Street Railway Journal

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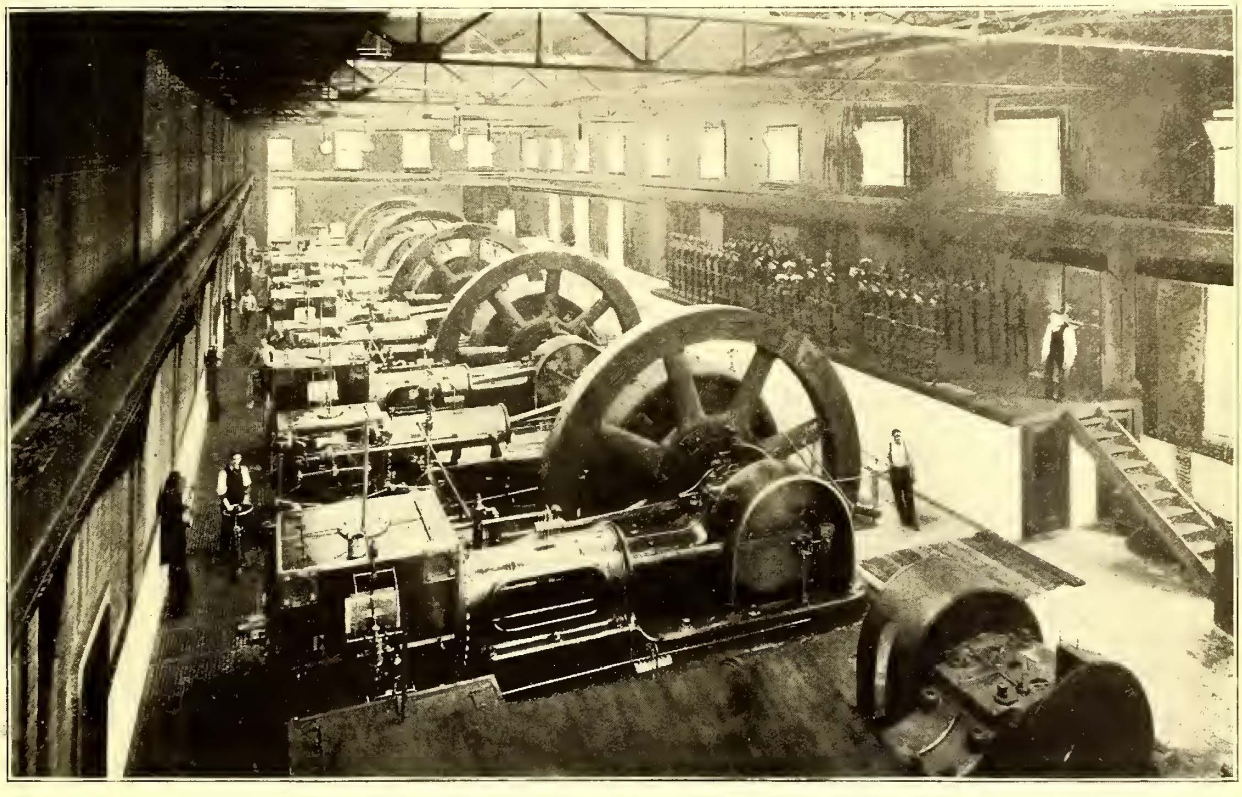
NEW POWER STATION, REPAIR SHOPS AND CAR HOUSES OF THE CONSOLIDATED TRACTION COMPANY OF PITTSBURGH

There are few street railway companies in the country, whose systems were equipped several years ago, that have so thoroughly changed over their methods and appliances to adapt them to the requirements of the hour, as the company named in the title of this article. The changes made, constitute, in some cases, radical innovations from standard practice, not only in the electrical equipment, but also in the mechanical and architectural departments, so that a study of the system is a particularly interesting one. The chief engineer, who is also manager of the system, originated all the plans and details, and is to be congratulated on the satisfactory results that have been reached, and commended for the original and novel manner in which the peculiar local problems have been met and mastered.



VIEW IN CENTRAL POWER STATION—CONSOLIDATED TRACTION COMPANY, PITTSBURGH

When the various cable and electric lines in the city of Pittsburg were consolidated, the new company found itself in possession of seven power houses; four of these, namely, Washington Street, Oakland, Wylie Avenue and Thirty-fourth Street, were cable power houses of the usual type; the other three, Forty-seventh Street, Ben Venue and Allegheny Traction, were electric power houses.

Before, and during the reconstruction of the system, these electric power houses were, of course, kept in operation, but there arose the problem as to what arrangements must be made for supplying power to the much larger system when completed. An examination of the list and map on the following page will show the situation as it stood.

It will be seen that none of these plants were well situated with regard to coal and water supply, the most important factors in the location of a large power house. The cable power houses were necessarily located on the streets along which the cables were operated, and therefore little regard was paid to coal and water supply. These plants stood on valuable ground, the cost of hauling coal by wagon was large, and lack of water rendered the use of condensing engines impractical.

The electric power houses were somewhat better off in regard to coal supply, but Forty-seventh Street and Allegheny Traction were too far from centre of system, while Ben Venue had no suitable water supply, and only one source of coal supply. It became evident, therefore, that one or more new power stations were demanded in localities not too far removed from centre of system, and where coal and water were easily and surely obtainable.

In deciding between one large plant and two or more smaller ones, Pittsburgh's marked geographical peculiarities largely influenced the result. The street railways converged in the crowded business portion down town, and again at East Liberty, after traversing a district of heavy grades. This brought the centre of the system in the midst

of the hills, as shown on the map, at a considerable distance from available coal and water supply, hence it was impracticable to put power house in this part of the system. Railroads are compelled to follow the Monongahela and

Power Data of Original Stations.

Letter.	Name.	Boiler.		Engines.			Total I. H. P.	Machine Driven.
		H.P.	Type.	No.	Size.	Type.		
A	Allegheny Traction	750	W. T.	2	14x28x20	V.C.C.C.	500	2-200 kw. gen.
				1	21x42x30	"	750	1-500 kw. gen.
B	Ben Venue	1200	T. T.	2	32x60	H.	1200	2-500 kw. gen.
				1	2-22x42	H.	450	1-375 kw. gen.
				1	2-24x48	H.	600	1-500 kw. gen.
C	Oakland	800	R. T.	2	28x60	H.	1000	1-800 kw. gen.
D	47th St	300	R. T.	3	11x19x24	H.T.C.C.	600	3-100 kw. gen.
E	34th St	800	R. T.	3	28x60	H.	1500	Cable Machine.
F	Wylie Ave	100	R. T.	3	2-28x60	H.	1500	" "
G	Washingt'n St.	200	R. T.	1	22x48	H.	250	" "

R. T.—Return Tubular.
V. C. C. C.—Vertical Cross Compound Condensing.
W. T.—Water Tube.
H. T. C. C.—Horizontal Tandem Compound Condensing.

Allegheny valleys, so that both coal and water are readily obtainable along the banks of these rivers. A location on the Allegheny River, on the other hand, offered advantages of far better water, with equally good coal facilities, nearest to the centre of the system, and of less difficulty in obtaining land.

With so little choice in location, the advantages of a single power house, rather than two or three in different parts of the city, seemed to the managers of the company evident. Danger of fire and of accident to a single plant can be eliminated by proper construction, while much of the initial cost and operating expense of the plant is independent of the size, and therefore, as great for each of the smaller plants as for the large one. To illustrate the economy of a single power station over the several original ones, it might be stated that the operating expenses of five of the old plants as compared with the new one are about two and one-quarter times as great.

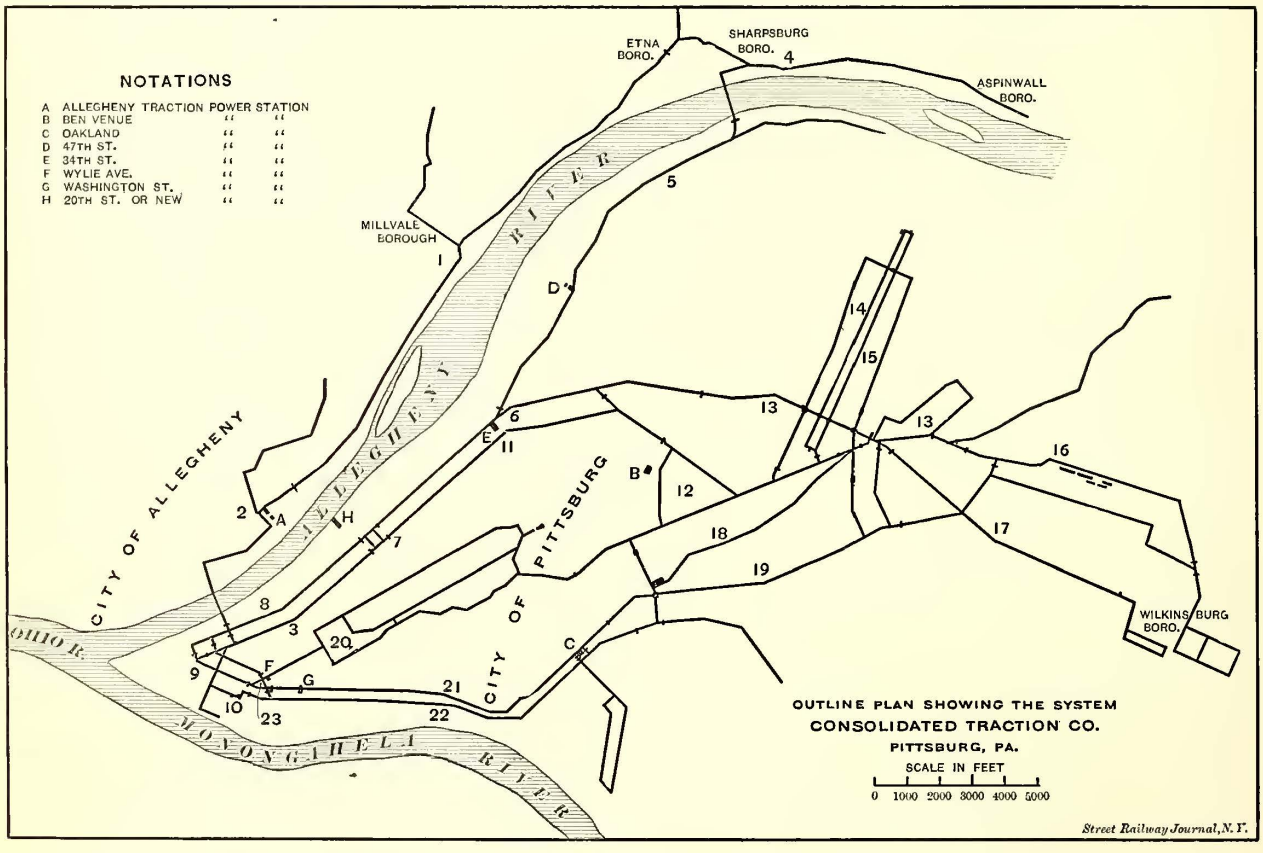
The new station is larger than the combined capacity of the old stations considered, yet runs for less than one-half the daily operating expense. The value of the real estate of the separate plants is sufficient to cover the cost of construction of the new station.

