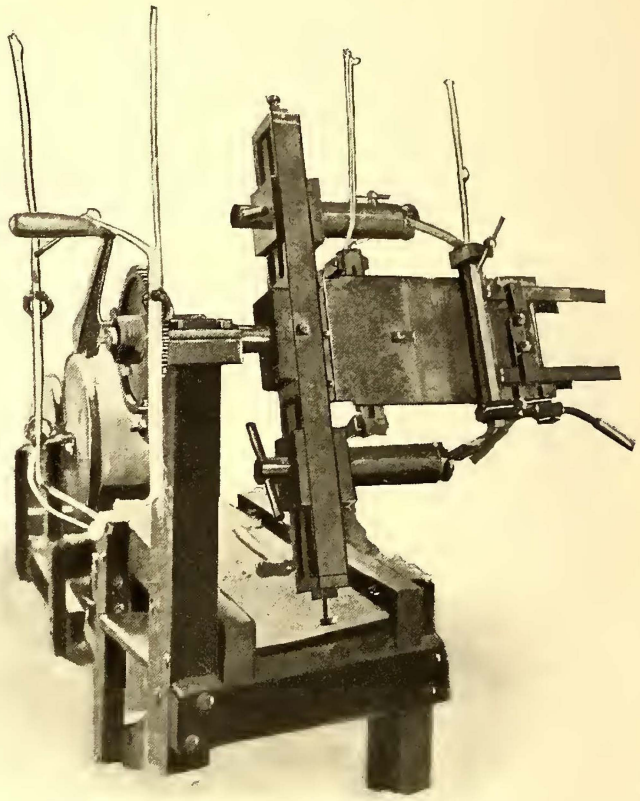


FIG. 2.—ARMATURE COIL WINDER FOR G. E. 57 AND OTHER MOTORS, COIL SPREAD READY TO TAKE OUT

one particular class of work to shops where room permits more than ordinary overhauling to be done. By the latter it must not be understood that there has been any material reduction in the number of car houses or the number of places where ordinary overhauling is done, but that as far as possible special kinds of work are concentrated at places specially well equipped to do them. A thorough system of keeping track of all motor and car repairs was also part of the work of the mechanic.

NEW ARMATURE SHOPS

The company has good reason to be proud of its armature department, which is under the management of John Anderson. The methods there are so well perfected that not a few manufacturers of electrical machinery have been able to get valuable pointers from a visit to the shops, and inquiry into the methods and machinery used. It has come to be accepted by a great many street railway motor repair men that unless a road is very large and can afford to fit up for winding armature coils on a large scale, that it is much cheaper to buy from the large factories

which can keep a large force of boys and special machinery at work on coil winding. The St. Louis Transit Company is one of the roads which is large enough, profitably, to establish an armature department which winds it own coils by special machinery. The machines used in this department are all the design of Mr. Anderson, the foreman. The armature coil winding is done by three machines, which can be altered to make every type of motor coil used by the company.

The machine shown in Figs. 1, 2 and 3 winds coil for G. E. 57, Johnson type 34, G. E. 52, Westinghouse 12 A (high and low speed), and for modified form of Westinghouse No. 3 motor armatures. Fig. 1 shows this machine in the process of winding a G. E. 57 coil. One of the finished coils is hanging on the machine. At present the machine is turned by the hand crank shown, and a boy turns while a man attends to the winding, but they will soon be fixed to operate by power, in which case one man

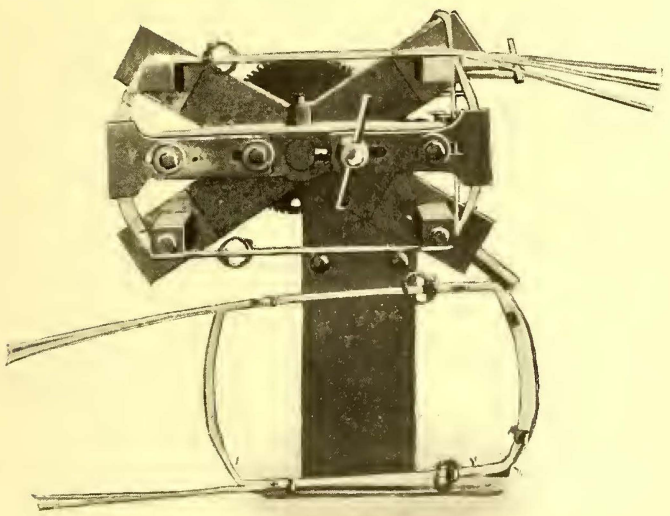


FIG. 4.—ARMATURE COIL WINDER FOR WESTINGHOUSE 56 MOTORS. COIL JUST COMPLETED

can work the machine alone. Power will be transmitted to the machine through a friction clutch, thrown in by a foot treadle. When the treadle is released the brake is applied, so the operator will have no difficulty in stopping just where he wishes. This plan is already in use on the field coil winding machines described later. In Fig. 1 the coil has just been wound between the two arms, drawing its wire from a spool in the background, and dies have been clamped on, which give a slight twist to the sides of the coils. The distance between the arms is adjustable with the clamp screws shown. This adjustment with the change of dies adapts the machine for the winding of the different kinds of coils mentioned. Particular attention should be called to the caps on the ends of the arms, which are adjusted to form the groove into which the wire goes as it is wound. The width of the groove is, of course, varied to suit the gage of the wire that is being wound. This width of groove is adjusted before the machine is started by one of the clamp screws seen on the arm, which adjusts the distance to which the cap can be pushed in. By loosening the other clamp screw on the arm the cap can be taken off entirely when a coil is to be pushed in. By loosening the other clamp screw in the arm the cap can be taken off entirely when a coil is to be taken off. After a coil has been wound and dies put on, as seen in Fig. 1, the clamps holding the arms are loosened, and the rack and pinion, seen at

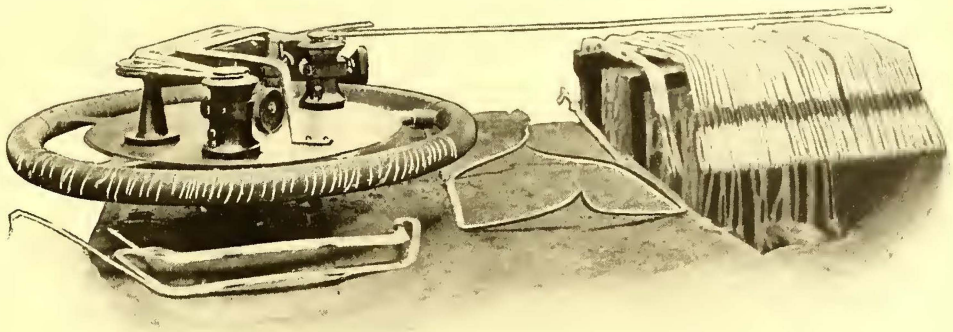
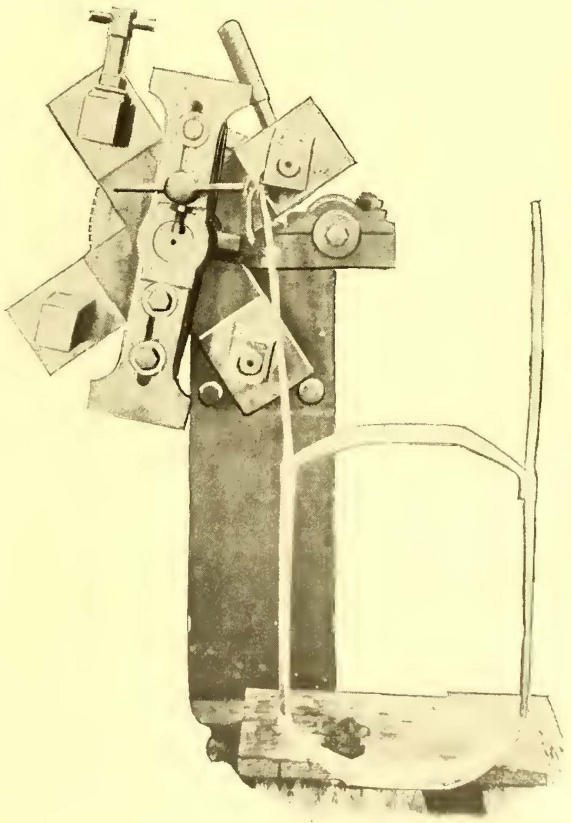


FIG. 5.—ARMATURE COIL WINDER FOR G. E. 800 MOTOR

the right in Figs. 1, 2 and 3, is used to spread the coil into proper shape. In Figs. 2 and 3 the coil has just been spread. Clips are put on during the spreading process, and before the coil is taken out of the machine a few wraps of tape, near the corners, as seen in the completed coil in Fig. 1, are put on to hold it together. When it is taken out the spring clips seen on the coil in Fig. 1 are also put on, and remain while it is being handled, until the coil is dipped in varnish. Fig. 3 is to show the details of the die, rack and pinion, and other adjustment features mentioned.

The machine for winding armature coils for Westinghouse No. 56 motors is shown in Fig. 4, with one of the



FIG, 6.—ARMATURE COIL WINDER FOR WESTINGHOUSE 49 MOTORS

completed coils below it. This machine is comparatively simple. To remove a coil after winding, the block on one corner is loosened, and also one of the end clips. In Fig. 3 the coil is just completed, and has the spring clips on ready for handling.

The G. E. 800 motor armature coil winder is clearly shown in Fig. 5. The winding is accomplished by a back and forth motion of the hand wheel. The coil is taken out of the winder by removing the caps around which the ends of the coil make the turn, and the coil then has the form seen in the coil on the table just in front of the hand wheel, Fig. 5. It is then spread to the form shown on the table at the right of the hand wheel.

FIG. 7.—COIL TAPING MACHINE

having tried it. A diagram of the scheme is given in Fig. 8. The belt is made very loose, and an idler pulley, worked by the treadle, presses the belt against the running pulley when the machine is to be run. The friction is ample for the purpose.

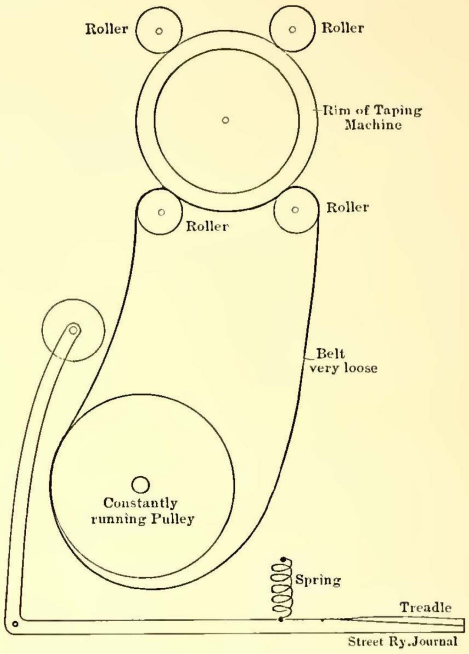


FIG. 8.—DEVICE FOR DRIVING TAPING MACHINE

The Westinghouse No. 49 armature coils are wound on the machine shown in Fig. 6, which is very similar to the Westinghouse 56 winding machine.

Next in order in the list of coil making apparatus is the machine for taping the coils, seen in Fig. 7. It is a ring, with a diagonal opening in one side to admit the coil to be taped, and mounted between four rollers. The belt which revolves the ring passes under the ring between it and the two lower rollers. The operation of the machine is apparent from the picture. The tape spool is carried on a spindle fastened to the revolving ring. The tension of the tape in running off the spool is regulated by the thumb nut on the end of its spindle. The friction drive on these coil winders is of interest, as it is the result of an accidental discovery, and is not likely to be thought of as practical by one never

In Fig. 9 are the two field coil winding machines, with tension blocks and reels. This company uses field wire insulated with a layer of asbestos and a single cotton covering to hold the asbestos on.

One notable thing about all the coil winding apparatus in this shop is that no wood forms are used. All forms are metal, and hence have practically no wear, hence there is not the danger of misfit coils due to the wear of the forms. With the use of metal entirely it is easier to design apparatus which can be worked rapidly and conveniently, and the danger of abrasion of insulation is no greater if corners are properly rounded. With power on the armature coil machines now run by hand crank, it is thought that a man can easily wind coils for two (198-coil) armatures in a day. At present a man, with the assistance of a boy to turn, and

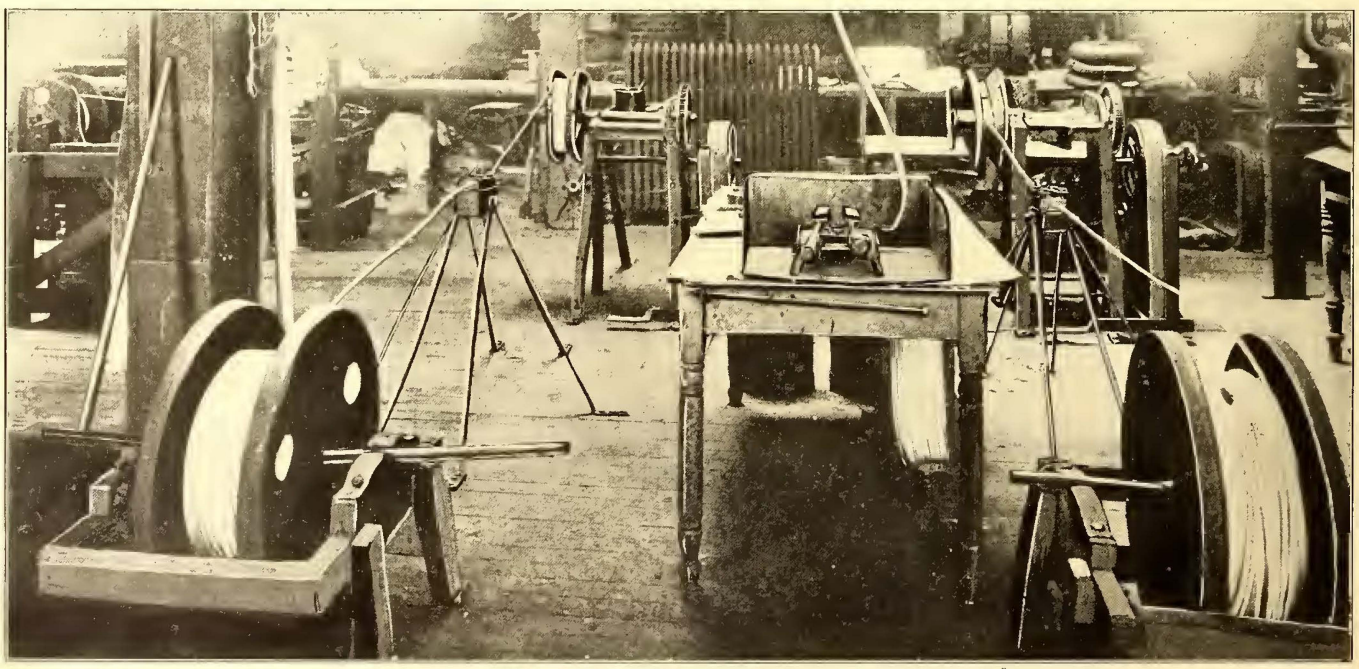


FIG. 9.—FIELD COIL WINDERS

who divides his time between two neighboring machines, can wind 150 coils per day. The boy working the G. E. 800 coil winder (Fig. 5) will turn off 350 to 400 coils per day.

After the coils are wound they are first dipped in Sterling extra insulating varnish. They are then baked at 200 degs. F. for about one hour. The straight sides of the coils then have manila paper pressed on, and over this a layer of micanite cloth. Over this a layer of fish paper is stuck on with Le Page's liquid glue. As the glue is not a good insulator, it is carefully kept away from intimate contact with the coil, and used only under the fish paper which forms the outside layer. The fish paper is said to be superior to anything yet used for the outer insulation. In pressing on these various thicknesses of cloth and paper the coils are put in presses, the row of which is seen in Fig. 10. These presses have interchangeable dies to fit various coils. One man uses several presses at a time. He puts a coil in one, sets the press down tight, and goes on to place coils in other presses while the coil dries. After pressing on the slot insulation the ends of the coil are taped in the machine that has been described (Fig. 7), and the coil is baked thirty-six hours. Cotton sleeves are slipped over the leads of a coil. G. E. 800 coils are taped all the way around instead of on the ends only. After an armature has been completed it is coated with armalac.

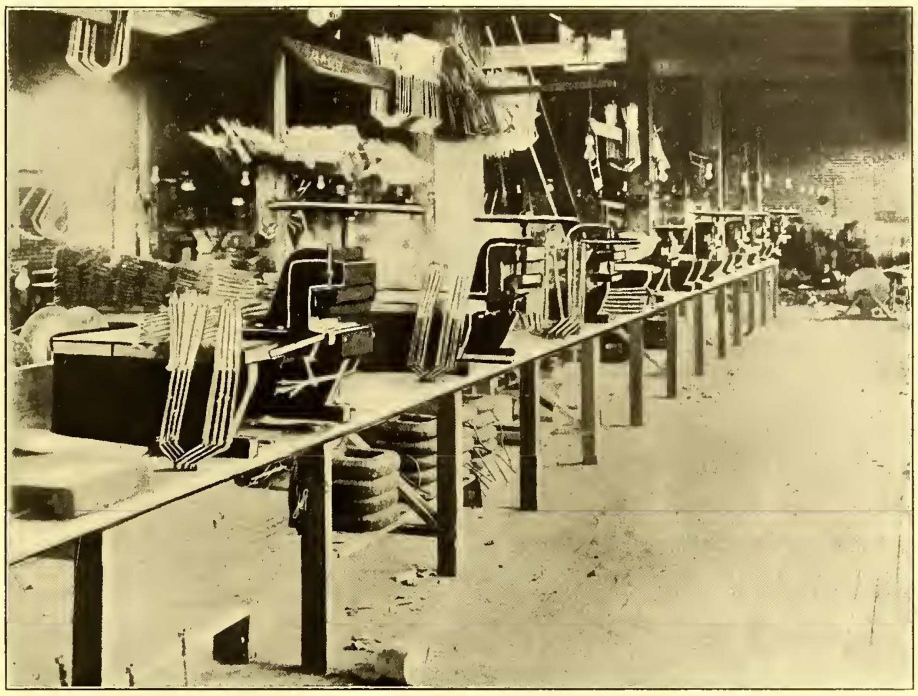


FIG. 10.—PRESSES FOR INSULATING ARMATURE COILS

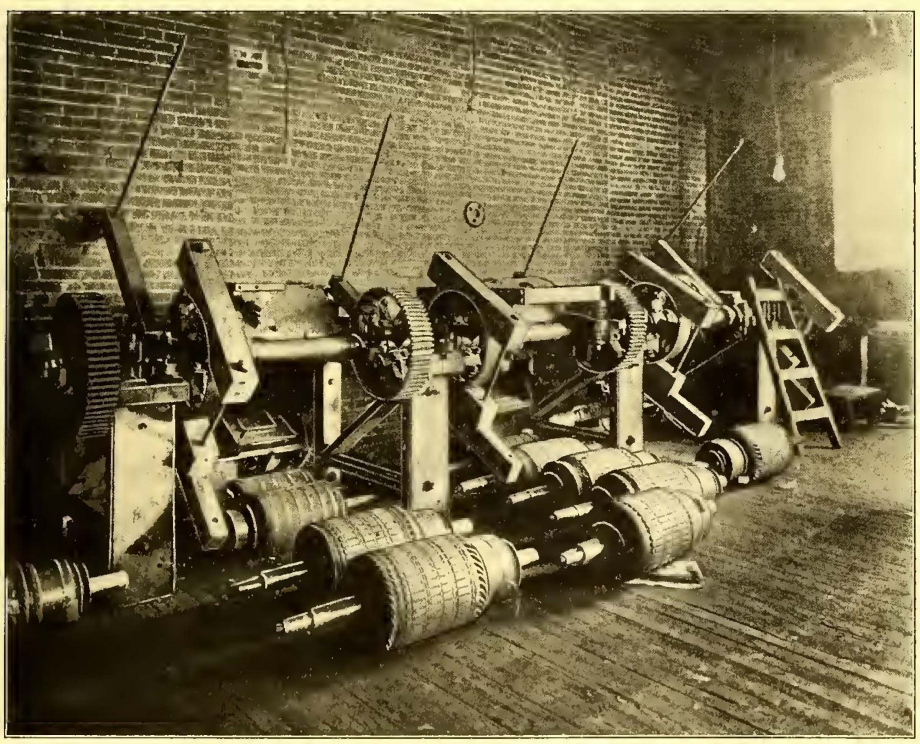


FIG. 11.—TESTING FRAMES FOR BRAKE TESTS OF ARMATURES

Before sending an armature out of this department to be put in service at some car shop it is put in a testing case and run under a friction brake test. The motor field casings mounted in testing frames into which the armatures under test are placed are located in one end of the armature room, and are shown in Figs. 11 and 12. There are at present installed on the testing rack the following motor field cases: Johnson 34, Westinghouse 56, Westinghouse 12a, G. E. 57, and G. E. 800. G. E. 52 and Westinghouse 49 are to be added. Each motor is geared to a brake pulley, and the brake is provided with a rod, which bears down on an ordinary platform scales to measure the torque. The current is regulated during a test by a controller, and resistance mounted on a hand truck, as seen in Fig. 12. To obtain current, it is only necessary to plug in two jacks in the posts under each testing rack. The leads for the controller are then run, and connected to the motor leads by temporary connectors, and all is ready for the test.

For moving armatures around the room, a block and tackle hung from an overhead track furnishes all the facilities. Besides regular fixed armature racks there are plenty of portable iron racks, with roller bearings, which can be set anywhere desired.

An armature car is in use all day distributing and collecting armatures from the eleven shops, where they are taken out of and put in the motors. This car is heated in winter to keep armatures thoroughly dry.

Field coils on the Westinghouse No. 49 armatures, which are bent instead of being wound on an elaborate bent form, are wound straight as any other field coil, but are made slightly wider than the pole they are to go on. Then they are bent to form in the press seen in Fig. 13.

In assembling the troublesome two-part clamps, which are difficult to draw up evenly, have been abandoned in favor of a three-part clamp, shown in Fig. 14. When the commutator is assembled and is to be bored out, it is put in a three-jaw chuck in the lathe, the jaws of the chuck bearing on the clamp midway between the bolts. Billings & Spencer drop forged bars are used.

Westinghouse resistances have been modified to give more room for ventilation, and make it possible to take the spools apart easily. One of these resistances is shown in Fig. 15.

During rush hours, at present writing, 860 motor cars are run, and on Sunday 1200 motor cars. About twenty men are employed in the armature repair shop.

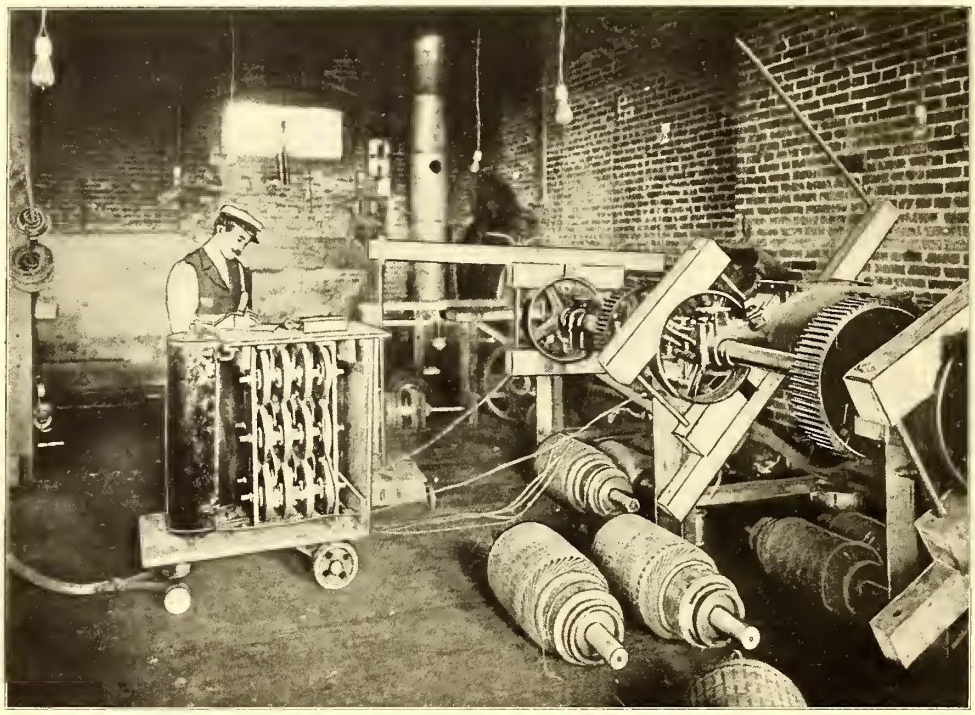


FIG. 12.—TESTING FRAME SCALES AND MOVABLE CONTROLLER WITH LEADS AND PLUGS

M. H. Logan, electrician of this department, has made out a table of data on motor windings used by the company for convenience and quick reference, which, through his courtesy, is here given, as it may prove of use to others in similar work. Mr. Logan is also preparing for reference purposes a set of prints showing the core commutator and three or four coils of each type of armature. With these any armature winder can learn the winding of an armature he is not familiar with in a very short time, and with little other instruction.

MASTER MECHANIC'S RECORDS

With the consolidation of so many car shops and houses under one management, Lee Massengale, master mechanic, appreciated more fully than do many the importance of keeping close track of what is going on in every car shop on the system, and the scheme of records he has worked out is very complete. Every man of the 200 and over employed on car, truck and motor repair work, and in new construction in the eleven shops of the company, turns in to his foreman every night a report of labor done, telling what parts of what cars he worked on and the material used. The foremen turn these in to the master mechanic, and by 10 o'clock the next morning the master mechanic has a good idea of what was done on the road the previous day. The workman's reports are used in keeping track of the repairs of each car. For car repair records a loose leaf ledger is used, of the form shown in Fig. 16. The sheet is very long (36 ins.), and 15½ ins. high, and is divided into three main divisions, viz.: Motor, truck and car body. For convenience of reproduction these headings are shown herewith, one under another, but the reader will understand that they extend side by side across the blank. The sheet contains, as will be seen, space for entering the date and cost of all the repairs on a car where they can be easily seen. The chief clerk posts this ledger from the workmen's reports, calculating the cost from the amount of labor and material given thereon. When a sheet of the ledger is full, it is taken out and a new one put in. From the ledger a recapitulation and report made out once a month shows for each of the eleven car shops and twenty-eight divisions the cost of material under the items: "Motors," "Trucks," "Car Bodies"; also the cost of labor on those three items, the cost of miscellaneous labor, the total cost and the average cost per car. The cost per car operated per month for maintenance and repairs on the various divisions varies enormously, depending on the age and nature of equipment. On one division, where new cars are run, it is less than $10, while on the worst division it is over $40. The average per car operated on the whole road for the month of April, 1901, was $26.45. This includes the wages of all men engaged on rolling stock repair and maintenance, but does not include the wages of eighteen rolling stock inspectors and one chief inspector, which are charged to operation. The inspectors are, however, under the inspectors' supervision. The eighteen inspectors note and report defects on cars discovered during the day while in operation, and thirty-one night men make the repairs reported as necessary by the inspectors. Regular run cars are run in every eight days for washing, and at the same time are looked over and overhauled as much as necessary. Tripper cars are washed every three weeks. The monthly recapitulation before spoken of shows also the number of cars run in during the month for troubles not discovered on wash days. In the master mechanic's office three men keep the records, one of whom keeps time

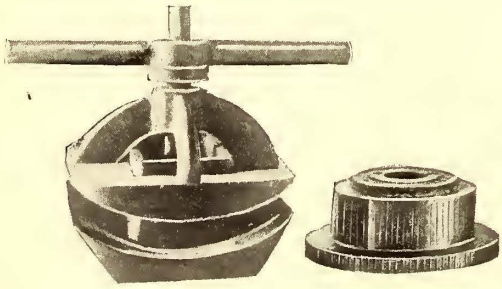


FIG. 13.—FIELD COIL PRESS

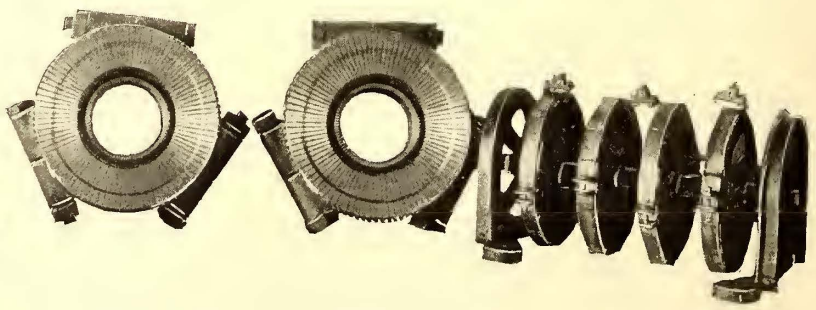


FIG. 14.—COMMUTATOR CLAMP

FIG. 15.—RESISTANCES

for the 200 or more men employed in the master mechanic's department.

"DETROIT" PLATFORMS AND NEW CARS

Some of the latest types of new cars purchased from the St. Louis Car Company last year are shown in Figs. 17, 18 and 19. The most recent change, however, is the adoption of the Detroit 7-ft. platform. The adoption of this platform is so recent that at present writing no cars with it are in operation, but it will be used on all new and rebuilt cars. This platform came from Detroit with Mr. Du Pont, its success and popularity there leading him to adopt it for St. Louis. It will first be put out on eighty-six cars

MOTOR

TYPE ____________

	ARMATURES														FIELDS																	
OVERHAULED	NO. 1 END				NO. 2 END				COMMTR. BEARING		PINION BEARING		AXLE BEARING		NO. 1 END		NO. 2 END		GEAR		GEAR CASE		PINION		BRUSH-HOLDER		TROLLEY		OTHER MATERIAL NOT SPECIFIED	COST OF MATERIAL	COST OF LABOR	TOTAL COST
	IN	NO.	OUT	CAUSE	IN	NO.	OUT	CAUSE	1 END	2 END	1 END	2 END	1 END	2 END	TOP	BOTTOM	TOP	BOTTOM	1 END	2 END	1 END	2 END	1 END	2 END	1 END	2 END	NEW	REP.				

TRUCK

TYPE ____________

	WHEELS																			
DATE PUT IN	NO. 1 END		NO. 2 END		KIND		CAUSE OUT	MILLEAGE	OIL BOXES		OIL BOX BRGS		BRAKESHOES		CHECKPLATES		OTHER MATERIAL NOT SPECIFIED	COST OF MATERIAL	COST OF LABOR	TOTAL COST
	DRIVER	PONY	DRIVER	PONY	NEW	REGD.			1 END	2 END	1 END	2 END	1 END	2 END	1 END	2 END				

CARBODY

NO. ____

NO. ____ BUILT BY ____ KIND ____

LENGTH {CARBODY ____ / OUTSIDE ____ WIDTH {CARBODY ____ / OUTSIDE ____ LENGTH OVER BUMPERS ____ HEIGHT FLOOR TO CEILING ____

SEATING CAPACITY ____ SEATS NO. ____ KIND ____ REGISTER NO. ____ KIND ____ SIGNS NO. ____ KIND ____

PAINTED	COST OF PAINTING	VARNISHED	COST OF VARNISHING	REPAIR WORK	COST OF MATERIAL	COST OF LABOR	TOTAL COST

FIG. 16.—FORMS FOR KEEPING REPAIR SHOP RECORDS

DETAILS OF MOTOR RESISTANCES. ST. LOUIS TRANSIT CO.

FIELD COILS.

Make.	Type.	R. w.	Turns.	Wire Gage.
Westinghouse	56.	.037	75.	1.
"	49.	.080	114.	4.
"	12A.	.123	159.	5.-□.
"	3.	.263	180.	6.-□.
Gen. Electric	57.	.073	110.	3.-□.
" "	52.	.147	157.	5.
" "	800.	.273	220.	6.-□.
Johnson	34.	.045	172.	5-2 in ‖
Walker	34	.161	153.	5.
Sprague † A	6.	1.375	365.	12.
" † B	6.	1.675	430.	12.
" † C	6.	1.185	340.	11.
"	*	.452	357.	7.

ARMATURE COILS.

Make.	Type.	R. w.	Remarks.
Westinghouse	56.	.0050	2. wires in ‖.
"	49.	.008	1. wire.
" †	12A.	.016	1. wire.
" *	12A.	.012	1. wire.
"	3.	.023	1. wire.(long coil.)
"	3.	.021	1.wire.(short coil.)
Gen. Electric	57.	.0055	2. wires in ‖.
" "	52.	.014	1. wire.
" "	800.	.012	1. wire.
Johnson	34.	.0060	1. wire.
Walker	34.	.016	1. wire.(long coil.)
"	34.	.015	1.wire.(short coil.)

ARMATURE WINDINGS.

Make.	Type.	R. w.	Slots.	Coils.	Turns per Coil.	Wire Gage.	Bars in Commutation.
Westinghouse	56.	.138	39.	117.	2.	10.	117.
"	49.	.230	59.	117.	3.	9.	117.
" †	12A.	.371	47.	93.	5.	10.	93.
" *	12A.	.353	47.	93.	4.	10.	93.
"	3.	.500	95.	95.	4.	11.	95.
Gen. Electric	57.	.121	33.	99.	3.	9.	99.
" "	52.	.308	29.	87.	4.	10.	87.
" "	800.	.292	105.	105.	3.	10.	105.
Johnson	34.	.155	33.	99.	3.	7.	99.
Walker	34.	.412	95.	95.	4.	10.	95.
Sprague †	6.	.669	Smooth core	56.	8.	12.	56.
"	*	.509	Smooth core	56.	8.	11.	56.

CONTROLLER "BLOW" COILS.

Make.	Type.	Turns.	Gage.	R. w.	Remarks.
Westinghouse	28 and 28 A.	20.	4.-□.	.017	1. wire.
Gen. Electric	K.-11 and K.-10.	90.	4.-□.	.026	1. wire.
Johnson	38.	72.	5.-□.	.012	2. wires in ‖

* High Speed.
† Slow Speed.
in ‖.= In Parallel.

Wire Gage = B. and S. Standard.
3.-□., -4.-□., -5.-□., and 6.-□. = Square Wire.
B. and S. Gage as Numbered.

which are being made, each from two old Olive Street cable cars—grip and trailer. These cars, one of which is shown in Figs. 20, 21, 22 and 23, have, in the splicing, been altered to the closed, cross-seat type, which is more numerous than any other type in St. Louis, and is proving popular the country over with companies and public, because it is comfortable to ride in in all seasons, being practically a convertible car, and adapted to both summer and

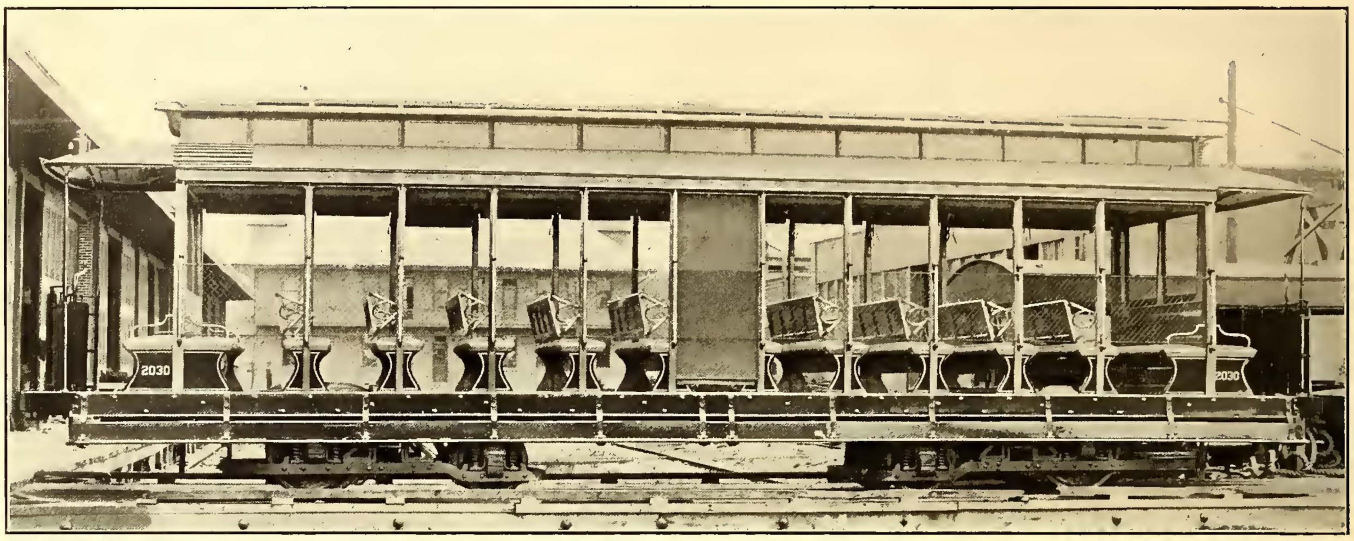


FIG. 17.—STANDARD OPEN CAR, ST. LOUIS TRANSIT CO.

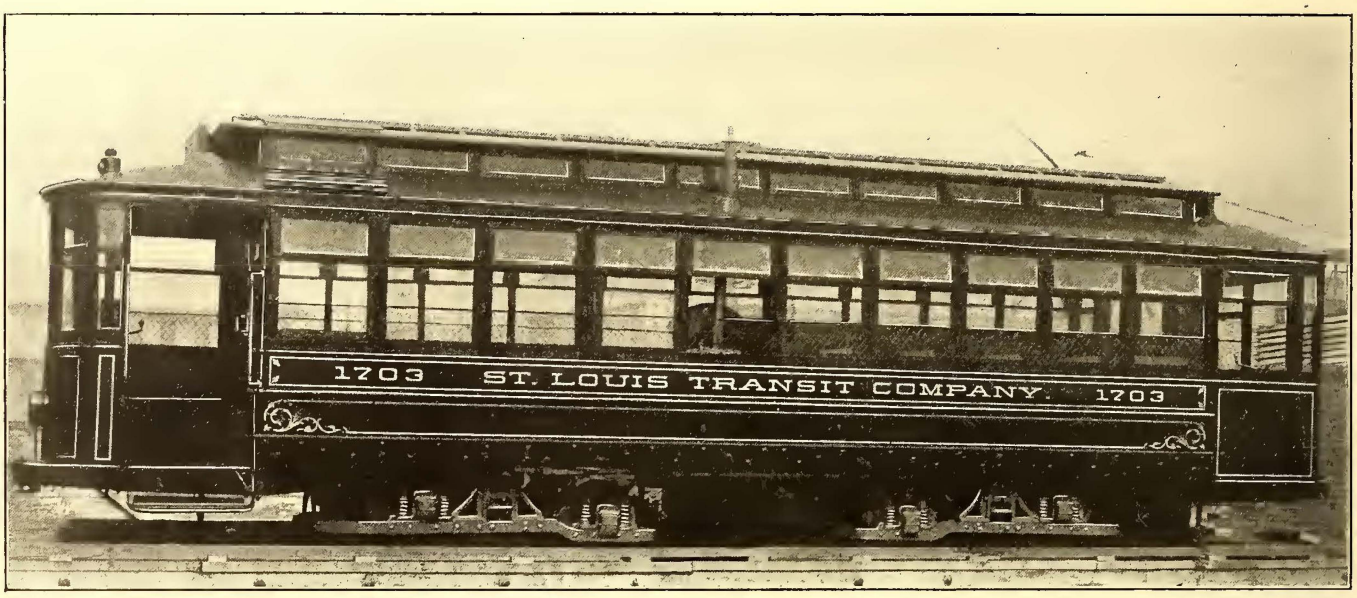


FIG. 18.—STANDARD CLOSED CAR, ST. LOUIS TRANSIT CO.

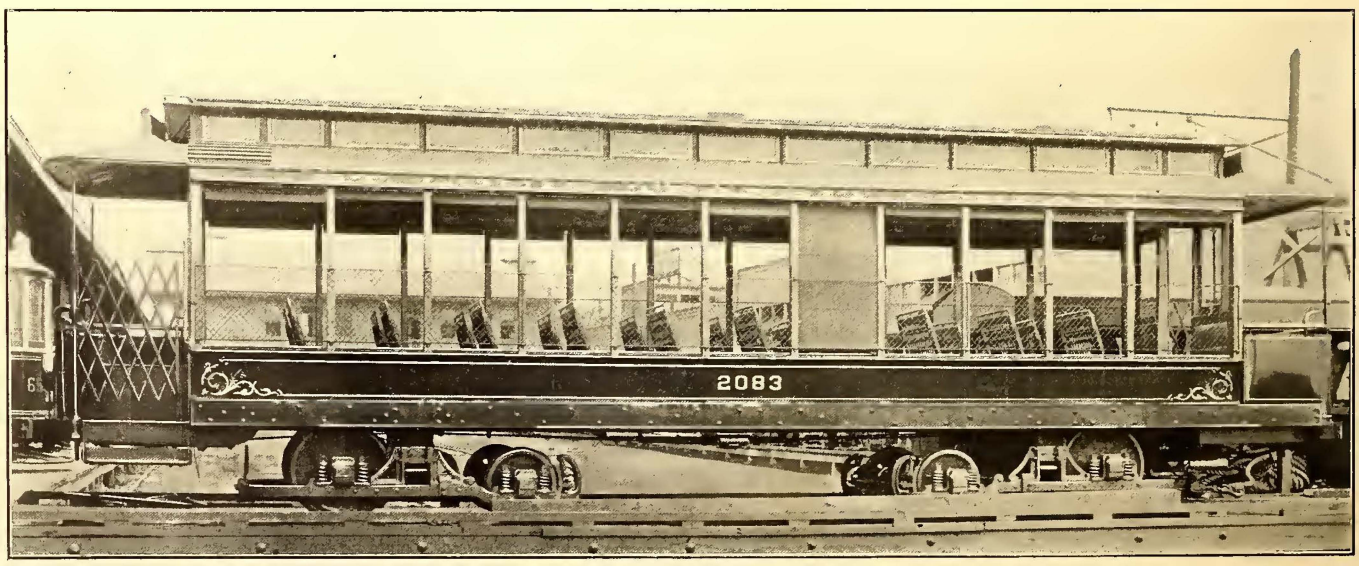


FIG. 19.—STANDARD SPLICED CAR, ST. LOUIS TRANSIT CO.

winter use. The Detroit platform is best shown in Fig. 23, and its general appearance on a car in Fig. 20. The passageway is kept clear by the conductor, and those who wish to stand on the rear platform keep behind the railing. There are always plenty who want to stand on the back platform. The railing is a great convenience, and does away with practically all the inconvenience of the back platform load. The railings made hereafter will have a bow in them, so the conductor can stand in front of the railing and assist passengers without being unduly in the way.