The location finally obtained was at Twentieth Street, between Railroad Street and the Allegheny River; the property being 177 ft. deep, and 360 ft. to harbor line; the length of the building was limited to 265 ft. by a private right of way. Coal can be secured from either the B. & O. system, the Pennsylvania Railway, or from the river, while an unlimited supply of fairly good water is close at hand.

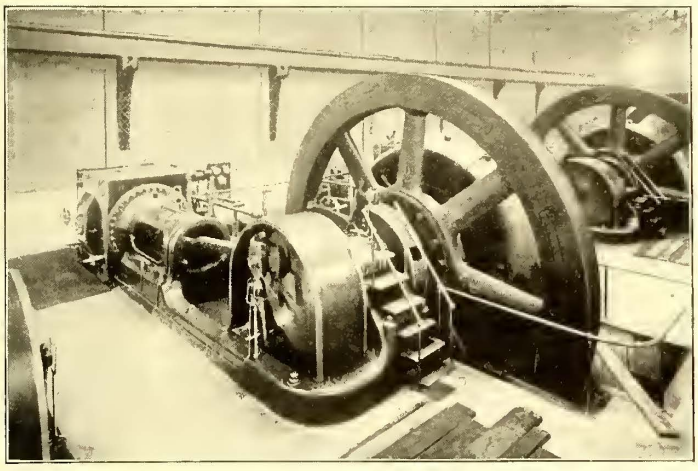
The station is designed for a 12,500 nominal h.p. equipment, which will consist of eight units, six of which are at present installed. Each unit comprises a 1560 h.p. engine of the cross compound condensing type, with "Corliss" valve gear direct coupled to a 1000 kw. generator. The cylinder dimensions are 30 ins. and 54 ins. x 48 ins. The rating given above is based upon a cut-off in the high pressure cylinder of 23 per cent and a terminal pressure in the low pressure cylinder of 6 lbs. above absolute vacuum, and running at 80 r.p.m., but with a higher percentage of cut-off the machines are easily capable of developing 2500 h.p. each. The steam and exhaust valve are operated by separate eccentrics, and the governing mechanism controls the steam in both cylinders. Reheating receivers are placed between the high and low pressure cylinders, being located beneath the floor of the engine room, and the steam and exhaust pipes are attached to the under side of the cylinders. In this way there are no steam pipes visible in the engine room, and there is nothing to interfere with the operation of the traveling crane which is provided for handling all heavy parts.

In the design of the engines, horizontal engines were chosen, because it was found that the type selected could more readily accessible for attendance and repairs, and less be put in even less floor space than vertical engines, are expensive.

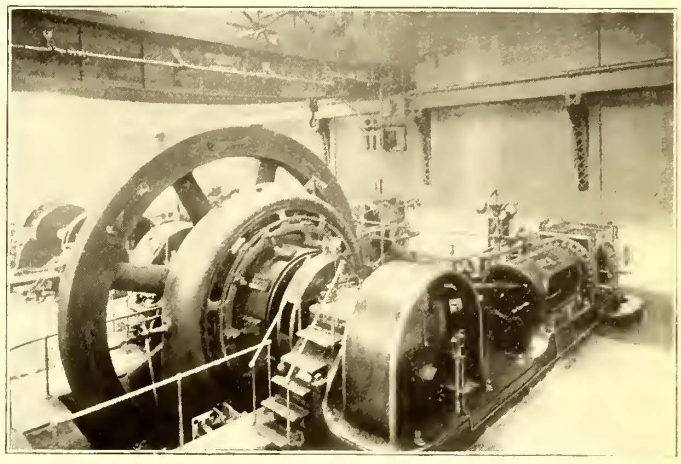
At first sight, there is nothing very striking in the design of these engines, except that the outlines are graceful



for so large a mass of metal, but there is a combination of simple factors which renders them exceptionally efficient. The bed plate is of the Tangye type, the plate and pillow block being cast in one piece, while the cylinders are overhanging and supported on a rest plate, which is adjusted for the support of the cylinder, after expansion has taken

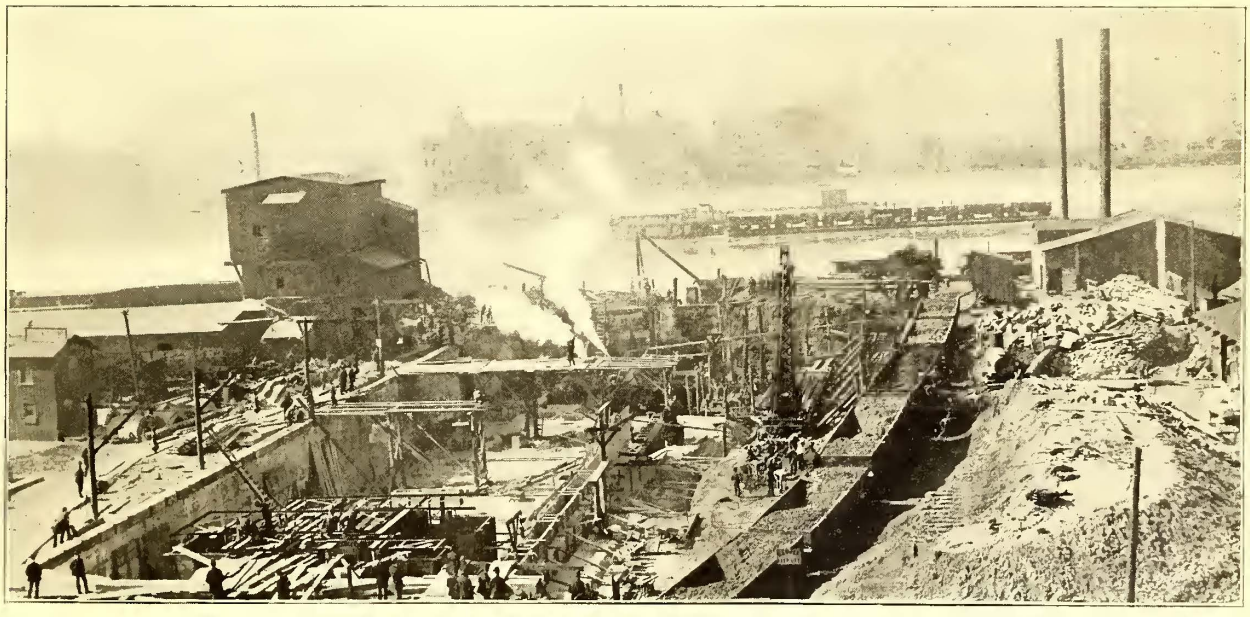


LOW PRESSURE SIDE OF ENGINE



HIGH PRESSURE SIDE OF ENGINE

place from the action of the steam. Each pair of cylinders are steam jacketed, the barrel and jacket being cast together. All the journal bearings and the connections for the valve gear have screw and wedge adjustment. The journal bearings have the adjustment on the sides, but the wedges are accessible through the top cap. The main bearings are 20 ins. in diameter, and 40 ins. long; this may seem very wide for a 44,000-lb. armature and 110,000-lb. fly wheel, but the engineers prefer to distribute the wear over a large surface, believing that there is much less danger of the bearings wearing to a dangerous degree. The fly wheels are each 20 ft. in diameter and weigh 110,000 lbs.



CONSTRUCTING FOUNDATION FOR STATION

An automatic oiling system is used, and the caps of the main bearings have each three oil cavities protected by brass strainers. From the different bearings the oil is led to filters in the basement, from which it is pumped to elevated tanks, and descends by gravity to the different bearings. The air pumps of the jet condensers are of the double acting type, and are operated by a rod from the extension of the crank pin of the low pressure side. The condensers and auxiliary steam equipments are located in the basement of the structure, or rather chambers provided for them in the engine foundations, which are built up of concrete to the height of 17 ft. above the foundation floor. The condensing water is lifted by pumps from an intake pipe 40 ft. below engine room floor, and which extends under the bed of the river. The engines were built by the Pennsylvania Iron Works Company from specifications furnished by the engineers of the Consolidated Traction Company.

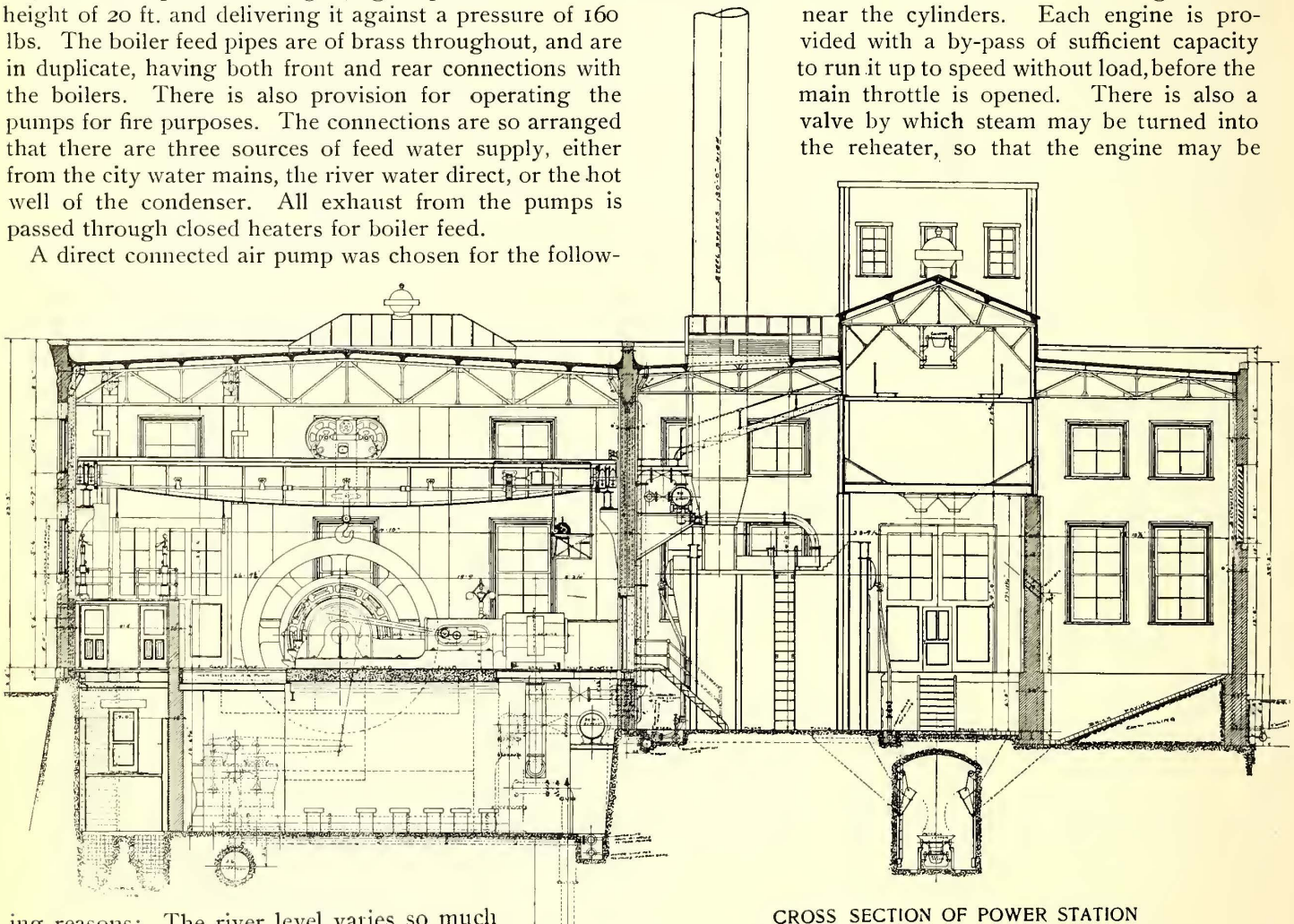
The boiler equipment consists of six batteries of forged steel type sectional water tube boilers of special design made by the Babcock & Wilcox Company. Two boilers constitute a battery, and each battery is rated at 750 h.p. In order to economize floor space, these boilers are shorter and higher than the usual type. Each is made up with three 36-in. drums, 20 ft. long, and 18 sections of tubes, each 15 ft. long, giving about 4000 sq. ft. of heating surface. They are designed for a pressure of 200 lbs., and were tested under hydraulic pressure to 300 lbs. The fire boxes are equipped with the Hawley down draft furnaces, having a grate surface of 66 sq. ft. The furnaces are guaranteed to show 10 per cent greater efficiency than the ordinary flat grate and to be able to burn 40 lbs. of coal per square foot

of grate per hour, and to reduce the smoke by 92 per cent. The boilers with the Hawley furnaces are guaranteed to develop 75 per cent efficiency with less than 1 per cent of moisture at full load, or 1½ per cent at 50 per cent above rating. In tests which have been made the above guarantees have been attained. There are six unlined iron smoke stacks, one for each battery. Each stack is 66 ins. in diameter, and rises 147 ft. above the grate bars, giving a draft of 1 in. to 1½ ins. of water under ordinary conditions. The breechings and stacks are carried on special supports entirely independent of the brick boiler setting.

The feed pumps are three in number, of the Worthington duplex direct acting type, with outside packed plungers, and are capable of lifting 240 gals. per minute to the height of 20 ft. and delivering it against a pressure of 160 lbs. The boiler feed pipes are of brass throughout, and are in duplicate, having both front and rear connections with the boilers. There is also provision for operating the pumps for fire purposes. The connections are so arranged that there are three sources of feed water supply, either from the city water mains, the river water direct, or the hot well of the condenser. All exhaust from the pumps is passed through closed heaters for boiler feed.

A direct connected air pump was chosen for the following reasons: The river level varies so much that any style of pump would have to be designed to do more than is ordinarily required of it, hence the pump will rarely be running at full load, and will therefore be less economical than in the case of more uniform water supply; the effect on the economy, it was thought, would be less, however, in the case of a direct connected air pump where it practically forms part of the friction load of a large compound condensing engine, than in the case of either a single separate pump or a number of smaller pumps designed for economy. Moreover, separately driven pumps, it was thought, would be more expensive (if equal workmanship is obtained) because the cost of steam cylinders and valve gearing is added to that of the pump itself; starting with a direct connected air pump is very much easier, and practically no attendance during operation is required. The main disadvantage, of course, is that the engine must be run non-condensing in case of break down of its own pump.

The steam piping is of cast steel throughout, and each boiler is connected to a 20-in. steam main, which is located along the top of the boiler room above the back end of the boilers, and this main is provided with two copper expansion loops. The main is divided by valves between each battery of boilers, and the steam enters it from the boilers through pipes having a long radius bend, which are tapped into the under side of the main. The pipes leading to the engines lead out from the top of the main and bend down along the wall and out under the floor of the engine room. The valves are of the Chapman manufacture, and are operated from a gallery that runs along the entire side of the boiler room, back of the steam main. The throttle valves and by-pass valves are operated from wheels on four valve stands on the floor of the engine room near the cylinders. Each engine is provided with a by-pass of sufficient capacity to run it up to speed without load, before the main throttle is opened. There is also a valve by which steam may be turned into the reheater, so that the engine may be started by the low pressure cylinder, should the high pressure side be on the center. The exhaust steam pipes terminate at each end of the building above the roof in two Marlin exhaust steam heads. These are each 15 ft. high and 12 ft. 6 ins. in diameter at the top, being among the largest exhaust heads so far erected in this country.



CROSS SECTION OF POWER STATION

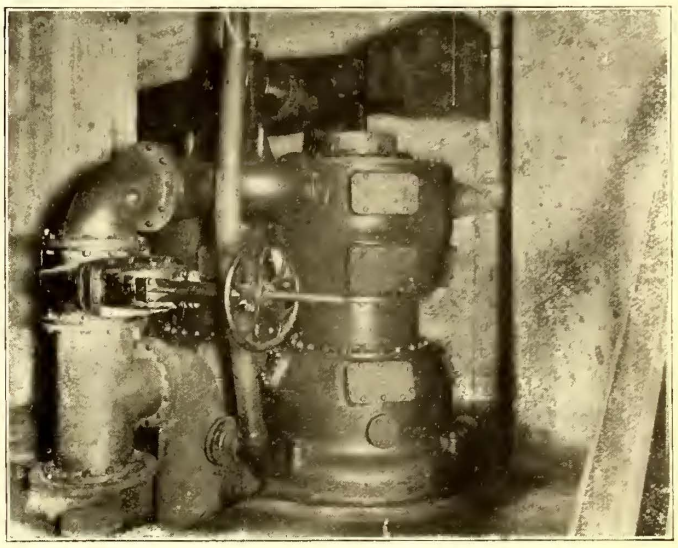
Adjoining the boiler room, and separated by a wall running the whole length, is a storage bin for coal, in the lower part of the separating wall are coal chutes which eventually will be used as ash pits whenever the station is enlarged, the structure being so designed that the coal space can be utilized for a boiler room whenever the capacity of the station is to be increased. The main coal bunker, however, is an elevated steel structure made of plate girders 10 ft. deep and extends the entire length of the boiler room. This bunker has a capacity of 6 tons per running foot, or a total capacity of 1632 tons. A Mead coal conveyor with an automatic weighing bucket with a capacity for handling 40 tons per hour is used. This con-

veyor is driven by an electric motor, and takes about 15 h.p. to operate it. The coal is received by rail at the river end of the boiler room, and, after being weighed, is elevated about 50 ft. and passed to the coal bunker, being dumped anywhere desired. Afterward the conveyor passes into tunnel beneath the boiler room and is utilized for removing ashes.