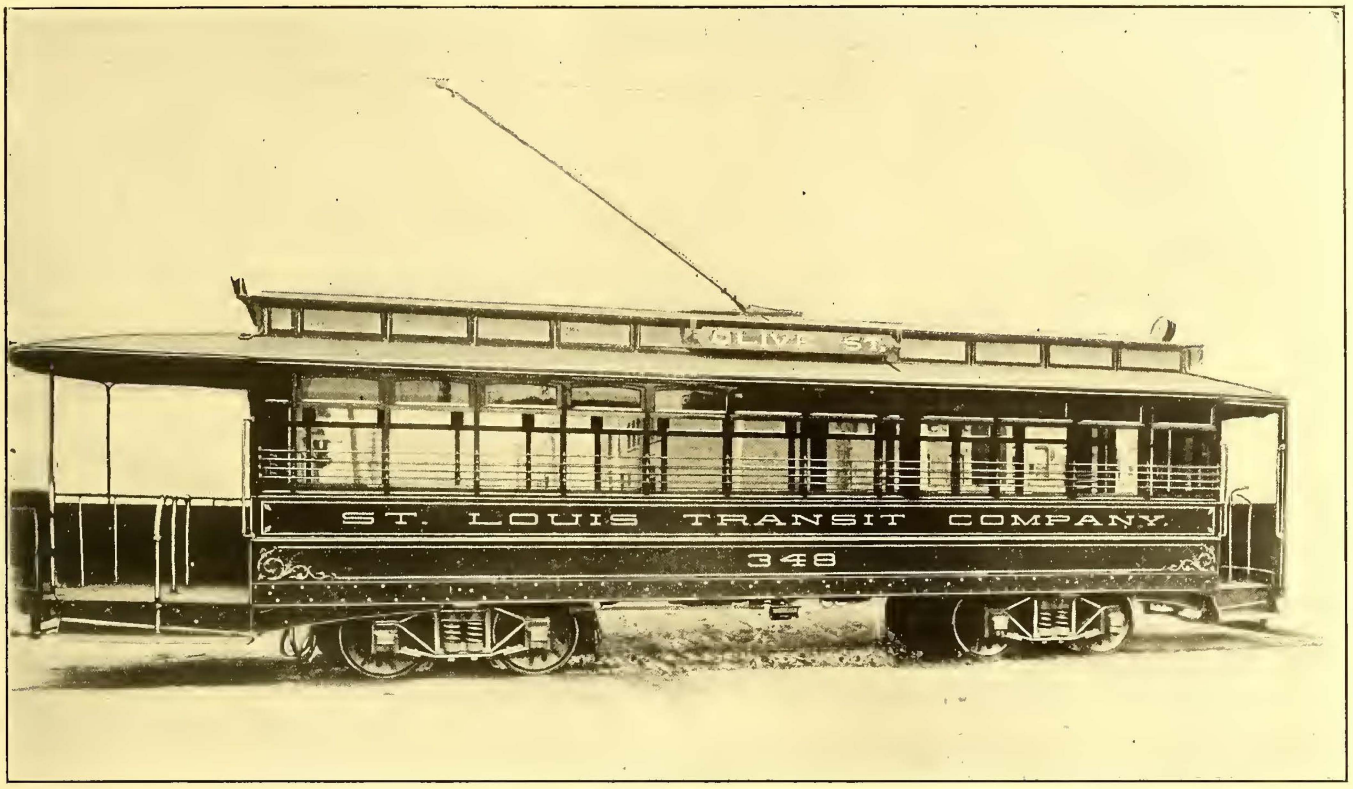


FIG. 20.—NEW SPLICED CAR WITH DETROIT PLATFORM

The body of this car is 31 ft., 9 ins. long. The front platform extends 5 ft., and the rear platform 7 ft. The supporting timbers under the rear platform are 12 ft. long. There are twelve Scarritt seats inside, two of which are placed lengthways on each side at the rear end. The car

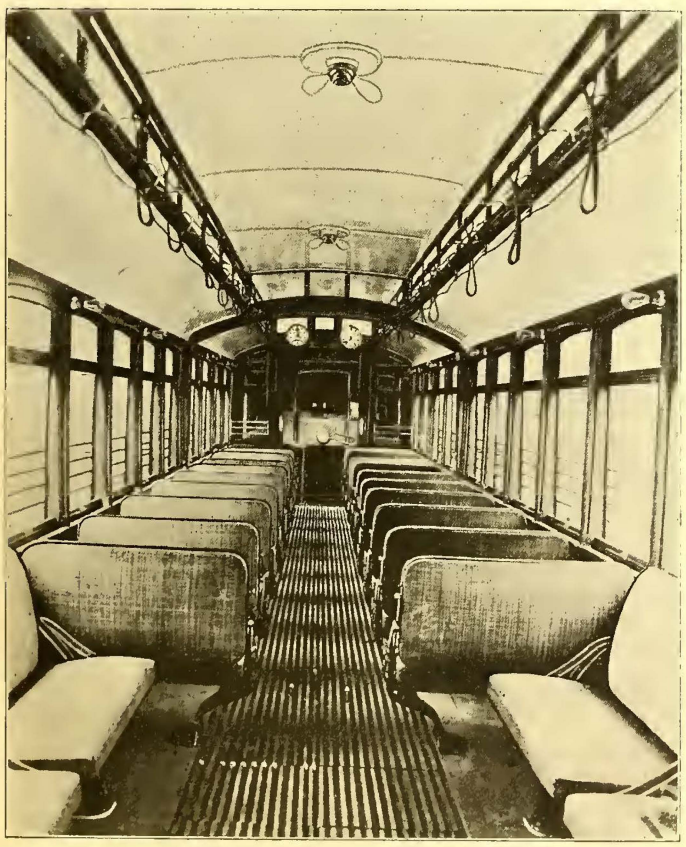


FIG. 22.—INTERIOR

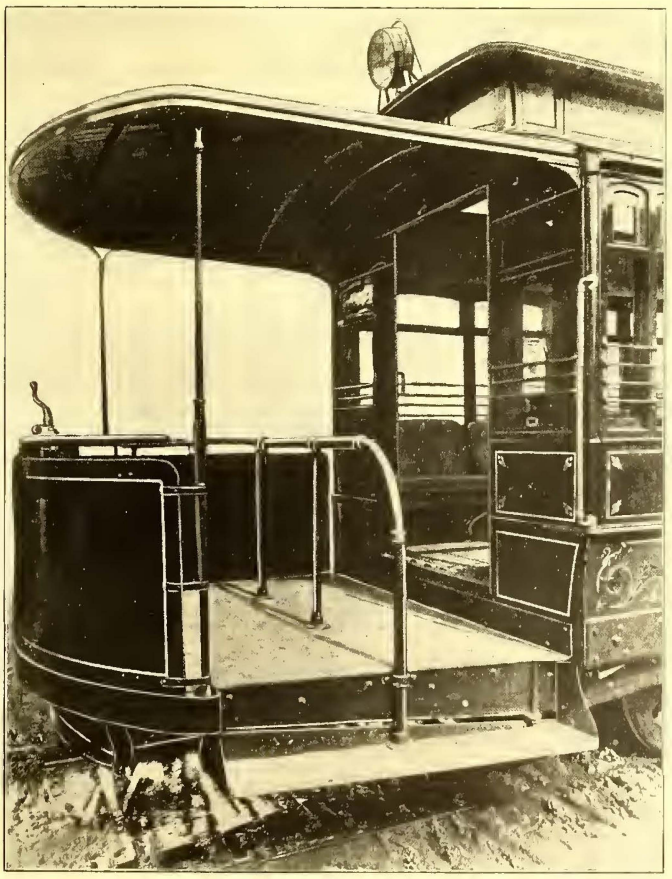


FIG. 23.—NEW DETROIT 7-FT. PLATFORM WITH PASSAGEWAY AND STANDING ROOM

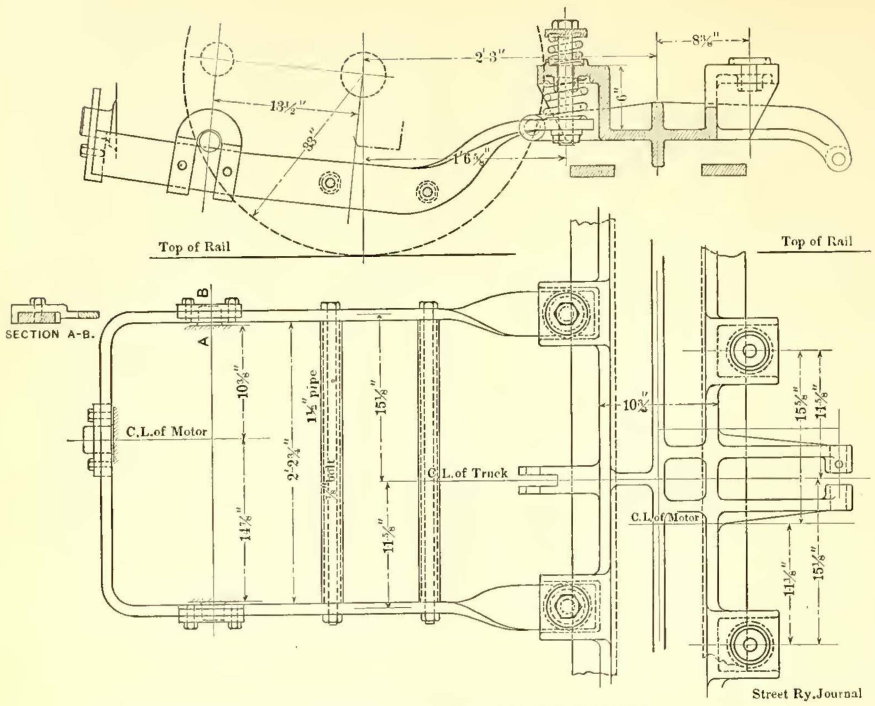


FIG. 24.—MOTOR SUSPENSION OF DOUBLE TRUCK

is 87 ins. wide inside; aisle width 21 ins.; seat width 33 ins. There are four G. E. 800 motors under the car, with a suspension noted later. The overhang from the rear king pin to the rear bumper is 13 ft., 6 ins. In splicing 3½-in. x 4-in. sills were run under the entire length. The signs have the letters cut in the wood, and the background is white celluloid. A lamp is put behind the front sign in front of the dome of the car, but the side signs are illuminated from the interior of the dome. The trucks are the company's own make, and are very similar to a freight car truck. The plans are given in Fig. 25. Mr. Du Pont believes that by selecting springs of proper stiffness it is not necessary to have many sets of springs to insure easy riding. The present truck has an outer set of springs for a light load, and as they are compressed the inner springs come into compression. The motor suspension which it is intended to use under these cars is peculiar, and its plan is shown in Fig. 24. The motors are outside the axles, but there are no bars on the truck outside the axles. The yoke seen in

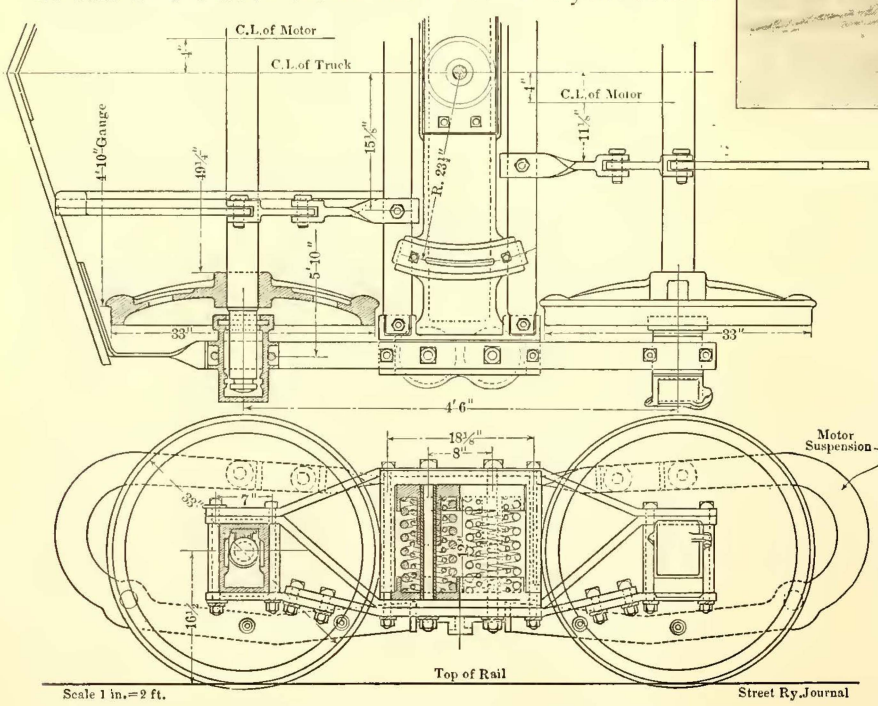


FIG. 25.—STANDARD DOUBLE TRUCK

Fig. 24 is fastened rigidly to the motor casing, and the ends of the yoke extend back under the sand bolster of the truck. The thrust of the yoke is, therefore, upward under the sand bolster. The weight on the motor axle bearings is much greater than the weight of the motor, because it is on the long end of a lever, but the dead weight on the axle is partly compensated for by the lifting of the car weight by the ends of the yoke under the sand bolsters.

As to fenders, a number are in use. The Broadway line is being equipped with the Hunter automatic fender. The St. Louis & Suburban Railway, of St. Louis, is equipped throughout with this fender.

The power house change and construction, which is being carried on under the supervision of W. D. Boyce & Company, consulting and supervising engineers, of St. Louis, is as yet in too incomplete a state for full description, but this article would not be complete without some brief mention of the work going on in that department.

FIG. 21.—FRONT VIEW, SHOWING SIGNS

There are two enormous power houses under way. One of these is a reconstruction and enlargement of the old Lindell Railway power house at Park Avenue and Vandeventer Avenue, in the west part of the city. This will have an output at economical rating of 23,500 hp, in apparatus as follows: Four 3400-hp Fulton-Corliss cross-compound condensing engines; four 2250-kw Westinghouse direct-current generators; three 2300-hp same type engines; three 1500-kw same type generators; three 1000-hp Porter-Allen tandem compound condensing engines; three 600-kw Westinghouse generators; fourteen Stirling water-tube boilers; fourteen Hawley down-draft furnaces; sixteen O'Brien water-tube boilers; sixteen Green traveling link grates; Hoppes

purifiers; Excelsior feed-water heaters; Holly system of pipe drainage; Worthington jet condensers, with twelve cooling towers; Mead automatic conveyors.

The power house on the north side, at Salisbury Street, a block east of Broadway, will have 14,000 hp in apparatus, as follows: Sixteen O'Brien water-tube boilers; sixteen Green traveling link gates; Hoppes feed-water purifiers; Excelsior feed-water heaters; Wheeler surface condensers; Barnard-Wheeler cooling towers; Mead coal conveying apparatus; two 3400-hp Fulton-Corliss compound condensing engines; two 2250-kw G. E. direct-current generators; two 1800-hp same type engines; two 1200-kw three-phase G. E. alternators; three 1200-hp Allis-Corliss engines; three 800-kw General Electric generators.

MANAGEMENT

The general management of the St. Louis Transit Company is under A. B. Du Pont, second-vice-president. The rolling stock and the employment of men in all the shops comes under Lee Massengale, master mechanic.

Polyphase Transmission on the St. Louis & Suburban Railway

The demands for power on the lines of the St. Louis & Suburban Railway having become so great that, some time ago, the addition of more generating machinery became apparent, and the best method of enlarging the plant was considered. The first idea was simply to add more direct-current machinery and more copper feed lines. This was carried almost to the point of adoption, but it was found that the immediate investment in feed wire necessary to maintain voltage at the downtown end of the rail would be enormous. Fig. 1 is a map of the lines operated by the St. Louis & Suburban Railway Company, and shows as well the lines the company is planning to build, and proposed capacities of power stations. The greater part of the power is generated at De Hodiamont, which is about 7½ miles from the downtown terminus at the Southern Hotel. At the present time all the traffic comes down town over one pair of tracks.

It was calculated that properly to maintain voltage at the downtown end of the road would require an expend-

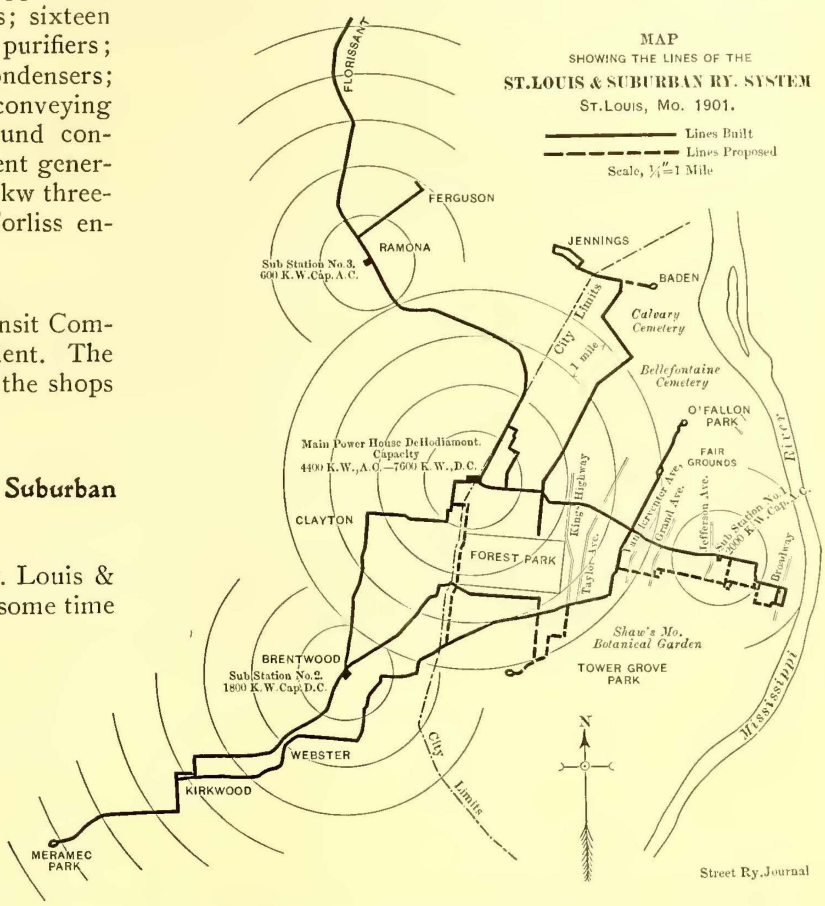


FIG. 1.—MAP SHOWING LOCATION OF POWER STATION AND TRACKS OF THE ST. LOUIS & SUBURBAN RAILWAY CO.

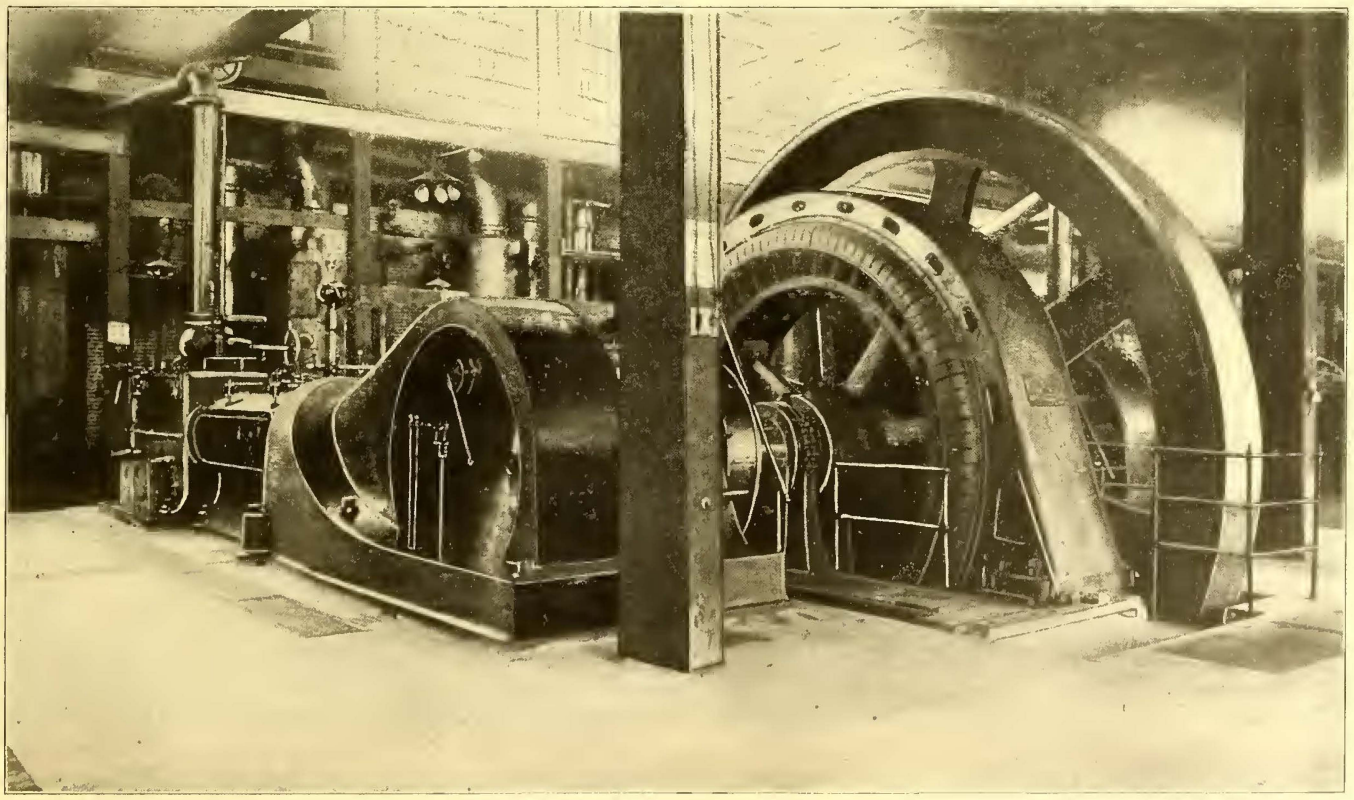


FIG. 2.—ST. LOUIS & SUBURBAN RAILWAY, NEW 1200 KW ALTERNATOR

iture of $110,000 in copper alone, to say nothing of the cost of power-station machinery. Furthermore, this copper would be of no value to the balance of the line. It was

then concluded that the proper solution of the problem would be to put in a couple of 1200-kw, three-phase generators, which could supply the downtown end of the road

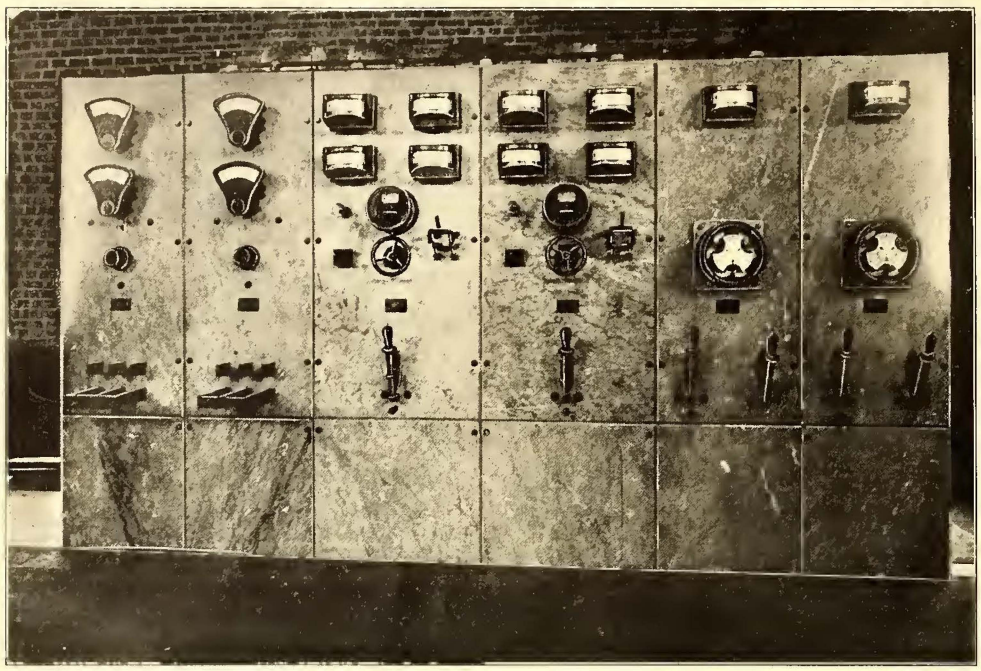


FIG. 3.—POLYPHASE SWITCHBOARD

and other distant points if desired. The estimated cost of these two engines and generators, with all transforming apparatus, and steam plant with condenser cooling tower, was $270,000.

One unit of 1200 kw is installed at the main power house and is running. It supplies a sub-station located near Sixteenth and Wash Streets, as seen in Fig. 1, and

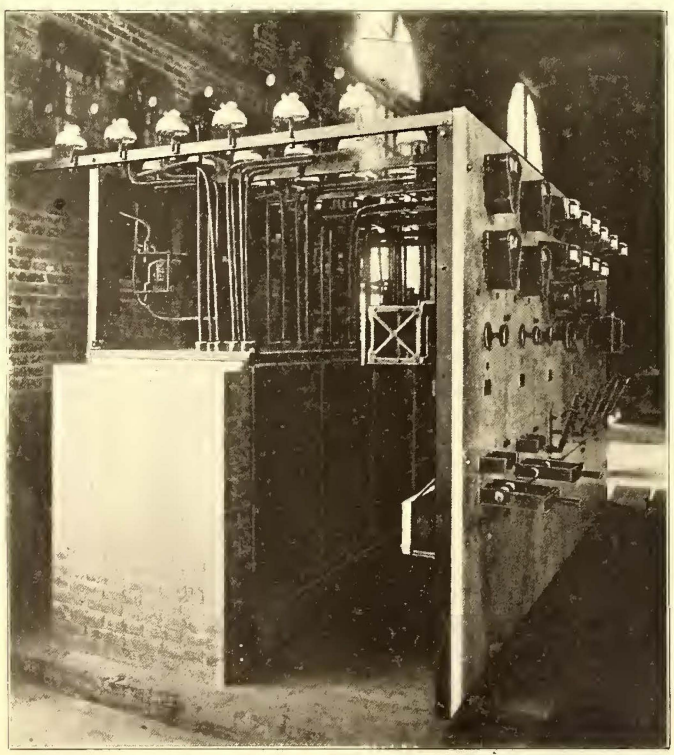


FIG. 4.—SWITCHBOARD WIRING AND BRICK CELLS FOR OIL SWITCHES

this sub-station feeds the downtown district, with the result that there is an enormous improvement in voltage on the downtown lines. Preparations are also nearly completed at present writing to place rotary converters at the steam power house at Brentwood, and run that power house as a sub-station, except on Sundays during the heaviest load, when the steam plant will be started up. Another sub-station is also being considered at Ramona.

The 1200-kw generator at the De Hodiamont power house is a 6600-volt, 25-cycle, 105-amp. machine of General Electric make, direct connected to a 30-in. and 50-in. x 60-in. compound condensing Corliss engine, built by the Fulton Iron Works Company, of St. Louis. To run this new unit some old horizontal return flue boilers were taken out of the boiler plant and replaced by three 500-hp water-tube boilers built by the J. O'Brien Boiler Works Company, of St. Louis, and fitted with Hawley down-draft furnaces. The engine operates at 75 r. p. m. It is the intention to build a cooling tower and run condensing. The cylinders on the engine are lubricated by a Phœnix automatic pump lubricator, which consists of several small pumps operated from the

FIG. 5.—EXTERIOR OF WASH STREET SUBSTATION

valve motion of the engine. Each pump draws from a drop by drop supply, which can be regulated by the engine. The exciter for this generator is a General Electric 50-kw direct-connected marine, generating at running 400 r. p. m. The 1200-kw unit is shown in Fig. 2.

The switchboard (Figs. 3 and 4) is a good example of modern high-tension work. It is designed for the two generators, which will ultimately be installed. The two middle panels in Fig. 3 are generator panels. Each has a double-throw, three-pole oil switch for throwing the gen-

erators on to either one of two sets of bus-bars. The switch can not be thrown from off on to either set of bus-bars without first releasing the catch by pulling the knob below the switch handle. The switch can be thrown off instantly from either bus-bar without releasing the catch, but it will catch in off or middle position. Just above the main switch is the rheostat handle for regulating the field current. At the right of this is the double-pole knife switch with auxiliary contacts for breaking the generator field circuit. At the left of the rheostat is the synchronizing plug for connecting the synchronizing transformers to the bus-bars, and above the synchronizing plug is the synchronizing lamp, which is on the secondary of the synchronizing transformer. In the middle above the rheostat handle is a polyphase recording wattmeter, which records the output of the generator in watt-hours. At the top of the panel are an indicating wattmeter, two ammeters and one voltmeter. At the left of the generator panels are the two exciter panels. At the right of the generator panels are the two 6600-volt feeder panels. Through one of these the high-tension current passes for the downtown sub-station on Wash Street, and through the other the current for the Brentwood sub-station. Each panel has an ammeter in one leg of the three-phase circuit, and an electrostatic ground detector. The feed circuit also passes through both a three-pole, double-throw oil switch, by which it can be thrown on the upper or lower bus-bars, and through a three-pole oil circuit breaker. The handle of the double-throw switch is shown at the left, and the handle for resetting the circuit breaker at the right on each panel.

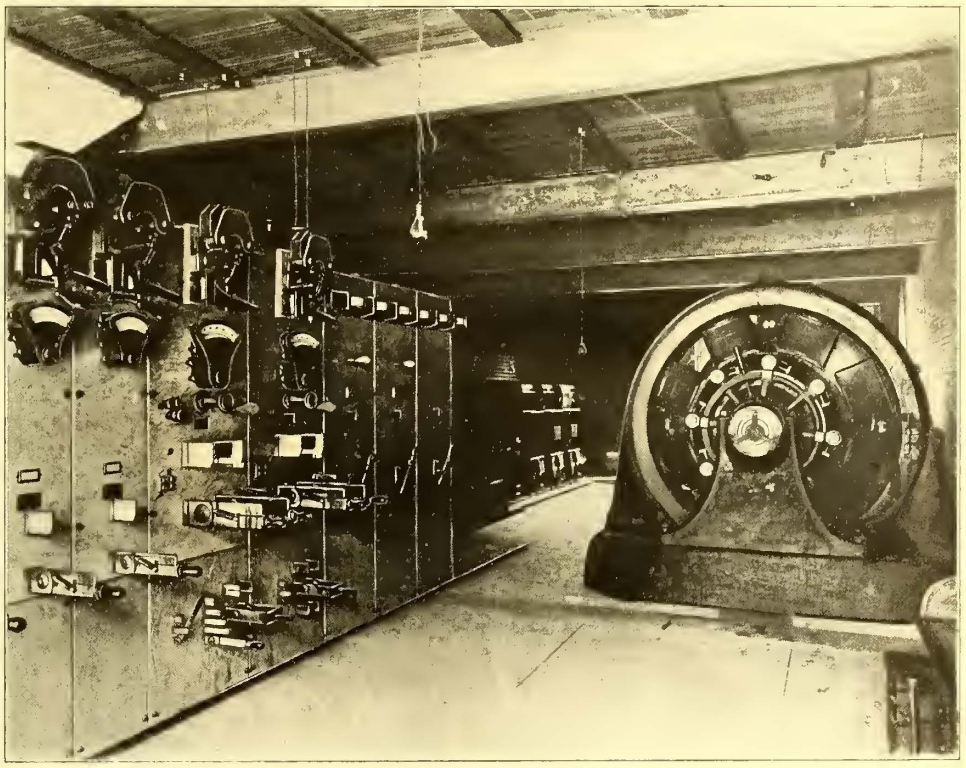


FIG. 6.—INTERIOR OF WASH STREET SUBSTATION

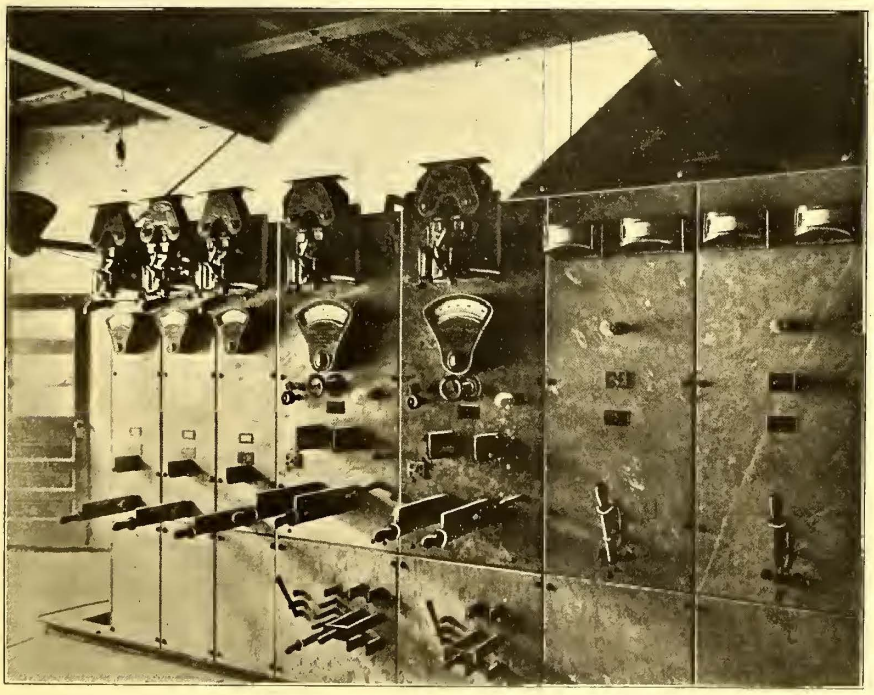


FIG. 7.—SWITCHBOARD OF WASH STREET SUBSTATION

The automatic circuit breaker is tripped by a coil supplied with direct current from the exciter. A small transformer is placed in series on the feed circuit. When a short circuit comes on the feed lines the secondary of this series transformer actuates a solenoid plunger, which closes the exciter circuit that trips the circuit breaker.

The circuit breaker is built on the same principle as the oil switch. The switches and circuit breakers are located in a set of brick cells some distance back of the board, as seen in Fig. 4, and a series of rods and bell crank levers connects them with the handles on the board. A good idea of the wiring behind the board can be obtained from Fig. 4. Plenty of room must be allowed for safety and convenience around a high-tension board of this kind. The series transformers and lightning arresters are on the wall back of the board.

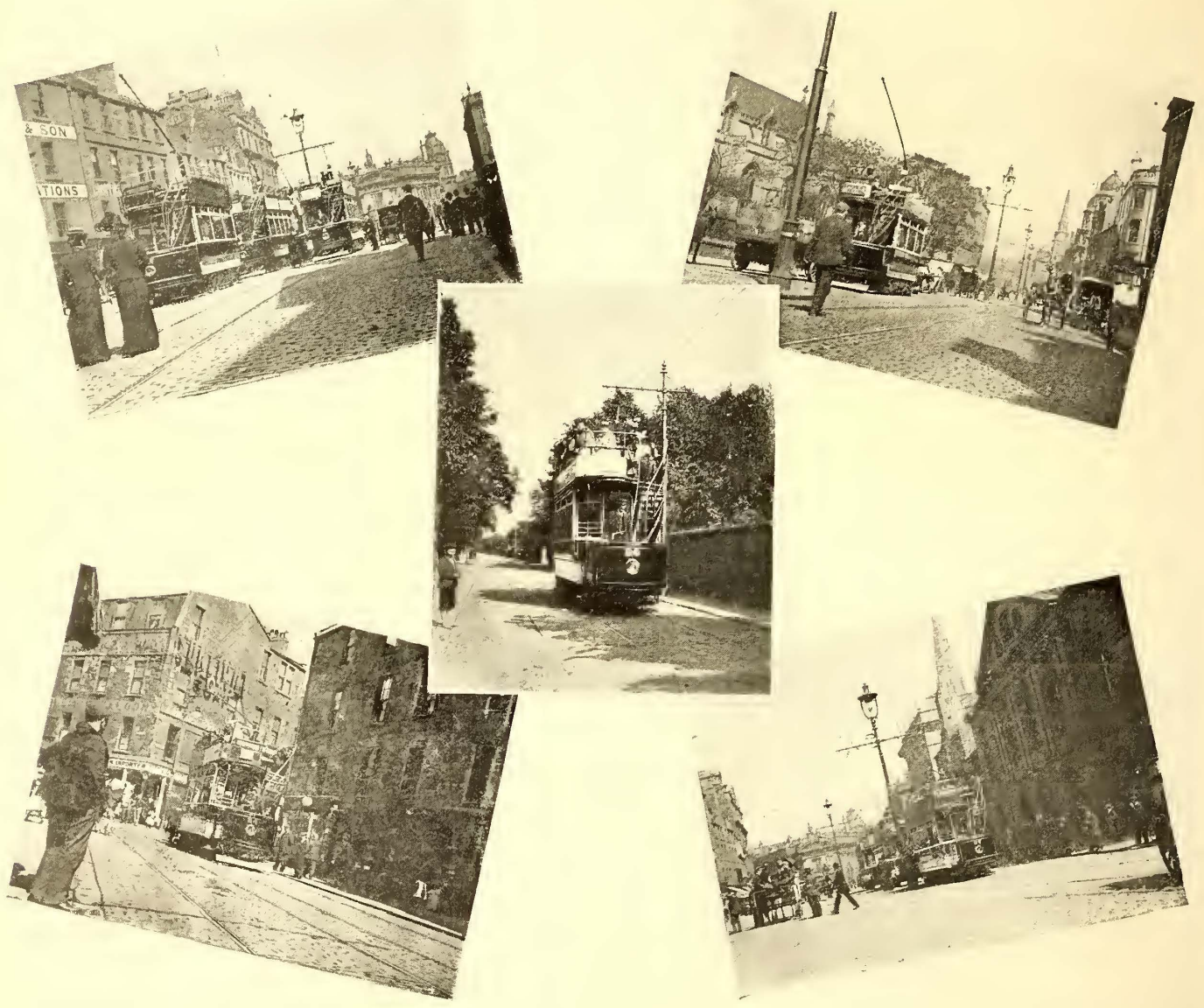
The 6600-volt current for the Wash Street sub-station is taken on three wires carried on glass insulators on the same poles as the 500-volt direct-current lines. The exterior of the Wash Street sub-station and the high and low-tension wires entering it are shown by Fig. 5. This sub-station contains two G. E. 600-kw rotary converters. Each rotary has a bank of three 250-kw G. E. static transformers reducing from 6600 to 350 volts to supply it. There is also one 250-kw static transformer kept in reserve in the station, though not connected up or placed over the air blast. Each bank of transformers has its own air blast furnished by 3.6-hp motors driving Buffalo Forge Company fans. In the view of the interior of the sub-station, Fig. 6, a bank of transformers and its blower is seen in the background. The switchboard shown in Figs. 6 and 7 has one main panel at the right for receiving the 6600-volt

circuit. This panel has a double-throw, three-pole oil switch for throwing the incoming current on to either the upper or lower bus-bars, a voltmeter and an ammeter. There is also a high-tension panel for each bank of transformers, shown at the extreme right in Fig. 7. Each of these has a double-throw, three-pole switch for connecting to either set of bus-bars and a voltmeter, ammeter and synchronizing plug and lamps. The alternating-current ends of the rotary converters are connected directly to the low-tension side of the static transformers, the switching being all done on the high-tension side of the transformers by means of the switchboard panels just mentioned. The direct-current ends of the rotaries are handled by switchboard panels similar to generator panels, with the addition of switches for starting the rotaries from the direct current on the line. There are three of the ordinary direct-current railway feeder panels at the left end of the board. A 30-volt, 950-amp. reactionary coil is in the secondary circuit of the transformers. The rotaries have a new ball device for causing end play, which is seen on the bearing of the rotary in Fig. 6.

The conditions on the St. Louis & Suburban are most favorable to alternating-current power distribution because the road extends over a long territory, east and west.

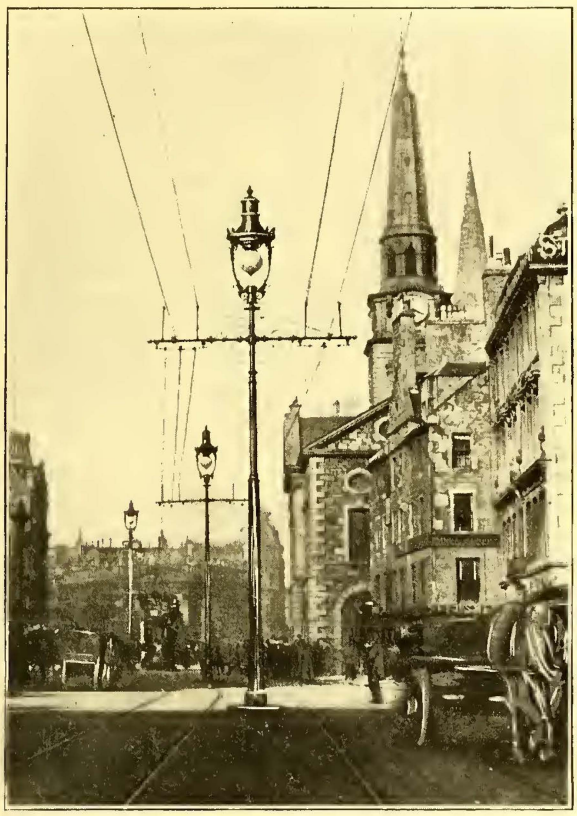
Tramway Equipment of Dundee

Since about the middle of last year the city of Dundee, one of Scotland's most important cities outside of Glasgow and Edinburgh, has been in the enjoyment of electric traction, and a short description with a few illustrations will doubtless prove interesting to the reader. Dundee is known the world over as the home of the jute trade, but in this hustling city by the sea there are many other important industries, and in addition to its being an important seaport, it may be classed as a manufacturing city. Notwithstanding this, however, Dundee has many beauties, its old-fashioned streets and buildings proving quite attractive to the casual visitor. It speaks volumes for the energetic Dundonians, therefore, to have been among the very first to introduce electric traction in Scotland, Aberdeen only rivaling it in this respect. The tramway system of Dundee is scarcely a quarter of a century old, but considering the natural difficulties that had to be overcome, the development has been fairly rapid. The streets are hilly, narrow and crooked, and the problem of satisfying every district which cried out for the service has been far from easy. When the Town Council two years ago took over the system it was finally decided to adopt electricity, and whatever difference of

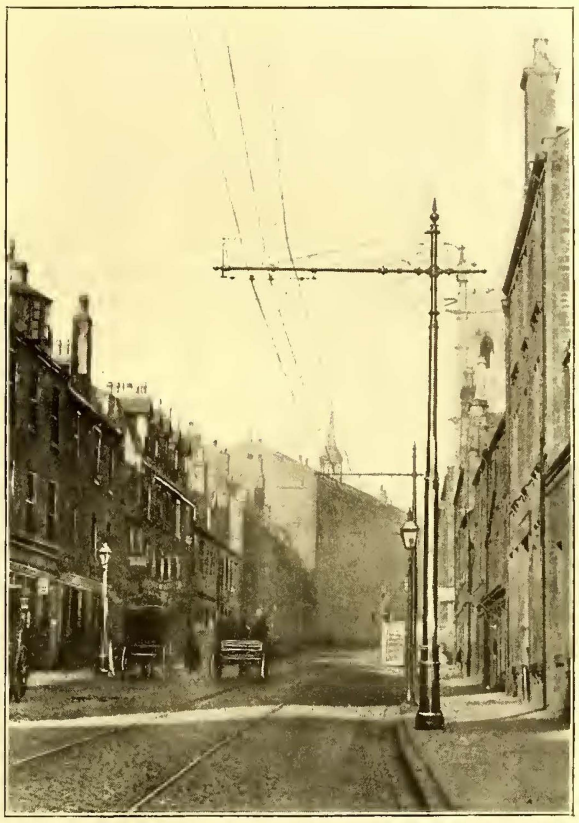


VIEWS OF THE DUNDEE TRAMWAY SYSTEM

opinion there may have been as to the new routes to be opened, it was early agreed that electricity was to entirely supersede steam and horse haulage.



CENTER POLE CONSTRUCTION, DUNDEE



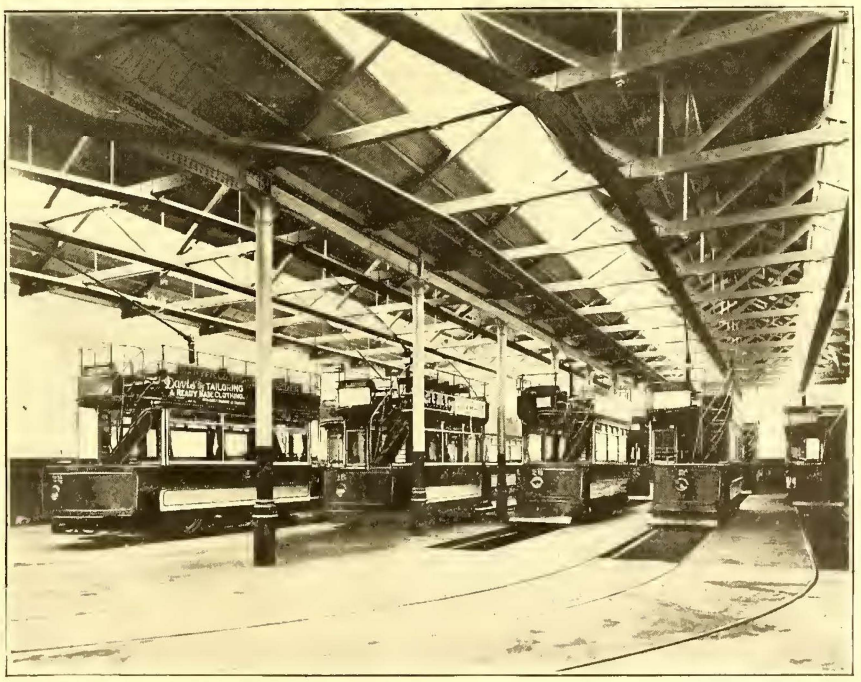
SIDE POLE CONSTRUCTION, DUNDEE

It was also early decided to adopt the overhead system and a uniform gage, though to do this much old property has had to be demolished, streets widened, and new buildings erected. From the first ex-Provost Brownlee, the convener of the tramways committee, took a very active interest in the work, and is largely responsible for the municipalization of the Dundee tramways, the adoption of the overhead system, as opposed by those favoring a conduit system, and for the broad manner in which the whole work has been executed, comprising, as it does, many permanent improvements to the city. Hitherto, Dundee has been a somewhat congested city, but now the suburbs have been well opened up, and the congestion much relieved, many being now able to live out in the suburbs which could not previously be readily reached.

THE GENERATING STATION

The tramways department obtains its current for the electric cars at present from the same generating station that provides current for lighting purposes. A large new power house has, however, just been completed, and is being equipped, adjoining the electric light station, which will virtually hereafter be one station and under one management. It is in the center of the city and is on a piece of ground at the corner of Dudhope Crescent Road and Lochee Road.

There are two new boiler houses—one 88 ft. x 61 ft., and the other 75 ft. x 61 ft. The larger one will hold eight boilers and the smaller one seven. The roof is strongly framed with steel girders so as to carry the cooling tanks. Adjoining are the necessary economizer house and pump room. The stack is one of the largest in Dundee, being 220 ft. in height, 20 ft. in diameter at the bottom, and 12½ ft. at the top. The new engine house is 112 ft. in length and 36 ft. in width, with a height from the floor to the attics of 40 ft., and is lined internally by enameled fire brick in various shades. The old boiler equipment of the station consisted of four 300-hp Lancashire boilers, and an additional four of 500 hp each have been put in by Messrs. Cooper & Creig. The accommodation, however, will be sufficient for eleven other boilers of a similar capacity when needed. This will bring the total boiler capacity of the station at the



INTERIOR OF CAR HOUSE

present time up to 3200 hp for both lighting and haulage purposes.

The new generating plant consists of two Willans-Parker combined units of 300 kw capacity, and a large Willans-Parker unit of 500 kw. capacity. The engines are Willans & Robinson's high-speed triple expansion engines, each set having high, intermediate and low-pressure cylinders, working on separate cranks. The two smaller sets are of 450 hp each, and the large set of 750 hp. They are coupled direct to a Parker four-pole dynamo. The smaller sets run at 357 r. p. m., and the larger one at 250 r. p. m. The traction generating plant thus has a combined horse power of 1650, and has been supplied by Lowden Brothers, Dundee. Space is left for five other dynamos and engines to be put in as required. The engine house is fitted up with a traveling crane, and all the most modern appliances for rapid and efficient working. The new switchboard has also been supplied by Lowden Brothers, and by it will be controlled the electric power to the whole of the new tramways.

The car houses occupy an area of over 1500 yards, and the work shops extend to about 350 yards.

The whole of the overhead system in Dundee has been

STANDARD CAR, DUNDEE

carried out by Robert W. Blackwell & Company, of London, and span wire, side pole, and center-pole construction has been adopted wherever advisable. Now that the electrical standards are in position, and the public eye has become habituated to their appearance, one hears less talk about the offense given to esthetic taste by the introduction into Dundee of the overhead system of electric haulage.

Several of the illustrations show the various types of construction, and it must be admitted that the work in certain of the streets, such as the Nethergate, where the center-pole construction has been adopted, with arc lights on the top of the poles, looks particularly well. In design and structure the poles and brackets are neat and of a strength far in excess of requirements. The feeder wires are all underground and section pillars are provided at stated intervals, so as to minimize the area affected by any possible breakdown in the overhead work, and guard wires have also been erected.

The permanent way has all been supplied by Dick, Kerr & Company, of London, and consists of steel girder-rails laid in a concrete bed, and paved between with granite sets, all joints being carefully bonded and the rails cross-bonded. The crossing points were also supplied by this firm.

ELECTRIC CARS AND EQUIPMENT

All of the electric cars, of which there are about fifty now in service, have been built by the Electric Railway & Tramway Carriage Works, of Preston, equipped with motors of the English Electric Manufacturing Company, of Preston, and supplied by Dick, Kerr & Company. They are all of the double-decked type, but some are mounted on single Brill trucks, giving accommodation for forty-three passengers, and some on Brill bogie trucks, giving accommodation for fifty-seven passengers. They are of handsome design, having lofty ceilings, some being finished in millboard, picked out in gold, some in quartered oak, and some in cherry.

Reference has already been made to ex-Provost Brownlee, who has done magnificent work in forwarding the interests of the tramways, but the actual management of the tramways is in the hands of Peter Fisher, to whom we are indebted for much of the information and the illustrations used in this article. Mr. Fisher is a native of Braco, Perthshire, and has had a large amount of experience in tramway work, being for many years permanent way superintendent and assistant traffic superintendent of the Vale, of Clyde system, but has now been in Dundee for about seven years, and has been very successful not only in developing the tramways but in making them work successfully and smoothly and with general satisfaction. As has already been stated, the power house in Dundee does not come under the tramway department, but is in the electricity department, and the sole responsibility of the power house rests with the electrical engineer of Dundee, W. H. Tittensor. Mr. Tittensor comes originally from Manchester, but was appointed to the position of assistant electrical engineer some eight or nine years ago, and in 1896 was promoted to the control of the station. The electricity department was comparatively a small affair when Mr. Tittensor first took hold of it, until with growth of electric lighting it became a comparatively large station, and now that electric traction has been put in, the station assumes a position of great importance. We are also indebted to Mr. Tittensor for some of the information and illustrations contained in this article.

Kinks on the Sutro Railroad, San Francisco

The Sutro Railroad of San Francisco, now owned by the Sutter Street Railroad and operated as an extension of that line, is under the superintendency of J. Reynolds, of the Sutter Street Railroad, and under the more immediate charge of E. M. Van Frank, electrician, who has put in use a number of features of interest.

BLOCK SIGNALS

At a corner near one of the terminals of the road only a single track was allowed. Formerly conductors had to run ahead some distance to see if a car was coming in the opposite direction, and then signal the motorman. A block signal has been put in operation, which goes to danger whenever a car enters the single track, and returns to safety when a car leaves the single track. This signal was home-made, and seems to possess many good points. It is operated by the momentary contact of the trolley wheel on a clip 18 ins. long, placed alongside the trolley wire. The trolley wheel touching both the trolley wire and clip at the same time makes a contact which energizes a magnet in the signal box long enough to throw the signal. The contact clip is fastened directly to the ear of the trolley-wire hanger, and the span wire is used to conduct the signal current. This is much simpler than insulating the clip and running a signal wire out to it alongside the span wire, as is sometimes done. The signal proper is worked by an ingeniously arranged electromagnet of the dimensions shown in Fig. 1. It is, in reality, a double magnet, one coil of which acts to throw the signal one way, and

the other to throw it the opposite direction. When current is sent through the right-hand coil the upper end of the armature is attracted to the right (the lower end being pivoted), and the signal is turned through a rack and pinion movement. When current is sent through the left-hand coil the armature is attracted to the left. Both coils being connected so as to make their upper ends of the same polarity, the tendency each time is to demagnetize the armature of what little residual magnetism may have remained in it from the previous moment. On the same shaft as the pinion which works the signal is a commutating device, which changes the connections each time the signal makes a movement, so that the current will traverse the opposite coil the next time the trolley makes a contact at a clip. As the inertia of the signal is rather great, and as the contact made by the trolley wheel on the clip is of short duration, the pinion is not rigidly fastened to the signal shaft, but is connected through the medium of a spiral spring. The armature, therefore, moves easily at first. As the spring tightens it gets more into range of the magnetic field, and the pull becomes stronger. The armature, consequently, moves rapidly over against the pole, where it is held by residual magnetism, even after the trolley-wheel contact has ceased. The spring draws the signal along behind at a somewhat slower rate. The connection-changing device consists of three contact rings on the shaft insulated by hard fibre, on which the copper brushes bear.

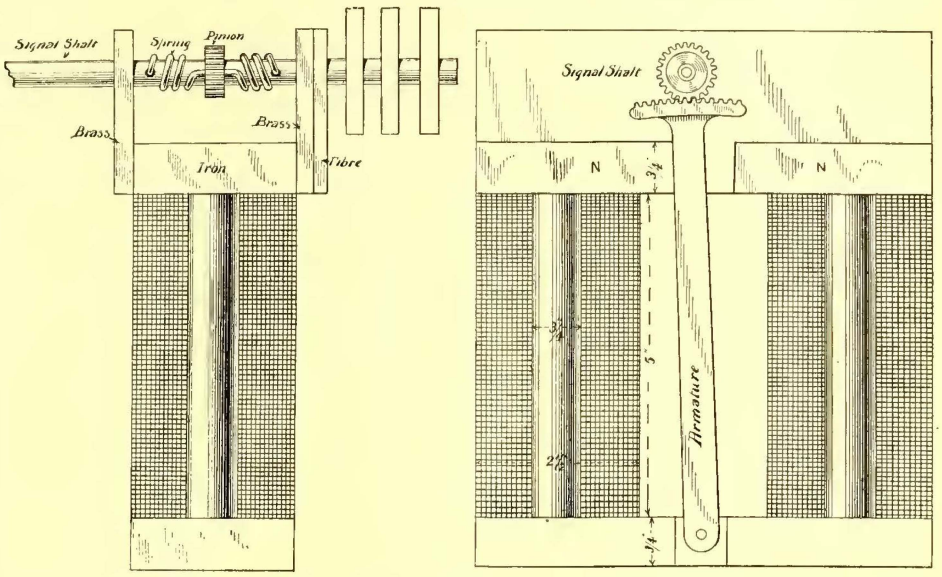


FIG. 1.—SECTIONS OF ELECTRO MAGNET USED IN OPERATING BLOCK SIGNAL SYSTEM

STOPPING GENERATOR SPARKING

In the power house of this company is a G. E. 360-amp., 550-volt multipolar generator, direct-connected to its engine and running 200 r. p. m. Much trouble was experienced with this machine from sparking, until sheet-iron bridges, 3-32 in. thick, were put between pole tips. The brushes were also reduced in thickness from $\frac{5}{8}$ in. to $\frac{1}{2}$ in.

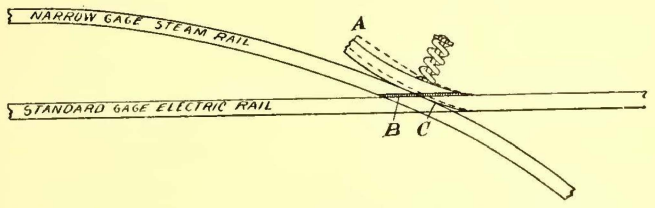


FIG. 2.—SPRING FROG AT CROSSING OF STEAM AND ELECTRIC RAILWAY

The bridges make no apparent difference in the field excitation required.

FEED PUMP REGULATION

The power house used condensing water from the ocean, and consequently has closed coil condensers and returns all condensing water to a heater. The boiler feed pumps are regulated by a float in the heater.

REPAIRING ROTTED POLES

A scheme for obtaining double life out of square sawed redwood poles employed in a number of places in California is used on this road. Instead of renewing a pole at an expense of over $8 for the pole (to which the expense of loosening up the span wires must be added), a temporary guy is put up to take the strain off the pole, and the dirt around the bottom of the pole is removed. Then a box of 2-in. plank, 10 ft. long, is put around the pole to supply the strength taken away by the rotting of the pole. At the top the plank box is neatly beveled off. The planks are painted with tar and asphaltum. The plank costs only about one-third what a pole would and costs less to place. Where square poles are used the plan is a considerable saving over renewing poles whenever they rot off at the butts.

WIRE SPLICE

A very simple scheme for splicing No. 0000 wire has been used. It is so effective and easily worked, it is strange it has not been more commonly employed. A brass tube $\frac{1}{2}$ in. inside diameter, with walls 5-64 in. thick, is slipped over the two ends of the wire for a sleeve and upset in four places by placing a $\frac{1}{2}$-in. round iron transversely across the tube and hitting with a heavy hammer. A joint made this way is stronger than the wire, though at first thought it would seem to be an uncertain kind of a job. For the sake of conductivity, the sleeve is usually soldered through four holes in the sleeve.

LIGHTS IN CARS

The regular California type of car, closed in the middle and open at both ends, is run on the Sutro Railroad. In the closed part of the car five 16-cp, 100-volt lamps are put in series. The open parts are wired so that there are always two 16-cp, 100-volt lamps on the rear, one 16-cp, 100-volt on the front, and a 220-volt, 32-cp in the headlight in series.

NOVEL SPRING FROG

At one point on the road a narrow-gage steam road runs along the same roadbed, and uses one of the electric road's rails. At the point where the steam road leaves the electric road a spring frog, as shown in Fig. 2, is laid. The bent rail, *A*, is held firmly against the narrow-gage rail by a spring. A flangeway, *B*, just deep enough for the electric car wheels, but not deep enough for the steam car wheels, is cut across *A* and the narrow-gage rail. When a steam train passes its deep flanges force the swiveling rail *A* back to allow the flanges to pass. The success of the frog depends, of course, on the steam-car wheel flanges being deeper than the electric. Otherwise the steam flanges would catch in the flangeway of the electric.

A bill to prevent passengers standing in open cars is being agitated in New York.

The Storage Battery in Railway Power Station Service

BY LAMAR LYNDON

The application of storage batteries to generating and distributing systems which are subject to varying or fluctuating loads—and only under such conditions is their use advisable—may be (1) as a reserve for power storage, the function of the battery being to absorb energy during periods of light load and discharge on the "peaks," thus equalizing the load on the station and bringing up the efficiency of the generating apparatus; (2) as a regulator on the station load to absorb, or compensate for, rapid fluctuations of current demand and maintain a constant voltage; (3) as a regulator on a long feeder-supplying receiving apparatus, which draws varying amounts of current from the system, and to compensate for the changes of voltage due to changes of drop, maintaining at all times a uniform voltage at the terminals of the receiver, or (4) a combination of any or all the three functions named.

FIG. 1.—LOAD DIAGRAM FROM TYPICAL LARGE STATION

It is the purpose of this article to discuss these various applications with a view to affording definite data for determining the sizes of battery and booster necessary to cover requirements under given conditions.

POWER STORAGE

On large railway systems the momentary fluctuations due to grades or starting, while small, as compared with station output, are quite appreciable, and effect both the station economy and strains on the operating machinery. These systems will also have peaks that rise far above the normal or average load, and when these are of short duration, a battery can usually carry them more economically than a generating equipment of a like capacity, which will only be in use a short time each day.

As an example, the load curve shown in Fig. 1 is taken which represents the load on a large system in an Eastern State. The minimum load is 800 amps., maximum 11,600 amps., and average 5740 amps.

First is the determination of the size of the battery. The cost of a battery with its booster on a basis of one and one-quarter hour discharge approximates that of equivalent generating equipment. In Fig. 1 any area taken is, to proper scale, equal to the amp.-hours necessary to supply the current demand during the time considered, and by means of a planimeter the amp.-hours for any condition of load during a given time can be determined.

The ideal condition for station efficiency would be to have the generating equipment sufficient only to supply the average demand, the battery being large enough to care for all variations therefrom. In the case under consideration this would require a battery of about 24,000 amp.-hours' capacity, and it would discharge continuously for fourteen hours. This would, of course, be out of the question commercially.

In arriving at the proper size of battery there are so many inter-dependent variables involved, that a satisfactory mathematical formula is impossible, and the compution is always one of trial and error; that is, different sizes of battery are assumed and the commercial value of each, as related to the system under consideration, is determined, the one best suited being adopted. To facilitate these calculations, Figs. 2 and 3 are herewith given. The curve in Fig. 2 shows coal consumed per 100 kw-hours under various percentages of load, and the cost thereof at $3 per ton. A station operating compound-condensing units of not less than 500 hp each is assumed.

Curve I. in Fig. 3 shows the variation in amp.-hour capacity of a battery with varying rates of discharge; curve II. shows amperes delivered continuously at varying discharge rates; curve III. shows cost per kilowatt at varying discharge rates, and curve IV. shows variation in cost per amp.-hour at different discharge rates, the eight-hour rate being taken as 100 per cent.

Curve I. shows that the amp.-hour capacity of a battery is a function of its discharge rate. In order to fix some definite basis for calculations, the discharges will all be referred to the three-hour rate. A more rapid discharge depletes the battery a greater amount than amperes × time, if referred to the three-hour rate. From curve I. the following table is computed:

Discharge rate	K
3 hours	1.00
2 1-2 hours	1.07
2 1-3 "	1.11
2 "	1.15
1 2-3 "	1.25
1 1-2 "	1.30
1 1-3 "	1.36
1 "	1.50

To refer any discharge to the three-hour rate, the product of time × amperes must be multiplied by K for the actual depletion of the charge in amp.-hours, K being taken to correspond with the rate at which the discharge is effected. The discharge at any time should not exceed the one-hour rate.

The cost of battery erected, exclusive of booster, is taken as $146 per kilowatt on a three-hour rating, or $73 at one hour, and that of generating equipment as $80 per kilowatt.

In a case of a peak like that at "A" (Fig. 1) the depletion of battery can be found with sufficient accuracy by dividing the area which is enclosed by the portion of the

load curve on which discharge takes place, by the time elapsing between the beginning and end of discharge; the quotient being the *average* rate of discharge. From this K can be determined, and with the proper correction by this factor, the depletion referred to the three-hour rate is found.

In the case of a peak, such as "B" (Fig. 1), this method would give a result too small, and, in order to get the actual amp.-hours, referred to a given basis, it is necessary to divide the peak into a number of smaller vertical divisions. The area of each of these is then taken and divided by the time over which the discharge extends, and reduced by the factor K to the equivalent three-hour rate. The summation of these gives the amp.-hour capacity of battery required on a three-hour rating.

The capacity of battery will first be assumed as sufficient to cover the peak *m o g t*, with a maximum discharge of 4100 amps. This requires a battery of $4100 \times 1.5 = 6150$ amp.-hours at three-hour rate, or 2050 amps. normal discharge rate. With the peak divided into twenty-minute sub-divisions, the following results are obtained:

Time	Duration	Amp. hours	Discharge rate	K	Amp. hrs. × K
4:35 to 5:00....	25 min.	213	512	1.0	213
5:00 to 5:20....	20 "	373	1,088	1.0	373
5:20 to 5:40....	20 "	692	2,076	1.0	692
5:40 to 6:00....	20 "	1,166	3,498	1.3	1,516
6:00 to 6:30....	30 "	2,050	4,100	1.5	3,075
6:30 to 6:55....	25 "	746	1,790	1.0	746
					6,615

The summation of the last column in the table shows 6615 amp.-hour capacity required at three-hour rating.

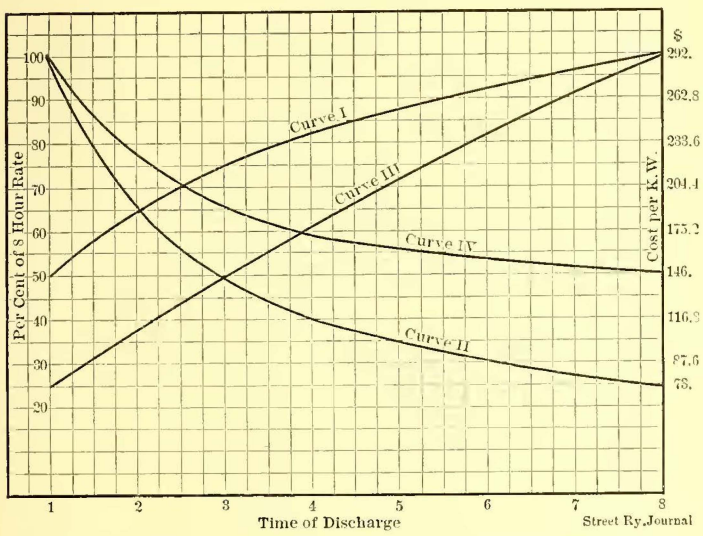


FIG. 3.—DISCHARGE CURVES UNDER VARIOUS CONDITIONS

As this is about 10 per cent greater than capacity assumed, the battery will have to be increased somewhat or the generators required to work a short time at a small overload from 6 p. m. to 7 p. m. of 600 amps., or about 8 per cent. The cost of the battery installed will be about $160,600.

Where accumulators are used for storage of power principally, and regulation is a secondary consideration, the compound booster is the type best adapted for the work.* This machine is an ordinary compound-wound dynamo in which the shunt field produces an e. m. f. to compensate for variations in battery e. m. f., and the compound winding produces an e. m. f., which is proportional to the current flowing, and equal to the drop due to resistance of the battery circuit. This includes the internal resistance of the battery and the resistance of the series-field and armature of the booster.

If the current is discharging from the battery, the series field induces an e. m. f. in such a direction as to assist the discharge by an amount equal to the drop. If the battery is receiving charge, the current passes through the series coils in an opposite direction, and produces an e. m. f., assisting the charging e. m. f. Briefly, the series winding causes the battery to act as if it had no internal resistance.

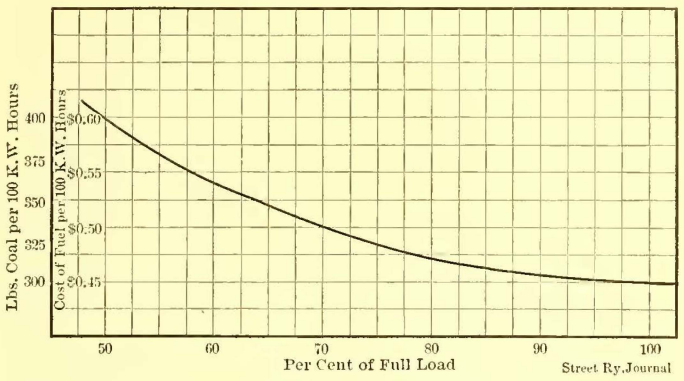


FIG. 2.—COAL CONSUMPTION UNDER VARIOUS PERCENTAGES OF LOAD

The shunt field is connected to a reversing rheostat so that it may be made to produce an e. m. f. varying from zero to maximum in either direction. The booster voltage is always the resultant of the two windings, which may act to assist or oppose each other.

The maximum voltage of battery—on open circuit—will be about 2.3 and its minimum 1.9 per cell. The working voltage is taken as 2.05 volts, which gives about 550 volts for 270 cells normal, with a maximum of 621 volts and a minimum of 513, or a range of 109 volts. As the field may be reversed, one-half of this range, or 55 volts, should be sufficient for the maximum voltage of the shunt coil. This is increased somewhat to take care of extraordinary conditions, 70 volts being usual on railway boosters. The series winding is capable of giving approximately 30 volts as a maximum, though this varies with conditions.

The booster is connected in series with the battery, and the two connected across the line. Normally the shunt voltage is very small or zero, and the battery and booster float across the line. A heavy current demand will start the discharge and the series winding then assists the flow. The reverse operation takes place when the external load becomes light.

As the battery voltage rises from charge, or decreases because of discharge, the rheostat in the shunt field is adjusted by hand so that booster shunt voltage, plus battery voltage, equals line voltage at normal load. The booster shunt voltage may be positive or negative according as it assists or opposes the battery e. m. f.

The series coils and armature windings must be of sufficient carrying capacity to admit the maximum current flow to or from battery. In the case under consideration this is seen to be 4100 amps., and to last about forty minutes. The continuous carrying capacity should, therefore, be about 300 amps.; consequently the booster is a 300-kw machine.

The motor to drive the booster will not be so large as the latter, as the maximum volts and amperes do not occur at the same instant. An allowance of 1 hp per kilowatt of booster is ample. This makes the value of the motor and booster installed about $10,000. The total cost of battery and booster equipment installed will be $170,600. This displaces 2200 kw of generating machinery, which, at $80,

* Lyndon "Storage Battery Auxiliaries," *Electrical World*, June 8, 1901.

represents a cost of $176,000, or a saving of $5,400 is effected by installing the battery.

Next come the comparative operating costs of the station, with and without batteries. Consider the station equipped with seven units of 1500-amp. capacity each and one of 1000 amp. capacity operating without a battery. From 9 a. m. to 4:40 p. m. there will be five 1500-amp. units in service, supplying an average of 93 per cent of normal load, and delivering within this time 29,411 kw-hours. At 4:40 p. m. the 1000-amp. machine is started up. At 5 p. m. and 5:30 p. m. two remaining 1500-amp. machines come on. At 6:40 p. m. one 1500-amp. machine; at 7 p. m. another, and the 1000-amp. machines are shut down. The average load factor for the two hours and twenty minutes is 89 per cent, and 12,450 kw-hours are delivered. During the next two hours the machines in service deliver 7425 kw-hours, operating at 90 per cent of normal load. At 8:50 p. m. another 1500-amp. unit is shut down, and four machines deliver 5740 kw-hours at 80 per cent load between that time and 11 o'clock.

At 11 p. m. another machine is cut out and three then operate at 87 per cent load up to 12 o'clock, delivering in this time 2145 kw-hours. Two machines carry the load until 1:20 a. m. Load factor 83 per cent = 1815; 1:20 a. m. to 1:40 a. m., generating amperage = 1500; 1:40 a. m. to 5:20 a. m., generating amperage = 1000; load factor 1:20 a. m. to 5:20 a. m., 86 per cent; kw-hours = 2000.

5:20 a. m. to 5:40 a. m.	generating amperage	=	3000
5:40 to 6:00	" "	=	4500
6:00 to 6:30	" "	=	6000
Average load factor		=	70 per cent
Kw-hours		=	2120
6:30 a. m. to 9 a. m.	generating amperage	=	9000
Load factor (omitting overload)		=	92 per cent
Kw-hours		=	12,490

Following is a tabulated statement of kw-hours, percentage of load and cost of fuel for station operating without battery:

Kw hours	Per cent of full load	Cost of fuel per 100 kw-hours	Total cost of fuel
29,411	93	$0.4575	$134.55
12,450	89	.461	57.39
7,425	90	.459	34.08
5,720	80	.475	27.17
2,153	87	.463	9.97
1,815	83	.47	8.55
2,000	86	.462	9.24
2,120	70	.505	10.70
12,490	92	.4576	57.19

It is to be noted that these load factors are high, as the sizes of station units are almost ideal in their division to meet the load requirements, and at the same time have all of them but one identical. It is scarcely possible that the machines would be handled in the station as closely to the load curve as has been mapped out on paper. The actual load factors realized would undoubtedly be lower than as computed, and the fuel consumption greater. With the battery in service the loads on generating equipment will be as follows:

6:40 a. m. to 8:50 p. m.	7,500 amps.	=	106,250	amp.-hours
8:50 to 12:00	4,500 "	=	14,250	" "
12:00 to 2:30 a. m.	3,000 "	=	7,500	" "
2:30 to 5:40	1,500 "	=	4,750	" "
5:40 to 6:00	3,000 "	=		
6:00 to 6:20	4,500 "	=	4,500	" "
6:20 to 6:40	6,000 "	=		
Total			137,250	" "

This gives 75,487 kw-hours, against 75,584, as found in the previous calculation—a difference of 97 kw-hours. Assuming that the kw-hours are 75,584, the cost of fuel per diem at .0045 per kw-hour would be $340.12. The cost of fuel without battery was found to be $348.72. The difference between these two, or $8.72, represents the saving made by the battery daily, which is $3,182.80 per annum.

It will be noted that the efficiency of the battery is not taken into account. This is because under the conditions given where the battery output is small as compared with station output, the losses due to warming up and starting large machines and the variation of the demand on the boilers will practically counterbalance the losses due to battery and booster efficiency. A further advantage of the battery is the continuous regulation that it affords, absorbing all its fluctuations due to sudden changes of load, which last for a few seconds only. The engines and generators are relieved of the excessive strains and shocks which attend these fluctuations.

The actual saving in fuel affected by the battery will be much greater than the amount calculated, as the deviation of generator capacity from load curve will be more, in practice, than the theoretical herein assumed; and the load factors will, therefore, be reduced below the figures given.

As all well made generating equipments will carry from 25 to 30 per cent overload continuously, and even greater for a short time, a battery as large as the one calculated is not necessary if the load curve on which the computations are based shows the maximum peak to which the station is subject.

By adjustment of the rheostat in the booster shunt field, the generator can be made to take an overload, beginning at 5 p. m. and rising until the maximum load is reached at 5:50. Allowing an overload at 15 per cent, the total generator load would be 7500 + 15 per cent = 8625 amps. The maximum battery discharge then will be 2975 amps. If this be the hour rate, a battery of about 4500 amp-hours referred to three-hour rate, will be required. Trial calculations show, however, that this battery would be too small to carry the peak at "B" when corrected by factor "K" for rapid discharges. Therefore it would be necessary to increase the length of time at which the generators work at overload or increase the size of the battery.

The proper size is found to be 4800 amp.-hours at three-hour rate. Cost is $125,840, and motor-driven booster will cost about $8,000, installed, making total cost of equipment $133,840. It displaces 1636 kw of apparatus, which, at $80, would cost $130,880, showing a saving in favor of the generating equipment of $2,960. The annual saving effected by the battery will, however, be about $2,500 per annum, so that the extra amount required to install the battery would be well invested.

The foregoing applies, of course, to new stations in which it is possible to select sizes of generators and batteries that will best suit the requirements. The case is somewhat different in existing stations where the generating equipment is of sufficient size to handle the peak.

By computing the probable fuel consumption with some of the smaller and more inefficient machines cut out and held only as reserves, the other running always on normal load, and comparing with the actual consumption, the saving that would be effected by a battery can be arrived at. Usually, however, the matter of installation of accumulators is not taken up until the load becomes excessive, as compared with the station capacity, and the case becomes practically the same as that of a new station.

REGULATION

In power stations where the number of cars run is small, the sudden fluctuations of load may be great as compared with the station output. In such instances the generating

equipment works at a low efficiency, and the machinery is strained by reason of the sudden applications of load. With rotary converters the tendency to "hunt" when running in parallel is diminished if operated in connection with accumulators.

In the computation of size of battery necessary, the only consideration is the rapidity with which it can be discharged or charged. There are instances where batteries, acting as regulators, are discharging as high as the forty-five minute rate for periods of several minutes, although it is seldom wise to exceed the one-hour rate.

If the battery is to be used both as a regulator and for power storage, the capacity necessary must be computed for each case separately, and the larger one adopted. The booster best adapted for regulation is the "constant" current. There are two types of this machine. One is differentially wound and generates an e. m. f. inversely proportional to the load passing through the armature. The other is so compounded that it varies its speed inversely as the load through the booster armature, and its e. m. f. varies inversely as some exponential function of the speed, nearly as if square; small-speed variations, therefore, produce large changes in e. m. f.

The constant current booster is placed in series between the main dynamo and the power bus-bars, making the voltage between the bus-bars greater than that of the dynamo by an amount equal to the e. m. f. added by the booster.

Any increase in external load is followed by a slight increase in current through the booster, which lowers at its e. m. f. This reduces the e. m. f. at the power bus-bars and the battery, which is connected in parallel with the bus-bars, discharges. When the external load falls below the normal generator current, the voltage of the booster automatically increases and the battery is charged.

In practice the variation of dynamo current above or below normal load will not vary over 10 per cent, with a variation of external load from zero to three times the normal. In cases where the battery both regulates and affords power storage, either the constant current or the differential booster is applicable.*

The differential booster consists of a shunt dynamo with two series windings, which latter act together and oppose the shunt. The shunt coil produces an e. m. f. tending to charge the battery, while the opposing e. m. f. of the series windings tends to discharge it. One series winding is connected to take the total external current, which is the sum of the battery and generator currents.

The other series winding carries the generator current only, being between the generator and booster armature, while the first series coil is between the booster armature and the external load. The two series coils are in series with each other, the lead to booster armature being taken out at their junction.

The armature is in series with the battery, which, with the booster, is placed across the line. In computing the required discharges from a battery which is to act as a regulator, calculations of the amount, and duration of changes, can seldom be made with accuracy, though a fair approximation may be arrived at with sufficient data. Generally, however, it will be found better and safer to examine the conditions that govern some existing plant similar to the one in which the battery is to be installed.

A properly designed battery and booster system will keep the load on the station constant whatever the fluctuations of external load may be, relieves the generating equipment of all strains and shocks due to load changes, and maintain a constant voltage on the dynamo bus-bars —which are separated from the power bus-bars.

By the use of these regulating systems, lights and variable power may be supplied from the same generators without any "winking" of the lamps; and such systems are now largely installed in buildings where lights and elevators are supplied from the same generators.

COMPENSATION FOR FEEDER DROP

One of the most advantageous situations for a battery is at the end of a long feeder which carries widely varying currents. The copper in such a line must be sufficient to keep the drop, due to maximum current, within the limits required for satisfactory service; and as the maximum load is generally of short duration, the investment required is excessive, as compared with the continuous service given by the feeder.

Boosters may be used to raise the voltage on the line, but if this boosting goes on for several hours, the cost is excessive. A case that came under the writer's observation was that of a long feeder supplying current to a branch of an electric railway where a booster of 150-kw capacity was operated for six hours each day, averaging 600 kw-hours daily, the total energy supplied by the booster being dissipated in the line.

The cost of energy per kw-hour was 1.2 cents. This booster, therefore, cost $7.20 per day to operate. Its cost was about one-third that of a battery, and, with the latter in service, over two-thirds of the line loss would have been saved.

To determine the size battery to install at the end of a long feeder, the load curve of the line should be plotted, and the capacity of the battery found by taking the maximum discharge as the one-hour rate. If commercially feasible, the battery should have sufficient capacity to store and deliver an amount of energy equal to the difference between the *average* current and the peak of maximum area, giving greatest battery draft.

In this case the feeder is made of sufficient cross section to transmit only the average current at the allowable drop. The number of cells in series should be such as to give an e. m. f. equal to the voltage of the line at the point where the battery is connected to it, each cell being taken as having an e. m. f. of 2.05 volts. The battery, when thus installed, is said to "float" on the line, depending only on the variation of the feeder e. m. f. at the battery terminals due to varying drop to effect charge or discharge.

Where the amount of energy to be transmitted is large and the battery is of sufficient magnitude to form a sub-station requiring attendance, a differential booster placed at the sub-station would assist regulation and help to maintain a constant voltage.

If the battery is not large enough to warrant the continuous presence of an attendant, a constant booster placed in the power station and connected in series with the line will materially assist in regulation and in bringing the battery up to full charge on light load.

In computing the commercial value of a battery at the end of a large feeder, the following are the comparisons to be made: Difference between cost of feeder for average current and cost for maximum current, voltage at the end of line to be the same. Increased efficiency of operating machinery and possible reduction (in case of a large battery) of the generating capacity required.

Against these is the cost of battery and its maintenance. The present practice of transmitting over long distances by means of the alternating, high-tension, polyphase system, and converting into unidirectional by rotary converters, is contracting this field of usefulness for the stor-

* For complete description of these boosters and analytical discussion see Lyndon on "Storage Battery Auxiliaries," *Electrical World and Engineer*, June 8, 15, 22 and 29, 1901.

age battery. It is, however, unusually desirable and dividend producing to install a battery to operate in parallel with the rotary if the load is subject to fluctuations or has peaks, both of which conditions are almost invariably present.

Street Railway Evolution in Syracuse

BY E. G. CONNETTE

"As the world goes roun' and roun',
Some goes up and some goes down."
—*Bob Taylor.*

In compliance with the request of the Street Railway Journal to write an article as to how the improved conditions in the affairs of the Syracuse Rapid Transit Railway Company were accomplished, I shall endeavor, without egotism and with a proper sense of modesty, to give briefly an outline of "how it was done."

Not a decade ago the company was not in a robust state of health, financially, and had suffered from two cases of "strikes," a severe case of popular dislike, an acute attack of German wrath, which resulted in a torn-up track and a demolished car, and a long spell of municipal antipathy. Its habits were somewhat dissipated, it had few friends and was barred from good society, but by a course of treatment, consisting of such remedies as were necessary to make it more affable and courteous toward the public as well as more congenial and agreeable to the municipal authorities, its energy was rejuvenated, a zealous disposition to make its service prompt, regular and convenient was created, and, by cleansing its system of popular prejudice, it has begun to grow strong and healthy, and is able to earn a living and lay away a little for a rainy day.

THE PEOPLE

A "public-be-damned" policy is disastrous to any enterprise, especially to one which is quasi-public in its nature. Street railways have become a public necessity as well as a public convenience, and a proper management will consider the interests of the company from both standpoints. The service of street railways as a convenience should be such as to invite the patronage of those who, by reason of other means of conveyance or of those who live in close proximity to their places of business, are independent of street car service. They should also not regard their suburban patrons as a "matter of course," but should give attention to making the service to them a convenience as well as a necessity. The whims of the people are diverse, and it is, therefore, essential to be diplomatic, conservative and forbearing, and discuss matters of contention with reason and justice, keeping in view the old axiom not to be "penny wise and pound foolish"; concessions now and then may be "bread cast upon the waters." Men in mercantile pursuits cultivate patronage and offer inducements, and by courteous and polite treatment, popularize and increase their business, and the same business methods should apply to any enterprise.

The people naturally feel that they have some right to be heard in matters pertaining to the operation of "public utility corporations," because of the franchise rights which they enjoy, and if corporations of this character were more inclined to consider the rights of the public and be reasonable, the public would be more inclined to meet them in the same spirit. A disposition of indifference to public desire, of oppression, of unreasonable domination, of burdensome capitalization which arouses public attention to the probability of a sacrifice of service in order to pay interest on inflated values, all have a tendency to invite discontent, prejudice and opposition. Only a short while ago the people living along one of the lines of the Syracuse Rapid Transit Railway Company tore up its tracks and smashed a car with cobblestones because they claimed the company did not fulfil its promises and turned a deaf ear to all of their petitions. Under the present policy of the company they are satisfied, and, at least a large portion of them, are friends of the company, and the business on that line has improved.

When a disposition prevails in the management of a street railway to please the people and cater to their patronage, the old familiar correspondents of the newspapers, viz.: "Pro Bono Publico," "Old Citizen," "Patron," etc., feel encouraged to address the manager over their own cognomen, or call and have a friendly chat as to the best plan of operating the road, and even if the manager is an "encyclopedia" of street railway knowledge, he frequently receives suggestions from these friendly advisers which are good and serviceable.

A restoration of the confidence of the people has contributed largely toward smoothing the rough places and making success possible within a short space of time at Syracuse.

THE CITY GOVERNMENT

The most cordial relations did not exist for some time between the municipal authorities and the company, a condition which is always deplorable, and should not exist if it is possible to avoid it. There is no company, on account of the provisions of its franchise, but what must have more or less dealings with the city officials, and it should always be disposed to fulfil its obligations in a reasonable way. If friendly relations exist between the administration and the company, and a spirit of co-operation prevails in matters common to both parties, much better results can be attained. Municipal authority can, if it is so disposed, make things unpleasant, and many times can arbitrarily obstruct the progress and success of the service and annoy the management, and still technically keep within the bounds of its official functions. Even if the antagonism should reach a state of persecution, the authorities can hide behind the antipathy which sometimes exists against corporations in general. Politicians are generally governed by circumstances, and are always on the lookout for campaign material, and if the street railway is the "scapegoat" of the community, it is, of course, popular to jump on it at every opportunity. This fact alone emphasizes the essentiality of popularizing the road and causing the populace to sing its praises and thus of making the way more easy for a congenial, cordial and co-operative relationship with the "powers that be." Municipal ownership is born of adverse conditions; the contagion of discontent lurks in every community, and it spreads and becomes epidemic when popular sentiment is aroused by the alleged ills of mismanagement; it is then that the various "isms" are prescribed by the ambitious politician.

Co-operation with the people and a cultivation of their confidence, together with a disposition to meet the just requirements of a municipality, will generally result in bringing about amicable relations with the city authorities.

THE EMPLOYEES

During the year 1898 there occurred two "strikes" of the motormen and conductors, and the relations existing between the company and its employees were not agreeable. It is unnecessary to relate the incidents leading up to the unpleasant and disagreeable relations, as it savors more or less of the "same old story," but the feeling of unrest and dissatisfaction on the part of the employees was doubtless augmented by the unpopularity of the company.

At the present time there exists no organization except an employees benefit association, which receives the earnest support of the company, and is in a healthy and thrifty

condition, having accumulated quite a reserve fund, and it has, indeed, been a benefactor in helping the sick and distressed employees. Its board of trustees are selected from the different departments, and are elected annually by the members of the association; the company allows the trustees one-half holiday each month on pay to attend to the business of the association.

The employees appear to be satisfied, contented and happy; a state of mind necessary to attain the best results, as men can not, and will not, do their best and labor for the interest of their employer when they are discontented, dissatisfied and unhappy.

The present management has endeavored to inculcate a disposition of co-operation among the employees; that they are not only servants, but have a function to perform in the successful management of the property. Conductors are expected to be polite, courteous and attentive to the patrons; forebearing with such as are inclined to be contentious, and make the service so pleasant that the "customer" will come again. Motormen are taught to be active and alert in looking out for passengers, and especially to keep a close watch for the "regulars" who ride daily, as it impresses people with a desire to please; to stop cars at crosswalks so the patrons will not have to wade in the mud or walk half a block to catch a car that has run by the crossings, and to run cars on time, so that patrons can depend on the regularity of the service. Motormen are especially impressed with the necessity of using great care to avoid accidents and to handle the car in such a manner as to cause the least wear and tear, as this is one of the sources of great expense. A co-operative spirit on the part of conductors and motormen insures an increase of patronage and reduces the operating expenses.