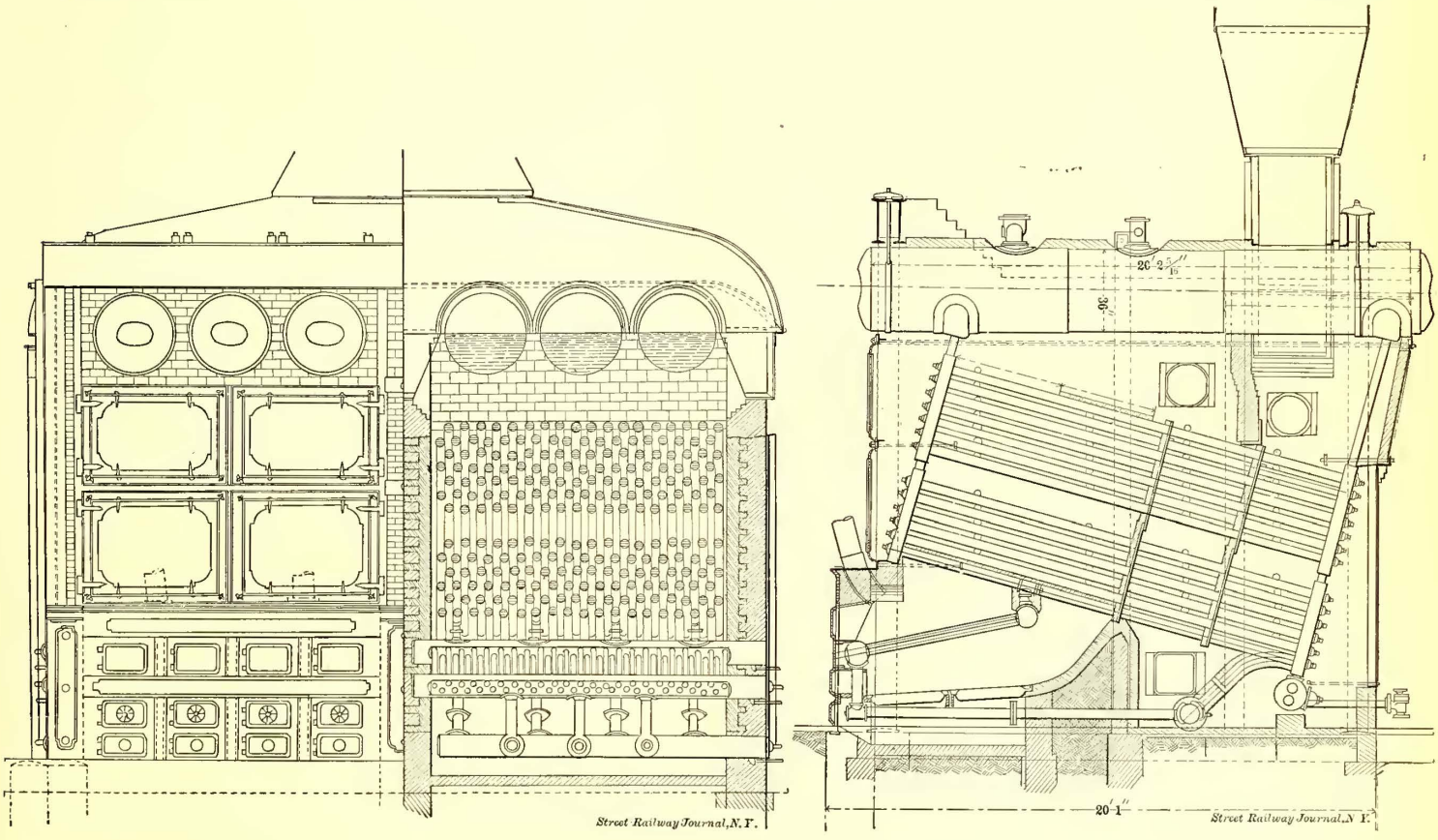
The exterior of the building is of Pompeiian brick with Cleveland sandstone trimmings; the interior of the engine room is Pompeiian brick with enameled brick wainscotting, having a slate cap. The floor is of Mosaic known as "granito," with slate border. The roof is supported on steel riveted girders of the Warren type, having one inclined top chord. The specifications for the framework called for open hearth steel having a tensile strength of from 60,000 to 65,000 lbs. The roof is cinder concrete with iron stiffing bars, having felt and crushed slag imbedded in pitch on the upper surface. Large ventilating and lighting areas with wire screen guards as a protection against falling glass, are also provided.

In the design of the foundations, it was necessary to avoid the possibility of a flood stopping the plant, hence the engine room floor level was fixed 1 ft. above the highest recorded level of the river (a stage of 33 ft. 8 ins. in 1884), normal pool level being stage of 6 ft. On the other hand, the intake pipe must at all times be completely covered with water, thus requiring the top of the pipe to be below stage minus 1; the pipe had to be kept below this level underneath the engines, to keep the vacuum from being lost in times of low water, hence there was required an excavation over 300 ft. in length and over 40 ft. deep from the surface, or 13 ft. below normal river level. This pipe was surrounded with concrete to make it permanent, and to secure good foundation for the engines above. Concrete was chosen because of the ease of handling it in difficult places, such as under caving banks, without removing bracing in water, etc.

The ground dimensions of the entire structure are 272 ft. x 115 ft., while the engine room is 55 ft. wide and the boiler room 60 ft., including the coal storage bin above described. An electric traveling crane of 90,000 lbs. capacity spans the engine room and serves for the quick handling of any piece of machinery or piping. To provide for the lifting of the condensers, areas are left in the engine room floor. These spaces are covered with iron grating that can be readily removed. Similar provision is made in the floor between the back wall and engine cylinders for reaching the steam piping and the reheaters. The foundations of the building contain 20,000 cubic yards of concrete, the side walls being in some places 7 ft. thick. The whole foundation is built as a unit, and has a bed of river gravel upon



DOUBLE ACTING DIRECT DRIVEN AIR PUMP WITH BALANCE LEVER



SIDE ELEVATION AND SECTION OF BOILERS

which it rests. In the process of building, a concrete mixer, referred to more particularly later, was used. The material, or rather the sand and gravel for the foundation was obtained from the river near by, and the material was hauled from the boats up an incline and delivered to an automatic measuring cylinder, which delivered the material, sand, gravel and cement in proper proportion to the mixer.

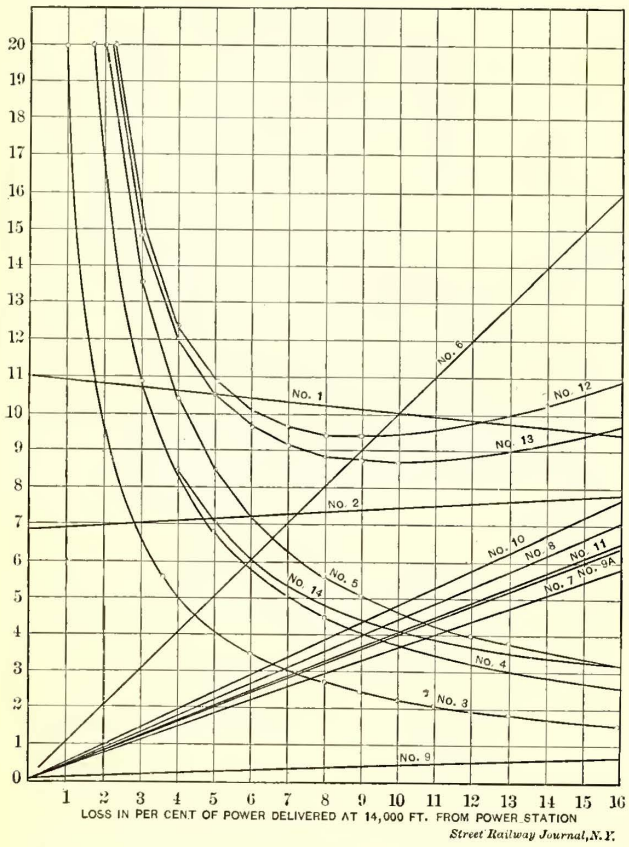


DIAGRAM SHOWING METHOD OF DETERMINING MOST ECONOMICAL ARRANGEMENT OF STATIONS

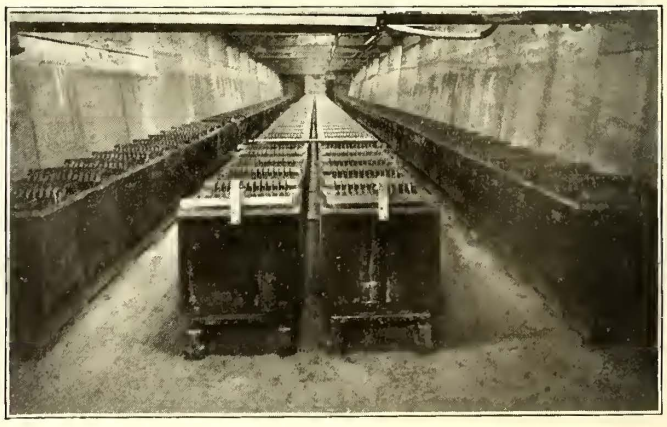
No. 1—Volts at motor, with 1110 at switchboard; scale 100 volts.
No. 2—Amperes at motor for 1000 h. p.; scale 100 amps.
No. 3—Circular mils required, $\frac{2160 \times \text{dist.} \times \text{watts delivered}}{\text{per cent. loss} \times [\text{volts at motor}]^2}$; scale 1,000,000 c. m
No. 4—Capital invested in line, at $1,645 per mile of 500,000 c. m. cable; scale $10,000.
No. 5—Interest and depreciation (12½ per cent) on No. 4; scale $1,000.
No. 6—Power lost in line; scale 10 h. p. May also represent necessary increase in power station capacity.
No. 7—Value of wasted power at $36.50; scale $1,000.
No. 8—Cost of wasted power yearly at $44 per h. p.; scale $1,000.
No. 9—Interest 10 per cent, depreciation, etc., on increase in power house capacity, at $40 per h. p.; scale $1,000.
No. 9A—Increase in power house investment at $40 per h. p.; scale $1,000.
No. 10—Sum of No. 8 and No. 9; scale $1,000.
No. 11—Sum of No. 7 and No. 9; scale $1,000.
No. 12—Total variable portion of annual expenditure, sum of No. 5 and No. 10; scale $1,000.
No. 13—Total variable portion of annual expenditure, sum No. 5 and No. 11; scale $1,000.