When men are satisfied and have confidence in their employer, the labor agitator and walking delegate find little comfort or consolation among them.

The good results obtained by the faithful, zealous and earnest co-operation on the part of the conductors and motormen was recognized by the management in the form of a complimentary notice posted on the bulletin boards last Christmas morning, accompanied by a voluntary increase in the scale of wages.

The cordial relations existing between the management and the employees has been a large factor in bringing about the improved conditions.

THE MANAGEMENT

This subject has been partially covered by the topics hereinbefore discussed, and the remainder of the article will be devoted, briefly, to the question of operation. The improper routing and scheduling of cars will entail a loss which does not appear specifically on the books of the company. Various methods are used to systematize the transportation department so as to attain the best results; some are theoretical, others practical, and sometimes there is no method at all. An efficient man at the head of the transportation department, who is qualified to study the conditions existing on each line regarding the movement of the people, with a corps of efficient and intelligent street aides to assist him, will be able to secure better results than a compilation of tabulated statistics from the conductors' reports, which require a very large amount of clerical labor, and even after being completed, do not serve the purpose, practically, toward meeting the conditions. The receipts per car mile or the receipts per car hour is a barometer of what the various lines are doing. The cost per car mile for operation, plus the cost per car mile for fixed charges, is the dividing line between loss and profit, and if the cars on a line fall below the "dead line" the transportation department should look after this particular line with a view of improving the conditions, either by a change of service, so as to induce more travel, or to reduce the car service, so that the earnings will be brought up above the "dead line." The conditions vary on one line as compared with another, and the service must be adapted to the conditions; it is sometimes necessary to vary the service in accordance with the variableness of the weather; the car service should be arranged so as not to double up with other lines, causing the cars to trail one behind another, if it can be avoided, and no more "dead" territory should be covered than possible by a schedule which the particular territory does not warrant; "lay-over" time at the ends of the various lines, when added together, in the course of a year, amounts to an inconceivable loss. No matter what the schedule is, the cars should, as far as possible, be run with regularity and promptness, so the patrons may depend upon the service. The conductors should be taught that politeness costs nothing and forebearance is a great virtue, both elements of which are necessary to obtain a satisfactory car service. Motormen should be educated in the proper handling of the controller, so as to economize in the use of power, as power costs a certain amount per kw-hour, and an improper handling of the car will cause a large waste of power. They should also be impressed with the necessity of using particular care to avoid accidents, as this is also a source of great expense. The methods of securing efficient service in the application of these two suggestions should be such as will encourage the men, and not of such a nature as to humiliate them.

The mechanical department should be in charge of capable and competent men, who should not be burdened with the compilation of numberless reports of various kinds and sizes which require time and expense to make up, and which are piled upon the shelves and, eventually, sold for waste paper; their time should be principally devoted to keeping the equipment up to a high standard of maintenance, and, when troubles occur, to devote themselves to diagnosing and ascertaining the cause, and applying such remedies as will not only prevent a recurrence, but possibly improve the conditions. Certain reports are necessary in order to keep properly informed, but they should be simple and concise. It is much more important to have the cars in shape to run than it is to have various reports showing why cars broke down, or describing the various details of the mechanism which caused the trouble, as these are details which will be looked after, anyway, if a proper man is in charge of the department. A deterioration of the rolling stock, frequent breakdowns and accidents to the mechanism is an indication that the head of the department is either incompetent or is not diligent in the discharge of his duty.

The track and overhead departments should be economically organized, so that the departments will be kept to a standard of maintenance where there will be but little depreciation, and attention especially given to the track department to see that the force is reduced to a minimum in winter, when very little work can be done, and increased to proper proportions during the summer months, when the track is in condition for repairs to be made. Various methods can be utilized in both of these departments to save money, which it is unnecessary to mention, as they are common, generally, in the operation of all street railways.

The power house, being the vital point of the system, should be in charge of a man who has a clear head, who is trained mechanically and knows how to take care of the machinery and keep the boilers clean, so as to obtain the most economical results of operations; one who is capable

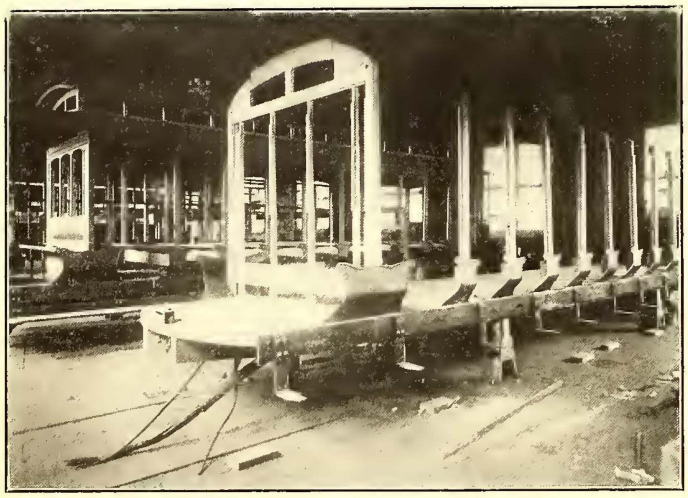
of giving attention to every detail; who knows how much service he can get from a pound of coal; when trouble arises he should be able to take care of the situation and not disable the road. Deterioration becomes rapid and extravagance runs rampant in a power house which is improperly governed.

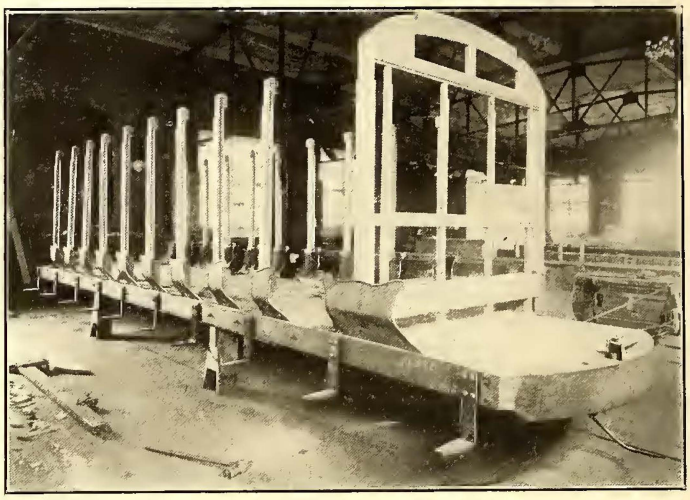
Finally, remove all sinecures from the system, as they are the bacilli which tend to eat up the profits of the company.

These methods have been successful at Syracuse.

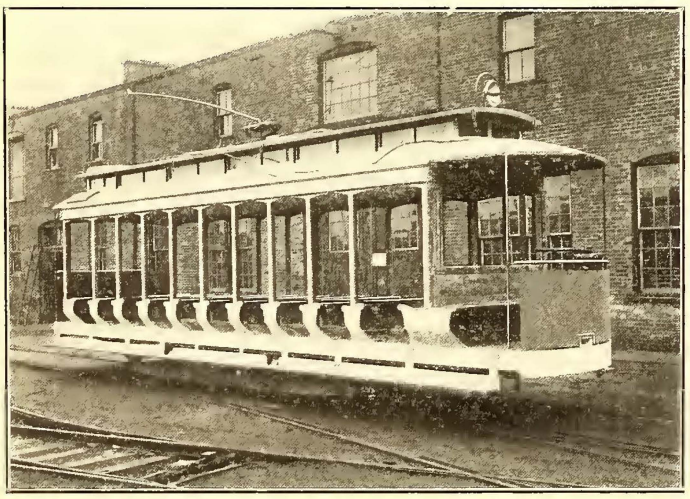
Car Construction in Detroit

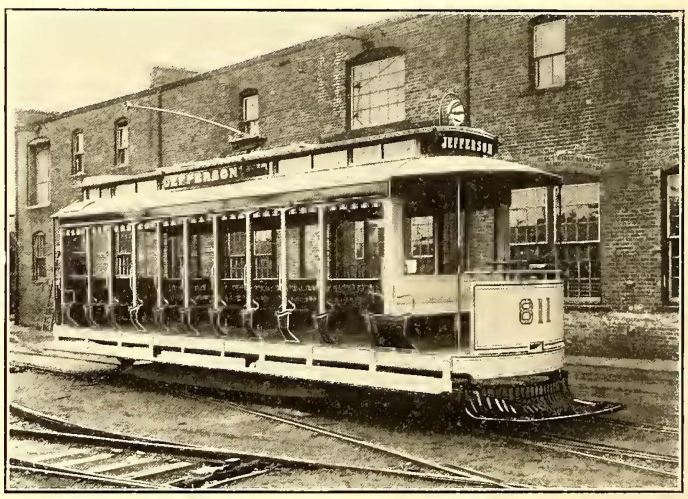
T. Farmer, superintendent of machinery for the United Railway, of Detroit, has under construction in the shops of that company a number of ten-bench open cars, which embody some new and apparently excellent features of construction. These can be seen, from the accompanying photographs of cars taken during construction.





CARS DURING ERECTION IN DETROIT SHOP





CARS BEFORE AND AFTER PAINTING, DETROIT

The side sills are 7-in. channel iron. To this channel are bolted castings, which support the posts. The posts are perfectly straight, and are not bent in and continued down to the sill, as in a usual form of construction. The castings serve the double purpose of post bases and seat supports, and make a very solid, substantial construction, being bolted as they are to the channel iron sills and forming a long, solid socket for the posts, so that the working of the car roof back and forth (the common fault of open cars) is reduced to a minimum. The step supports, which are bolted to the sills, are made very heavy, and the guard behind the step, instead of being made of light wood, is a strip of $\frac{3}{4}$-in. iron, which is intended to help out the channel iron sills in acting as a truss. The construction of the ends is easily seen. The dash is flush with the end of the platform. The cars are "single enders," made to be operated only one way, as is the universal practice in Detroit.

The standard closed car on this road is one having a 6-ft. platform on the rear of the car for carrying a large standing load of passengers who do not wish to go inside. To prevent this standing load from interfering with the exit of passengers from the closed part a passageway is shut off by an iron railing from the balance of the platform. To take care of the long overhang the supporting timbers of the platform are run forward to the third cross sill.

Motor armatures on this road are all put in a testing field and run before being sent out, so as to save the labor spent on mounting defective armatures in motors.

Gear cases now have their edges planed in a milling machine at the rate of eight per day. With the shaper formerly used a man could put through no more than two per day.

The strike of the employees of the Kingston Electric Railway Company, of Kingston, Ont., which had been in progress for eleven days, was finally settled on June 22. By the new agreement motormen will receive $1.25 per day and conductors $1.10 per day. The increase for the latter is 10 cents a day.

CORRESPONDENCE

The Proper Wheel Section for Interurban Railways

NUREMBERG, May 14, 1901.

EDITORS STREET RAILWAY JOURNAL:

In connection with the subject of the proper wheel section for interurban railways, discussed in the May number of the STREET RAILWAY JOURNAL, you may be interested in a communication recently submitted by me on the "Sections of Tires for Electric Railway Wheels" to the German Street Railway Association (Verein Deutscher Strassenbahn und Kleinbahnverwaltungen):

When a pair of wheels of different diameters on the same axles are running on a straight section of track the larger wheel will describe a circle round the smaller until the flange of the wheel encounters the rail, when the smaller wheel must be dragged along in this position. In order to overcome this tendency the tread is made conical, as is well known. The larger wheel then only describes a circle until the diameter of the smaller wheel has become so much greater that it equals the diminishing diameter of the larger wheel. In order, however, that this equalization may become possible it is necessary for the flange to have the necessary amount of play in the groove of the rail.

If the flange be too thick this condition is at first of little importance in the case of new tires, which are evenly turned. But variations in the material used and also the wear due to curves frequently produce a small difference in the diameters. When once a difference exists it rapidly increases as the smaller wheel,

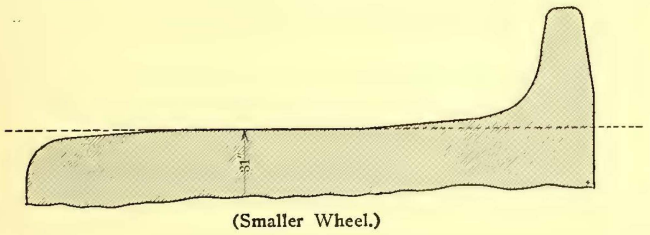


FIG. 1.—WEAR PRODUCED WHEN WHEELS ARE OF DIFFERENT DIAMETER

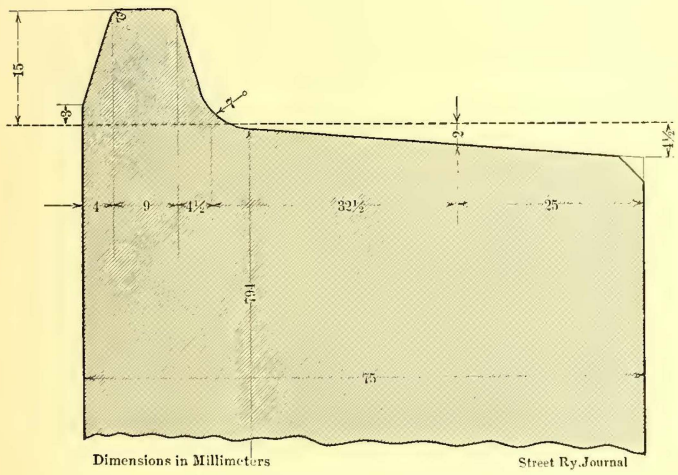


FIG. 2.—STANDARD WHEEL SECTION, NUREMBERG

in consequence of the smaller leverage, constantly slides a little, and its thick flange does not permit an equalization. The flange of the small wheel then always travels against the carrying rail, while that of the larger grinds against the guide rail. The wear then assumes the form shown in Fig. 1. At the same time the entire truck frame is twisted, as a rule, at an angle to the track, and the wheels diagonally opposite each other show equal forms of wear, although to a smaller extent.

I do not believe that flange wear, as described above, is often caused by the trucks being "out of square," as if it were the case, the truck would adjust itself to run obliquely and the wheels, which always have some play in the axleboxes, would run correctly. I have ascertained by means of more than sixty measurements that the diameter of the wheel with sharp flanges was, without exception, smaller than its mate, and that up to ¼ in. Fig. 2 shows the wheel section used by me in Nüremberg.

I assign the following reasons as the cause of the unequal diameter of the connected wheels:

1. Difference in the quality of the material in the tires.
2. Difference in the quality of the material in the brake shoes.
3. Bad adjustment of the brake.
4. Narrow one-sided curves.
5. *Poor measuring appliances, so that the error is present from the first.*

Cars with wheels of unequal diameters consume as much as 15 per cent more current than if the wheels were correctly mated. This fact has been ascertained by numerous experimental measurements.

Since January last I have been employing, with very successful results, on the Nüremberg-Fürth Street Railway, the method of current distribution proposed by John C. Henry in the STREET RAILWAY JOURNAL of September, 1900. The suburbs are supplied with current at 580 volts, the congested districts with current at 520 volts.

In consequence of this arrangement the cables, which were formerly used for the return, are now employed for feeding the trolley. The system is used without appreciable outlay or trouble, and the projected installation of the polyphase method of distribution has been rendered unnecessary. A considerable saving in outlay has thus been effected.

K. SIEBER.

NEW YORK CAR WHEEL WORKS

BUFFALO, N. Y., May 23, 1901.

EDITORS STREET RAILWAY JOURNAL:

We have been very much interested in the articles which have appeared in your issues of April 13 and May 4 (International Editions for May) on the subject of wheels for interurban electric railways, and are rather surprised at the statement that steel-tired wheels on the Hartford Railway have been in service for six months without showing appreciable wear. We have followed very closely the results obtained from both chilled and steel-tired wheels on electric railways in this country and Europe for the purpose of gaining knowledge in regard to the class of wheel that would give the best results from every standpoint. Several years ago an electric line equipped forty-eight cars with steel-tired wheels with the following results:

Total number of cars operated	48
Total number of wheels	384
Cars put in service	May 20
Cars removed from service	Oct. 1
Total number of days in service	133
Total average mileage of wheels	11,000
Condition of wheels	Worn out

We send you herewith profiles showing the average condition of these wheels that were removed, from which it

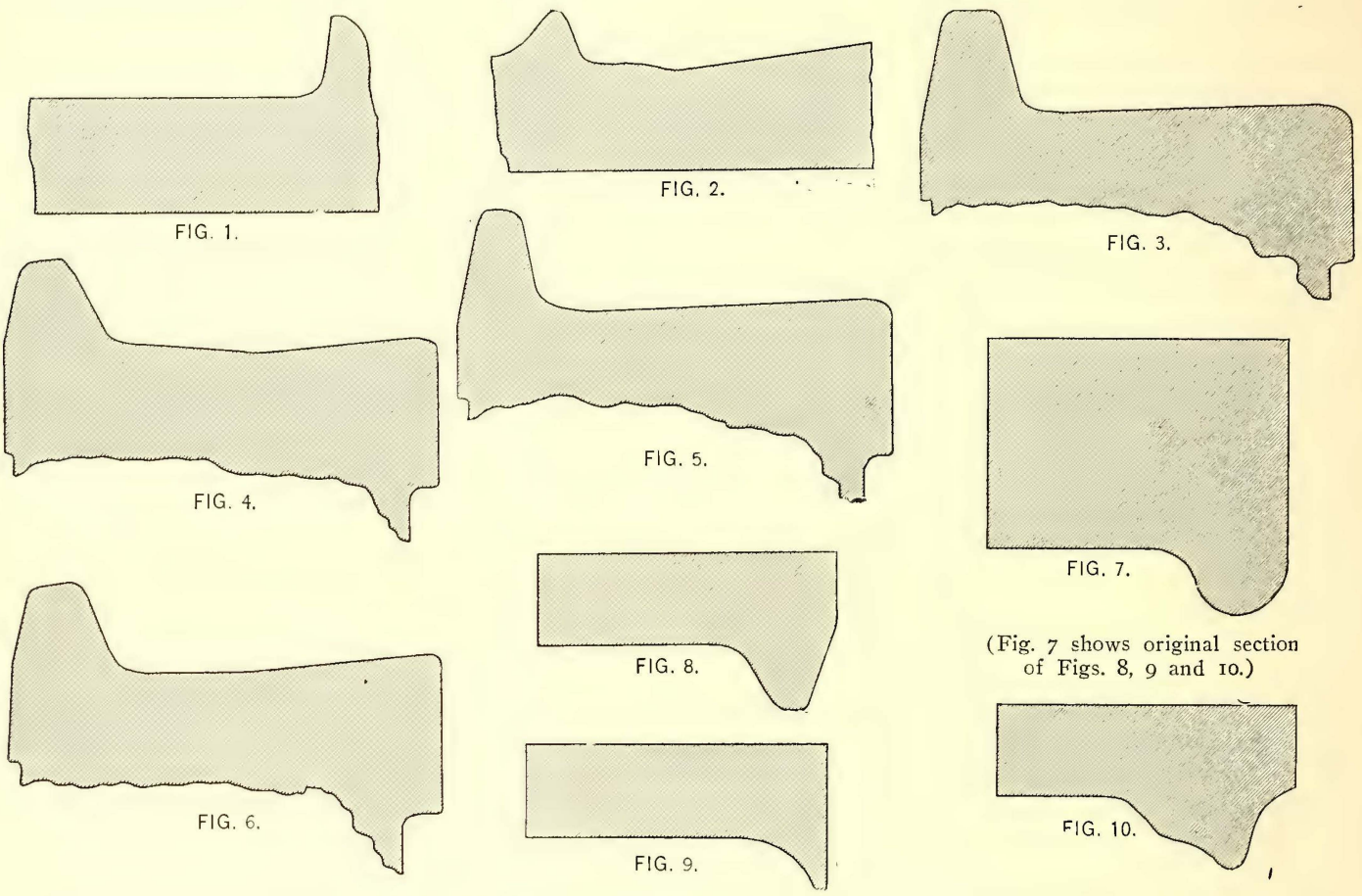
will be noticed that it was not possible to turn the tires down for further service. (Figs. 1 and 2.)

We also attach profiles showing results of another trial of steel-tired wheels on another electric tramway, with the results as shown on drawings inclosed, Figs. 3, 4, 5 and 6. In this case the steel wheels were guaranteed for 150,000 miles of service, but were removed after making a mileage of not over 12,000.

We also enclose you sketches, Figs. 7, 8, 9 and 10, herewith, showing the results obtained from the use of steel-tired wheels on a prominent electric railway in Europe, and the condition of wheels after a mileage of about 25,000 kms., or about 15,000 miles.

There is no doubt that from certain standpoints steel-tired wheels have advantages, but the question is, whether taking the question of wheel service from every point of view, the advantages in favor of steel-tired wheels are in any respect equal to those that can be obtained from chilled wheels, setting aside the fact that steel-tired wheels cost from four to five times as much as the chilled wheels. A peculiar phase of the situation seems to be that in some cases where trials have been made of steel-tired wheels, because results obtained from chilled wheels were claimed to be unsatisfactory, that officials of railway companies making the trials were unwilling to pay a price for chilled wheels that would enable the manufacture of the best quality, and yet were willing to consider trials of steel wheels which, if satisfactory, would involve a very much greater wheel expense. As your correspondent strikingly puts this matter, it seems to be expected that chilled wheels can be purchased "at a price per pound little, if any, more than brake shoes or sash weights can be bought for," and yet that such wheels should be equal to the severe strains put on them in interurban service with cars weighing from 25 tons to 30 tons loaded, and running at speeds from 35 miles to 50 miles an hour. There certainly should be wisdom in paying a price for the best quality of chilled wheels that would admit of the use of a proper weight and section, and the use of proper material and care in manufacture.

This same question is confronting the managers of steam railroads in dealing with wheels for use under 50-ton cars, and they are finding that it is advisable and necessary to pay a price that will purchase a good quality of wheel, rather than to attempt economies by the use of cheap grades. The latter may prove considerably more expensive in the end, owing to accidents that are likely to occur from their use. The Carnegie Steel Company, for whom the first 50-ton cars used in this country were constructed, and whose experience in the qualities of metal can not be questioned, after a careful consideration of the wheel question, decided that the original cost of the wheels was not as important as the matter of quality, and, therefore, put under 1000 50-ton cars wheels of a superior quality made from the best charcoal iron. The results obtained from the use of these special wheels have been entirely satisfactory, and the Pittsburgh, Bessemer & Lake Erie Railroad has been entirely free from any of the difficulties encountered by other railroads in the use of wheels under 50-ton cars. The builders of steel cars finding themselves in competition with the builders of wooden cars, in order to induce railway managers to order steel cars, had to make the cost of them per ton approximately as low as the cost of the other style of car, and this precluded the possibility of following the high standard set by the Carnegie Steel Company, and instead of using a special grade of wheel under the cars they have constructed, have used the ordinary quality. The results are very striking, for, whereas, of the 8000 wheels that have been in service under the 50-ton Carnegie cars for the past four years, less than one-half of 1 per cent have been removed for any cause whatsoever, and not one for breakage or failure of any kind, the railroads using the ordinary grade of wheel have had all sorts of trouble, and



SECTIONS OF STEEL WHEELS WORN ON FLANGE OR TREAD

in several cases disastrous wrecks, resulting from the failure of the wheels.

The increase in the weight of cars on steam roads is relatively no greater than the increase in load and speed on cars on electric roads in the past five years, and it is only fifteen years ago that the majority of cars on the railroads of this country had a capacity of only 40,000 lbs., or 20 tons, which, together with the weight of the car, made about 30 tons, or approximately the weight of the electric cars that are being built for interurban service to-day. Under all these cars the wheels were double plate, and weighed for a 33-in. wheel 550 lbs., although the cars certainly did not on every trip, if ever, reach speeds of 40 miles per hour. How then can tramway managers expect a chilled wheel, weighing from 380 lbs. to 420 lbs., to stand the more severe service?

The greatest difficulty the wheel maker has to contend with in the designing of a wheel for electric service is, that the length of the axle is a fixed quantity; the electric companies are given all the room they want for their motors, the truck builder takes the space that he requires for his brake rods and journal boxes, and the wheel maker is then invited to design a wheel to fit the space that is left. Instead, therefore, of having a sufficient depth through the hub to permit of a pressure per square inch that is reasonable, he is compelled to make a shallow hub, and increase the diameter of it so that it will stand the strain of mounting, and as he is limited as to the distance between the rim of the wheel and the front hub, he designs his wheels to conform to the dimensions given, and can not give the spokes or plates the curves that have been found so successful in railroad practice as to be universally adopted.

The necessity of using a better material in wheels for high-speed service than is used in cheap wheels that are on the market at the present time will readily be recognized, when it is considered that while it may seem a simple matter to make a wheel stronger by increasing the diameter of the hub, or the size of the arms, or the thickness through the rim, it is not possible to increase the section through the flange, owing to the groove of the rail and the special work, and that a broken flange on a car running at high speed can bring about results quite as disastrous as a broken wheel.

We have been advocating for the past three or four years a special grade of wheel for high-speed interurban and heavy railroad service, and it is very gratifying to us to find an increasing number of roads each month who are using these wheels as a result of trials they have made of them.

PEMBERTON SMITH,
Engineer, New York Car Wheel Works.

CATASAUQUA, Pa., May 25, 1901.

EDITORS STREET RAILWAY JOURNAL:

We were much interested in reading the article on page 525 of your issue for May 4, entitled "The Proper Wheel Section for Interurban Railways," and wish to say that we think this is the best article that we have read on this subject. We can add very little to it, as it covers this subject fully. We have continually urged our customers to increase the weight of their wheels, and have strengthened the back of our wheel flanges, and we have claimed right along, no matter how good the quality of the iron in the wheel is, the wheel must be heavier to meet the service, but we find that many of our customers object to paying the additional cost for this additional weight. In some cases, no matter how good the quality of iron or how heavy the wheels, as explained in the article, the wheel will not stand the service on account of the condition of the road. It is very evident that this article was written by a person who has given this subject a great deal of attention, and it is exactly in accordance with our views.

J. W. FULLER, JR.,
Secretary and Treasurer, Lehigh Car, Wheel & Axle Works.

Specification Clauses Proposed by Engine Builders

ENGINE BUILDERS' ASSOCIATION OF THE UNITED STATES,
WATERTOWN, N. Y., June 24, 1901.

EDITORS STREET RAILWAY JOURNAL:

At the May meeting of the Engine Builders' Association of the United States, held at Indianapolis, May 27 and 28, certain suggestions were made for the consideration of architects and engineers who might draw specifications for the installation of steam engines. These suggestions represent conditions which seemed to them fair and reasonable, and which it is hoped the architects and engineers will approve. They are given below.

S. F. BAGG,
Secretary E. N. A. of U. S.

[INCLOSURE]

The Engine Builders' Association of the United States respectfully submit to you the following suggestions in connection with specifications for the installation of steam engines, and trust that you will consider them as reasonable, and such as you can properly incorporate in your specifications:

First. That contracts which provide a penalty for failure to deliver in time, or for failure to meet guaranties, ought also to provide equal premiums for earlier delivery or better results than specified.

Second. That bonds should not be required on installation contracts unless corresponding bonds for similar amounts are given to secure payment, an exception always being made in the case of government, State or municipal contracts.

Third. That settlements or any part of them ought not to extend beyond three months from completion of contract, and that delay on the part of the owner ought not to delay payment beyond a reasonable time.

Fourth. That a guarantee against defective material or workmanship should not be made to cover a period of more than one year from date of shipment.

Fifth. That purchasers of engines ought not to be furnished with complete working drawings, but simply with general drawings, showing the assembled engine in outline, with such principal dimensions as will answer for building foundations, the erection of engines or their care.

Brooklyn Elevated Lease

A lease of the Brooklyn Union Elevated Railroad Company to the Brooklyn Heights Railroad Company, of Brooklyn, was filed June 26 with the Secretary of State at Albany. The lease is of the date of July 1, 1901, and expires June 30, 2900. The lessor conveys to the lessee all its property and franchises, the lessee agreeing to pay the interest on the bonded indebtedness of the lessor and to cooperate with the lessor in the payment of the principal of such indebtedness, and further agreeing to pay $3,000 per year to continue the corporate existence of the lessor company.

The lessee agrees to pay as part of the rental, on or before each Sept. 30 after June 30, 1902, until Sept. 30, 2900, all the net earnings received from the operation of the property after deducting from such net earnings all amounts otherwise agreed to be paid by the lessee to the lessor. The lessee agrees, however, that the net earnings thus to be paid to the lessor shall not be less for each of the fiscal years ending June 30, 1902, 1903 and 1904 than $150,000, or less for each of the fiscal years ending June 30, 1905 and 1906, than $200,000, and for each year thereafter not less than $250,000. The certificate is signed by J. L. Greatsinger, president, and Charles D. Meneely, secretary, of the Brooklyn Union Elevated, and T. S. Williams, second vice-president, and C. D. Meneely, secretary, of the Brooklyn Heights Railroad Company.

STREET RAILWAY JOURNAL

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NOTICE.

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

Special effort will be made to answer promptly, and without charge, any reasonable request for information which may be received from our readers and advertisers, answers being given through the columns of the JOURNAL *when of general interest, otherwise by letter.*

Street railway news and all information regarding changes of officers, new equipment, extensions, financial changes, etc., will be greatly appreciated for use in our news columns.

All matters intended for publication in the current issues must be received at our office not later than Wednesday of each week.

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The past month has afforded two excellent examples of the fact already well known that the increasing demands for local transportation in our larger cities are now, and are likely for some time, to more than overtax the provisions made for them. The electric railway system on Broadway, in New York, although supplying a much better service than the cable system, is already overcrowded, while the newly opened elevated system in Boston has more passengers than it can comfortably carry. Four or five years ago, when the elevated system for Boston was proposed, there were many who thought that the traffic would not be sufficient to make the plan pay, but the only criticism which can be raised against the elevated system of Boston now is that it can not adequately carry all the people who want to ride. The moral of this is that under the conditions in which the business of modern cities is transacted, local transportation becomes an ever-increasing necessity, and plans which might seem liberal under conditions of to-day soon prove inadequate. Only the broadest views should be held by city and State authorities in considering plans for future development in transportation systems, and any step like that of Governor Crane in vetoing the Subway bill under Washington Street, Boston, can not but act inimically to the interests of the municipality.

That many important economies result from the consolidation of electric railways is proved by the large number of such consolidations perfected during the past six or seven years and by which the street railways in practically every city in this country have come under single managements. The economies secured have been many, but one which has not always been given the consideration which it perhaps deserves is that of unifying the repair work. Full details are published elsewhere in this issue of the results in this particular direction which have followed the bringing together of the different systems in St. Louis. Here the consolidation was on a large scale, because while the city was one of first importance, there were seven distinct companies, each with separate organizations. Repair shop practice, when carried on by a corporation of this magnitude, can mean more than the simple repair or replacement of worn-out parts. The scale upon which the business is carried on is so large that much new apparatus can be manufactured to advantage, and this has been followed in St. Louis and by other large companies in a way which would certainly have been out of the question a few years ago. At just what point the disadvantages of doing this, and that there are certain disadvantages must be admitted, outweigh the advantages, it is not the purpose to discuss here. But that there will be tendency to go more and more into the manufacturing business as the corporations increase in size is unquestioned.

The Metropolitan Street Railway Company, of New York, has taken the initiative in a plan for the general handling of express matter, which we have long advocated, but which, so far as we know, has never been put in operation on an extended scale in any large city. This plan contemplates the establishment of express depots in various parts of the city, where electric express cars can be run and loaded with their packages, and where they can discharge their loads. Stub tracks for the proposed service will also be run into the incoming baggage departments of the various steam railroads and ferries, so that trunks and heavy express matter can be loaded directly on the electric cars without transference. The local deliveries and collections, which are not possible directly from the electric cars, will be provided through automobiles, and a complete system of caring for the delivery service of the large dry goods stores and other retailers will be consummated, if the plan proposed is followed to its logical conclusion. So far as is possible the express service will be carried on at night. It is needless to comment on this plan, which is directly in the line of modern improvement, and which should be a welcome relief to every resident in a large city. It is the worst kind of waste to convey freight by noisy drays in city streets, when for the greater part of the distance, certainly, it can be carried over rails without wearing the pavement and disturbing anyone within earshot. A step of this kind, if it can be extended so as to remove all, or nearly all, the heavy trucking from the pavements to the rails, and we believe that this will be done in the city of the future, would also permit the laying of much smoother pavement, which can not be employed now because it is not durable enough to

withstand the heavy wear to which it is subjected under the present conditions.

The comments on the subject of the best wheel section for interurban railways, published on another page of this issue, show that the keenest interest is being taken in this question, which is, indeed, a vital one if the many interurban railways which are extending in all parts of the country are to attain high speeds and yet enter the terminal cities over the city tracks. The convenience of the public would not countenance any other arrangement, but if this is to be done and the public served in the best possible way, many preconceived notions held by municipal bodies as to the type of rail suitable for city streets will have to be changed. The popular idea that because New York City or some other large city uses a rail with a certain width of groove in it, that the same type of rail must be better for the public than a tram head or a wider groove is a prevalent one among the engineers of some of the smaller towns. It never occurs to them that the conditions of street railway operation are so widely different that what might suit one city might be absolutely unfitted for another. It so happens that the street railway lines on Manhattan Island, for example, are not employed by any interurban cars, and owing to the geographical location of the city, its surface tracks will probably never be put to this service. In this respect the city is probably unique among American municipalities, yet this vital consideration is often lost sight of when the local engineer of some important interurban center is requested to specify the type of rail to be employed on the streets under his jurisdiction. We believe that street railway companies in all new work would do well, where there is a possibility or probability of the tracks being used for interurban cars, of employing either a T-rail or a girder rail with a high head where possible, or, if a grooved rail must be used, to insist upon the employment of as high a head and as deep and wide a groove as will ultimately be required by the heaviest interurban cars.

The recent report from England of a projected monorail road between Manchester and Liverpool would be of more vital interest to the engineer if there were a reasonable certainty that it would be built. We call to mind several charters granted in this country for such enterprises, but nothing has ever come of them, and three or four short experimental roads represent the sum total of American achievements in that field. We are bound to say, however, that the experimental lines referred to have been rather successful in everything except inspiring public enthusiasm. This has been the fate of nearly all monorail projects since the first attempts of Palmer eighty years ago. Between that day and this more than a score of inventors have tackled the problem and evolved plans more or less feasible, but seldom materialized. And yet on its face the proposition is most attractive in its simplicity. When it is possible to run upon a single rail with speed and safety, the need for two does not appeal strongly to the imagination. Moreover, we do not remember any conspicuous failure when the plan has been put to the test. The experimental lines have, as a rule, been far too short to be operated at extremely high speeds, but in other particulars they have worked pretty well and certainly have encountered no difficulties sufficient to condemn them. Yet in this country they have come to nothing and abroad they are only beginning to win an uncertain recognition. The cause of this failure is by no means obvious. It has usually been laid by disappointed inventors to the bitter jealousy and persistent enmity of existing railways, seeing in the new systems a fatal rivalry foreshadowed. Undoubtedly, the advent of competition of any kind is savagely opposed by railways, as by any other commercial enterprises, but we think a monorail line would, on the whole, provoke less active effort than one of the ordinary kind. Besides, monorail systems seem to have met equally unfavorable receptions before great railway combinations began to dominate the public domain. Every electric interurban line feels the heavy hand of railway opposition, and none the less lightly because it runs upon two rails.

It is pretty clear that something else must be the matter with monorail systems, and the real causes of their lack of success are worth a bit of study. It seems to us that the conspicuous objection to most schemes of this kind is that their apparent simplicity is, in fact, unreal, and that for equal traffic on a large scale their roadbeds and rolling stock are as extensive as in the usual construction. If one examines carefully these so-called monorail projects, it appears that for the most part they actually involve the use of from three to five rails. Some of these, to be sure, are balancing rails, but they have to be bought and installed and kept in alignment against torsional strains that may sometimes be rather severe. The actual effect of these guide rails upon traction and upon maintenance of way is unknown and may well be regarded as a dubious factor in the matter. Now and then a system, like the Langen, for instance, really runs upon a single rail, but it is an exception to the rule. The Langen system actually suspends the car from a massive goose-neck curling around below the rail from the driving truck overhead, and is in operation on an 8-mile line between Elberfeld and Barmen. Even the "bicycle" railway, one of the simplest and most practicable of the class, requires one or more overhead guide rails which must be supported against strains normally inconsiderable, but which might rise to formidable magnitude. In a word, while monorail railways seem admirably simple in a sketch, the working drawings usually have told a very different story.

Another thing which has exercised a malign influence upon such schemes is that they have too often been exploited on the basis of attaining transcendental speeds, a purpose for which they are not now, and perhaps never may be, required. Some of them have qualities of sterling worth for the construction of cheap and effective cross-country lines, but with locomotives passing the hundred-mile-an-hour mark, pretty frequently the necessity of monorail construction for high speeds is not altogether obvious. Nevertheless, the interest displayed abroad in such systems for at least moderate speeds seems to be real and growing, and the results there obtained will well bear careful watching. We hope the English enterprise will be pushed to completion, and will in no wise disappoint its promoters. In methods of traction, the more the merrier, and if from the struggle emerges one really practical and valuable, the world will be the gainer. If through monorail construction it becomes possible to put in paying cross-country roads where they are not now possible, or to install elevated lines with half the structure now used in the streets, a real step in advance will have been made even if

the methods are not of general applicability. Meanwhile, we get on very well with our present roads. It is time, however, for some steps to be taken in the way of the high-speed electric traction that has been threatened for nearly a decade. Just at present it looks as if this problem, like the monorail one, would be threshed out by foreign engineers, while we on this side of the water are still talking about it. If this must be, we will take comfort that the foreigners are paying the bills for the world's experience in this particular. It is safe to say that the results will not be neglected by American enterprise.

Safety Devices and Their Uses

Several unfortunate accidents upon electric railways of late have served to call the attention of managers, as well as the public, to appliances and methods for the safe running of cars. It is not our purpose to sit in judgment upon these accidents. Some there are which no amount of skill and foresight can avert, and we trust that due investigation will place in this category the recent disasters to which we refer.

The thing to which we wish forcibly to call attention is that extension and expansion of electric railway work which, by almost insensible degrees, has created a necessity for methods and apparatus little needed in the past. The modern electric car is the product of evolution, rapid to be sure, but steadily following, like organic evolution, a well defined line. The first step was the conversion to electrics of the queer old horse cars of the early tertiary, say about 1886 to 1888. A few fossils of this period may be found in the side streets of our smaller cities employed as night lunch carts. These converted cars served their purpose for a while, but were too light to stand the shaking of increased speeds, and were soon succeeded by slightly heavier single-truck cars of similar pattern. The speed took another step forward and disclosed new imitations. But it took, to the best of our recollection, at least one grave accident involving the loss of several lives to enforce the lesson that light cars with a short wheel-base could not safely be driven beyond a certain moderate speed. Heavier service implied heavier cars and a type well fitted for suburban and inter-urban work was soon developed. It would run steadily and take curves smoothly and was fitted with powerful hand brakes capable of keeping it under full control in almost any emergency.

Within the last five years there has been immense activity in electric railroading of a yet more extensive character. The service is still faster and heavier than before and the new conditions have been imperative in demanding further safety appliances which have generally been forthcoming. Powerful air, electric, and other brakes have been devised and wherever installed have tended greatly to security.

But look for a moment at the stage of operations that has thus been reached. In point of speed and weight of car or train the modern electric road is at least the equal of the railroad of forty years ago, or even of a somewhat later period. If traffic is to be safely conducted, the electric line must be not only equipped but operated with the same amount of precaution that the experience of years proved to be necessary with other railroading on a similar scale. This hint has already been taken and we find to-day electric roads well equipped with power brakes, with well arranged telegraphic or telephonic systems of train despatching adapted to the work undertaken, and when occasion demands, with complete block systems of the most advanced type, as in some of the recent fine elevated roads.

Now, the moral to be drawn is this. We are to-day dealing in electric traction with problems in progressive railroading. It is not sufficient to install a first-class track and feeder system and to equip it with the best modern cars. The system must be taken under consideration as a problem in safe transportation and studied in the light of the experience acquired in ordinary railroading. With electric cars having their whole weight available for traction, power brakes and motors capable of a tremendous turning effort in reversal, such a thing as a head-on collision ought to be a sheer impossibility, and a rear-end collision unthinkable at any speed likely to do serious damage.

Perhaps the most serious difficulty in a practical way is that few electric roads have been built with due foresight of the traffic and the speeds that will have ultimately to be dealt with. After a time the equipment outruns the track and roadbed and the trouble begins. At each stage of development the system ought to be critically overhauled with reference to its operative capabilities. The division superintendent of a trunk line would see more that is important to be seen in a couple of hours than the average constructing engineer would in a week. Then is the time to adopt better brakes if they are needed, to plan a system of train despatching or a block system, not fully organized at first, perhaps, but adequate to meet the existing conditions and capable of expansion.

But it must be remembered that even the best arrangements for safe operation are in the last resort dependent on the skill and faithfulness of the men who run the cars. We can not speak in too warm terms of praise of the far-sighted policy pursued by several of the large electric railway systems, in choosing, and then carefully training, their operating force. It takes a clear-headed, cool and nervy man to run a high-speed electric train, almost, if not quite, the same grade of man as it takes to run a locomotive, and it pays to train him thoroughly. His physical labor is lighter than that of a locomotive engineer, but he should know his machine no less thoroughly and keep his wits about him in perhaps an even greater degree.

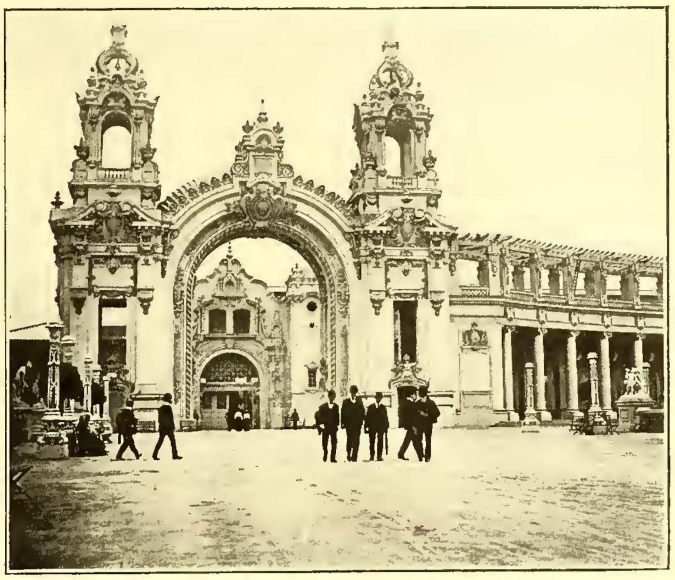
Given proper safety appliances and men carefully trained in their applications, and it should be possible to attain almost perfect immunity from accidents. Obviously, it does not follow that all electric roads should install complete block systems, or that if they did they would never have an accident. Here, as elsewhere, the means must suit the end, and perfection in things human and of human construction is difficult to reach. But a road, electric or other, which runs fast trains must take precautions which would be needless if the trains were slow and infrequent, and if it is double-tracked throughout, must plan for safe operation in a different way from that which would be advisable on a single track. As speed or density of traffic increases new conditions of operation are disclosed and must be followed up, and the personnel of the system must follow the line of progress. For the whole road, men and material, is a delicately organized machine for handling traffic, and its adjustments must be varied to suit the output. It will seldom fail if it be given adequate care, but the higher the speed and the heavier the duty, the more watchful must the mechanism be superintended.

Notes on the Pan-American Exposition

The Pan-American Exposition, which was officially opened May 20, has been well prepared for the reception of visitors now for some time past. Although during the last month some of the finishing touches have been added to the grounds, buildings and exhibits, nevertheless, as previously explained, these were not too vital features of the Exposition, and anyone who has visited the Fair at Buffalo during the past month has not met with disappointment caused by any state of unreadiness of the Exposition features.

The attendance at the Exposition so far has not been equal to the average which was expected by the managers and residents of Buffalo, but this has, perhaps, been only natural, because at all fairs of this kind the visitors during May and June have been less than those who have visited the fair later. This is partly because many wait until their friends bring back a report of what they have seen, and also partly because the summer vacations have not begun. July will undoubtedly witness a considerable increase in the average number of visitors, and this increase will grow greater as the following months arrive. September and October were the crowded months at the Chicago Fair, and there is every reason to believe that the same condition will exist at Buffalo. In the meantime, those who take advantage of July to visit the Fair will escape the crowds which will inevitably be present during the final months of the Exposition.

As has previously been stated in this paper, the principal spectacular feature of the grounds is the night illumination, and the electrical engineers who have had this work in charge deserve great credit for the manner in which it has been carried out. In this spectacle the electric tower is, of course, the centerpiece, as it is of a day effect, but the illumination of the individual buildings is also very beautiful and effective, as can be seen from the night view of the Electricity Building, which is presented herewith, and which differs somewhat in its treatment from that of the Machin-



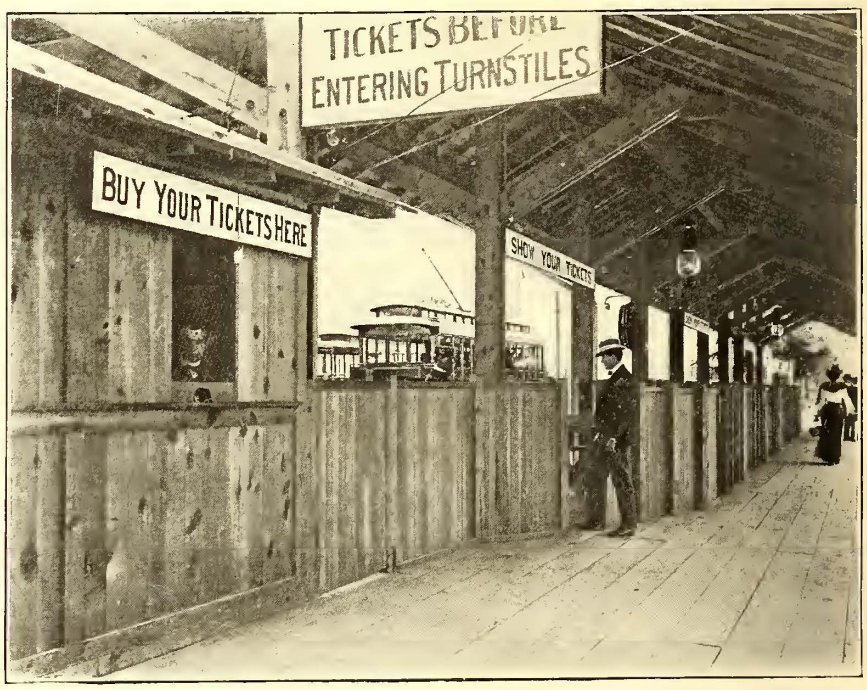
VIEW LOOKING THROUGH PROPYLÆA TO BELT LINE STATION

ELECTRICITY BUILDING AT NIGHT

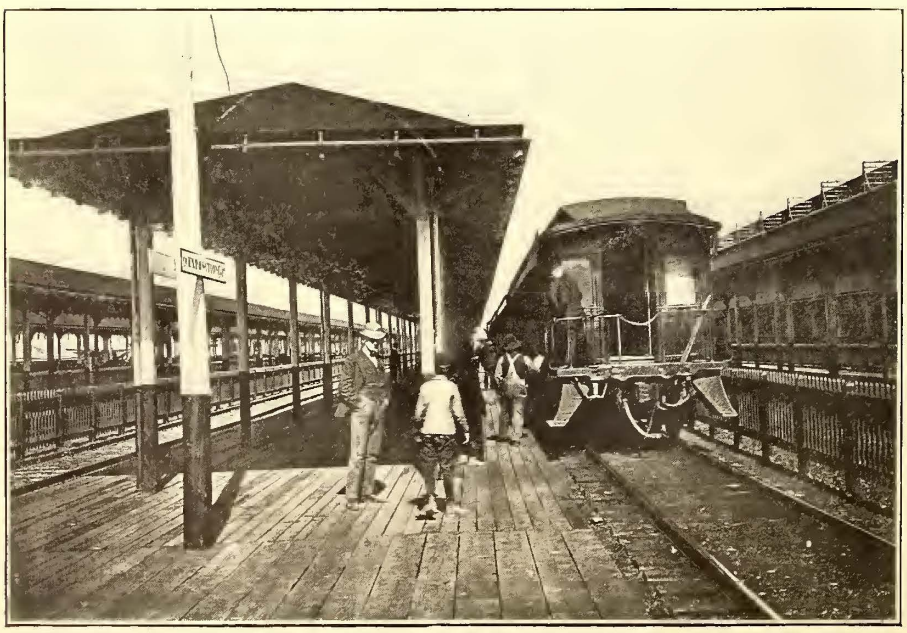
ENTRANCE TO SUBWAY LEADING TO BELT LINE TRAINS

ery and Transportation Building, previously illustrated. The illumination is entirely by incandescent lamps, and in this particular the Exposition differs from any which has hitherto been held. The lights are all of 8 cp, and are supplied in most part from Niagara Falls power by means of the large group of transformers forming part of the exhibit of the General Electric Company in Electricity Building, although this power is also supplemented by two auxiliary plants, one located at the extreme northeastern end of the building and the other in the basement of Machinery and Transportation Building.

It is not the intention of this article to describe any of the individual exhibits in the different buildings, as they have already been covered by previous articles, or will be taken up in later issues, but to give some particulars of the transportation features to the grounds, which were not described in the June issue of the Street Railway Journal. It was stated in that issue that there were three means of reaching the grounds, one by the electric railway lines, which approach the West Amherst entrance at the west of the grounds and terminate in a large loop at that point, from which visitors enter the west end of the Mall. The second entrance is that provided by the electric railway lines converging at the east side of the grounds, and by which access is provided to the East Amherst gate at the east end of the Mall. Both of these terminals belong to the International Traction Company, and are employed exclusively by the cars of that company. They were described fully in the June issue. The third entrance, to which only a brief mention was given in the last issue, is that at the northern end of the grounds, and by many it is thought that later in the season it will be used by more visitors than either of the others, as it is the natural means of access, not only by parties who come to the city over the trunk



ENTRANCE TO EAST AMHERST ELECTRIC RAILWAY TERMINAL

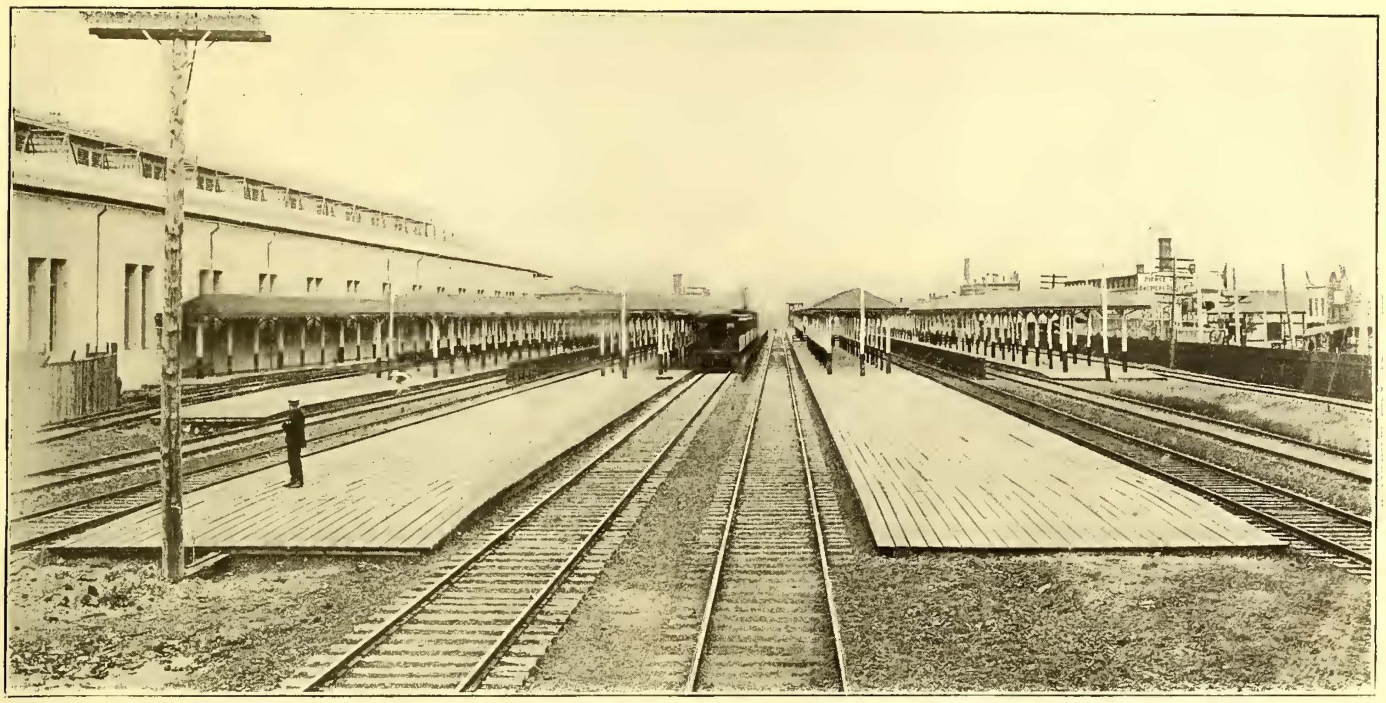


BELT LINE TRAIN AT UNLOADING PLATFORM

line railroads which terminate in Buffalo, but also the region north of Buffalo, including Niagara Falls and Lockport. As is generally known, the New York Central Railroad operates a belt line around the city of Buffalo, passing at the south through the Exchange Street Station, and at the north past the upper end of the Exposition grounds. It is a double-track road, and trains are run around the loop each way. The stations are located at intervals of from one-half mile to a mile and a half. During the first part of the Exposition, the headway of trains has been about every half-hour, but the terminal facilities are such that trains can be run in both directions at intervals of five minutes, providing a quick and almost inexhaustible means of carrying passengers from the lower part of the city to the Exposition grounds. The fare is 5 cents between any two stations on the Belt Line, and the cars used are

not steam railroad coaches, but are provided with longitudinal seats, with the exception of eight cross seats at the center, and the fares are recorded by ordinary street-car registers.

The terminal station at the Exposition has been planned to accommodate this large number of visitors, and its cost is stated to have been in the neighborhood of $1,000,000. There are nine through steam railroad tracks, not counting



GENERAL VIEW OF BELT LINE STATION AT PAN-AMERICAN GROUNDS

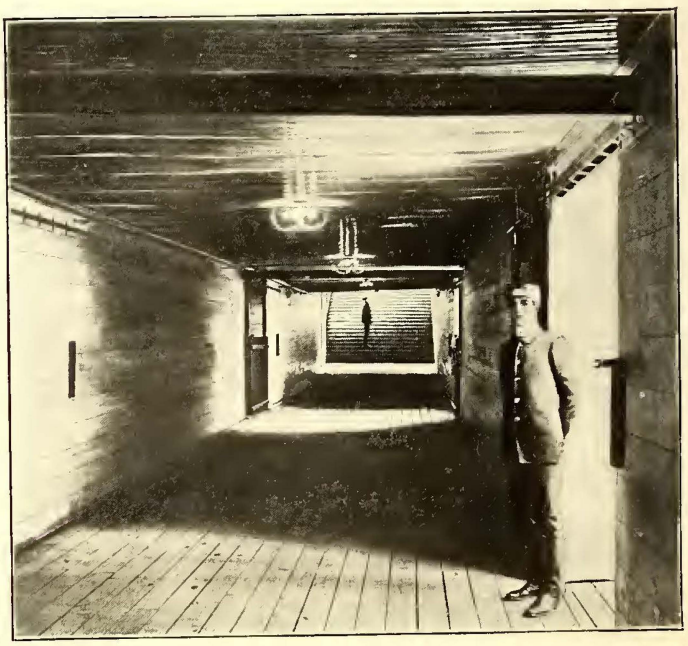
TERMINAL STATION OF THE NIAGARA FALLS AND LOCKPORT ELECTRIC CARS.

the electric railway tracks, at the northern end, devoted to the cars of the International Traction Company to Niagara Falls and Lockport. Each platform is divided into two divisions by gates, one for the incoming and the other for the outgoing passengers. The latter after reaching the platforms descend a flight of stairs, with which each platform is provided, and enter a subway which leads them under the belt line tracks to the entrance to the grounds. Opposite the Exposition entrance is the New York Central ticket office, where there are twelve booths protected by railings, for the sale of tickets. The terminal station of the Niagara Falls and Lockport electric lines is outside of the Belt Line Station, and access to the grounds is provided through the same subways already described. A person entering the grounds by either of these ways passes through an end of the Station Exhibit Building, then through the western arch of the Propylæa, and immediately enters the Plaza, when he is well within the grounds.

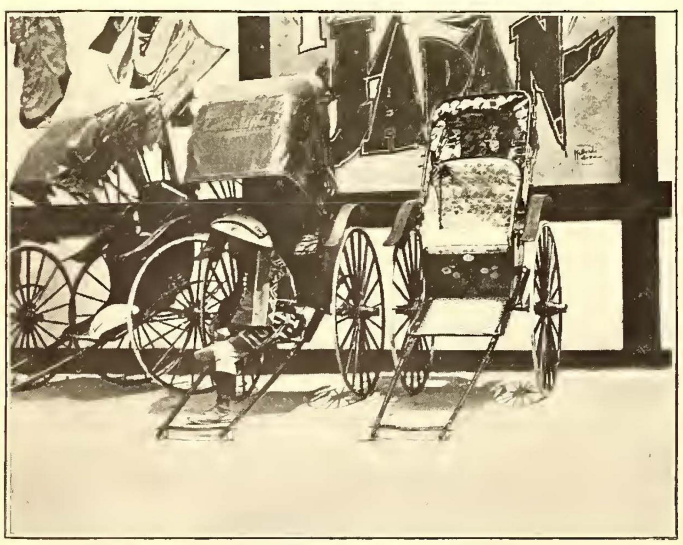
ENTRANCE GATE TO EXPOSITION AT BELT LINE TERMINAL

Although the problems of transportation to the grounds have been carefully worked out by the companies interested, there is a lack of transportation facilities around the grounds, and some criticism has been caused from this fact. It is quite a

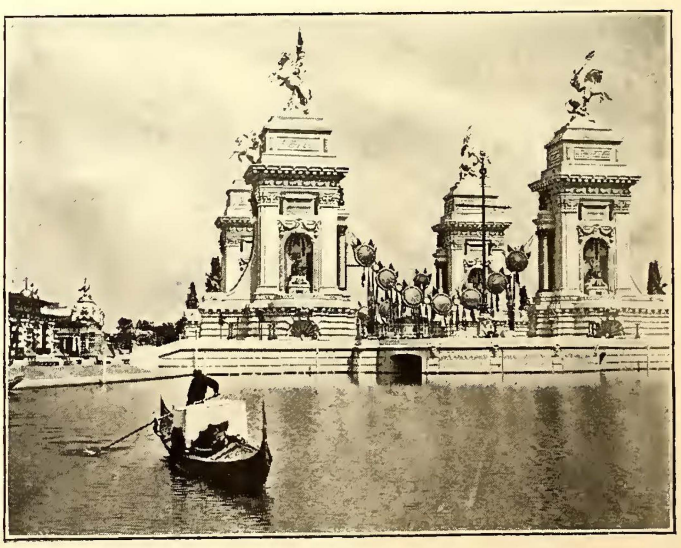
JINRICKSHAS AT THE EXPOSITION



VIEW OF ONE OF THE SUBWAYS



A JINRICKSHA STATION



GONDOLA AND TRIUMPHAL BRIDGE

long walk from one end of the grounds to the other, and if some cheap and convenient means of transportation was provided, there is no doubt but that it would

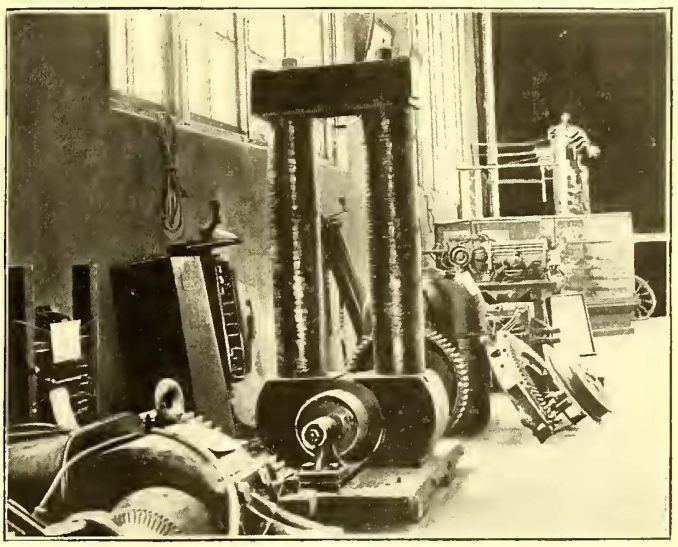
THE PROPYLAEA AS SEEN FROM THE STATION EXHIBIT BUILDING

be well patronized. Such means were furnished at the Chicago Fair by the Intramural Railroad, and at the Paris Exposition by the moving sidewalk, but at the Pan-American Grounds the only recourse is to the Japanese jinrickshas, the rolling chairs, or to the gondolas or launches, which operate on the canals. As all of these are expensive, and like all individual means of transit, are somewhat difficult to secure when wanted, although greatly in evidence when their services are not desired, it is the general opinion that an electric line, either surface or elevated, passing around the grounds, would have proved both convenient and profitable. The gondolas and jinrickshas, however, give a picturesque appearance to the surroundings as the views accompanying this article show.

The Historical Exhibit at the Pan-American

At the western end of Electricity Building is a row of historical exhibits, which are sure to attract wide attention. The first case, to the left, contains the earliest types of watt and ampere meters, quick break switches, etc. Adjoining this is a bipolar alternator with notched poles, built by Elihu Thomson in 1888. Then follow two famous types of railway motors, which also originated with the Thomson-Houston Company, and a few of which are still doing valiant service in different parts of this country. These are the W. P. 30 motor, with fields of cast steel, and the F-30 motor, with double-reduction gearing. Close to these motors is one of the original rheostat controllers made by the Thomson-Houston Company, and called the type J controller. Both of these motors appear now extremely antiquated, although only about a dozen years have passed since they were the leading types produced, yet in the W. P., the method of enclosing the fields, which is now the universal practice, is clearly shown.

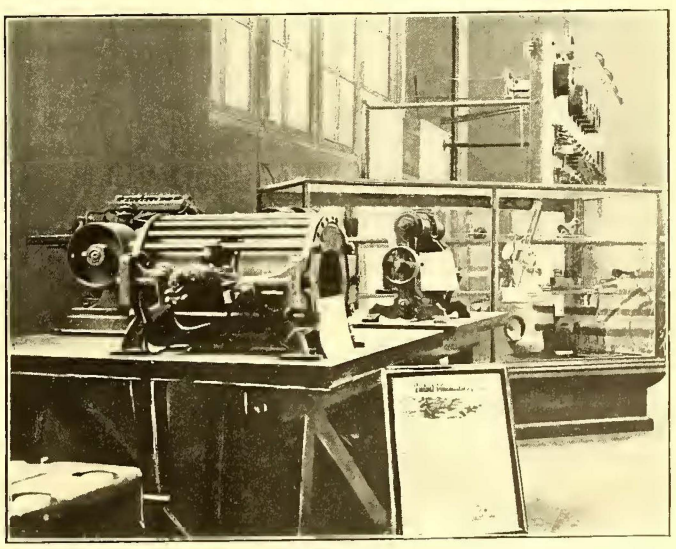
Following down the row of historical exhibits, the visitor next comes to the pioneer of them all or the old Z Edison bipolar dynamo, with its long, thin poles surmounted by an enormous yoke. Next is a No. 51 railroad rheostat, and adjoining this is one of the original Vandepoele railway motors. The date at which this machine was built is unknown, but it was about 1885 or 1886. It is a large bipolar, double-reduction machine. Adjoining this is the famous S. R. G. railway motor, so called because it used single-reduction gearing; it is the first one of this type built for regular commercial work. The visitor then sees an early Thomson arc light, dating from 1880, and adjoining this



OLD EDISON DYNAMO IN HISTORICAL EXHIBIT

is one of the early, if not the earliest, form of Thomson welding machine with welder combined to the generator.

The pioneer Brush work in the electric field is represented by the first Brush arc dynamo, with its characteristic design. This was built in 1876 and 1877, and adjoining it is an early Brush plating machine designed for 5 volts and



EARLY THOMSON ARC MACHINE IN HISTORICAL EXHIBIT

75 amps. At the northern end of the exhibit is a case containing some of the original railway overhead material, including an early hanger made of wood or composition with a sheet metal cone, together with a number of early strains and pull-offs made of molded mica, and some primitive commutators. Altogether, the exhibit is a most interesting one, and the General Electric Company, through whose courtesy the apparatus was loaned for exhibit, deserves the thanks of visitors at the Exposition.

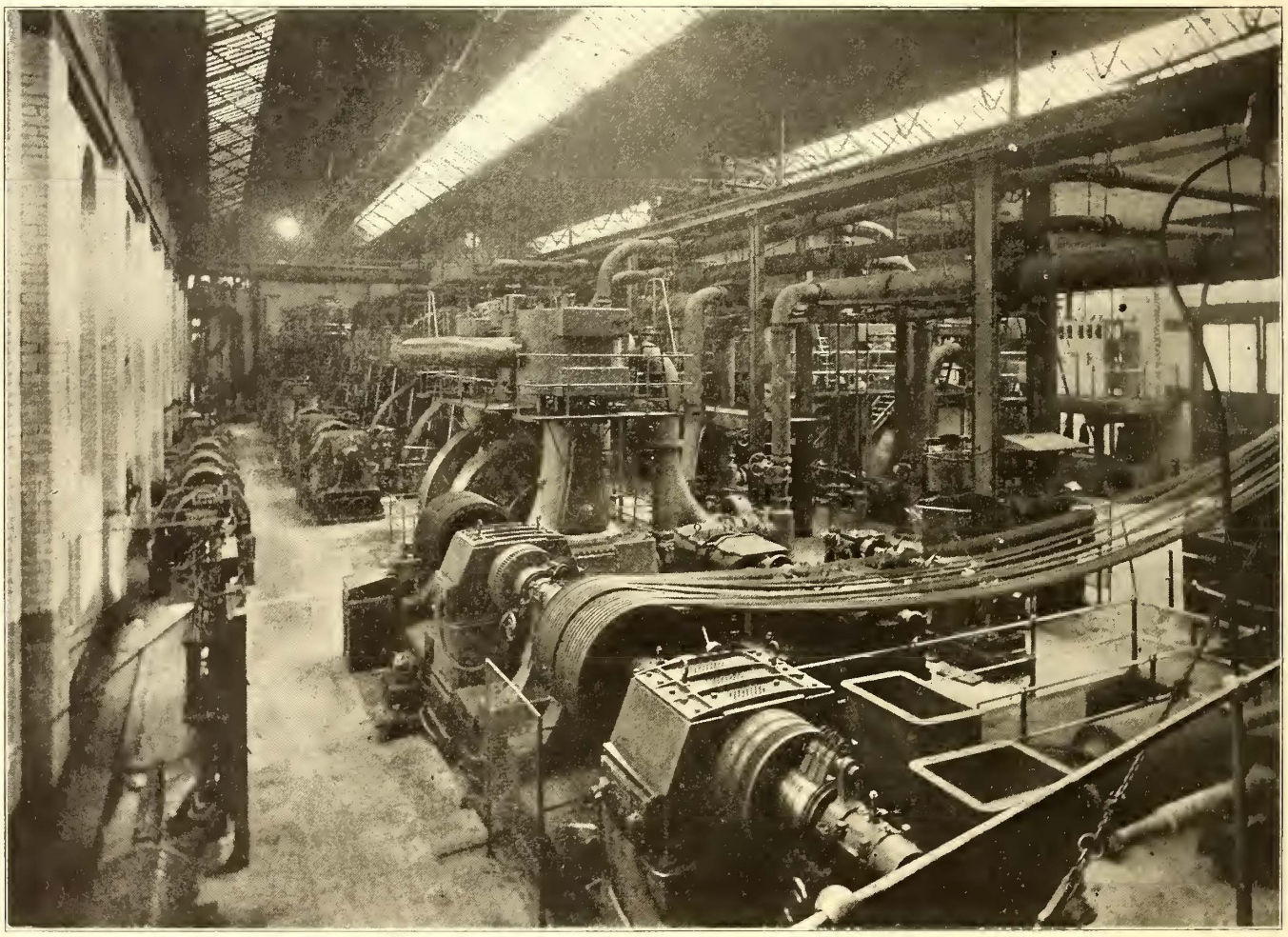
The New Manchester Tramway System

In the years 1875, 1878 and 1881 the Corporations of Manchester and Salford obtained powers for and constructed tramways in their respective boroughs. Subsequently a company calling itself the Manchester Suburban Tramways Company constructed extensions of those lines in the suburban district, and the Corporation of Oldham and the local boards of Withington, Moss Side and Eccles also obtained powers and constructed lines in their several districts. The various corporations and local authorities owning the lines leased them to the Manchester Carriage & Tramways Company (the successors of the Manchester Suburban Tramways Company), and this company has, during the past twenty-one years or so, operated the entire system.

In the year 1895 the corporations of Manchester and Salford began to consider the question as to what was to be done at the expiration of the leases in 1901, and after two years' consideration by special committees, it was determined by the two corporations respectively to municipalize their tramways. A glance at the accompanying map will show that, owing to the ownership of the lines being in various hands, the difficulties in the direction of a general municipalization of the entire tramways of the district were very great, and it was predicted that the various local authorities having conflicting interests would never come to an agreement. This prophecy, however, was not fulfilled, as agreements have now been entered into which enables the municipal working of the entire system to be carried out.

The tramway system hitherto worked by the Manchester Carriage & Tramways Company will be divided in future into four groups, viz.: (a) the Manchester group; (b) the Salford group; (c) the Oldham group, and (d) the Ashton and Stalybridge group.

It might appear that this splitting up of the system into groups is a public disadvantage, but in reality it is not so, as the Manchester Carriage & Tramways Company has worked its system in seven or eight distinct sections, each controlled by a separate manager. The Manchester lines are to be extended and the total track mileage, when completed, will aggregate 150 miles of single track. The policy pursued by the Manchester Corporation is to make arrangements for having tramcar communication between the city and the nearest large towns and the district within a radius of 7 or 8 miles of Manchester will be probably one of the largest tramway centers in the world, having a total length of about 500 miles of single track.



ONE SIDE OF ENGINE ROOM, DICKINSON STREET STATION

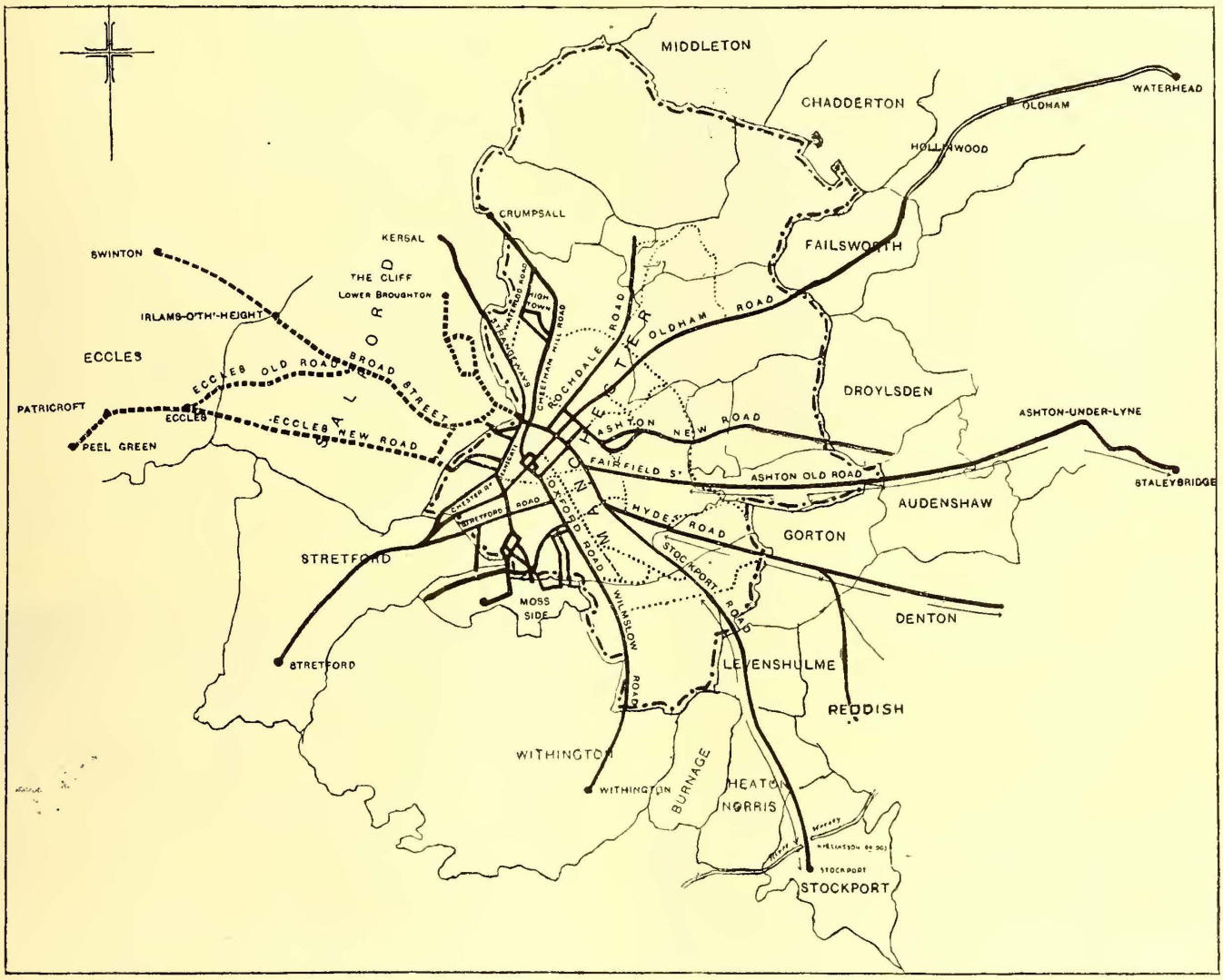
POWER STATIONS

The three routes first equipped are the Cheetham Hill Road, Rockdale Road and Bury New Road; part of the latter is in the Salford district, and has been equipped by the Salford Corporation. The work of electrification will in future be carried out in sections until finally the electric system is used throughout. As the transformation progresses new generating stations will be required to supply sufficient current to the lines, so that although the first three tramway routes mentioned above are to be supplied with current from the existing Dickinson Street power station, it is intended that the Bloom Street works, now nearly completed, and the Stuart Street works, now under consideration, shall ultimately be the chief sources of supply for current for tramway purposes.

The total horse power in the Dickinson Street station

amounts to 13,000 obtained from engines varying from 400 hp to 3000 hp. The accompanying illustrations show general views of the engine and boiler rooms. When one considers that the Bloom Street works, which are expected to be completed by September next, will consist of four engines aggregating 12,000 hp, and also that the Stuart Street works, for which tenders have recently been accepted, will, as a first instalment, be fitted with 15,000 hp, and that the site selected at Stuart Street will in a comparatively short space of time be filled with 60,000 hp, the magnitude of Manchester's proposed system is made apparent.

At Dickinson Street there are at present two engines



MAP OF MANCHESTER, SHOWING TRAMWAY LINES

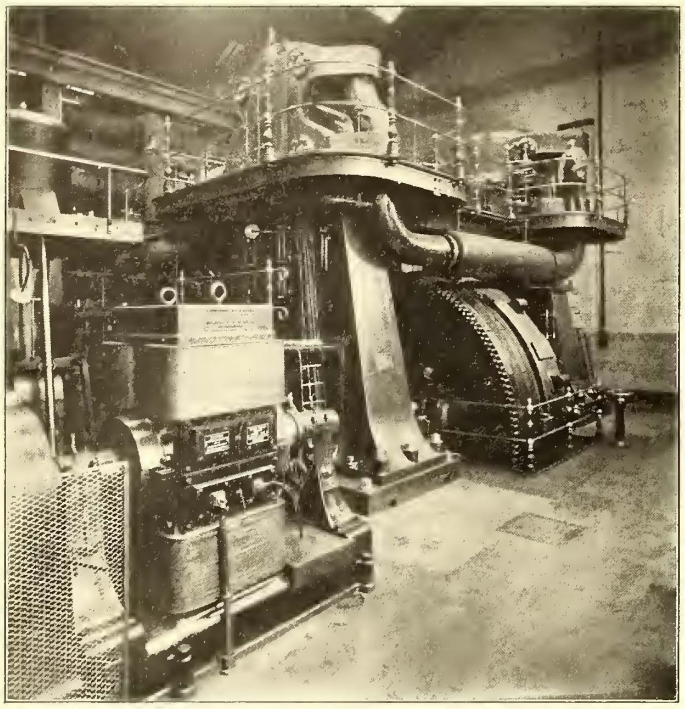
each of 1500 hp, made by Messrs. Ferranti, of Hollinwood, for tramway purposes only, but they are so arranged that the dynamos they drive, which are of the Westinghouse Company's manufacture, can also, in case of emergency, be used for lighting purposes. A handsome special switchboard for equalizing purposes has been erected and is illustrated herewith, and a second switchboard contains the feeder and Board of Trade panels. The British Thomson-Houston Company supplied these switchboards, etc., and also the feeder and section pillars. The electrical development of the tramways has been under the supervision of G. F. Metzger, who was recently appointed electrical engineer of the corporation, and all switchboard arrangements have been ordered, obtained and erected since Mr. Metzger took over his duties on the 1st of April, as also have the necessary feeder pillars in the streets.

In the equipment of the Dickinson Street works is included the three-phase machinery required for feeding the outside districts for lighting and power purposes. The pressure used for the purposes is 5000 volts, which is conveyed to the sub-stations fixed in the outlying region, and in these sub-stations the current is reduced to the pressure required for supplying light and power to consumers. The boiler houses are three in number and contain a total of twenty-two boilers, eighteen Lancashire and four Babcock & Wilcox type, all of which are stoked automatically. This is sufficient to give a spare unit, as every one of these boilers is required for the winter requirements, and every engine in Dickinson Street will as well be called upon during the ensuing winter to do its utmost in order to supply the demand. At the end of last year the number of 8-cp lamps amounted to no less than 367,000, and it was with difficulty that steam could be maintained, but since then 13,000 additional lamps have been installed and the tramway lines opened. It will, therefore, unless relief comes in the shape of the completion of the Bloom Street works, be an extremely hard task to supply the demand for power next winter.

LINE CONSTRUCTION

All of the material used in connection with the overhead line construction in Manchester has been specially designed, supplied and erected by Macartney, McElroy & Company, Ltd., London. Both center and side pole and rosette construction is employed, all of which is of the best. It was at first intended to use more of the center poles, but so much popular objection was expressed at the interference to vehicular traffic, that the original

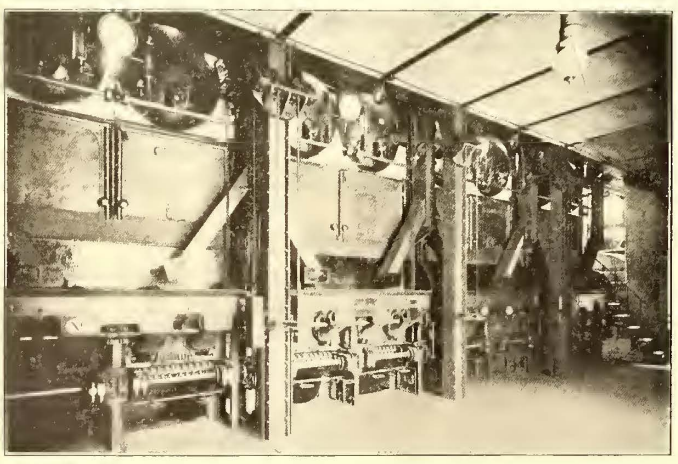
plans were modified after a considerable number were in place. The poles, as seen, are handsomely ornamented with scrolls made from original designs of Macartney, McElroy & Company, and present a very attractive appearance. The trolley wire is No. 0000 and is supported on the flexible suspension system, the hangers being of the very



3000-HP LIGHTING SET, DICKINSON STREET

best gun-metal and sufficiently strong to stand a testing strain of 8000 lbs. without breaking.

Although the overhead work was done under contract, and has given entire satisfaction, the corporation intends in future to do all of its own construction work. The track already laid was put down by men employed by the municipality and the work was accomplished with a commendable lack of inconvenience and a minimum amount of annoyance to the public. In the center of the city the work was done at night, and at no time was the regular tramway ser-



PART OF THE BOILER HOUSE, DICKINSON STREET

vice interrupted during the laying of the new 100-lb. full-grooved rails.

CAR HOUSE

The buildings for the Queen's Road car house, now approaching completion, are believed to be the most extensive hitherto erected in Europe, and cover upward of 4 acres of land. The site, which is irregular in shape, has a frontage on two streets, namely, Boyle Street, about 975 ft. (775 ft. only being utilized at present), and Queen's Road, about 330 ft. The materials used for the Boyle Street elevations are gray-end bricks in the spaces between the piers, and stock brick for the piers, gables, arches, etc.; the front elevation and main gateway are entirely of stock bricks.

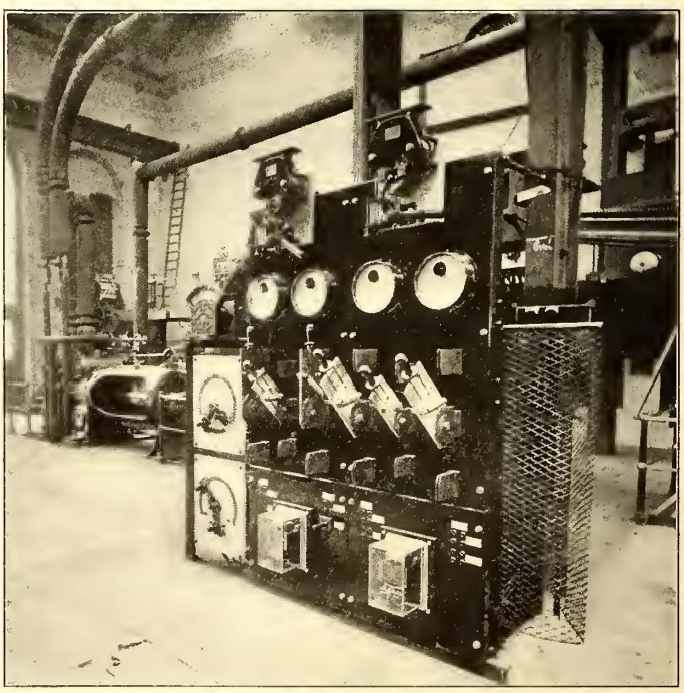
Provision is made for 252 cars, and the entire area of the land required for this accommodation and for the approach leading to the sheds is covered by roofs consisting of steel principals, purlins and girders supported on cast-iron circular columns, with boards, felt and slate, and with suitable roof lights glazed with Mellowes & Company's, Sheffield, patent "Eclipse" glazing.

The main approach to the sheds from Queen's Road consists of a roadway 48 ft. wide, entered by a massive gateway 16 ft. wide, and provided with three emergency exit gateways, each 14 ft. wide in Boyle Street.

The sheds for the cars are placed at right angles to the approach road, and consist of fourteen sheds, each 37 ft. wide, to contain eighteen cars; that is, having three tracks holding six cars each.

Eleven of the sheds, with capacity for 198 cars, stand over a pit 395 ft. long by 150 ft. wide, the bottom of which is 4 ft. 6 ins. below the track level. This pit gives access to the motors under the cars and facilitates inspection and repairs. The remaining three sheds are for fifty-four trailer cars which will stand on the solid ground.

The accompanying plan shows the immense amount of special work which must have been necessary in the construction of the tracks for accommodating the cars in storage. This work has all been done by the Lorain Steel Company at its works at Johnstown, Pa., and is of the well-known hardened steel plate type. Chief Engineer E. B. Entwisle, of the Lorain Company, has spent considerable time in England arranging for this car house track and



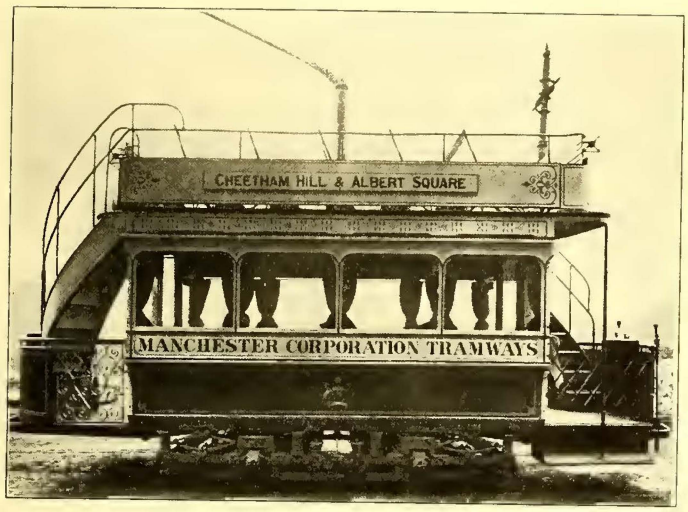
MAIN TRACTION SWITCH BOARD

some 160 other examples of first-class special work located throughout the system. It is all of guaranteed construction and similar to that furnished to the Glasgow and other tramways in Great Britain. The front part of the car house has been fitted up as offices of the company, club rooms for the employees and other rooms for general purposes. A complete repair shop with store rooms is also provided,

and there is a swing jib crane and hoist door. The buildings were designed and erected under the superintendence of J. Gibbons, F. M. S. A., Architect, Manchester.