STORAGE BATTERY STATIONS

There are three storage battery stations, each located about 3 miles from the power station, and so distributed that they serve to balance the load in a very satisfactory manner. The first of the battery stations was installed in 1897, and the second soon after. The equipment of these two stations consists of 248 cells each, having a capacity of 500 amps. The third, the one recently installed, has a capacity of 1000 amps. For this station a new building has been recently erected on one of the business streets in East Liberty. In addition to its use as a battery station, the first floor will serve as a receiving house, as the batteries occupy the basement. The rear portion of this building will accommodate an emergency wagon of the automobile type, for which storage batteries will furnish the power. The rear of the second floor is finished up with sleeping and toilet rooms for the accommodation of the emergency force, and is fitted with a pole down which the men slide when a call comes, as in fire department stations.

SWITCH ROOM

The generators are of 1000 kw. capacity each, and as mentioned in the Street Railway Journal for February, 1898, are designed for operating the line by the three-wire system. The switchboard and all the connections are also thus wired, but the road is being operated by the single wire system at present. The term switchboard in connection with this plant is a misnomer, for there is no switchboard in the ordinary sense of the term, but in its place there is a four-deck vault or room, 48 ft. x 9 ft., one side of which is formed by the foundation and brick wall, while the remaining walls are of brick. The floor is of slate supported on steel girders, making the chamber fireproof. The cables, which are of 1,000,000 c.m. capacity, lead out from each machine, through tile ducts located in the floor of the basement. These communicate with the lower gallery of the switchboard room, and from this the nine cables from each machine lead up into the second gallery, being held by iron supports having mica bushing, so that there none of the weight is supported by the circuit breakers. The circuit breakers are arranged in rows on each side of the second gallery, while the double throw switches are supported from the ceiling, and all are arranged to be operated by pneumatic appliances from stands on the upper deck. The circuit breakers are thrown in by single acting air cylinders, while there is also a small cylinder for tripping the circuit break when necessary. The switches are



STORAGE BATTERY

controlled by a double acting cylinder. There are thirty-two 1,000,000 c.m. cables which form the return circuit, and these are connected to a vertical bus bar located in the middle of the second chamber, this, in turn, is connected to the neutral bars above. The bus bars proper are placed in a horizontal position and are located between two sets of I beams, the lower of which forms the support for switches in the room below, and the upper set supports the slate walks of the third chamber, being in plain sight and easily accessible. The bus bars, both for the positive, negative and neutral limbs, are each made up of fifty copper strips of 3 ins. x ⅛-in. section, each being of sufficient capacity for the distribution of the current of all of the 1000 kw. generators, when it becomes necessary to operate by the three-wire system.

On the walls of the third chamber are placed two watt meters, rheostat face plates, air pipes, ammeter leaves, etc. In the center of this chamber are the rheostats, which are

protected by a perforated metal cover. The controlling stands are located on the upper deck, which is really a platform overlooking the engine room. From this platform all the current controlling appliances are operated. These stands are numbered, and there is one for each feeder and one for each generator. These stands are arranged in two rows, with one stand in the middle, on which is placed the air pressure gage, alarm bell for low air pressure, and air valves for lighting switch and circuit breaker of the station lighting circuit. This latter is so connected to the leads of any of the generators, that should all the generator circuit breakers go out, the station would not be left in darkness. On the top of each controlling stand is a red tell-tale lamp, which lights automatically when the corresponding circuit breaker is thrown out. Below this is an ammeter illuminated by a shaded lamp, while near the middle of each stand are two handles which operate the air valves for circuit breakers and switches. These handles are so interlocked that the switch cannot be operated when the circuit breaker is in, nor can the circuit breaker be closed when the switch is in, so that it is impossible for the attendant to make a mistake. The generator stands have, in addition to the above, a small hand wheel for operating the rheostats, and a receptacle for plugs for connecting the volt meters to the different generators. At the middle of each row of stands is a revolving stand, on one of which are three volt meters, and on the other three ammeters, which can be turned so that they may be read by the attendant at any point on the platform. One volt meter is connected to the plug switch, and the other two give the voltage of the positive and negative bus bars, respectively, while the three ammeters give the current of the positive, negative and neutral bars. The instrument for the negative bar is double reading, and shows which side of the three-wire system has most load.

From the switchboard the lead covered cables are carried through a subway to a brick tunnel, which leads off through the foundations of the building in the direction of Penn Avenue, and which extend a distance of nearly 600 ft. The interior dimensions of this tunnel are 5 ft. x 7 ft., or sufficient to provide for the ultimate capacity of 40,000,000 c.m. of feeder cable, beside room for the free passage of the employees. In the construction of this tunnel, there was imbedded in the concrete foundation in two rows extending the whole length of the tunnel thirty-two girder rail conductors, the rails being 63 lbs. section per yard. The ends of these rails are double bonded, and to these the return feeders are attached. At Penn and Liberty Avenues the cables are brought up through large distributing poles, from which they lead off in eight directions, being supported from the trolley poles.

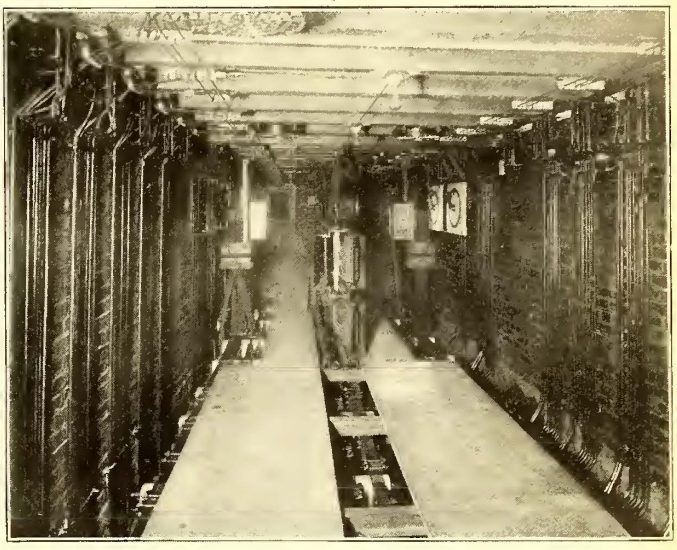
The diagram opposite shows graphically the calculation to determine the most economical size of feeders to employ, consideration on the one hand being taken of the loss of power through resistance, and, on the other, of the interest on the investment.

CONSTRUCTION OF PLANT

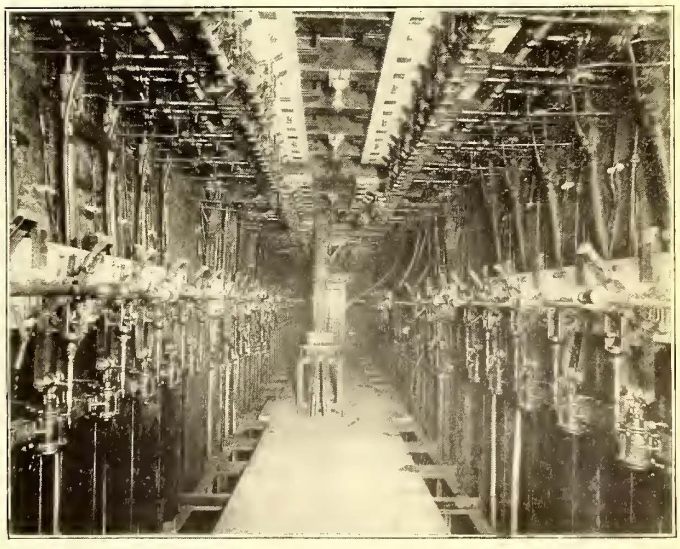
Excavation for the power station was begun Sept. 1, 1897, the material being shoveled directly into cars on the siding leading on to the property. After the excavation deepened, and the grade became so heavy that this method became impractical, two machines were used, one a bucket conveyor, the other a traveling hoist. The total excavation amounted to about 35,000 cu. ft.