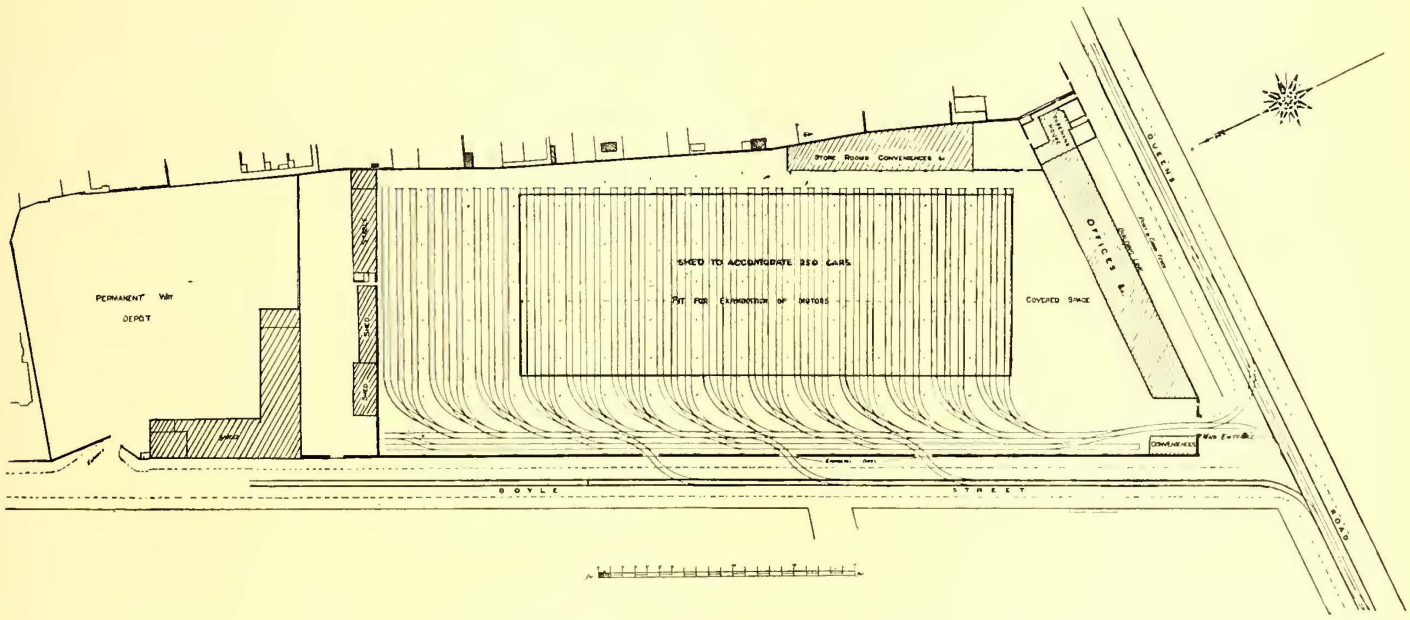
ROLLING STOCK

There are now about one hundred cars in the sheds, but orders have been placed for 450. The cars on the Cheetham Hill route, now ready for the conveyance of passengers, are double-decked, and are designed to hold sixty-seven people in the larger size, and forty-three in the smaller one. Before coming to a decision in regard to design the Tramways Committee bought six sample cars from six leading makers. It examined the points of each, took note of those which were regarded as best, combined the various good qualities and rejected those which were thought inferior, and then invited tenders for the 450 cars framed to its own specification. While the present center for the 250 cars shortly to run is Cheetham Hill, it will be needful later on to provide further establishments at Ardwick and probably at either Bradford or in South Manchester. On the Higher Broughton route cars will be used, at any rate at the beginning, with no outside seats, an arrangement which has been made because of the lowness of the railway bridges on the line of route. At Gaythorn and at Ardwick there will, later on, be experienced a somewhat similar trouble with low bridges. Cheetham Hill passengers are happily so situated that there is not a single bridge they have to pass under. Of the 450 cars under order 150 more are soon to follow the 100 already received. The Tramways Committee expects that in two or three years the total number that will be running will reach the figure of 600, and that in five or six years it will be at least 1000. Workmen's cars, at particularly cheap rates, will be a feature of the service. There will be about a dozen to begin with. Fixed stopping places have, of course, been rendered necessary, a change from the old system of stopping anywhere on signal, and push buttons are placed in the cars for the convenience of passengers, those on the roof being placed on standards. The old collecting boxes now in use



CAR USED AT OPENING CEREMONY

CHEETHAM HILL ROAD, CENTER AND SIDE POLES



PLAN OF QUEEN'S ROAD CAR HOUSE

will give place to the bell punch and ticket system.

The orders for the car bodies have been given partly to G. F. Milnes & Company, of Hadley, and partly to the Brush Electrical Engineering Company, of Loughborough. Some are mounted on Brill trucks and some on Peckham trucks, and the equipments are those of the British Thomson-Houston Company and Dick, Kerr & Company.

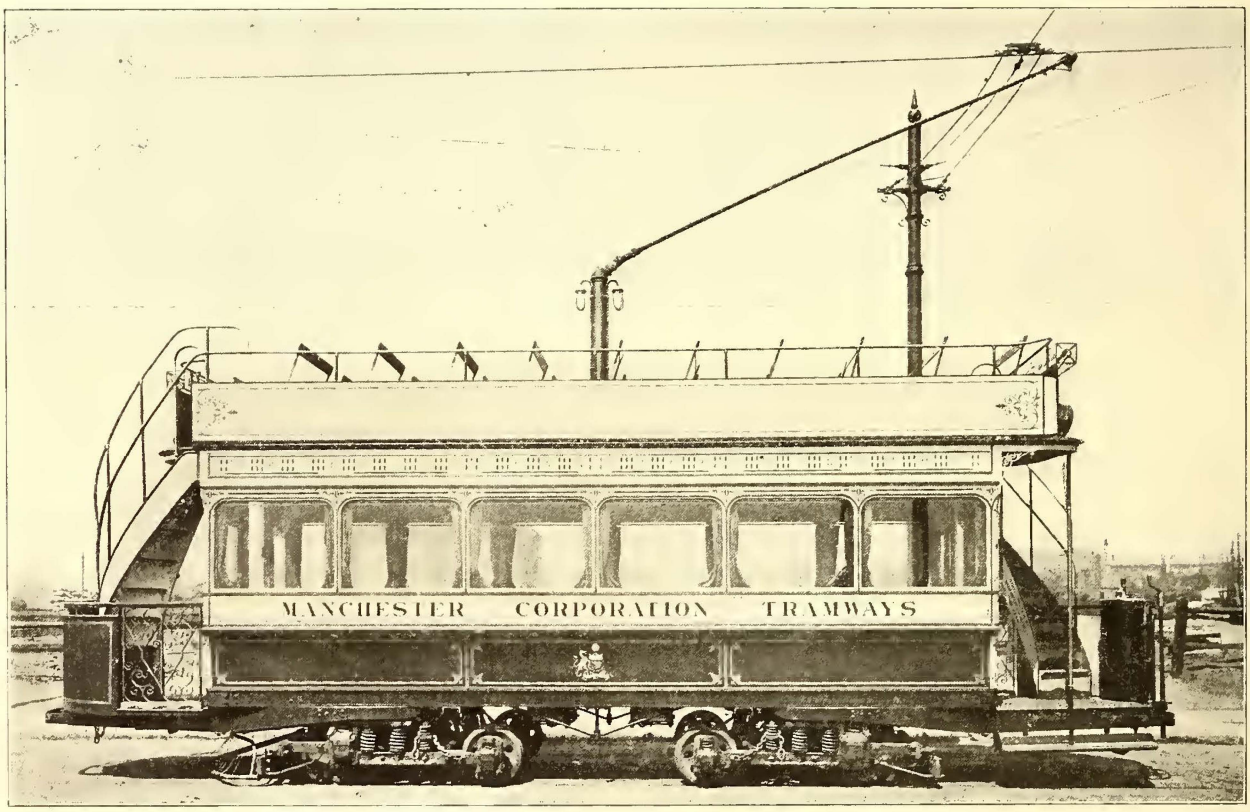
The smaller car illustrated with this article was made by G. F. Milnes & Company and used at the opening ceremonies of the road a few weeks ago. All at the opening were from this firm, part of an order for 210 cars.

These cars have top seats, are capable of seating forty-three passengers, and are mounted upon rigid four-wheeled electric motor trucks. The length of body is 14 ft. 2 ins., and the length of each platform 5 ft. The width over body is 6 ft. 6 ins.

The side construction is of selected Honduras baywood paneling, curved at the bottom to give a good, artistic effect, the main framing consisting of well-seasoned teak. The interior finish is of finest teak, with handsome sycamore raised panels, fluted teak pilasters and carved pilaster blocks being used on each window pillar. All the windows are fixed and glazed with polished plate glass. Each end of the car body has a wide sliding door permitting easy access to the car. A handsome overdoor with embossed teak moldings is placed at each end of car, the pilasters being carried to the bottom of the end casement. The curtains are made of a handsome design of tapestry, sliding upon brass rods, and provided with curtain holders to each window pillar. The ceilings of the car, of the clerestory type, are furnished with beautiful bird's-eye maple veneers and teak moldings, French polished in natural grain. All the ventilator sashes are glazed with ornamental glass, the design being ruby on a white ground, and are pivoted to allow of free ventilation. Along each side of the car a polished teak handrail is carried, fixed by ornamental brass brackets to the ventilator rail, and provided with leather handstraps.

The seats inside the car are finished with perforated Birch veneer and teak framing, and covered with Wilton carpet rugs of a handsome design, while the metal trimmings are all of solid bronze, highly polished, of the latest improved patterns and designs. The platforms are hung below the underframe, and the step is very low, the distance from the ground being not more than 13 ins., thereby making the car easy of access. Access is made to the roof by means of a stairway having sides of sheet steel, and seats are installed on the roof for twenty-five passengers. These seats are reversible and placed each side a center gangway, so that passengers may face forward in whichever direction the car is traveling.

The lights inside the car are distributed from the clerestory ceiling by handsome cut globes, thus making reading easy and agreeable. Revolving roof lanterns made of aluminium are mounted over each canopy. The cars are equipped with ratchet brake handles of bronze, brake spindles having foot pawls, etc., and sanding arrangements with platform pedal gear. Dedenda pedal gongs 12 ins. in diameter are used. The color of the car is white, with rocker panels of vermilion, decorated with the Manchester coat-of-arms, handsome corner designs, and fine lines of gold.



DOUBLE-DECKED, SIXTY-SEVEN PASSENGER CAR

MOTOR EQUIPMENT

The 100 British Thomson-Houston motor equipments which are being supplied to the Manchester tramways consist of G.E.-52, four-turn motors, B-3 controllers and the usual accessories. The company's rheostat method of braking is to be used, by means of which the car is braked electrically directly from the controller. This method of braking involves the use of no additional wearing parts, and no alteration of the motors. The braking effect is produced by so connecting the motors that they act as series generators. The two motors are arranged in parallel with one another, and in series with the same resistance that is used for starting the car. This resistance is arranged to be gradually cut out in the successive brake positions of the

controller handle, thus gradually increasing the current generated by the motors, and, therefore, the braking effect. In order to prevent the possibility of one of the motors reversing and running in series with the other motor, the armatures and fields are separately connected to one another.

GENERAL

Now that the electric tramway is in satisfactory operation, the management intends to conduct it according to the highest standards.

A comprehensive book of rules has been supplied to all the employees. The conductors or "guards" are instructed to accept postage stamps as payment if no change is available, and are sternly warned not to "chaff or have the last word with passengers inclined to argue." Each car official has been trained in the principle of mechanical "first aid" to his vehicle in case any hitch should occur.

The tramway's general manager is J. M. McElroy, who has already shown that he is capable of handling the problem of rapid transit in Manchester in a most praiseworthy manner. With such men as Mr. McElroy in the management and Mr. Metzger in the engineering department, the corporation is surely to be congratulated in the selection of its tramway's staff of officials.

How to Make Non-Paying Roads Pay

BY H. S. COOPER

VIII. Maintenance—(Continued.)

Before proceeding further it would be well to discuss a matter that seems to receive careless consideration from a great many owners and operators of small and medium-sized street railway and lighting properties, viz., the large returns often obtainable on money invested in *small* improvements, facilities and economies in the operation or maintenance of such properties. The writer finds many owners who will open their purses to large schemes of reorganization or extension, based on purely theoretical profits, who yet refuse much smaller sums to the properties for small improvements or facilities that would immediately give large and absolutely certain returns on the money invested. Let us figure a little.

An improvement that effects a saving of, or increases the earnings, 5 cents per day will give a total of $18.25 per year, which equals 6 per cent interest on a purely financial investment of $300, or, if the investment is made in some tool, apparatus or other article that will depreciate with age or use, it gives 6 per cent interest on an investment of $100, and a 12 per cent allowance charge for that depreciation—a very liberal average return on such an investment. On the basis of the above and on actual results obtained in practice, it may be stated as a general principle that every extra 5 cents that can be made or saved per day for a year or term of years warrants the investment of $100 for that purpose for that period, simply as a conservative, commercial transaction on the part of the investor. When, however, it is considered that in such cases the investor is the owner, and by so investing appreciates the value of, and the return from, his own property, the collateral returns from such cause are often more remunerative than those from the investment. And when it is further considered that in many cases the saving or earning is much greater than that given above, and that many such instances often occur in one property, the total savings or earnings of which would make the difference between loss and profit in the operation of that property; when these points are fully considered, does it not seem strange that men who are considered in other lines as good, clear-headed business men, should, under such circumstances, be so short-sighted as to utterly refuse to recognize these facts and principles? Yet such is very often the case. Because the property, as a whole, is not paying, it seems to them that it needs change as a whole, the putting in of small sums seems too trivial a thing to influence such a large matter.

One trouble seems to be that there is a feeling among many owners that because the business is largely a technical one, ordinary business principles do not, or can not, be applied to it. It is no uncommon thing for the writer to have said to him by owners, as an excuse or apology for the condition of the property, "We don't know anything about electricity, none of us are technical men," when the lack of good results in the case was due to an absolute neglect of the plainest and best known business principles, principles which they acted on every day in their own individual business. Again, with many it is found that their sole idea of lessening their losses is by niggardly retrenchment, they will economize to parsimony, will pare a paring and try to skin that, not seeming to realize that a wise increase of expenditure is often more remunerative or more truly economical than a decrease of expenses.

In nothing is the truth of this principle better shown than in the methods, tools, appliances and forms used in the practical part of the operating, especially in the maintenance, for, as a rule, no portion of the operating is so meagerly provided with facilities for quick, thorough and accurate work and lasting results. The inspection of the equipment of the ordinary work and repair shops of either car house, line or power station of most small and medium-sized roads is enough to make a good workman weep, and even where there is a fair supply of tools and appliances, their condition, care and arrangement is still a subject for tears.

That these matters are much better than they used to be is true; that they are, as a rule, much worse than they ought to be is equally true. The improvement is mainly due to two causes, the descriptions of appliances and devices given in the correspondence, descriptive and advertising columns of the technical press, and the discussions and free interchange of ideas at the local and national conventions. In the former, much credit is due to the larger companies for the freedom with which they have allowed to be given, through the columns of the street railway technical press, the full and fully illustrated descriptions of their new and improved installations and for the thorough and wholehearted way in which their forms, blanks, methods and practice have been exploited for the benefit of their lesser brethren. Of course, it may seem queer that such things as triple-expansion direct-connected units, self-stoking boilers, four-equipment double-truck cars, high-voltage transmission, conduit trolley, complete stock-room and accident accounts, etc., etc., should interest or improve the manager in neck-o'-woods with his ancient simple high-speed engine, cylinder boiler, belted bipolar, double-reduction commutated field-control motors, ramshackle single-truckers, 45-lb. rail and junk-shop of a work and store-room, but it *does!* It not only interests him, stimulates him, sets him to thinking; the details given so freely, clearly and explicitly—the results as they are of the best brains and experience in the business—not only give him the principles, but even the application of something that he has needed and fruitlessly puzzled over; but the action of both these and the conventions is reflex in that they encourage him to give freely of his knowledge and experience both in discussions and in the technical journals, and it is only justice to the small manager to say that many valuable ideas have orig-

inated and been developed, proved and made public by him.

It is for these reasons that it is not only wisdom, it is absolute *duty* of all street-railway owners and managers to give *all* their employees the opportunity to become fully acquainted with the periodical technical literature of the business and to give to their managers and heads of departments the opportunity to attend (with as little expense to themselves as the company can afford) at least the local or State conventions. It would be wisdom also if the smaller and medium-sized roads should give their manager or superintendent an enforced visiting vacation of two or three weeks once a year to allow him to visit as many similar roads as possible and "swap" ideas and "kinks." This can be done in the street railway business as in no other, for, from the almost universal non-competitive isolation of each road there is less jealousy, secrecy and "hugger-mugger business" among street-railway men in separate places than in any other profession. As a rule, the average electric-railway manager, superintendent or foreman is delighted to show and explain to some brother-in-sorrow anything and everything in the line of improvements, economies and "kinks" that he has, and to receive in the same broad spirit the mite that is offered in return. But this is not "maintenance!"

Where any operation in repairs, renewals or replacements has to be often repeated it pays to use a "special" tool, apparatus, appliance or method for doing it. To thump off a commutator, pinion, collar or wheel with a sledge or piece of old rail, to pry a car body off its trucks with a piece of timber or a single jack, to lift or lower a motor with crow-bars or treacherous rope-pulleys, to "line-up" car axles "by sight," to adjust brake-shoes and brake-rigging "by guess," to measure wheel circumferences with an advertising yardstick, to take off nuts (and also their corners and some skin from the knuckles) with "whopper-jawed" and misfit wrenches and pipe-tongs, to roll armatures and drag fields over the pit and barn floors with their accumulation of oil and dirt, to lift and handle them by "main strength and ignorance," to ream out holes with a flat chisel or the shank of a file, to force a fit with a draft-pin and a lot of shims, to do a thousand and one things without the proper facilities, simply because those facilities cost a little money, *may* be a "saving," but it is not economy. In years past, when there were none—or but few—special tools or appliances for maintenance operations, when experience had not even shown us what was needed, when any such thing made had to be virtually created by the superintendent and a local machine shop, there was some excuse for their absence. At the present time, however, when the experience of ourselves and others has shown us what is really needed and what is best; and when we can, in nearly every case, obtain such things ready made, of the best quality, most conveniently and compactly arranged and at very reasonable prices, there is no excuse for any road, however small and unremunerative it may be, continuing the "main strength and ignorance" methods of its early days. Chain-hoists, both fixed and traveling, and of any speed and power, jacks of all sizes, powers and kinds of power application, screw and hydraulic presses from a few pounds to many tons capacity and of all sizes from the "vest pocket" up, special trucks and carriers that enable a man safely and easily to carry anything anywhere, ratchet, pneumatic, electric or hydraulic drills and attachments that allow a hole of any needed size to be drilled, reamed or tapped, and in any location or position, fixed and adjustable wrenches of every size and shape and capable of tightening, loosening or holding any shape of nut or bolt, combination sets of taps, dies, reamers, etc.—all these are now on the market and may be obtained at such reasonable prices that it simply does not pay any road to be without some of them in certain of its repeated operations. It is not only that the time actually saved by their use will always pay good interest on the investment, no matter how cheap the rate of wages paid, but the ability to do the work quickly very often means a large reduction in the loss of fares and shortage in equipment, especially during rush times and on the smaller roads which are generally at a disadvantage on the point of extra equipment. The use of competent facilities also guarantees more thorough and lasting work on the part of both machines and men, and consequently less later re-repairs and renewals.

Not only should there be every possible convenience consistent with remunerative return on their use, but there must be for such a place where they can be safely and easily stored or placed when not in use and where they can be easily and quickly obtained for use by the proper person or persons. To guard against their abuse, misuse, mislaying or loss, that place should be so arranged as to show at once and at a glance to the foreman or person in charge, whether the article is in its place and in proper condition, and, if *not,* who is responsible for its absence or condition. Where a "tool room" is fully maintained, or where regular men do regular work and are regularly furnished with certain tools or appliances, this part is taken care of, but with the size or road under discussion a tool room or a full force of regular workmen in all departments is a rarity and generally a financial impossibility. In such cases the foreman and his inspection and discipline must be largely relied on for results, and he may be greatly aided in obtaining such results by a few simple expedients. The principle of such expedients is that the absence and—if possible—the condition of every tool and appliance should be plainly visually indicated, as should the identity of the person who is responsible for its absence or condition. The first condition may be very fairly fulfilled by arranging all tools and appliances in fixed places and in such a manner that their absence from that place will quickly appeal to the eye. In the case of hand tools or small devices which may be hung or fastened on a wall or board, their absence from their place may be shown as a facsimile outline in some bright-colored paint, or by the word "out" painted on the board in such a position that it will be covered when the tool, etc., is in place. The outline or facsimile is the better, as it not only shows that an article is not in its place, but it shows *which* article is not in its place and there is then no chance of a dissimilar article being substituted, as might be the case where the word "out" is used. Articles which are too bulky, heavy, or of a shape which will not allow them to be hung, should be placed on shelves or in bins or pigeonholes so arranged that a flap or leaf giving the name of the article will be in plain sight whenever that article is absent.

The second condition, that as to the condition of the tool or appliance when it is returned to its place, can not be fully complied with in all cases and here the inspection and discipline of the man in charge will have a chance to assert itself. With the most careful men and management, excusable accidents will happen at times to tools, apparatus and appliances, and a foreman who knows his business should have no difficulty in locating the blame—or lack of it—when informed of the circumstances. If he knows how to select and handle his men and is reasonable in his demands as to the care of tools, etc., used by them, it should be sufficient that every man be required to report to him at once any damage done by them to the tools, etc., with an explanation of the occurrence. If neither the foreman nor the men have arrived at such a point where this may be securely trusted to be done, it will be well to require every

man to exhibit the tool or appliance to some person in charge, before replacing it.

To obtain the third condition, that of fixing the person responsible for its absence, the tool-room check method is probably the simplest and most efficient if it is fully carried out. This method is simply that of having each man leave on a hook, near, or in the exact place of each article, a brass check on which is a number peculiar to that man for that day. These checks, on a ball-end keyring which will allow them to be quickly taken off and on, should be issued every morning in a certain specific number to each man and that full number of properly numbered checks should be returned by him when leaving for the day. To avoid offering unnecessary temptation, it is well to give a different numbered check to each man every day and to have the checks struck on a private and ornate die with the initials or name of the road on it and the figures large and plain, it having been found that where the checks are plain and easily counterfeited that some unscrupulous workmen have found it easier to counterfeit a fellow-workman's check and put the onus of a missing tool on him than to own up to their own fault.

There are, as is easily seen, grave deflects and shortcomings to this system. It is not, however, offered as a perfect one, but where it is impossible to have one person in entire charge of the tools and appliances, it is a long way better than no system, and if fully carried out will greatly aid in keeping those articles in their places when not in use. If any reader has in practice—or in theory—a better system, the writer (and many readers) would be glad to learn of it.

Next to the locating of tools within one shop or work room comes the segregating of tools and appliances when there are several departments or work rooms for them. A cold-chisel is a cold-chisel whether it is used around the trucks, on the track, on the line, in the machine shop, the winding room or the carpenter or paint shops, and unless it has, or is given, a distinct identity it is apt to become naturalized in a foreign shop on short notice and without chance of recall. To "pinch" a tool from another shop or department is not only a venial sin, it is a commendable act in many workmen's eyes, and is on the principle of "massa's chicken for massa's nigger;" it is regarded as merely robbing Peter to pay Paul, but it nevertheless leaves Peter—and his employer—at a disadvantage when the cold-chisel is badly needed. Quite a number of roads prevent such relocation by giving each shop or department a separate and distinct color and letter or letters, everything paintable in each shop being fully covered and kept covered with its color, while everything not paintable is deeply branded, punched and stamped with its letters. This serves as a ready means of identification both at home and abroad, saves disputes, tools, time and temper, and, besides, the paint preserves the things it is on, and many things thus get painted which otherwise would not.

Tramways in Switzerland

Official statistics of the Swiss tramway systems for the year 1899 shows that thirteen roads were in operation. The total length of track was 175,816 km (109 miles) with 299 cars. The interurban electric lines, of which there are three operated by electricity, are not included in this list and have a total length of 29.86 km (18.3 miles). There were also 23 km (14.26 miles) of mountain roads operated by cable with electric motors or water balance.

Convention of the Street Railway Association of the Rhineland District

The forty-seventh general meeting of the United Street Railway Superintendents of the Rhinelands, Westphalia and the Neighboring Districts took place at Aachen, on June 7. The good work done by this body has frequently been referred to in our columns, and has been made possible by frequent meetings and large attendance, due to the short distances by which the members are separated from each other. Below will be found the various topics discussed and the digest of the discussion.

What means for lessening the noise of street cars at curves have so far been found successful? All speakers agreed that before grease and other means are employed for the lessening of noise the causes of the trouble should be discovered. Of these there are several. There is, firstly, the unavoidable grinding of the wheel flanges in the rail grooves (in Germany the grooves are from 28 mm to 30 mm wide, and of the same depth). Then there is the binding due to any widening or narrowing of the gage. The wheel flange may not have the right shape. Furthermore, the outer rail at the curve may be raised too much.

One speaker gave an entirely new explanation for the "whistling." He said that upon close investigation two distinct noises can be heard. One is the "screeching" which is caused by the friction of the wheel flange against the rail, and the other the "whistling" which, in his opinion, is due to a vibration of the wheel, and is especially noticeable when the axles are of very small diameter. He claimed that perhaps the inner wheel rolls properly along the curve, but that the outer, which has a greater distance to travel, is held back. This will twist the axle, if it is small enough. As soon as the torsion has attained a certain degree, then the wheel which was held back will jump forward, and so on. How often this happens can be accurately determined by the pitch, as a physical law tells us that each pitch corresponds to a certain number of vibrations.

The observer also found that the "whistling" stopped as soon as a heavier axle was substituted. This explanation, which appears to be quite novel, deserves careful consideration, because it appears to be one of the most frequent causes of the noise which can easily be remedied.

It was further pointed out that solid plate wheels, formerly used in Germany, gave a whistling far more noticeable than the forged spoke wheels, with tires shrunk on, which have lately been exclusively employed.

Another method of reducing the noise pointed out was that which has been in use in Hamburg for a number of years, and which not only reduces the noise, but reduces the power required in rounding of curves. On all curves of short radius the groove of the outer rail is not made of full depth, but is only 8 mm deep, so that the wheel flange runs almost on top of the rail, and the outer wheel, for the same number of revolutions, travels a greater distance than the inner one. The fear has been expressed that this method does not insure sufficient guide for the wheel, and that the car, therefore, could be more easily derailed. The Hamburg delegate, however, stated that the method had proved perfectly satisfactory, and that the Hamburg public had never complained about noise at curves. No derailments, due to this method, had been reported, although more than 100 million car-km had been traveled over these curves. He stated that the axles were quite heavy, and that only forged wheels, with very low flanges, 15 mm in height, are used.

Formerly the groove of half depth was used in Hamburg only on curves having a radius up to 50 m, but it was found that the tires of the wheels wore off more than the flanges. Lately, therefore, the thoretical limit has been reached where the increased wear of the outer wheel corresponds exactly to the greater distance of the outer rail up to a 75 m radius. Now the flanges wear in the same ratio as the tires of the wheels under the existing conditions.

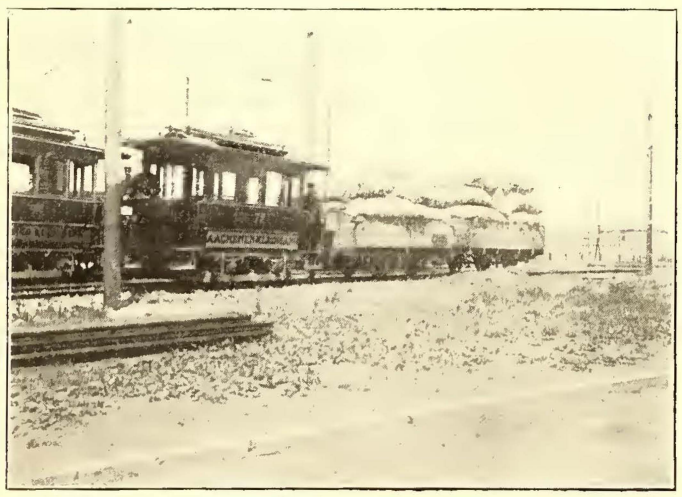
On other roads on which the causes of the noise could not be discerned or remedied, water and grease were employed. Water, besides being efficient, cheap and clean, does not injure the rubber tires of bicycles. Next to water, grease and graphite have given good service. In Frankfort each curve is lubricated two or three times daily. Some roads grease the wheels by means of ropes soaked in fat and graphite, the motorman lowering the rope so that it touches the wheels as soon as he nears a curve.

It was decided that each manager should investigate the causes of the noises on his road, and that the matter be again discussed at the next meeting.

The next topic discussed was, what regulations had been adopted in respect to compensation offered for lost commutation tickets. It seemed to be the unanimous opinion that tickets of considerable value should be replaced, but opinion seemed to differ in regard to tickets of less value, *i. e.*, tickets worth from M 3 to M 10. All

the delegates agreed that as much difficulty as possible should be placed in the loser's way, so as to make him more careful in the future, and make him take another look around to see whether he could not find the missing ticket. It is obligatory, for instance, for the loser to show a newspaper clipping, giving his name, and offering a reward to any one who might return the ticket. Furthermore, the loser must pay the company M 2 damages.

The next topic discussed was at which points free transfers should be issued. It seemed to be the universal opinion that the transfer system is a necessary evil, which can not be abolished after once it has been introduced. On the other hand, all means should be adopted to prevent fraud on the part of the public. It was found in Leipsic, where the public asked the company to abolish the rule that a transfer was only valid for one hour, that the workmen rode to their work on one line in the morning, and



VIEWS OF THE AACHEN STREET RAILWAY

(Taken During the Convention.)

returned on a parallel line in the evening with the same ticket. It is, therefore, necessary to designate definite transfer points, and the time for which it is valid (not more than one hour).

The method of formulating annual reports was the next topic discussed, and the wish was expressed that all roads accompany their annual reports by a map of their system, so that better judgment may be formed as to the value of the figures presented. It was also voted desirable that all roads present their annual reports and statistics in a uniform manner, so as to make it easier to make comparisons between the various roads. One delegate pointed out that this desire was not a novel one, but that Director Röhl, of Hamburg, made a plea for a uniform method of bookkeeping, at the International Street Railway Congress, held at Vienna in 1890. It was shown then that the plan was difficult of execution on account of the desire on the part of the banks to whom the annual reports had to be submitted to have the reports presented in a certain manner.

It certainly would be very beneficial if, regardless of the fact that financial institutions insist on certain methods, the railway companies should prepare uniform statistics for their own use, so that valuable comparisons might be made. It was decided to attempt the inauguration of a uniform system.

Regulations for the "Prevention of Earth Currents" was the next topic discussed, and former discussions and papers dealing with this subject were referred to. It was decided to make the attempt to have more street railway men elected on the committee of the Elektrotechnische Verein, so that the street railway interests might be better protected.

The next topic discussed was the removal of snow, and several delegates told of their experience with snow plows, and it was shown that for German conditions, where snowfalls are very light, that ordinary track brushes were quite adequate, if they are put into service soon after the snowfall, and are kept in action continuously. Favorable results have also followed the use of snow drags. These can only be used, of course, when the snow is not higher than the bottom of the motors. The best results were obtained at great speeds. With heavy falls, however, neither of these devices is adequate. Since the general introduction of electricity the municipalities, in most cases, have been responsible for the removal of the snow. Several roads, however, such as that in Breslau, have regular snow plows.

The question of accidents, premiums and damages was next taken up, and the complaint was made that the accident insurance companies demand excessive premiums. According to the German law all railway companies are *prima facie* responsible for all accidents caused by their cars, and the burden of proof is on them to prove the negligence of the plaintiff. For example, if a mother, carrying a child on her arms, should fall while she is boarding a car, and the child becomes injured, the company must pay for the support of the child, because it can not prove that the accident was due to the child's own negligence. Since electricity has been introduced accidents have become more frequent, and while formerly the insurance companies demanded .25 to .4 per cent of the receipts from passenger traffic as a premium, now they demand 1.0 and more. Large companies have, therefore, started accident insurance funds of their own.

The next topic discussed was that of a combination for the purpose of reducing the cost of coal, oil, etc., but no definite plan was formed. The matter will be discussed again at the next meeting.

Finally the delegates discussed the matter of publishing replies to public grievances, and the wish was expressed that such newspaper replies be sent to the various roads, so that they might all profit by the proceedings of any one road in such cases.

The next meeting will be held in October, 1901, at Mannheim. After the meeting the fifty delegates visited the shops and car houses of the Aachen Street Railway Company, on which road passengers and freight are carried, and which is very complete and modern in every detail.

Earnings of the Paris Metropolitan Railway

The Paris Metropolitan Underground Railway has been steadily extended during the last twelve months, and there are now three lines in operation. The first and oldest of the three, which is 10.633 km in length, and which crosses Paris from east to west, was put in operation July 19, 1900. The total number of passengers transported from Oct. 2 to Dec. 13 was 15,890,528 and the total receipts f.2,694,562.42. It is thus seen that the Paris road ranks in traffic with the largest city lines in the world. The operating cost was 42 per cent of the gross receipts, and on the paid-in capital of f.25,000,000 a 6 per cent dividend has been declared.

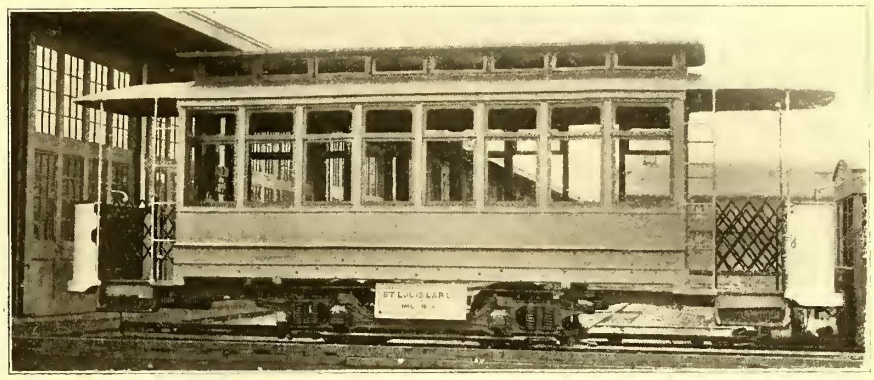
The good results secured induced the company to build the belt line No. 2, 10.5 km in length, which leads from the Place dc l'Etoile to the Place de la Nation, and on which construction was begun in October, 1900. At the close of 1900 the company owned 125 motor cars and trailers. Thirty-four trains were run at intervals of three minutes until 8 o'clock at night, and consisted usually of one motor car and three trailers. It was soon found that these lines, which were capable of transporting 4000 passengers per hour in each direction, were inadequate to handle the traffic, and the company decided to increase the capacity of the existing lines by running eight-car trains. These trains are 72 m in length, the greatest length permitted by the charter. Each train is propelled by two motor cars, each equipped with two Westinghouse motors of 200 hp each. The train crews work for twenty hours in two shifts. A full description of this line was published in the Street Railway Journal for September, 1900.

St. Louis as a Manufacturing Center in the Street Railway Industry

In a general survey of the cities in which the apparatus used on the street railway lines of this country is manufactured, St. Louis stands out perhaps more prominently than any other for the variety of its strect railway products, as well as the extent to which one particular industry, that of car building, has been carried on. This has been brought about by several causes, such as the natural advantages of the city in its nearness to the lumber, particularly the hardwood, market, its cheap fuel and its convenience as a distributing center for the West and Southwest.

The value of the street cars manufactured in the city last year, according to the latest accessible reports, was in excess of $10,000,000, and the output this year will run beyond that amount. The amount of capital represented in this industry, according to the most reliable authority, is over $5,000,000, giving employment to over 2500 men, and paying out over $1,500,000 annually in salaries.

Cars to suit all tastes, both foreign and domestic, are being put together beneath the roofs of the large factories here (one of which is admitted to be the largest in the world), the combined area of which is about 40 acres, and the total average output being about 3900 cars. One factory, that of the St. Louis Car Company, it is said, turns out 1800 cars a year, or at the rate of six each day. As the average length of these cars is about 30 ft., the cars manufactured in St. Louis, if placed end to end, would reach in the neighborhood of 22 miles.



CAR FOR BERLIN, ST. LOUIS CAR CO.

CAR BUILT FOR MEXICO, ST. LOUIS CAR CO.

Every city of importance in the United States, and many large cities all over the world, are using St. Louis cars. A list of cities in which cars of St. Louis manufacture can be found would include London, England; Leeds, England; Berlin, Germany; Stuttgart, Germany; Bordeau, France; Aguas Calientes, Mexico; Guanajuato, Mexico; Leon, Mexico; Mexico City, Mexico; Buenos-Aires, Argentina; Dublin, Ireland; Windsor, Canada; San Juan, Porto Rico; Honolulu, Hawaii; Port-au-Prince, Trinidad; Sydney, Australia; Odessa, Russia; Cape Town, Africa; New York City; Philadelphia; Chicago; Boston; Washington, D. C.; New Orleans, La.; Atlanta, Ga.; Milwaukee, Wis.; St. Paul, Minn.; Baltimore, Md.; Minneapolis, Minn.; Denver, Col.; Salt Lake City; Louisville, Ky.; Racine, Wis.; Duluth, Minn.; Shreveport, La.; Peoria, Ill.; Fall River, Mass.; Brooklyn, N. Y.; Cincinnati, Ohio; Omaha, Neb.; Nashville, Tenn.; Dallas, Texas; Pittsburgh, Pa.; Houston, Texas; Los Angeles, Cal.; Hot Springs, Ark.; Lincoln, Neb.; Dayton, Ohio, and Leavenworth, Kan.

Besides being a large producer of street cars, St. Louis is also an important electrical manufacturing center, and has a wide reputation for the excellence of the boilers, engines and other steam appliances. Many of the largest sheet metal, tobacco and brewers' establishments in the country, if not in the world, are located here, while all of the important manufacturers have large agencies and distributing points.

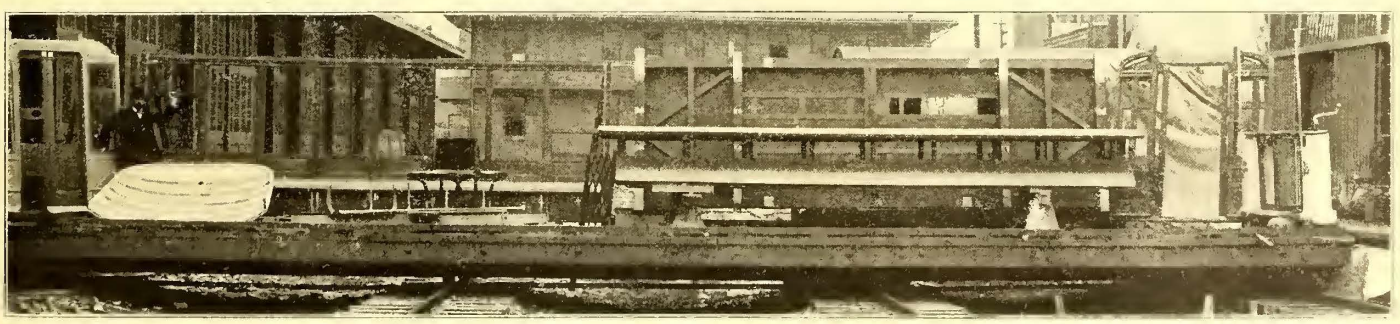
THE ST. LOUIS CAR COMPANY

Anyone desiring to impress the layman with the size and importance of the street railway industry in the United States and abroad, could not do better than to take him to the works of the St. Louis Car Company, at Baden, in the northern part of St. Louis. This company owns 37 acres of land, of which at least 15 acres are covered by buildings.

The erecting shop alone is 960 ft. x 2400 ft., making it possible to have under construction at once an enormous number of cars. These erecting shops have just been added to by the completion of an addition 400 ft. x 400 ft., and the company is preparing another addition 250 ft. x 280 ft. On Jan. 1 last a foundry 360 ft. x 420 ft. was completed for the manufacture exclusively of the new spiral journal boxes which are proving very popular. This bearing has the main wearing part phosphor bronge, lubricated with babbitt metal.

There are 10 miles of track altogether in the grounds, and all of this is operated over by a 50-ton electric locomotive belonging to the company. At every turn one is impressed with the arrangements for handling large quantities of material with a small amount of labor, and after visiting the works it is not hard to understand this company's ability to compete successfully on large contracts.

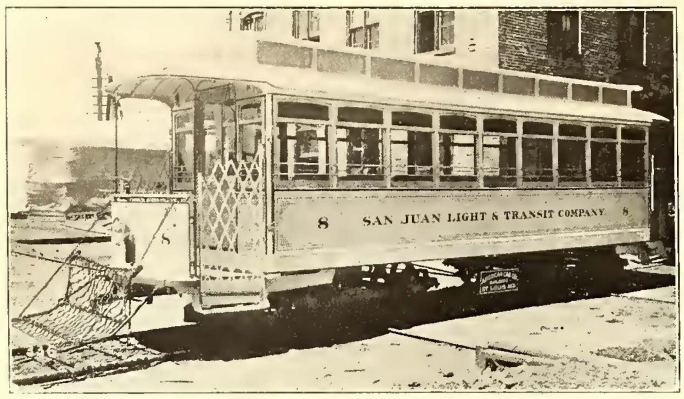
Foreign business is becoming an important proportion of this company's output. Some of the recent foreign orders are 250 cars for Buenos-Aires, Argentine Republic; 50 cars for Germany; 12 cars for Holland; 14 cars for Russia; 75 for Lisbon, Portugal; 45 for Mexico. Some recent cars built by the company are shown herewith.



BERLIN CAR DISSEMBLED AND READY FOR SHIPMENT

The first view shows a double truck first-class passenger car, adopted by Compania de Ferrocarriles del Distrito Federal de Mexico. The body is 25 ft. 4 ins. over corner posts, 34 ft. 4 ins. over all, and 8 ft. 2 ins. wide. It has a vestibule on one end, one entrance at the front end, and double entrance on rear end. The

rear platform of the dash is cut for access to the trail, or second-class car. The car is straight sided, sheeted up with tongued and



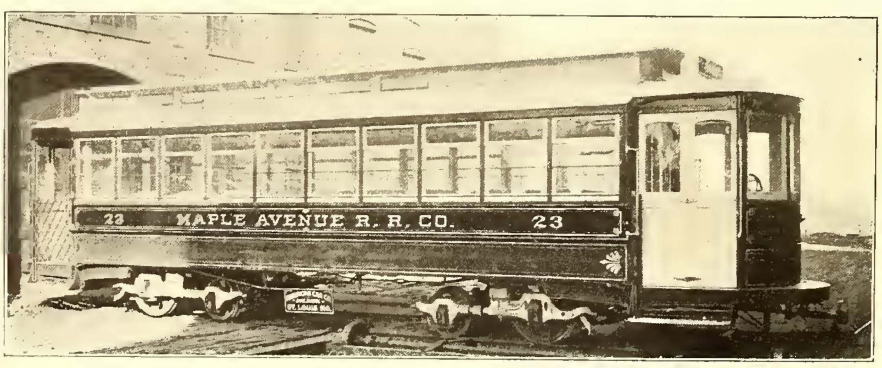
CAR FOR SAN JUAN, AMERICAN CAR CO.

grooved material, and covered with sheet steel, as this is found to be the most satisfactory panel in southern climates. There are nine sash on each side. The bottom sash is arranged to drop. The interior finish of the cars is cherry, with bird's-eye maple ceilings.

The cars are equipped with the St. Louis Car Company's "walk-over" seat, with new style handle, pantasote curtains, bronze trimmings, mirrors, etc. St. Louis Car Company's ratchet brake wheel is employed on the front platform. The cars are also equipped with Christensen air brakes.

The St. Louis Car Company is now building, in addition to twenty first-class cars, which have been sent to Mexico, ten first-class cars, ten second-class cars and twenty 18-ft. box cars, similar to the first-class cars.

The second engraving shows a single-truck convertible car, recently adopted by Berliner Strassenbahn Gesellschaft, of Berlin, Germany, as standard. Both sash drop flush with the arm rail, after which the opening is covered up with a flap. The company will build 200 of these cars for the Berlin company. The interior finish is fancy antique quarter-sawed oak,



CAR FOR ELMIRA, AMERICAN CAR CO.

with head-linings of the same material, and the seating arrangement is made up of double back to back seats on one side, and single back to back seats on the other, with center aisle. The trimmings are of bronze, and cars are provided with registers, etc.

The other view shows this same type of car in dissembled condition, showing how material is taken apart and shipped for export. The view shows side of car, bottom of car, bonnet, platform, seats, etc.

THE AMERICAN CAR COMPANY

The American Car Company, whose works are located at 1501 Old Manchester Road, St. Louis, and which is the second car manufacturing company, in size, in the city, was incorporated in 1891, and the following well-known business men compose its officers: W. Sutton, president; T. Papin, Jr., vice-president; E. Alexander, secretary; G. L. Krippenberg, corresponding secretary, and L. H. Tontrup, treasurer.

Its plant covers an area of a little over 9 acres, and has a complete outfit for the manufacture of the very best of cars.

When running at its full capacity it can turn out from 1000 cars to 1100 cars each year, and when working at its limit gives employment to between 400 and 500 men.

The various departments cover the following area: Paint and erection shop, 150 ft. x 300 ft.; building shop, 150 ft. x 150 ft.; varnish room, 100 ft. x 150 ft.; carpenter shop, 150 ft. x 150 ft., and mill, 150 ft. x 200 ft. These are all located on the same side of the railway tracks. On the other side are situated the machine shop and blacksmith shop, covering 150 ft. x 200 ft., and the boiler and engine room, 75 ft. x 100 ft. The value of the cars turned out last year amounted to between one million and a million and a quarter dollars.

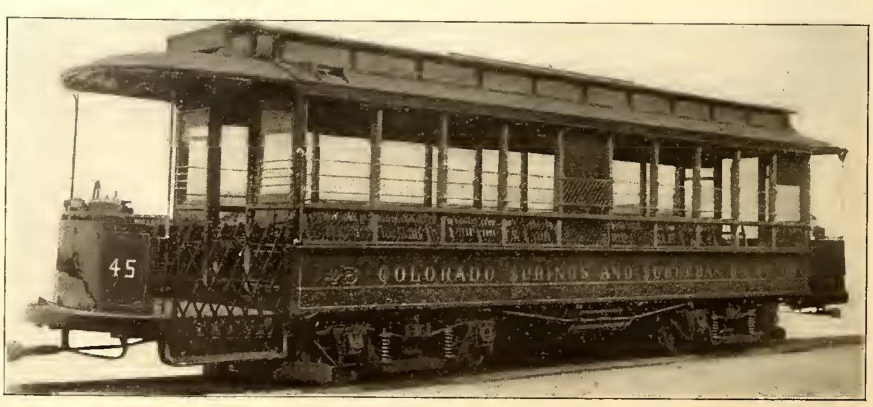
During the past year cars were built and shipped to the following points: New South Wales, Australia, Porto Rico, Honolulu, Hawaiian Islands, Phœnix, Ariz.; Los Angeles, Cal.; Shreveport, La.; New Orleans, La.; Durango, Col.; Norfolk, Va.; Richmond, Va.; Brooklyn, N. Y., and the City of Mexico, Mexico.

Among the latest improvements in patents of this company are a new single motor truck, and also a new double-pivoted bolster truck, with a solid steel frame. The works are now running full time, but not at their fullest capacity. In a short time, however, they are expected to be working to their limit, as there is a great

CAR FOR BUFFALO, AMERICAN CAR CO.

deal of work soon to be placed on the market, and which the company expects to get its share of. The American Car Company not only manufactures regular standard cars, but also a number of specially designed cars.

Some sample cars built by the American Car Company are illustrated in the accompanying views. One of these illustrates a long double-truck car, with cross seats, supplied to the Maple Avenue Railroad Company, of Elmira. The car seats forty passengers. The sash is made in two parts, with extra low main panel, so that in summer a practically open car is secured. The second engraving illustrates a handsome double-truck closed car of somewhat different pattern, built for the newly opened Buffalo & Depew Railway, and intended for high-speed interurban service, while the third illustration shows a double-truck electric car, of which a number have been shipped from the American Car Company's works to the San Juan Light & Transit Company, of San Juan, Porto Rico, and which has recently commenced operation by electric power.



CAR FOR COLORADO SPRINGS, LACLEDE CAR CO.

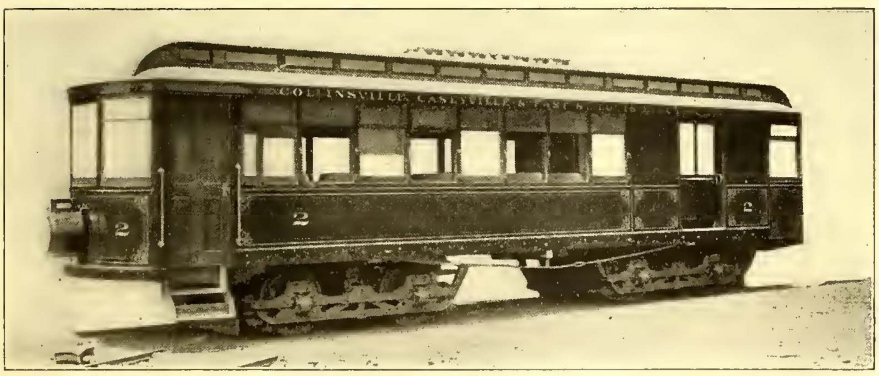
THE LACLEDE CAR COMPANY

This company was organized in 1883 by James P. Keily and Thomas F. Colfer, and soon took a front rank in the construction of street cars. The business has been one of constant growth, especially since 1891, when the company was enlarged, and secured the services of Edward I. Robinson, as vice-president and general manager of the company, and Abe Cook, as secretary and purchasing agent. Mr. Robinson's business takes him in all parts of the country, as the outside representative of the company, for whom he has secured a large number of orders. These orders have come from all sections of the United States, and the company, although located in St. Louis, has been particularly fortunate in securing a very large Eastern trade, particularly in Philadelphia, Cincinnati, Pittsburgh and New York. Most of this business has been given not in one order, but in many orders, indicating that the cars previously supplied had given excellent satisfaction.

The company's shops are located in North St. Louis, between Broadway and the river, in a section where the railway facilities are practically perfect. The buildings consist of no less than eighteen or twenty shops. In addition, the company has an extensive lumber yard, covering some 26,000 sq. ft. of ground, in which is kept a large stock of selected lumber of all kinds, thoroughly seasoned by the air and sun for many months before used.

Some recent cars built by the company are shown herewith. The first two views show open and closed cars, built for one of the Colorado lines. The closed car is 30 ft. long over body corner posts, and 42 ft. over vestibules. The extreme width is 8 ft. 2 ins., and the height from track to top of roof is 11 ft. 7 ins. The interior finish is of quarter-sawed oak, of modern design, with ceilings of quarter-sawed oak veneer, neatly decorated in gold.

Each car is provided with twenty Hale & Kilburn No. 80¾ walkover seats, upholstered in rattan, ten seats on each side, with an aisle in the center. The two end seats on each side are placed longitudinally. All windows are supplied with spring roller curtains, made of pale green Pantasote, with neat gold design printed on inner face, fitted with Burrowes No. 83 curtain fixture. The doors at ends of car are very large, and the open side of vestibule is supplied with double folding doors. A Hunter illuminated sign is placed on the hood at each end of the car. The car is also fitted with Wagenhals arc headlights, Consolidated electric heaters, International fare registers, and Robinson's sand boxes. The



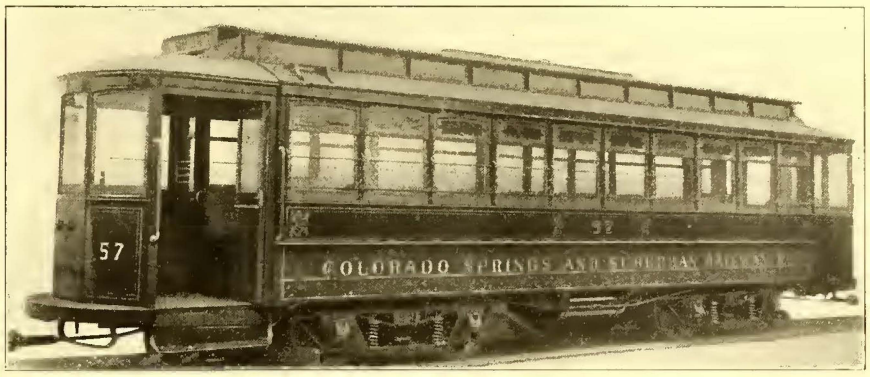
CAR FOR EAST ST. LOUIS, LACLEDE CAR CO.

side windows are protected on the outside with wire guards, extending the full length of car. The car is also equipped with Christensen air brakes and latest improved hand brakes, also fenders of the Lawton type.

The exterior of the car is handsomely painted and ornamented, the upper part being of a light olive green, and the lower panels yellow. The numbers and ornamentation on the upper panels and vestibules is in gold, and the lettering and striping on bottom panels is in aluminum. The trucks are of the M. C. B. type, with draw-bars of the Van Dorn pattern.

The open car for the same company is of the same general design and finish as the closed car, except that it has open platforms. There are no sash at the sides of car, and in place of the main panel there are wire guards. The seats are of ash, eleven on each side, and placed crosswise.

The car built for the Collinsville, Caseyville & East St. Louis Electric Railroad Company has a 32 ft. body, and the total length is 41 ft. 6 ins. The extreme width is 8 ft. 4½ ins., and the height from track to top of roof is 11 ft. 10 ins. This car has a baggage and express compartment at one end, 10 ft. 7 ins. inside, leaving the passenger compartment 22 ft. inside. The baggage compartment has a door at each side, 6 ft. wide, a single sliding door leading into vestible, and a single door in partition between compartments. The vestibules are enclosed at one side, and are provided with folding doors on the opposite side. These doors can be removed, and folding gates used instead. The roof of car is of the steam coach style, with fourteen ventilators at each side. All windows and vestibules have two sash, the upper being stationary and the lower made to drop flush with arm rail. The middle window in vestibule fronts have only one sash. The side windows in the car are fitted with hinged casings at the arm rail.



CLOSED CAR FOR COLORADO SPRINGS, LACLEDE CAR CO.

to cover the opening between the arm rail and the inside lining, both when sash are up or down. All curtains are of Pantasote, with gold star design, and are fitted with Acme fixtures.

The interior finish is of cherry throughout, with bird's-eye maple ceiling and trimmings of solid bronze. The car is fitted with eight Hale & Kilburn 80¾ rattan covered walkover seats on each side in the passenger compartment, and hinged wooden seats in the baggage compartment. The car is equipped with Consolidated electric heaters, New Haven fare registers, Wagenhals arc headlights, Robinson's sand boxes, hand brakes, with vertical ratchet wheel, and draw-bars of the Van Dorn design.

OTHER STREET RAILWAY MANUFACTURERS IN ST. LOUIS

Although the St. Louis industries already mentioned are entirely those pertaining to rolling stock, it is an interesting fact that in many other departments of electric railway work the St. Louis manufacturers have gained a prominence which is second to none in any other city. This has been particularly pronounced in the manufacture of steam engines, boilers and steam accessories. Thus, prominent among the boiler builders of the country are the Heine Boiler Company and the John O'Brien Boiler Works, while among the engines manufactured for street railway service are those of the St. Louis Iron & Machine Works and the Fulton Iron Works, both well known for the excellence of the machines turned out by them.

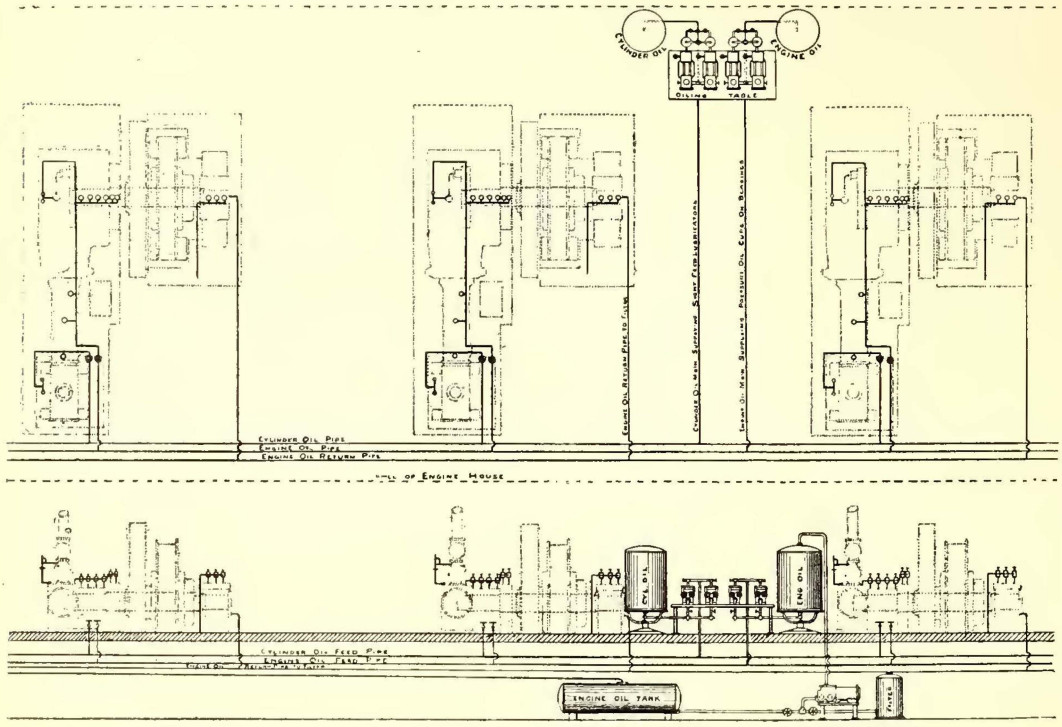
Heine boilers have not only been used extensively in St. Louis, but in all parts of the country. The company always makes an interesting exhibit at street railway conventions, and for the ease with which the boiler pipes can be cleaned, the excellence of the circulating system, and for its quick steaming properties, the boiler has won a deservedly high place among steam users.

The boilers of the John O'Brien Boiler Works have up to this time, perhaps, not gained the prominence in electric railway practice which their value deserves, largely because the company has been so busy in other branches of steam service that no special bid has been made for street railway work. Boilers, however, are to be used in the new work of the St. Louis Transit Company, and have been employed by other railway companies, so that the future extended use of this type in electric railway service seems assured.

The St. Louis Corliss engine, as made by the St. Louis Iron & Machine Works, has also won a deservedly high reputation for heavy duty service. The extensive works of this company were visited by many attendants at the St. Louis convention five years ago, since which time the company has increased its business, and is now receiving many orders from street railway companies.

The Fulton Iron Works also supply an engine which has been widely adopted by steam users, and has given excellent service where employed. Engines are built of all sizes.

Another industry which has made St. Louis famous among builders of steam plants is that of the Siegrist Lubricator Company, by which the work of the station engineer has been greatly lightened and the certainty of delivery of oil to the bearings of the engines and other machinery is assured. References have been published of the use of this device in prominent power stations, but a few words of explanation here will not be out of place. The center of the lubricating system is an iron table highly japanned, on which are mounted four specially made duplex pumps connected in pairs, two being used for the engine and two for cylinder oil. On the steam chest of each pump is placed a specially made governor, which controls each pump automatically. There is a gage each for the engine and cylinder oils, allowing the engineer to see that the same pressure is maintained at all times, and from a distance. A ¼-in. pipe for steam will operate the system, and on this pipe is a gage. Only one pump for each oil is used at a time, the others being held as a reserve in case of accident, or to repack the ones in use. Either pump can be thrown into service in a second by a valve. All the piping on the table is of highly polished brass, giving it a fine appearance. The piping from the table and the four legs are brass, and run through the floor. When the table is once started it requires no attention from those in charge, as governors control the pumps, no matter how much or how little oil is being used, and the same pressure is maintained on the oil line that the governors are set for. If no oil is being used, the pumps stop of their own accord, though the governors keep the same pressure on the oil line; when one engine is started, the pumps work fast enough to supply the oil, still keeping the pressure the same, and so on with one or several, with the same results. The diagram shows a plan and elevation of a portion of a modern power house with the oiling installation indicated in solid lines.



SIEGRIST AUTOMATIC LUBRICATING SYSTEM—DIAGRAM OF INSTALLATION

Reference has been made so far only to steam apparatus, but St. Louis is also an important electrical center, not so much for the manufacture, but for the distribution and sale of electrical supplies. The immense territory supplied from St. Louis, covering the West and Southwest, as well as a very large portion of the Middle West, has led to the establishment in the city of large supply companies, who are in close contact with the manufacturers of those articles which they themselves do not make. As they carry a large stock of these materials, this enables them to promptly fill all orders for electrical goods. One of the largest of these is the Western Electrical Supply Company, which through good business methods and the establishment of close connections with manufacturers, does a large business in railway supplies. This company publishes a large catalogue, which is a veritable encyclopædia of railway appliances, and from which the purchasing agent can select everything which he needs in the line of supplies. Another prominent supply house is that of Arthur S. Partridge, which has also secured the agency for some of the best and most extensively used railway supplies manufactured. The Wagner Electric Company has also a large business, and, although this company confines its manufacturing departments largely to alternating apparatus for lighting work, its close affiliation with the Bullock Electric Manufacturing Company brings it into close contract with railway work. In electric railway supplies, also the Columbia Incandescent Lamp Company has made St. Louis famous for the manufacture of this well-known lamp.

Other industries for which St. Louis is well known are the manufacture of car wheels, registers, lamps and other goods. Among the car-wheel manufacturers the St. Louis Car Wheel Company and the American Car & Foundry Company are, of course, most prominent, while in the line of car registers the St. Louis Register Company is one of the largest and most successful makers of registers.

Another industry which has grown to immense proportions in St. Louis is that of glass making. The Oriel Glass Company, which makes a specialty of bent glass, and which is also located in St. Louis, has the largest exclusive glass-bending works in the world, and its products are extensively used in street railway car manufacture.

American Wire in England

At a recent meeting of the Northern and Midland Counties Association of Tramway and Light Railway Officials, A. L. C. Fell, M. I. E. E., made some very complimentary remarks about the use of American trolley wire in a paper which he read on the equipment of the Sheffield Electric Tramway system. The wire used on this road was made by the Bridgeport Brass Company, of New York, and was of its well-known phono-electric type. Below is given an abstract of Mr. Fell's remarks:

"The most important item in connection with an overhead trolley system is to obtain the very best possible trolley wire. During the last eighteen months copper wire drawers in this country have greatly improved the quality of the wire supplied, but there is still room for great improvement. We have lately erected some patent wire known as 'phono-electric.' So far, excellent results have been obtained, the only disadvantage being that the conductivity is only about 50 per cent that of pure copper, but it only means a little more copper in the feeder cables to make up the loss in the trolley wire, and this is as nothing in comparison to the benefit derived by having the number of broken trolley wires reduced to a minimum.

"On the average it was found that the 'phono-electric' trolley wire gave about 50 per cent greater tensile breaking strength, and withstood about two and one-half times the torsional breaking strain of good hard-drawn copper. The table gives the results of a comparative test made on hard-drawn copper and 'phono-electric' trolley wire."

Table of Comparative Tests of Phono-Electric and Ordinary Copper Trolley Wire.

Sample.	Org. Dim.		Length.	Elongation.	Stress Tons.		Twist in 8 in.
	Dia.	Sec.			Total.	Sq. in.	
Phono	.324	.082	10 in.	.35	2.97	36.22	34.0
Copper	.324	.082	10 in.	.23	2.05	24.86	13.5

A New Semi-Convertible Car

Some particulars were published recently of the Brill semi-convertible cars, but further information is now available. Cars of this type are becoming more and more popular every year. Their use has been extending rapidly, because certain features seem to exactly satisfy the wants of both the street railway men and the riding public. Semi-convertible cars differ radically from the ordinary convertible, and also from the open car. The following are some of the leading features: They have large windows, which come much lower than those of the standard closed or convertible cars. They are provided with cross seats, and central aisle and end entrances only. The windows are usually a portion of the panels, and are made removable.

When a car of this type is wanted for summer service, windows and panels are taken out and stored. This leaves the cross seats and central aisle body with sides so low as to make it, in effect, an open car. The absence of side entrances, of course, makes such a car somewhat slower to load and unload than the regular open car, but there are offsetting advantages. The side panels, although somewhat lower than the usual forms, have great strength, and add stiffness to the car body, at the same time they make it much safer for passengers in case of accident than the open car, pure and simple, with its side entrances. The greater window spaces make them much more satisfactory for summer service than the ordinary box car with the windows open. The window rail is usually almost on a level with the seat.

The new type of Brill semi-convertible car, which is shown herewith, is the invention of John A. Brill. Its appearance, both outside and within, as illustrated in the engravings, will show little departure from standard types. The first car of this kind was built for the Washington, Alexandria & Mt. Vernon Railway. While in course of construction the car was seen by several street railway men, who were so favorably impressed with the design that several orders were placed for same type of car long before the first one was finished and shipped to its destination.

SEMI-CONVERTIBLE CAR, BUILT FOR WASHINGTON

As has been said, its appearance is much like the cars ordinarily used. The windows are much larger, and the window rail is lower, though it does not, however, come quite down to the seat level.

The noticeable feature, however, is that the sash are not removed for storage, neither do they, as in some convertible cars, drop into pockets. The serious objection to this last method of construction and disposal of sash are that the pockets take up valuable room in the wall of the car. This reduces the space in the car body, while at the same time the pockets become receptacles for dirt or refuse, which is thrown into them. This interferes with the handling of the sash. Dirt and moisture also accumulate, and unless the space is ventilated there is trouble from the decay of the wood. When ventilated, however, there are drafts which are uncomfortable for the passenger.

INTERIOR OF SEMI-CONVERTIBLE CAR

In the semi-convertible cars which have been employed in Baltimore and on the Newport, Covington & Cincinnati road the sash and panels have been made movable. This, of course, makes a great deal of labor in taking out and replacing the sash when changing from opened to closed. In making these changes there

is always considerable amount of damage to panels, as well as a certain breakage of glass. With such cars there is also the disadvantage of being obliged to guess at the season as well as the inevitable loss of traffic from having cars in service out of season.

In spite of the objections named, the semi-convertible car has been very popular on city and suburban lines. It has a large and rapidly extending field of usefulness. For long rides it is much more comfortable than the open car, and will be generally considered as a safer car where high speeds are attained. One of the advantages, of no small importance, and one which helps to keep the type in service, is, that when passengers leave they do not disturb those sitting at the outer end of the seat. This is an annoyance to passengers in the usual form of open car having side entrances. The new car differs radically from anything heretofore produced. It has the end entrance and platforms, and the central aisle of the convertible car, and also cross seats. It has the additional and important advantage that it is entirely self-contained. The sash are double, and when the sides are to be opened they slide up into pockets in the car roof, out of sight and out of the way, yet always ready to be dropped into place in a moment. The time and effort required to raise them into the roof or bring them down again is practically less than that required for raising the heavy window of an ordinary closed car.

SEMI-CONVERTIBLE CAR FOR THE BEAVER VALLEY TRACTION CO.

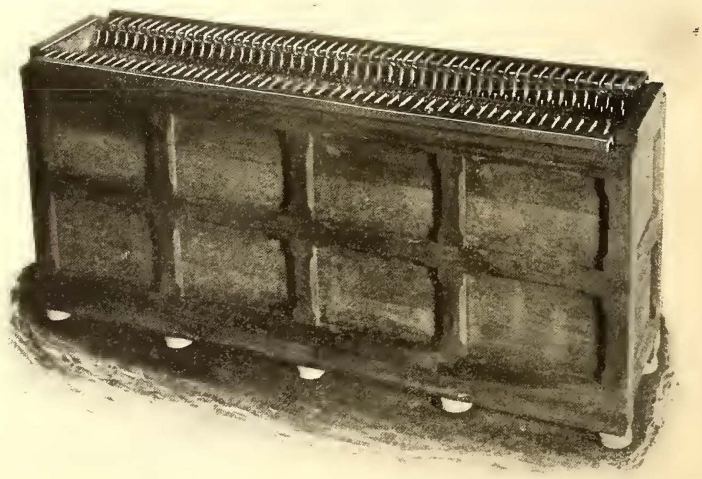
Advantages of this form of construction are numerous. There is no storage of sash, and consequently no breakage. The sash always fits the window, and there is none of the expense of handling and no delay in putting the open cars on in the spring or taking them off in the fall. During every warm day, or even every warm afternoon, they can be utilized as open cars, and the change can be made to the closed form in a matter of five minutes' time, while the car is running on the road.

The features are ingenious modifications of the Brill convertible car. The sash are in two sections, are held in the usual way between the posts by a pair of grooves on each post, into which trunnions on the sash fit. When it is necessary to raise the sash the lower one, after it has been lifted a short distance automatically engages the upper sash, and, carrying the latter along into the roof of the car, deposits it in a pocket, and slides upward till it drops over a switch, by which it is held in place, and at the same time prevented from moving or dropping. When once in the roof both sashes are completely locked, and can not fall. The brass work and mountings are particularly strong and large, and in fact they are of sufficient size to give the hand a firm hold on the sash. The operation of lowering is as simple as that of raising, and is almost precisely the same motion as is used in dropping the sash of an ordinary steam car. There is a slight forward and upward motion, when the lower sash comes down into place, bringing the upper sash with it, both locking themselves fast when in position. The sash can be raised and held by the sash lock at the desired height. This can be done by the passengers, the same as the window of a steam car is raised, as long as the sash is in a vertical line on the post.

The interior of the car is of the ordinary form. The ventilator or monitor deck can be made any desirable width or height. The seats are placed between the posts, and a considerable space is utilized which ordinarily serves no purpose beyond that of forming a pocket for the sash. The lining is set in between the posts, and the ends of the seats come between them in such a way as to make available about 6 ins. greater inside width than in the ordinary car, with flush lining. This 6 ins. can be divided between the length of the seats and the width of the aisles. At the same time this gain of width is made a truss plank is introduced, and on it the end of the seat rests. The truss plank is edged, bolted to the sills, and also screwed to every post; in this way the car has all the advantages of a solid side. In the construction of the roof a very material gain is effected, because in addition to the ordinary rail a heavy letter board is gained upon the posts, so that with this rail and lining, the plate of the roof has nearly as great a cross section of timber as the sill. The roof is also strong.

The Gould Storage Battery at the Pan-American Exposition

The Gould Storage Battery Company, of New York City, which has its works in Depew, N. Y., has a very handsome exhibit of its products in Electricity Building, near the west end. The Gould Company has recently doubled the capacity of its plant, so that it is now in a position to fill orders with promptness, and the interest taken by engineers in the exhibit would seem to indicate that this increased capacity may be considerably taxed in the near future. The principal feature of the company's exhibit is a large cell of battery at one end of the space, which is connected to a handsome switchboard, and can be charged and discharged if desired. This battery is the largest single cell ever made, and the plates which it contains were used in a competitive charge-and-discharge test some time ago at Cincinnati, in which the Gould Company's accumualtor proved its value. The plates are 15½ ins. x 31 ins., which is the standard central station size for this type of cell, but as the battery contains 101 of these plates, its capacity is far greater than any single cell before manufactured. Under actual test the battery has given 2000 amps. for eight hours, or 16,000 amp.-hours, 4000 amps. for three hours, or 12,000 amp.-

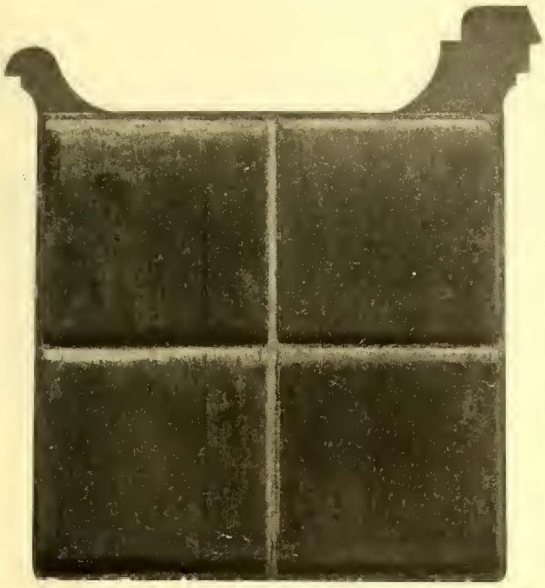


GOULD STORAGE CELL

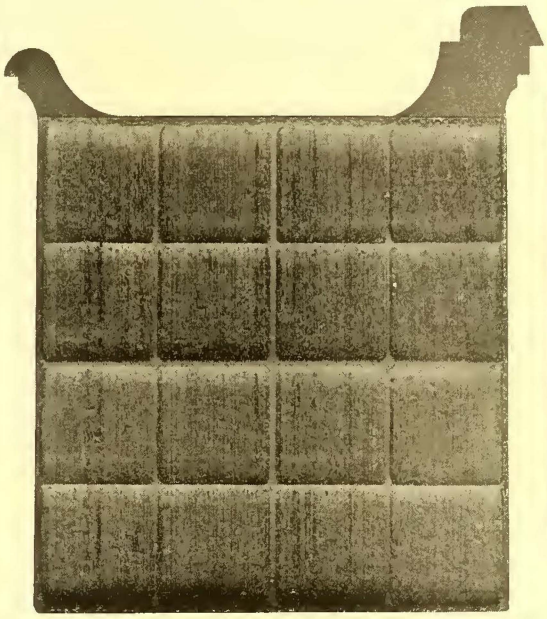
hours, and 8000 amps, for one hour, or 8000 amp.-hours. On a quick discharge 6000 amp.-hours have been obtained in one-half an hour, and 4800 amp.-hours in one-quarter hour. The rates of discharge for the cell for the several outputs, depending upon the time taken to discharge the available energy, are, therefore, on these rapid discharges very high, amounting to 12,000 amps. for the half-hour, and 19,200 for the quarter-hour. The equipment employed to charge and discharge this enormous cell is then necessarily of great current-carrying capacity.. The switchboard by which the cell is controlled at the company's booth is, for this reason, by no means the least interesting part of the exhibit, the massiveness of the copper conductors and their ingenious arrangement for the saving of distance in the connections attracting the attention of all visitors, who are in any way interested in storage battery operation.

The cell itself is handsomely encased in a wooden box, as shown in the accompanying engraving. The massive lead connecting bars, which are seen running down each longitudinal upper edge, and to which the plates of the cell are attached, are bent over into a channel shape, which adds greatly to their strength as well as giving a neat appearance to the accumulator. The plates connected are of the regular electrochemical type, which has been perfected by the Gould Company, in which pure rolled lead forms the foundation. The process of manufacture consists in the formation of leaves or laminations on the surface of these lead plates, which stand out normally to the surface, and which increase the superficial area of the plate in the ratio of 12 to 1. In "forming" the plates, the active material is "grown" out of the plate itself, thus producing an adhesive and extremely porous structure, being an integral part of the plate backing or grid; the loosening of the active material, even under extreme rates of discharge, is, therefore, substantially impossible. The life of a Gould battery is, for this reason, comparatively much greater than that of those constructed on less satisfactory principles. Furthermore, the entire absence of antimony or any other material employed to stiffen the grids or plates removes a common source of local action, and enables the Gould Company to claim for its cell that it is practically free from this evil of storage battery working.

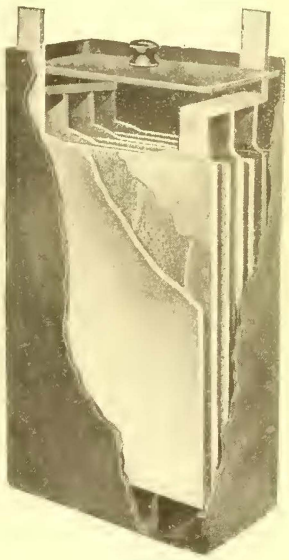
The plates of the large cell illustrate in a practical manner this property of the Gould accumulator. As stated above, they were used in the Cincinnati test, where, for a period of six months, they were charged daily and discharged at rates of twenty minutes to eight hours. The object of the experimenters was to destroy the batteries on test, if hard service could accomplish that result, and inspection of the plates in this Exposition cell will show that they are none the worse for the hard service they received.



THE GOULD NEGATIVE PLATE



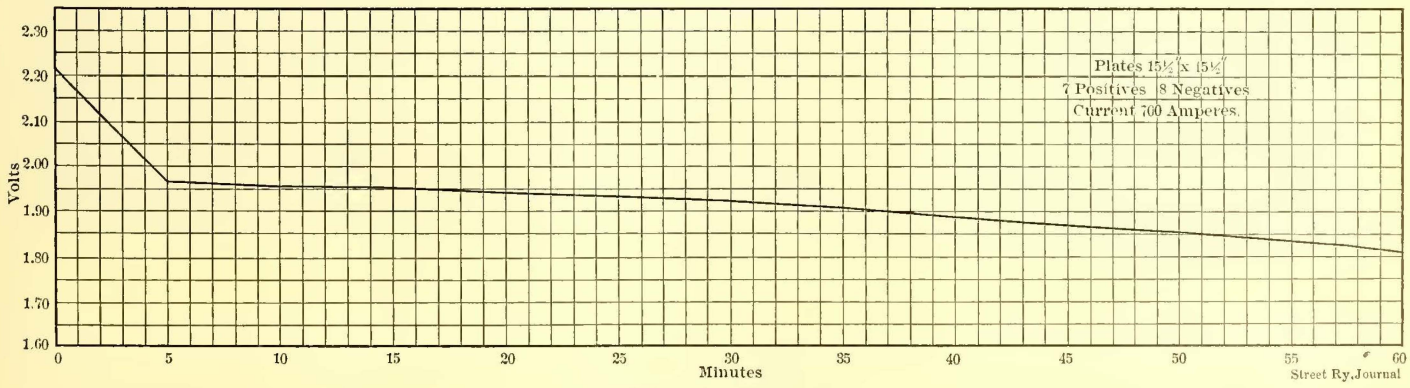
THE GOULD POSITIVE PLATE



TYPE OF CELL FOR ELECTRIC VEHICLES

Besides making this most efficient type of central station storage battery, the Gould Company also manufactures a very satisfactory vehicle battery. It is built on the same general plan, the plates being formed in the same manner, etc., but is considerably lighter for a given capacity than the ordinary stationary cell. Its lightness renders it suitable for long distance propulsion, and vehicles equipped with it are in successful operation on distances of from 40 miles to 100 miles, depending upon the class of vehicles, etc. The vehicle battery shown in the accompanying engraving has a weight per cell complete of 27 lbs., and an output in five hours of 155 amp.-hours, the rate of discharge being thus 31 amps. This gives a weight efficiency of 5.74 amp.-hours per pound, or 11.36 watt-hours per pound, a practical commercial output of 1000 watt-hours per 88 lbs. This is equal to 65.64 lbs. of battery per hp-hour.

The Gould formation is such that all active material is in constant contact with the grid, of which it is a part, and being formed as a thin coat over a large surface rather than as thick briquettes or plugs of high conductivity, and in poor contact with the grid, its electrical efficiency is increased. Leaving out, therefore all questions of life and durability, high efficiency of conversion, which is quite an important matter for consideration, is very satisfactorily obtained from the Gould construction. It is possible to discharge the Gould battery entirely within one hour, it being the case that if 8000 amp.-hours are taken from the battery in an hour, rather than 16,000 amp.-hours in eight hours, but 8000 amp.-hours,



DISCHARGE CURVE

or very little more, will have to be returned to the battery. The average e. m. f. undischarged is higher than that ordinarily found in storage batteries, while the average potential difference on charge is, on the other hand, lower, hence the efficiency of Gould storage batteries is particularly high, and the cost of maintenance correspondingly low. The accompanying curve is drawn from the results obtained in a discharge taken at Cincinnati on the plates now used in the Pan-American cell. The experiments on the Gould battery have thus shown that the statement that a battery with a high-cell efficiency will be a battery with a long life is correct.

The Westinghouse Electric Brake and Car Heater

The necessity of using some form of power brake in connection with electric railway cars operating on urban and interurban service has long been apparent to advanced street railway managers who wish to secure the very best possible results both in speed and safety.

With a world-wide experience in all matters relating to the design, construction and operation of brake apparatus, and with facilities for manufacturing various types of air brakes suitable for application either to steam or electric railway cars, the Westinghouse Air Brake Company has acquired and perfected the electric brake and car-heating apparatus described and illustrated in the following article. That this device more nearly approximates the ideal brake for electrically-operated cars than any other appliance yet invented is firmly believed by the company. By a simple and ingenious combination of a magnetic track brake with a wheel brake of maximum power, a braking effect of great strength is produced, while, in addition to this, cars equipped with the complete apparatus can be comfortably heated in winter without the use of line current, and, consequently, without cost.

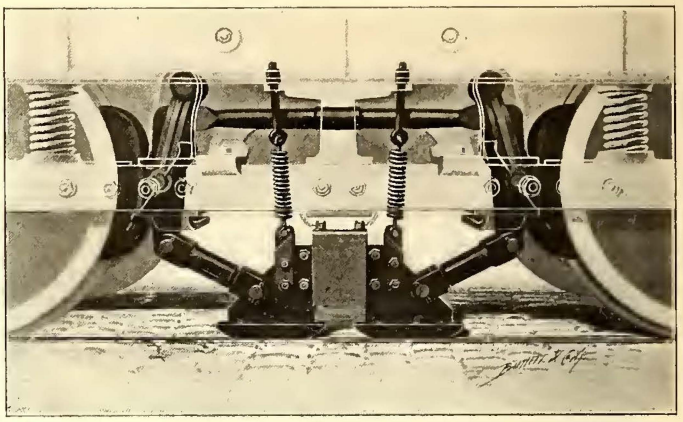


FIG. 2.—VIEW SHOWING METHOD OF ATTACHING BRAKE TO CAR

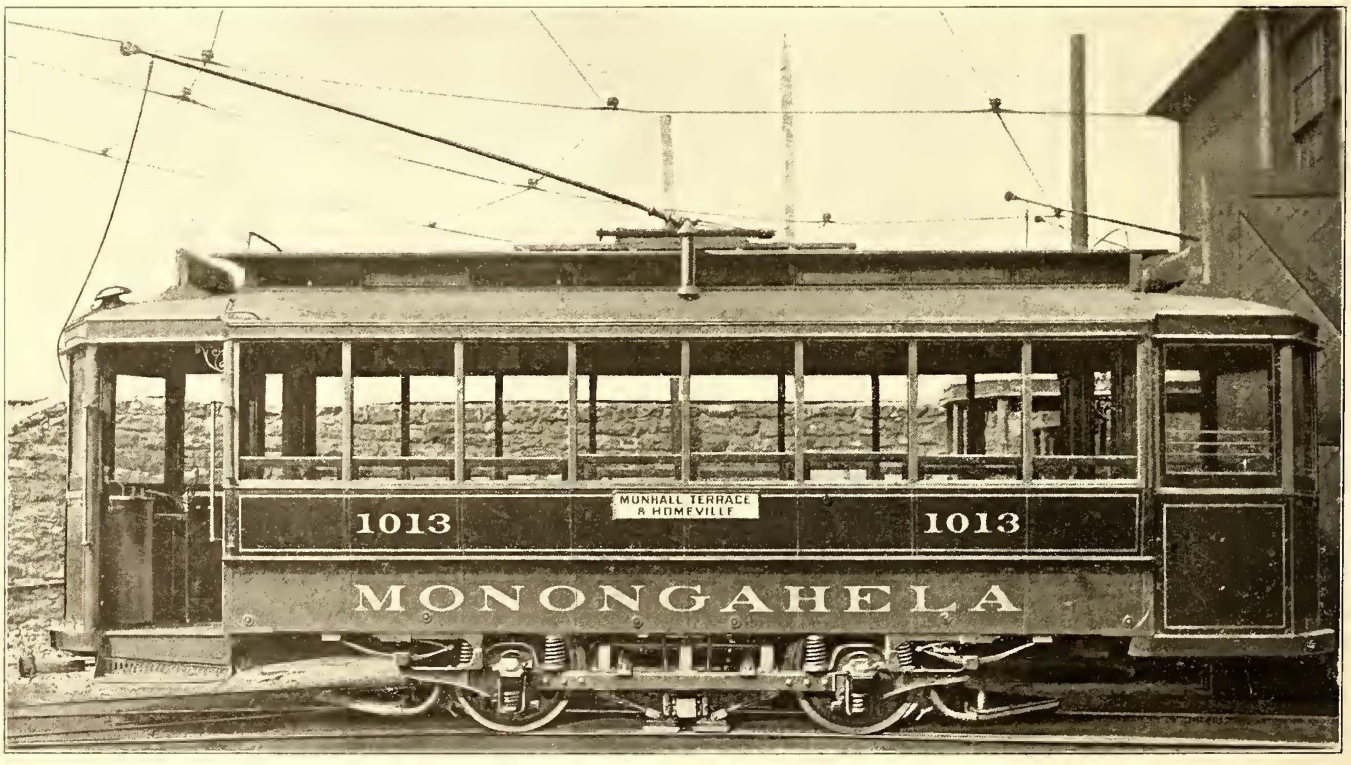


FIG. 1.—CAR EQUIPPED WITH NEW MAGNETIC TRACK BRAKE

The right to manufacture and sell this combined brake and heater has been acquired by the Westinghouse Air Brake Company from the inventor, F. C. Newell, formerly of Chicago, who is not only a well-known practical street railway constructor and operator, but who has devoted a number of years to the development of these appliances under actual operating conditions of the most rigid and exacting character.

The Westinghouse electric brake and heater, as indicated by its name, consists of two distinct elements—the brake and the heater. The former may be installed and used independently of the latter, but the operation of the heater is dependent upon the use of the brake, the heat produced being derived from energy that would otherwise be wasted. As will be observed by examining the accompanying illustrations, the brake proper comprises (1) a double track-shoe of peculiar construction, combined with a powerful electromagnet which, when energized by current produced by the car motors acting as generators, is strongly attracted to the rail by magnetic force; (2) brake-heads and shoes of the ordinary type, acting directly on the wheels and constituting a wheel brake of maximum power and efficiency, and (3) sundry castings and forgings for simultaneously transmitting the downward pull and resultant drag of the magnetic track brake into lateral pressure upon the wheels. The combination of these three elements in duplicate, together with the necessary tie-rods and attachments, constitutes a single-truck brake equipment designed for application to a four-wheel, or single-truck, car. A double-truck equipment, which is the equivalent of two single-truck equipments, as above described, is required for an eight-wheel, or double-truck, car.