As the walls and the foundations proper of the engines, as well as of the building, were of concrete, hand mixing was out of the question. A machine mixer was therefore erected. It was about 20 ft. x 16 ft. and 32 ft. high, and although largely experimental, did good service, turning out on some days over 500 cu. yds. per day of twenty hours, when that amount could be used, and making a total of about 20,000 cu. yds. The following table gives

CONTROLLING STANDS ON TOP GALLERY



UPPER GALLERY, SHOWING BUS BARS AND RHEOSTATS



LOWER SWITCH GALLERY, SHOWING CIRCUIT BREAKERS ON SIDES AND SWITCHES OVERHEAD

the cost of mixing concrete by the mixer, as estimated from actual experience during the past year:

Cost of materials	1-4-10	1-3-8	1-2-5
American Portland cement, @ $2.05 per bbl.	$1.37	$1.69	$2.66
Sand, @ 2½ cents per bu.	0.30	0.29	0.29
Gravel, @ 2 cents per bu.	0.38	0.38	0.37
	$2.05	$2.36	$3.32

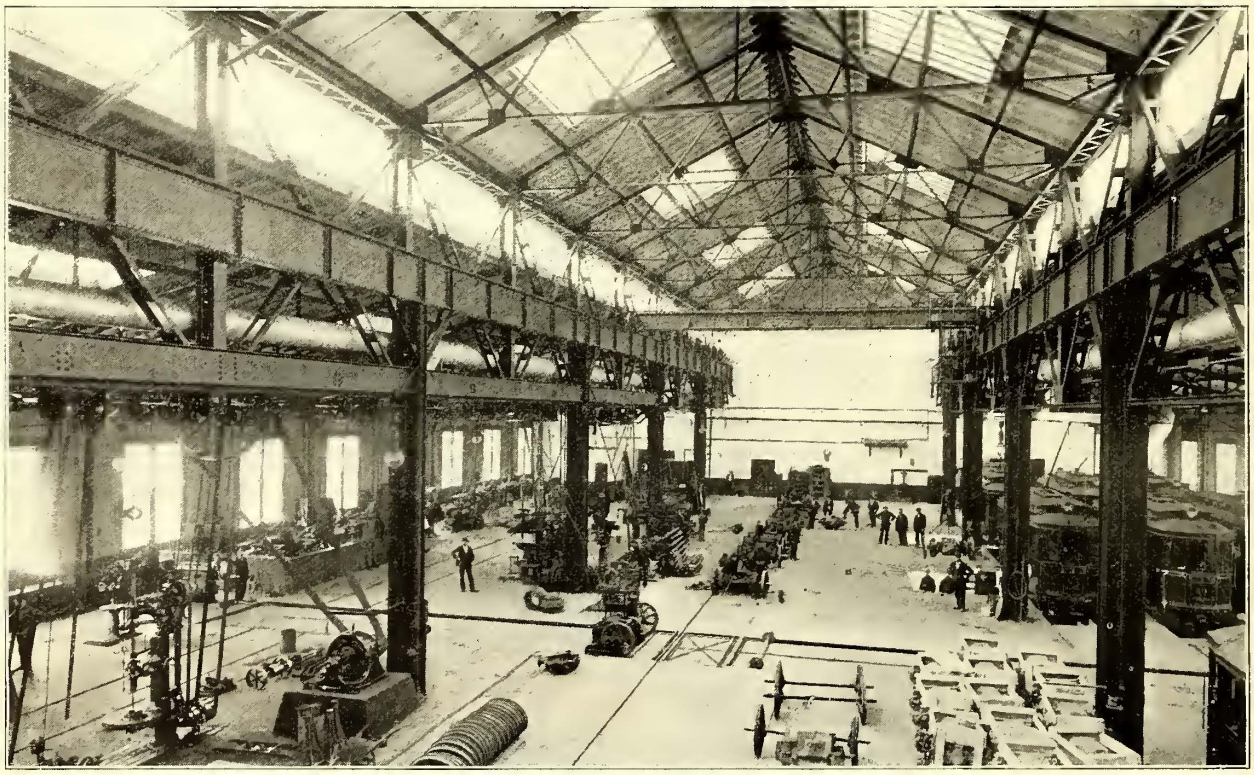
Cost of delivery to Mixer of materials	$0.07
Cost of measuring and mixing	0.05
Cost of delivery 150 ft. and return by wheelbarrow gang	0.23
Cost of tamping	0.18
Total cost of labor	$0.53

(The above represents the average of an ordinary day's run, but does not include share of cost or depreciation of mixer plant.)

An American Portland cement was used throughout, mixed with sand and gravel in proportions varying from 1-3-8 to 1-2-5; no broken stone was used as actual tests on concrete blocks showed that an equally strong concrete could be secured at lower cost by the use of gravel alone.

brick floor cement grouted. The second building in line is the repair shop proper, is 135 ft. x 576 ft. and is divided into the iron tool department, wood shop and erecting department and paint shop. The operating house is 135 ft. x 400 ft., and between it and the machine shop is a large area occupied by twelve storage tracks, all connected by a diagonal cross track, having both single and double slip switches. The warehouse is located just outside the storage tracks, and is 50 ft. x 150 ft. Near it, and on a line with the main shop is the boiler house, in which is a battery of tubular boilers which generate the steam for heating the buildings.

The iron working tools in the repair department are driven by power derived from a 50 h.p. electric motor, which is belted to overhead shafting. There is also a motor of equal capacity for operating the wood-working tools in the carpenter department. This motor is located beneath the floor, as is also the main shafting, so that the individual tools are driven by belts that come up through the floor. In the machine shop the iron-working tools occupy one



INTERIOR OF REPAIR SHOP, SHOWING TOOLS, DISMANTLING PITS, TRAVELING CRANE AND TRANSFER TABLE

Each engine foundation contains about 350 cu. yds. and is quite complicated in shape. If brick work this would have cost at least $6 per yard, while the actual cost in concrete was 50 cents for material and labor in erecting and removing the forms, and $4 for the concrete itself.

REPAIR SHOP AND CAR HOUSES

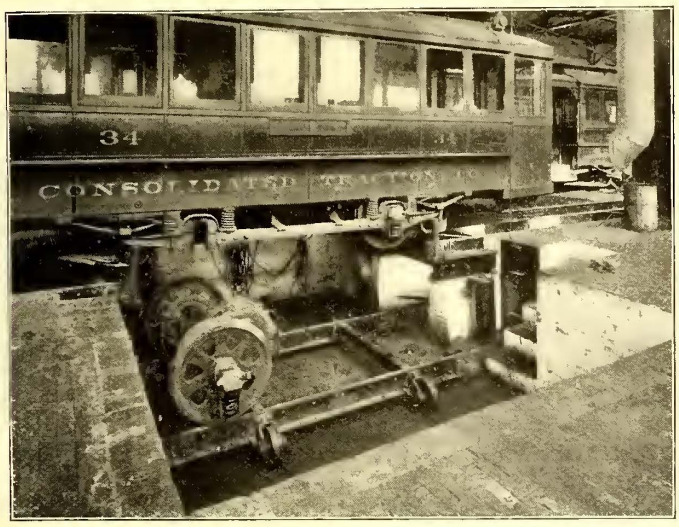
The company has six new car houses, conveniently located in different parts of the city, and all have the same general equipment. The repair shops and principal buildings, however, are located on Frankstown Avenue, and are known as the "Homewood Car Shops and Houses."

This station comprises four large buildings, with two small buildings, all of brick, with the roofs supported by steel truss riveted girders of the Fink type, and all about the same general design. The three main buildings are placed in line with each other in the direction of their longest dimension, and are all of the same width. The first is known as the storage house, and is 135 ft. x 220 ft. with a

side of the floor to the left of the main bay, and adjoining this space is the winding department. The tool equipment consisting of drills, planers, lathes, wheel-boring machines and slotters is very complete. There is also a lathe equipped with an axle key seating device. Along one side of the room adjoining the wall, a space is fenced off for a small tool room, which is in charge of an attendant who issues the cutting tools to the men on checks. This department is supplied with three machines for making small tools, consisting of a Brown & Sharp universal grinder, a milling machine of the same makers, and a small engine lathe.

The main floor of the repair shop, which is paved with brick, is devoted to the overhauling and cleaning of motors and the replacing of wheels. The shifting is all done by means of a traveling electric crane of 40 ft. span, and a capacity for lifting 20,000 lbs. It is operated by an attendant from a cage suspended from the main girder of the crane. The most interesting features, however, of the repair shop

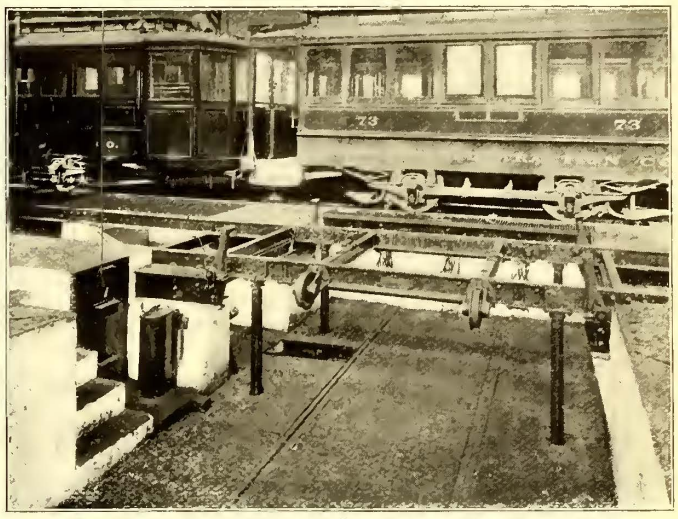
are the dismantling pits, which are located at one side of the main floor near the center of the shop. These pits are so designed that a pair of wheels, or both axles with their motors, can be removed from the truck and a new set substituted within the short space of twenty minutes. Five men only are required in this operation. The track over the pits is supported on steel girders, and is braced across, forming a truck, having small wheels on each side. This section of the track or truck is mechanically lowered or raised by means of four heavy screws, which are placed in the corners of the pit, and are operated simultaneously by means of connecting shafts and beveled gears. These screws are driven by a railway motor placed in a chamber to one side of the pit, and operated by an ordinary type "D" Westinghouse controller. In the operation of the device, the car is run over the pit, when the ends of the truck are supported by means of four folding props, which can be turned out of the way when the car is to be run on or off. The motor connections being severed and the brake mechanism unshipped, the portion of the track carrying the wheels is lowered quickly by means of the screws. When the side wheels of the section rest upon the track placed in the bottom of the pit at right angles with the car track, the truck with its load is readily rolled to one side. This brings



DISMANTLING PIT IN OPERATION

the wheels and motors into position to be readily picked up by the crane, by which they are deposited at any convenient point on the main floor. Here they are opened, inspected and cleaned. A new set of axles and motors are replaced by reversing the process. The crane deposits them on the truck, which is then run under the car, and the motor being started, each wheel is lifted to its place and secured in position, when the necessary motor connections are made.

The inspection pits of the shop are conveniently located adjoining the dismantling pits, and the rails are supported on posts, thus giving free access from one to the other, beneath the iron grating floor which covers the space between the pits. Another important machine in the shops is a Murphy wheel grinder, by means of which wheels are ground without removing them from the car. This apparatus is placed over one of the pits, near the entrance to the main floor, and is fitted with a frame work which supports a set of shafting and pulleys above the car. The truck is then supported independently of the wheels, when a portion of the truck under each wheel is removed. There are centering lathe heads on each side, so that by removing the journal box covers the axles are readily centered and left to rotate, and are operated by their own motors from the trolley current. In order to provide for proper control under these conditions, a section of the trolley wire over the cars is partly cut out of the main circuit by means of resistance coils, but there is sufficient current left in the trolley to bring the car into position. The emery

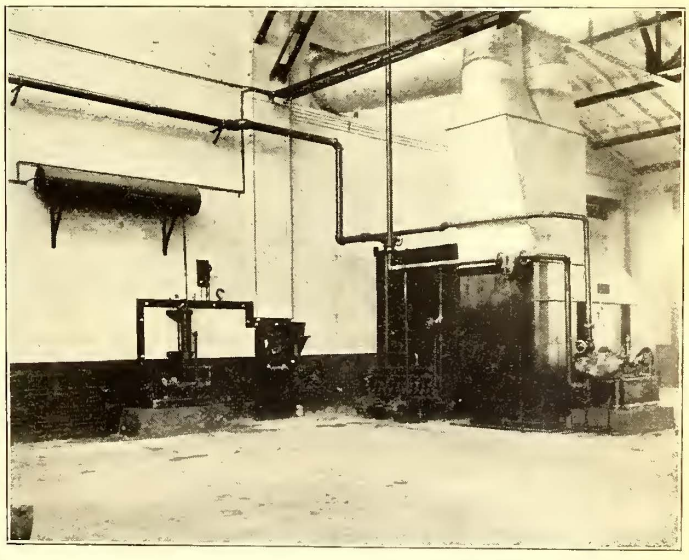


DISMANTLING PIT READY FOR CAR

grinding wheels are so placed that they come in contact with the tread of the wheel on the under side and are revolved in a direction opposite that of the car wheels. The emery wheels are driven by belts from the overhead pulleys, the power being supplied from an electric motor placed beneath the floor, and belted to the overhead shafting.

The blacksmith shop occupies one corner of the main floor, from which it is separated by a brick partition. There are four forges with draft flues, so designed as to remove all the smoke and fumes, a feature that is rarely found working successfully in shops of this character. The equipment includes surfacing plates and the appliances usually found in this class of shops.

Another interesting feature is the method of heating the



HEATING AND VENTILATING FAN, AIR COMPRESSOR AND TANK

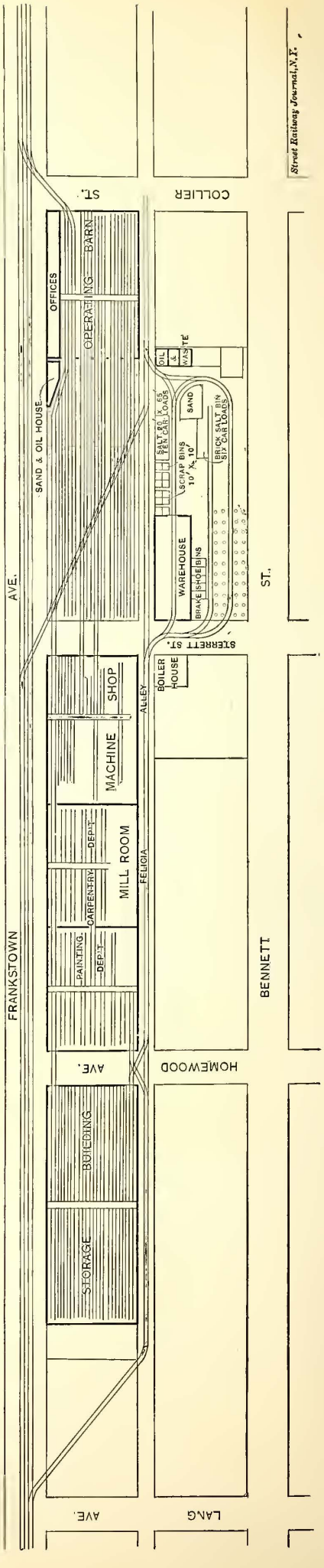
various departments of the shops and the operating house. This apparatus consists of two large fan cases, located at the sides and at the end of the main floor of the repair department. The case incloses a nest of steam pipes, which is open on one side, when, by the revolution of the fan, which

WOOD WORKING AND ERECTING DEPARTMENT

is driven by a small steam engine attached, the air is drawn in between the heated pipes and is forced out into large mains of galvanized iron, which lead in both directions along the ceiling. They are supported by the structural portion of the roof, and are furnished at suitable distances with branch pipes which lead half way down the posts that support the structure, and open at angles, so that the heated air is delivered in a downward stream. Steam for operating the engines of the fans is brought from the neighboring boiler house previously described. A similar equipment serves for heating the operating house.

Compressed air is used for blowing out motors, for cleaning car cushions and for removing the dust and shavings from the wood-working machines. The air is led to the various stations through pipes which terminate in a section of rubber hose with suitable nozzle valves. The air pressure is generated by means of a rotary compressor, driven by a 2 h.p. motor, which is started and stopped automatically by means of a pressure regulator in connection with the storage tank. This regulator shuts off the

PAINT SHOP, SHOWING ELECTRIC TRANSFER TABLE, BRACKETS FOR SCAFFOLDING AND HEATING TUBES



PLAN OF HOMEWOOD CAR SHOPS AND HOUSES

motor when the pressure reaches 100 lbs., and it starts up when it has fallen to 60 lbs. The use of compressed air as above described is considered by the general foreman as a very economical feature in connection with car cleaning and repairs.

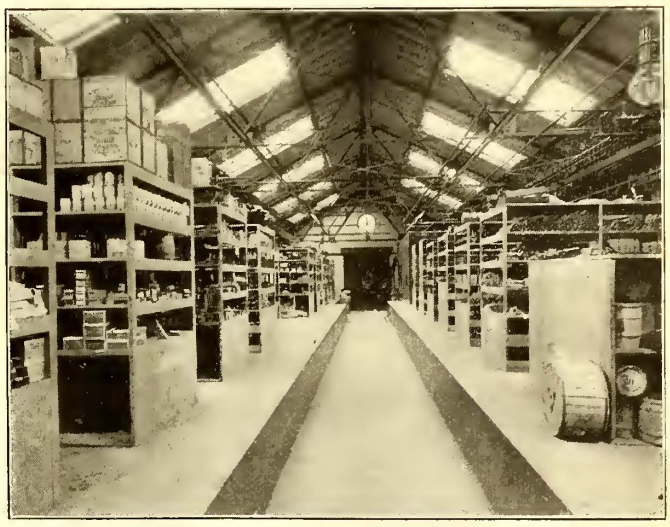
The wood-working and erecting department has a full set of wood-working tools, consisting of band and circular saws, planers, gaining and mortising machines. These are located on one side of the main floor, and are driven as before noted, by an electric motor. In addition there is an electric transfer car, which serves for shifting the cars from the main track to any of the side tracks. Similar electric transfer tables are used in the other two departments of the building.

The paint shop occupies the last section of the main building. Between each of the tracks is a row of posts which are equipped with pivoted iron brackets, which when swung into position toward a car serve to support the scaffolding, by means of which the painters are able to reach the sides and roof of the car. When not in use, these brackets are swung around in line with the cars, and are not in the way of the workmen. On one side of the paint shop is a small room, fenced off by a brick wall, in which the paints are mixed, and which is fireproof. Fire buckets filled with sand are placed in suitable position with which to extinguish an oil fire, should one start. There is also a separate room for storing the sash and blinds, and a curtain department in which the necessary supplies of trimmings, etc., are kept; the main supply being kept in the main warehouse.