In addition to the truck equipment, either single or double, as circumstances may require, a complete brake includes brake controller attachments for use when the motor controllers are not provided with braking points, and a diverter, or improved form of rheostat, for dissipating, when the heaters are not in service, the heat generated by any excess of current over and above that required to operate the brake. In Fig. 1 is shown a general view of a car on which the brake has been installed, Fig. 3 giving a

nearer view of the brake itself. Fig. 2, in which a portion of the truck frame is shown as transparent, so as to afford a clearer view of the mechanism connecting the track and wheel brake, illustrates the general arrangement and substantial construction of the apparatus; also the method of attaching the brake rigging to the truck, and of suspending the track-shoes and magnet frames directly over the track. When the brake is not in operation, the suspension springs carry the track magnets and shoes entirely clear of the rails, and, by means of their flexibility, permit the shoes to ride over or clear any obstruction not sufficient to cause the car to be stopped. When the brake is applied, through the

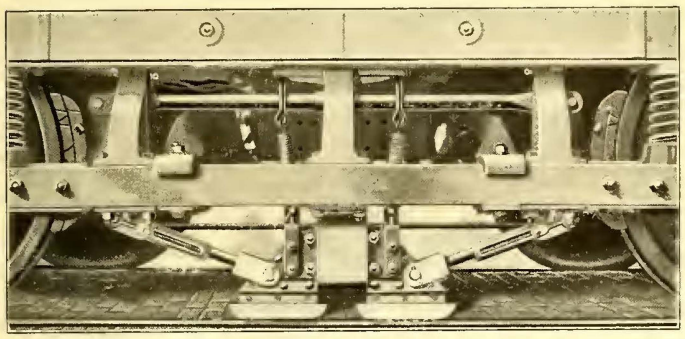


FIG. 3.—VIEW OF BRAKE

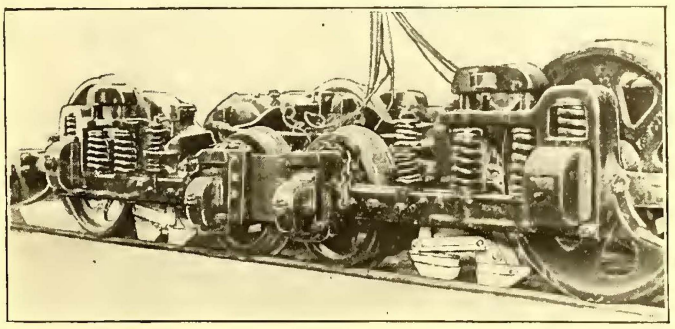


FIG. 5.—METHOD OF ATTACHMENT TO A MAXIMUM TRACTION TRUCK

saturation of the magnets with current supplied by the car motors acting as generators, the track-shoes are strongly attracted to the rails, producing three distinct effects: 1. A noticeable increase in the pressure of the wheels on the track, because of the downward pull of the magnets. 2. A pronounced retardation by reason of the friction generated between the track-shoes and rails. 3. A maximum braking effect on the wheels, obtained through the transmission of the resultant drag of the track-shoes to the brake-shoes by means of the mechanism provided for that purpose.

It is obvious, therefore, that the net result of these three effects combined represents a very high braking power, while, moreover, the feature of a powerful track brake, which, instead of decreasing the weight upon the rails at the wheels, actually increases it, is unique as it is valuable; it is this feature that differentiates the Westinghouse electric brake from all other track brakes of known construction. It is evidently highly important not to lessen but rather increase the pressure of the wheels upon the rails in the manner obtained by the magnetic brake, as if the weight is decreased on the wheels too much a condition is reached where the brake is less efficient than an ordinary wheel brake where the wheels are not skidding.

The general details of the brake, and the method of applying it as a whole to operate on electric street cars, are shown in the illustrations, but as these cuts are made from photographs of different equipments, they lack similarity in some particulars. In this connection it should be noted that, while the thrust against the wheel-brake shoes, caused by the drag or frictional resistance between the track-shoe and the rail, is similar in its effect to the thrust obtained from the expansive force of compressed air acting upon the brake-cylinder piston in the well-known air brake, the magnetic brake has a decided advantage over the older type in this particular, viz., that the brake-shoe pressure is automatically regulated by the condition of the rail surface. This is a fortunate feature, which results in securing the highest possible braking power at all times without danger of wheel sliding. For example, if the rail be dry and sandy, the drag of the track-shoes and the consequent thrust upon the levers applying the brakes to the wheels are great; if the rail be wet or greasy, the drag of the track-shoes is lessened in inverse proportion to the frictional resistance between them and the rail, thus automatically decreasing the corresponding brake-shoe pressure on the wheels. There is still another automatic adjustment of braking effect, scarcely less interesting, if somewhat less important. It is well known that, when the motion of the car is being rapidly retarded, the forward wheels carry a somewhat greater proportion of the weight resting upon the truck; from this it follows that, by placing the fixed lower fulcrum of the forward brake-shoe lever slightly above the pin connecting it with the telescope rod, as shown in Fig. 2, a brake-shoe pressure is applied to the forward wheels proportionately greater than that acting upon the rear wheel; when the car is reversed, the governing conditions are also reversed and entirely satisfactory results attained—the levers and connections being so designed that, when properly adjusted, the highest possible braking power is secured, without reference to the direction in which the car moves.

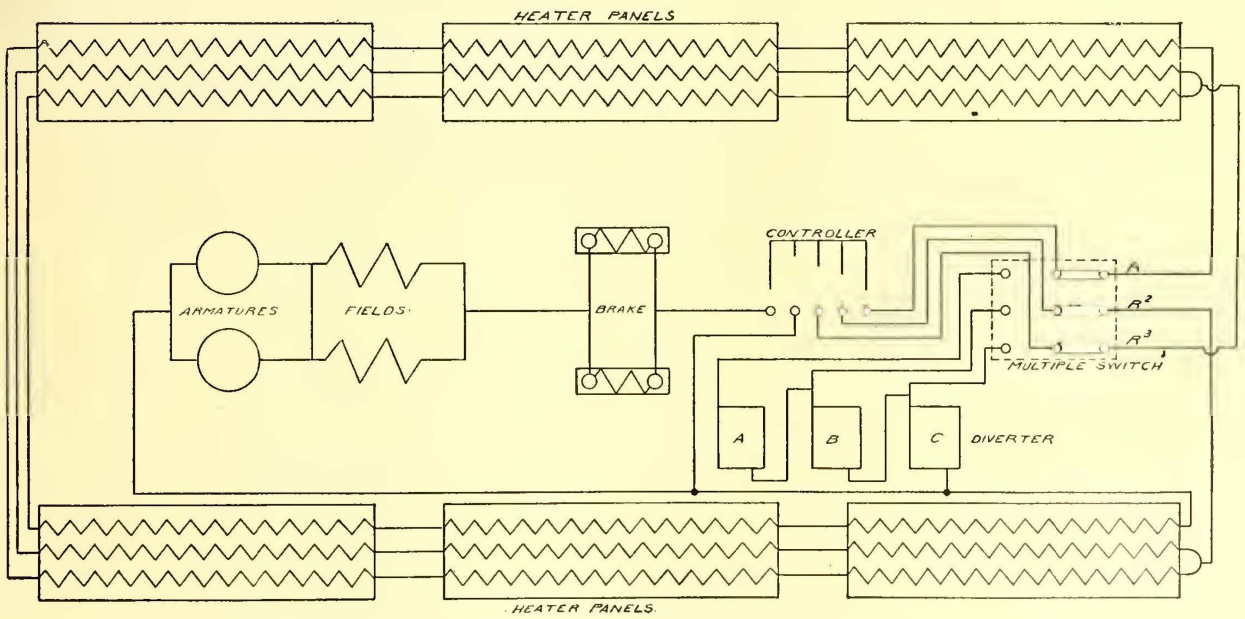


FIG. 4.—DIAGRAM OF WIRING

As previously explained, the track magnets are energized by current obtained from the car motors acting as generators, which not only obviates any expense in that connection, but also effectually prevents the possibility of accident through sudden failur-

of line current. The current necessary for the required magnetization is uniformly kept within safe limits by a proper adjustment of resistance always in circuit with the brakes, thus avoiding any injurious effect on the motors. An additional advantage gained by the use of the magnetic brake is found by employing the improved form of rheostat, or diverter (which has a constant resistance regardless of the heating produced by a continuous flow of current), in the automatic control of speed down long and steep grades. This result is owing to the fact that a certain resistance in the rheostat insures a fixed current flow at a given speed; and this resistance can be readily adjusted so as to permit just enough current to pass through the track-shoe magnets to hold the car at the required speed, against the action of gravity, on any grade; any increase in speed increases the current and causes the brakes to act with greater force, while a decrease in speed instantly decreases the current and the brake action at the same time, so that the speed of a car may be automatically regulated within narrow limits regardless of changes in the gradient. This brake can be readily applied to trail cars by properly attaching the track magnets and accessories to them and connecting the magnetic coils to the wiring system of the motor car.

An electric car heater occupying no valuable space, easily controlled, and costing nothing to operate, will prove equally satisfactory both to street railway companies and their patrons. One of the leading traction systems of Pittsburgh demonstrated this fact clearly during the past winter.

The method of installing the heaters underneath and along the front of the seats is similar to that of those in general use. These heaters are connected with the general system of wiring, by means of a suitably arranged switch so constructed that the braking and starting currents, both of which are used for heating the car in cold weather, may be divided as desired, and the whole or any portion thereof sent through the heaters, the remainder going through the proper portion of the diverter beneath the car.

The diagram of wiring (Fig. 4) clearly shows the manner of connecting the heaters and rheostats. An examination of this diagram will also show that whatever portion of the total actual current is flowing through the heaters flows through every section alike, which results in heating the car uniformly, no matter how small the amount of heat required.

The ordinary electric car heaters, in which the heat is generated by line current, have so small a storage capacity that they are cooled to atmospheric temperature very quickly when, for any reason the current is interrupted. An important advantage of the Westinghouse heater is its great capacity to store and retain heat within its mass. In the event of blockades or of the failure of line current from any cause, this heat storage capacity is so great that the car is kept comfortable for an hour or more, even in severe weather.

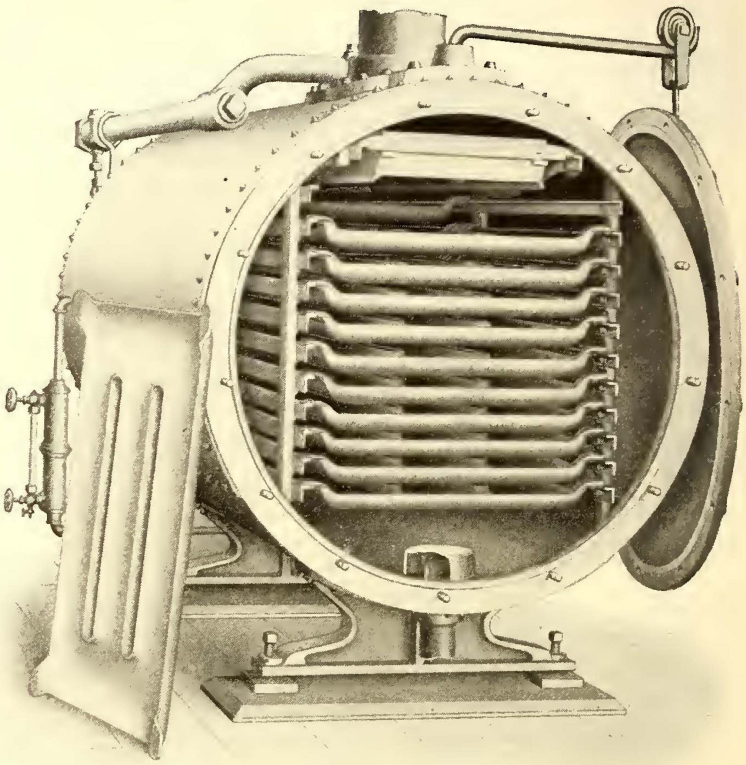
Fig. 5 shows the brake, as applied to two maximum-traction trucks, and is from a photograph of the exhibit of the Westinghouse Company at the Pan-American Exposition. In the space occupied by the company for its system of braking apparatus, at the eastern end of the Station Exhibit Building, are the two trucks referred to, and also a single-truck car equipped with the brakes and heaters. This car is arranged to run over about 300 ft. of track in the Station Exhibit Building. The ordinary stops are made quickly but smoothly, and with the softness characteristic of a graduated braking effort. The emergency stop is exceedingly rapid, and both the emergency and ordinary stops can easily be made on the short experimental track at Buffalo after the car has gotten to speed. An idea of the braking power available can be obtained from the statement that, while the maximum traction trucks illustrated in Fig. 5 weigh 10,200 lbs., a braking pressure of 28,000 lbs. can be secured through the magnetic attraction of the shoes for the rail.

The Stilwell-Bierce & Smith-Vaile Company, of Dayton, Ohio, recently shipped one of its 27-in. improved cylinder-gate Victor turbines to the North Carolina Electrical Power Company, of Marshall, N. C. The wheel is made entirely of bronze, and, under 60-ft. working head, will develop 750 hp, which will be used by one of the street railways of Ashville.

A New Feed-Water Heater

To meet the demand for a heater of cast-iron construction for certain localities where the water used contains acids or other corrosives, the Hoppes Manufacturing Company, of Springfield, Ohio, has put on the market the one shown in the accompanying illustration. The heater can, of course, also be used where the water is neutral. Where there is much lime and magnesia contained in the feed-water the company recommends its standard heater with sheet-steel pans, as they are more easily cleaned.

The bottom of the heater is illustrated below the water line; the pans and all parts with which the feed-water comes in contact are made from cast iron, and where bolts are used they are of bronze. Apart from making the heater non-corrosive, the main object sought for in its design was to make use of the Hoppes system of flowing water along the underside of the pans in a thin film, in such manner that the exhaust, passing through the heater, would come into direct contact with the water. To obtain this end it has been the object of the designer to preserve the trough shape



VIEW OF HEATER, SHOWING CONSTRUCTION

of the original Hoppes pan and at the same time secure a light and strong construction when made of cast iron. It was also desired to increase the heating and lime catching surface as much as possible for a shell of a given size.

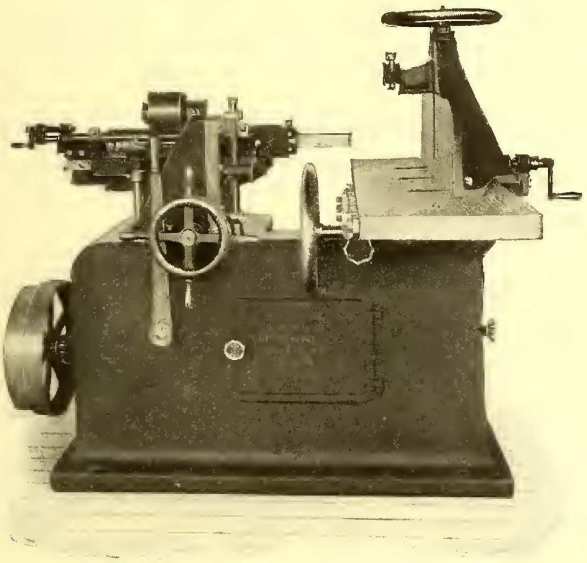
The pan shown standing beside the heater in the cut will give a good idea of the shape of the pans used in this construction. They are provided at each corner with lugs for supporting them on the ways in the heater. It will be noticed that the form of pans is such that the water will flow over the sides and ends as well as through the slots. The water, after overflowing the edges of either the sides or slots, will follow the underside of the pan to the lowest point before dropping into the next pan below, and so on over each pan, until it reaches the reservoir at the bottom.

The exhaust steam passing through the heater comes into direct contact with the water flowing over the pans and, therefore, can impart its heat to the water without heating through the metal of the pans or the lime deposited thereon. The comparatively flat form of the pan permits of about twice the amount of pan surface being put into a heater of a given size as compared with the original form, and, as a smaller shell can be used, quite a saving in space required for setting the heater is effected. This heater is provided with a hooded outlet for pump suction, an overflow skimmer, a large and effective oil catcher, an automatic water regulator, a crane for removing the head, and, when used in connection with steam-heating system, a trap for oil drips and overflow is supplied. Heaters of this construction have been manufactured by the Hoppes Company for a little less than one

year, but it has now in use machines ranging in size from 150 hp to 7000 hp, all of which are giving excellent results. The large reservoir at the bottom of this heater makes it well adapted to be used as a heater and receiver where installed with a heating system.

A New Horizontal Hollow Chisel Mortiser

Car builders and woodworkers in general should be interested in a description of the horizontal hollow chisel mortiser, shown herewith. Although a machine of medium weight and capacity, possessing all the advantages offered by this style of a mortiser, it is, in addition, equipped with many superior features of convenience and accessibility, which, in connection with its superior design and construction, particularly adapt it to the requirements of car and railway shops, carriage and wagon factories, and other similar lines where the range of mortising or framing is such as to require the greatest facility in operation. Particular attention should be given to the superior design of the main frame of the machine, which is cast in a single piece, and has a base of such dimensions as to afford thoroughly efficient support for the table, a point not generally found in machines of similar size. The ram,



NEW HOLLOW CHISEL MORTISER

or chisel, carriage has vertical adjustment instead of the table, insuring more rigid support for the table. This new mortiser is claimed to be the handiest to operate, and most powerful for its weight of any on the market, being superior in every particular to any hollow chisel machine yet produced.

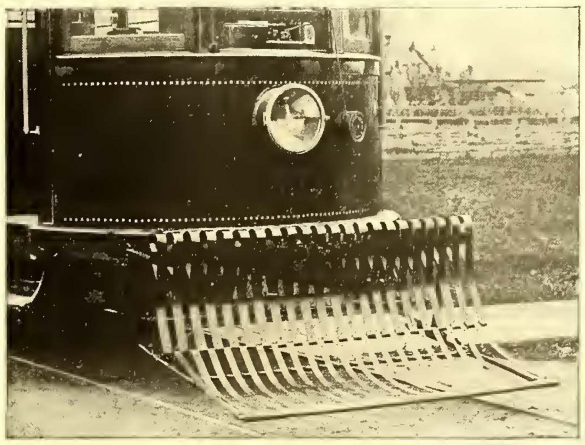
The following working dimensions of the No. 6 horizontal hollow chisel mortiser will be of interest, as showing the capacity of the various parts of the machines: The carriage has a travel of 9½ ins., and will raise to 11 ins. above the table; the table has a horizontal travel of 18 ins., and is provided with patent stops for laying off double mortises; timbers up to 12 ins. square may be clamped and chiseled up to 1½ ins. can be successfully used on hardwood. The weight, complete, is 4000 lbs. The Woods patent self-oiling loose and pneumatic pulleys are used.

This mortiser is manufactured by the S. A. Woods Machine Company, which has a car machinery department at Chicago, and works at South Boston, Mass. Besides the machine described above, this concern manufactures a full line of high-grade car building machinery, such as borers, car sill planers, gainers, saw benches, flooring machines, cabinet planers and molding machines.

The Consolidated Car Fender Company, of New York, maker of the Providence car fender, is getting a firm footing abroad through its agent, Henri Bordes, of Bordeaux. Special tests upon this particular type of fender have already been made under the auspices of the city authorities and the railway companies, and the efficiency of the device satisfactorily proved by the "rescuing" of dummies placed on the track. Large shipments have already been made, and more are expected to follow.

A New Car Fender

The accompanying illustrations show an ingenious car fender which has recently been put upon the market. This lifeguard has been thoroughly tested at high speed by the means of dummies placed on the track, and has withstood the severe trials to which

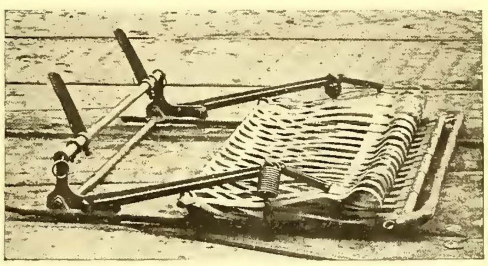


NEW FENDER

it has been subjected in a most satisfactory manner. It is made in two sections, or beds, as shown, which are hinged at their junction, so that when not in use the lower part may be folded up against the other. As shown, the two sections form a graceful curve from the lower edge of the dasher, so designed that any object encountered by the front edge falls easily on to the resilient metal ribbons, of which the device is made.

The frame which holds the fender in front of the car is mounted on a transverse rod, which is supported by brackets extending downward from the car. Upwardly projecting arms on this transverse rod or shaft, when held over by a push bar under the car, keep the front edge of the fender from touching the ground, but when released by means of foot lever on the front platform the fender falls into an operative position. Although the material of which the fender is made is of a very yielding nature, the force of the shock is still further reduced by a rubber buffer on the front bed, and by making this part of the fender so that it will slide backwards.

The fender can be raised to any desired height, even while the car is running at full speed, and is securely locked in position so that it can not be raised higher, but will always drop to the ground when a weight falls on it. It is easily detached from the car, and, as all the parts are perfectly interchangeable, the fenders can be changed from one end to the other, or to a different car, with great facility. The device is inexpensive and very durable, repairs, should any be necessary, being easily and cheaply made. It is known as the Twentieth Century fender, and is being exploited by its inventor and patentee, W. T. Watson, New York City.



FENDER REMOVED FROM CAR

The New Haven Car Register Company has been engaged for some time on the perfection of a new type of trolley catcher for electric railway cars. This device, which is of very simple and durable construction, embraces important features not contained in other catchers, and the trials which have already been made with it indicate that it will prove most successful. The New Haven Car Register Company has achieved a very enviable reputation in the construction of fare registers, apparatus requiring the highest type of machine work, and the company will undoubtedly enjoy a very large sale for its new trolley catcher, as any device manufactured and recommended by the company can be relied upon for sterling merit and proper construction.

NEWS OF THE WEEK

Raise in Wages for Cleveland Railway Employees

The Cleveland Electric Railway Company, of Cleveland, Ohio, has recently announced that it will increase the wages of its motormen and conductors. General Manager Ira A. McCormack has, therefore, issued a notice, which states that the board of directors, recognizing the loyal support and interest of its conductors and motormen in the welfare and prosperity of the company shown by the reduction of accidents and damage to cars and property has voluntarily ordered an increase in pay, effective July 1, 1901, as follows: First-year men, 18 cents per hour; second-year men, 20 cents per hour; all over two years, 21 cents per hour.

Compressed Air Cars in Brooklyn

The Brooklyn Rapid Transit Company is soon to start the operation of a compressed-air locomotive on its elevated lines. The recent fires and unavoidable accidents which have occurred in the company's power stations have reduced the available current supply to a dangerously low amount, and, notwithstanding the installation of several new rotary converters taking power from the Kings County Electric Light & Power Company, many of the old steam locomotives have been put back on the elevated. Even with these auxiliaries the slightest accident to a generator is liable to seriously cripple the service. The great advantage of a system where the cars operate independently of one another is especially marked under the Brooklyn conditions, and the adoption of compressed air may prove a satisfactory relief to the overburdened power stations. The locomotive is to be supplied by the Compressed Air Company, of New York.

Change in Baltimore Street Railway Presidency

At a meeting of the directors of the United Railways & Electric Company, of Baltimore, Md., held on June 27, Nelson Perin resigned as president and George R. Webb was elected as his successor. A resolution was unanimously adopted by the board expressing appreciation for the work accomplished by President Perin and commending his long services in developing the rapid transit interests of Baltimore. Mr. Perin resigned as a member of the board of directors and William P. Harvey also retired as a director. The two vacancies thus created were then filled by the election of John B. Ramsay and Wesley M. Oler. Mr. Ramsay was elected a member of the executive committee, and at the next meeting of that committee it is announced that he will be chosen as its chairman. Mr. Perin will soon resign as president of the United Electric Light & Power Company, when Mr. Webb will also succeed him.

Trolley Exensions in Indiana

It is estimated that plans have been drawn for a thousand miles or more of electric roads in this State. Petitions for franchises have been presented for routes from Indianapolis to nearly all of the most important towns and cities within a radius of 50 miles, and in most instances they have been granted. The last Legislature gave the promotion of interurban roads great encouragement by enacting a law giving the same right of eminent domain to electric roads that is enjoyed by the steam roads. Thus the interurban companies are enabled to survey and condemn a right of way where it would have been almost impossible to have obtained it without this new law. The courts are to decide whether an interurban road can condemn a portion of the 50-ft. roadway allowed to the steam roads and build its track alongside thereof at certain points, but the interurban men are confident that the ruling will be in their favor.

The Electric Railway Situation in London

Much interest is being manifested at present in London over the improvement of the transportation facilities. The London County Council, on June 25, decided to spend over £2,000,000 on new electric traction routes in various parts of London, and on the necessary widening of streets required by the new enterprises. Press despatches of the same date state that a Parliamentary committee discussed the bill to authorize the introduction of electricity as the motive power of the Metropolitan District Railway by arrangement with the new company now being formed by Charles T. Yerkes. It was announced before the committee that £600,000 of the £1,000,000 capital of the new company had already been subscribed, and that Mr. Yerkes and his friends were ready to subscribe the remaining £400,000. It also transpired that some difficulty had arisen between the Metropolitan District Railway and the Metropolitan District companies in the matter of reaching an agreement by which all should work together. Evidence laid before the committee showed that the trouble arose from antagonism between the Ganz and the Yerkes systems of traction, and that there was also friction with the other companies possessing running rights over the Metropolitan systems. Mr. Yerkes was examined before the committee, and said he was ready to carry out his agreements if he did not meet with too much opposition. He further said he intended to buy everything possible for the reconstruction of the road in Great Britain by preference, but if not, in the United States. Mr. Yerkes did not condemn the Ganz system of traction, but said he would not put a dollar in any concern worked under that system. Robert W. Perks, M. P., said that the capital of the new company had been offered in London first, the Parliamentary committee being anxious that the new company should not be entirely American, and that in all probability the capital would be taken up here.

Express Service on the Metropolitan Street Railway Company, New York

Preparations for the installation of a regular express service upon all of the surface railways controlled by the Metropolitan Company, except Broadway, have been in progress for several months. On June 28 the first express cars were started, the "opening" being attended by many officials of the railway and express companies. The old mail cars, which were formerly used on the Third Avenue road, have been converted into freight-carrying cars of the box type, and make excellent ones for this service. Each has a capacity of at least three times that of the largest express wagon in use. Only four cars were put in service, and they were run entirely over the Eighth Avenue line; but the officials of the Metropolitan Express Company, as the organization which is to run the cars is named, hope within the next few weeks to operate at least ten cars over the Madison and Sixth Avenue lines, in addition to those on Eighth Avenue. Plans are also being made to run over the Twenty-Third Street and Forty-Second Street crosstown lines. So far, the only loading and unloading stations decided on are at Fiftieth Street and Eighth Avenue, in Forty-Second Street, opposite the Grand Central Station, at 135th Street and Third Avenue, and at the present terminus at Fordham. As the company's business increases, however, stations will be added from time to time. Receiving offices will be opened in all parts of the city. The plan of the company is to divide the city into districts, with receiving offices in each. Baggage left at these places will be carried by automobile to the nearest depot, and there transferred to the express cars. The aim of the promoters of the new system is not to antagonize the existing express companies, but to make a working arrangement with these concerns. The main object is to carry the long-haul business, so that by means of the trolley cars, which will run on regular schedule time, the public will be benefited by having a more expeditious and more economical service than it now has. Not only will much time be saved, but a further advantage is that the number of trucks in the city will be lessened. Every truck taken off the street means a gain to the traveling public in the matter of accelerated speed for the surface cars. With the four cars now in use an hourly service can be maintained. The company proposes to do most of its heavy carrying at night. The service will also soon be extended to White Plains, New Rochelle, Yonkers and other towns in the southern part of Westchester County.

Report of St. Louis Grand Jury on Accidents from Street Cars

The rigid enforcement of city ordinances is recommended in a report made last week by the St. Louis Grand Jury on the street railway service of that city. The report says in part:

"We have given much time and careful consideration to the in-

vestigation of the numerous killings in the past few months by street cars of our city. We do not believe that there is, on the part of any one concerned, an utter disregard of human life, but no one can deny that many persons have been killed and injured.

"There is much to find fault with in the running of the cars, and considerable carelessness on the part of citizens and patrons of the cars and those who use the streets with equal rights. Much of the trouble arises from the fact that the street railway companies do not run a sufficient number of cars, resulting in the cars that are run being overcrowded. This necessitates frequent stops and loss of time, which they endeavor to make up by increased speed between stops. With more cars fewer stops would be necessary, and the same distance could be made in a given time, without being compelled to run at a high rate of speed.

"The remedy for these conditions is the enforcement of the city ordinances, there being no State law upon the subject. The ordinances of the city seem to have been totally disregarded by those whose duty it is to enforce them in the city police courts. We recommend a rigid enforcement of these ordinances where they do not conflict with the charters of the street railway companies. If the city officials, through the police courts, will take proper action, much of the existing trouble can be removed. Furthermore, if each car were equipped with a perfect fender, loss of life would be greatly reduced. We must, however, leave the determination of this question to the city officials who have charge of the same."

PERSONAL MENTION

MR. P. A. B. WIDENER sailed from London, June 27, on the "Deutschland."

MR. GEORGE WESTINGHOUSE, who for some time has held the office of vice-president in the British Westinghouse Company, was recently elected to the presidency.

MR. C. A. COFFIN, president of the General Electric Company, who has been in England effecting the absorption of the British Thomson-Houston Company by the General Electric, arrived home on Saturday, June 29.

MR. W. B. BECKNELL has been appointed superintendent of transportation for the Rockford Railway, Light & Power Company, of Rockford, Ill. The position of superintendent is a newly created office, and Mr. Becknell, who has just been appointed to the position, was formerly a conductor in the employ of the company.

MR. F. S. PEARSON, vice-president of the Dominion Coal Company, consulting engineer for the Metropolitan Street Railway Company, and connected with a number of other corporations, both in Canada and the United States, has just returned from Sao Paulo, Brazil, where he has been in connection with the Sao Paulo Electric Tramway & Power Company.

PRESIDENT SAMUEL GOMPERS, of the American Federation of Labor, fell from a street car, in Washington, striking his head. He remained unconscious for some time, and it was thought his skull was fractured. He rallied, however, and a further examination showed there was no fracture, but a severe contusion. He suffered severely from shock, but his recovery is expected.

MR. J. P. MORGAN, Mr. P. A. B. Widener and Mr. W. L. Elkins were passengers on the Hamburg-American Line steamship "Deutschland," which sailed from Southampton for New York on June 28. It is understood that Messrs. Widener and Elkins are hastening back to protect their interests and counteract the recent energetic operations of their rivals in the Pennsylvania field. Reports state that Mr. Morgan has made many successful deals during his short sojourn abroad.

MR. NELSON PERIN, who retired June 27 as president of the United Railways & Electric Company, Baltimore, has been president of that company since its formation. Prior to its existence he was president of the Consolidated Railway Company, and before that was formed he was president of the City & Suburban Railway Company, of Baltimore. Still earlier Mr. Perin was president of the Union Railway. The board of directors of the United Railways & Electric Company, in accepting Mr. Perin's resignation, unanimously adopted a resolution expressing appreciation of his work as the chief executive of the company, and commending, in appropriate terms, his years of service in the development of rapid transit in that city.

MR. A. K. WARREN, who has been closely connected for many years with street railway work in the East, has been appointed assistant engineer of line and equipment by the Brooklyn Rapid Transit Company. Mr. Warren was one of the pioneers of organized electrical maintenance and insurance in this country and has had a large amount of experience in the class of work which he will be called upon to do in his new position, both as a manufacturing and consulting engineer. He will be in charge of the East New York shops of the Brooklyn Rapid Transit, and most of his work will be, therefore, in connection with the rolling stock of the elevated railway, these shops being devoted to that division of the system.

MR. U. L. UPSON, general manager of the Buffalo, East Otto & Cattaraugus Railroad Company, was born at Canisteo, N. Y., in 1853, and has worked his way in the railway profession from the very bottom to his present position. He remained on a farm until 1869, receiving only a common school education, and then entered the service of the Erie Railroad Company as water boy for a gang of construction men. He was soon promoted, however, to the position of timekeeper, and after about four months commenced work as a brakeman on the road, where he remained for three years more. Later he was made conductor and worked for some time in both the freight and passenger service. While a brakeman he learned telegraphy, and later he was employed by the company in a position which required much office work. This caused his health to break down, and he returned to more congenial duties in the construction line as conductor of a work train on the West Shore Railroad. Since then he has confined himself almost entirely to construction work, both on the West Shore Railroad and the Wisconsin Central Railroad, his love for this kind of work keeping him in that department. He was, however, before he organized the Buffalo, Hamburg & Aurora Railway Company, conductor on the Boston & Hoosac Tunnel Railroad. Mr. Upson comes from a railroad family, having several brothers who, like himself, worked their way through all the departments of railroad work. The undertaking of which he is now general manager is one of considerable importance, and his present work is of a most congenial nature. The Buffalo, East Otto & Cattaraugus Railroad is to be some 35 miles long, and General Manager Upson is doing a work which, although it has been long in contemplation, has, owing to the engineering difficulties encountered, been supposed to be impracticable, four different companies which undertook the surveys abandoning the project. Work is now fairly well progressed, and Mr. Upson is to be congratulated on the able manner in which he has placed upon a satisfactory footing the railway development of this district, and has solved the many difficult engineering problems which baffled his predecessors.

U. L. UPSON

EX-GOVERNOR H. S. PINGREE, of Michigan, who died in London a week or two ago, was always prominent in street railway affairs. He was one of the most active, persistent and energetic agitators of the municipal ownership of street railways, or at least of the absolute control of street franchises, that this country has seen, and accomplished many reforms when Mayor of Detroit and Governor of Michigan. During his four terms as Mayor he was constantly advocating an improvement in the street car service and a reduction of the fares to 3 cents. It is claimed that very largely through his efforts the old horse car service which tenaciously held its place in that city was compelled to give way to the present electric system, one of the best in the country, besides material concessions in the matter of fares being made. At one time he succeeded in securing the passage of a bill providing for the ownership of the street car lines by the city of Detroit, and was appointed a member of a commission to purchase the property, but before it could be done, the law was declared unconstitutional by the Supreme Court of the State. While he was classed among the agitators of the country, he was not particularly unfriendly to street railway corporations, but claiming that the streets belong to the people, and that no franchises providing for their use by private corporations should be granted without the full consent of the people interested, he persistently maintained his principles.

Twin City Rapid Transit

The Twin City Rapid Transit Company, of St. Paul and Minneapolis, has given out the following statement of gross earnings:

	1901	1900	Increase	Inc. %
First week in June..	$59,877.85	$52,272.05	$7,605.80	14.55
Second week in June.	70,012.50	51,726.15	18,286.35	35.35
Month of June to date	129,890.35	103,998.20	25,892.15	24.90
Year to date	1,299,174.40	1,177,887.40	121,287.00	10.30

It is one of the best statements in the history of the company, notwithstanding that for three years past the company has been making steady and strong growth in volume of earnings. "The heavy increase of 24.90 per cent for June," says Vice-President C. G. Goodrich, "is largely the result of the recent conventions. The increase of $121,287, or over 10 per cent, for the year, is the important item." It may be said, however, that, as conventions, park entertainments and various excursions are the rule for the whole summer and fall in St. Paul and Minneapolis, with the largest State fair week in the State's history to follow, it is thought that the June increase of 25 per cent will be approximated during much of the season.

In June, 1897, Twin City common stock was quoted at 12, and in June, 1898, as low as 15 to 18. On Aug. 19, 1898, it had risen to 21, on Aug. 31 it rose to 30, and in December of the same year to 36. By Jan. 31, 1899, the quotations had risen to 63 and by Feb. 28 to 70. During 1900 the range was between 61½ in July to 70¼ in December, but by May 31 last the quotation rose to 85 and on June 19 to 94.

The recent reports of a probable change of Twin City Rapid Transit ownership and management arose, according to the Minneapolis *Journal*, simply by reason of the election, on July 10, of A. E. Ames, the Toronto banker, as one of the board of directors, in place of Mr. Cross, of New York, resigned. The election was in recognition of the large holdings of the Canadians in Twin City common. The Canadian purchases, however, contrary to current supposition, are nothing recent and exceptional. They date from 1896 down to the present week. Prominence has been given to recent Canadian buying by reason of Mr. Ames' election, but the purchases of the past fortnight in Toronto and Montreal do not exceed 1500 shares daily and will not average 1000 shares daily. This is far behind the heavy deals of January and February, 1899, when the average daily sales in Twin City common were nearly 3000 shares.

How large a volume of Twin City common is now held by Canadian capitalists is not known except to the New York office. When the list of stockholders and their holdings was examined at the time of the last dividend, early in the year, however, the Canadians held somewhere near one-fifth of the common stock. They may now have, the same authority thinks, about one-third. A controlling majority of the stock, however, is held within the Twin Cities by President Lowry and his friends.

CONSTRUCTION NOTES

PINE BLUFF, ARK.—The Citizens' Light & Transit Company has not yet begun the construction of its lines, but the contract for the power station and its equipment has been awarded and the work of constructing the station has been begun. The company has made no prediction as to the completion of the work.

WILMINGTON, DEL.—All the lines of the Peoples Railway Company are now in operation, including the belt line.

ATLANTA, GA.—The new line of the Atlanta Rapid Transit Company to Grant Park has been placed in operation. The new line to Grant Park is the one about which there was so much talk during the latter part of last year, when the Council referred all petitions of the Atlanta Rapid Transit Company, except the one for a line to Grant Park, to the Council of 1901.

DAHLONEGA, GA.—The North Georgia Electric Company's proposed new electric railway will extend from Gainesville to Dahlonega, a distance of 30 miles. The company has not decided upon the equipment for the line, but a power station, to be operated by water power, will be erected. The company is capitalized at $500,000, and its authorized funded debt is $750,000. The officers of the company are: A. J. Warner, president; J. F. Moore, secretary; N. A. Carlisle, engineer.

MARION, IND.—In the purchase of the abandoned power plan of the Union Traction Company, the Richmond Interurban Railway Company secured two 500-hp Buckeye engines, two 350-kw direct-connected generators, two water-tube boilers and other apparatus. The entire equipment is to be removed to Richmond, where it will be completely overhauled and installed in the new plant of the company, together with other apparatus.

GOSHEN, IND.—A proposition to vote a $20,000 subsidy to the Goshen & Northern Indiana Traction Company for an electric railway from Goshen to Angolia has been carried. The promoters say that construction work will be commenced at once.

INDIANAPOLIS, IND.—Articles of incorporation of the Indianapolis, Plainfield & Western Traction Company, filed with the Secretary of State last week, make it appear that the long-talked-of interurban electric railway between Indianapolis and Plainfield will be built. The capital of the company is fixed at $200,000. The board of directors is headed by B. F. Nysewander.

RICHMOND, IND.—The Richmond Street & Interurban Railroad Company will immediately begin the construction of its line to Centerville. All obstacles have been removed and certain franchises transferred, so the work of construction will progress rapidly. It is rumored that the men interested in this and other Eastern Indiana lines have secured an option on the Greenfield line, and will buy it to complete the link necessary to reach Indianapolis.

DES MOINES, IA.—The Des Moines & Southern Railway Company was organized June 22, with a capital stock of $250,000, for the purpose of constructing a railway from Des Moines in a southerly and westerly direction to the State line. Motive power is not provided for in the articles, but will be either electricity or steam. The incorporators state that surveyors will be placed in the field at once, and that the work of grading will be commenced within the next two months. The incorporators of the company are: R. W. Clayton, of Oskaloosa, Ia., and F. W. Cherry, of Creston.

COUNCIL BLUFFS, IA.—Several capitalists of Council Bluffs, Omaha and Des Moines are interested in a plan to form a stock company for the purpose of constructing an electric railway from Council Bluffs to Des Moines. It is proposed to build a direct line between the two cities, which will be considerably shorter in mileage than any existing steam line. The line proposed will pass through Pottawattamie, Cass, Union, Adair, Madison and Polk Counties. It will be constructed direct from Council Bluffs to Creston, where it will connect with the line which the New System Traction Company will construct from Creston to Winterset, and at Winterset connection will be made with the proposed extension of the Interurban Railway Company from Des Moines to Winterset. It is also a part of the plan to make connection with the Des Moines-Eldora line at Des Moines, the contract for the grading of which line has been let from Des Moines to Nevada, thus making one complete system from Council Bluffs to Eldora, a distance of over 200 miles. A meeting of the promoters and capitalists interested in the project is to be held this week for the purpose of organization. Definite action toward the construction of the line will be taken at this meeting, as the route has already been examined and found feasible. It is believed by those interested that the line would pay every mile of the way right from the start, as it would pass through a rich territory and touch many towns now unsatisfactorily served by the steam railroads. The promoters claim that the road is perfectly practical from every point of view. The line would be constructed and equipped for freight as well as passenger service.

OLD TOWN, MAINE.—At a recent meeting of the directors of the Bangor, Orono & Old Town Street Railway Company, James H. Cutler was elected president, general manager and treasurer of the company, and A. J. Durgin, of Orono, clerk. The directors of the company are: E. R. Bunpee, Charles Stanford, James Cassidy, of Bangor; George T. Sewall, Old Town; A. J. Durgin, of Orono; Charles A. Milliken, of Augusta.

KITTERY POINT, MAINE.—The petition of the Portsmouth, Kittery & York Street Railway for the Eliot extension has been granted by the Selectmen of Kittery.

AUGUSTA, MAINE.—The Togus extension of the Augusta, Hallowell & Gardiner Railroad has been placed in operation.

MIDDLETON, MASS.—The Middleton & Danvers Street Railway has been placed in operation between Danvers & Howes. About two years ago the building of an electric railway to connect Danvers and Middleton was agitated and a franchise granted. The road is now in operation for only 2 miles, half of its length, on account of the bridge over the Boston & Maine Railroad not being completed. As soon as this latter work is completed the road will be operated from Danvers to Middleton. The route is from the terminus of the Danvers Centre branch of the Lynn & Boston, over the old highway leading to Lawrence.

WARE, MASS.—The work of constructing the Hampshire & Worcester Street Railway, which is being built between Gilbertville and Ware, is being rapidly pushed, and the company expects to have the road built to Ware and running by the latter part of July. The work of laying the tracks is being done by the Mechanics Electric Company, of Boston, and already a mile of track has been laid from the crossing in Gilbertville, near the Boston & Albany station, toward Ware. The power house is almost completed, and the boilers, engines and other machinery are expected to arrive in a few days, and will be immediately placed in position. The cars are ready to ship. They are Newburyport and Stevenson cars, fitted with the Christensen air brakes and 100-hp motors. Many of them are fitted with the Bemis trucks.

WALTHAM, MASS.—It is the intention of the Waltham Street Railway Company to extend the line through Weston, Lincoln and Concord, where it will connect with the Concord, Marlboro & Hudson Street Railway and the Hudson & Clinton Street Railway.

AMHERST, MASS.—The Northampton & Amherst Street Railway Company will not build the South Deerfield and Hospital extensions this year.

MINNEAPOLIS, MINN.—The Minneapolis & Anoka Railway Company has recently been incorporated, with a capital stock of $200,000, to build an electric railway from Minneapolis to Anoka. The incorporators of the company are: John J. Elliott, Arthur W. Selover, E. E. Fuller, George H. Selover and William Williamson, of Minneapolis.