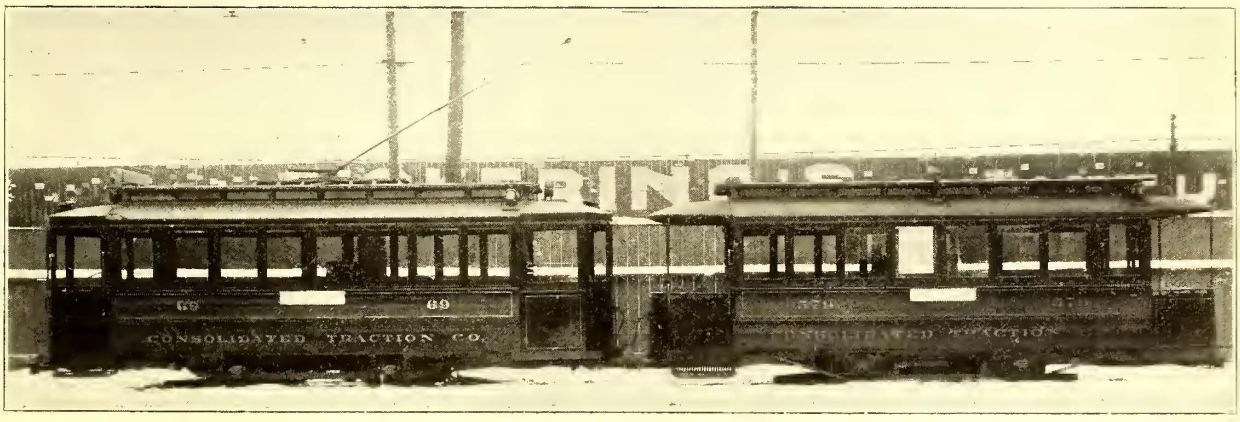
The operating house, which is also a receiving station, is provided with inspection pits, and with suitable appliances for washing and cleaning cars. The offices of the receiver and the operating foreman occupy one side of this building. These offices are finished in Georgia pine, and the counter of the receiver's office before each window is a marble slab, which furnishes a smooth and durable surface, over which the envelopes and money are passed. In the partition are suitable letter chutes through which the conductors deposit their reports. Adjoining the receiver's office is a long room designed for a waiting and lunch room for the employees. Here are suitable tables and chairs and lockers, which are arranged along each side of the room, and also in a row down the middle of the floor. The lockers number 298, and are in double deck rows. As noted above, the main buildings have about the same general structure, and for ventilating the main floors, the deck lights on each side of the monitor roof are arranged in sections, each including a number of lights, so that every other one can be slid in front of the other. The supporting frames are fitted with rollers and a track on which they run to allow this to be done. The alternate sash can be readily shifted to any degree of ventilation by means of small chains that come down near the main floor, and which are readily accessible.

The operating house, as well as all the other operating houses, with the exception of the one noted above as the storage house, are designed only as washing and inspection stations, as the cars when clean are run out and held on the storage tracks ready for service, an arrangement that saves largely in the insurance rates on the buildings. For shifting cars about the Frankstown station, dummy motor cars are employed. These cars have short bodies and are provided with electric and wheel brakes. For operating the trolley pole, the trolley cord is continuous, and passes through from end to end of the car under the ceiling with rollers so arranged that the motorman can free the trolley from the wire, reverse and return it, for running in the opposite direction without leaving the cab. These cars readily handle six or seven trail cars in a train, and pull them from the operating house to the storage tracks, where the motor cars, by means of the diagonal track above noted are able to pick up a trailer from any one of the storage tracks, and move with it to the street.

The warehouse to which all supplies are delivered has a sunken track down the middle, so that goods may be delivered to the platforms on either side from cars or trucks,

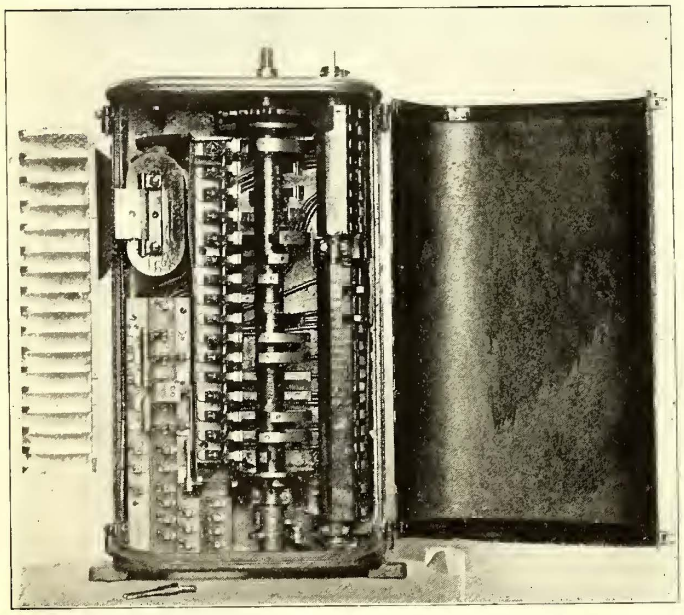


STORE ROOM, SHOWING RACKS FOR MATERIAL

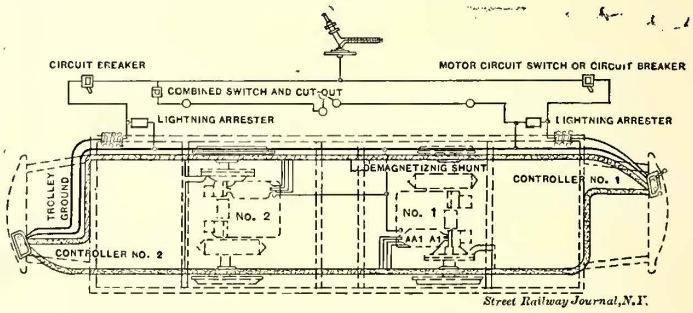


ELECTRIC TRAIN WITH ELECTRIC BRAKES ON BOTH CARS

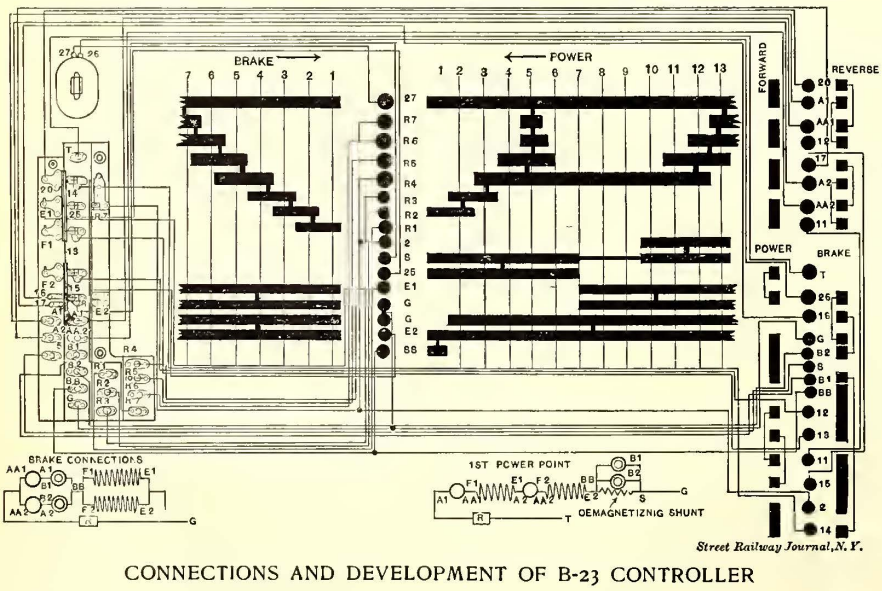
The store room is fitted with stands or racks 6 ft. x 10 ft. and 10 ft. high, which are divided into suitable boxes, bins and shelves for holding the material, one rack being assigned to each class of material. Each rack is labeled on the side toward the track in white letters, and designates the character of material which may be found therein; for instance, one reads, "rope, twine and power house supplies," another "carbon brushes and parts for standard motors," a third, " valves and pipe fittings," still another, "arc lamp supplies," and so on for each of the racks. In addition, there are shelves and drawers along the side walls in which shelf hardware is stored, and there are sliding ladders provided which give ready access to the higher shelves. Every class of articles is known by lot number, and when issued is charged up to the different departments, a most rigid system of accounts being maintained.



B-23 CONTROLLER



CAR WIRING FOR B-23 CONTROLLERS AND TWO MOTORS WITH ELECTRIC BRAKES



CONNECTIONS AND DEVELOPMENT OF B-23 CONTROLLER

ROLLING STOCK

In the matter of rolling stock equipment, the energies of the general manager have been directed to the standardizing of all parts and appliances. All appliances of the same kind are treated as a unit and repairs are made on a specific equipment at stated periods, without reference to the amount of wear they have sustained. The cars are all of the same design, the trucks all of McGuire manufacture, the motors Westinghouse, No. 38, with the exception of 120 new equipments mentioned below. The signal gongs are placed on the hood of the cars, and are sounded by means of a cord that hangs just above the controller handle. Recently a new type of illuminated sign has been adopted. To provide for the hauling of trailers, all the cars are equipped with the Van Dorn couplers.

Each of the 120 cars which the company has recently added to its equipment is provided with two 50 h.p. railway motors and electric brakes, manufactured by the General Electric Company. The motors are what are known as the GE-57 type, and contain all the latest improvements in construction and design. The frames are of cast steel and are fitted with laminated wrought iron pole pieces which are bolted to them. The bearings were designed with special reference to obtaining a large bearing surface and good lubrication. The armature is small and compact, having a diameter of only 14 ins. It is of the standard, iron-clad construction, such as is now universally adopted by manufacturers of this class of apparatus. The winding is of the three-coil per slot type, which has great advantages in the way of armature repairs and the ensuring of a high insulation. The weight of this motor is about 3000 lbs. complete. Each motor is fitted with a cast steel yoke, which is bolted to the frame on the commutator end of the motor. It is provided with two horns which project on each side of the axle and which are designed to support the brake shoe. The latter is of the AJ-11 type and is 26 ins. in diameter.

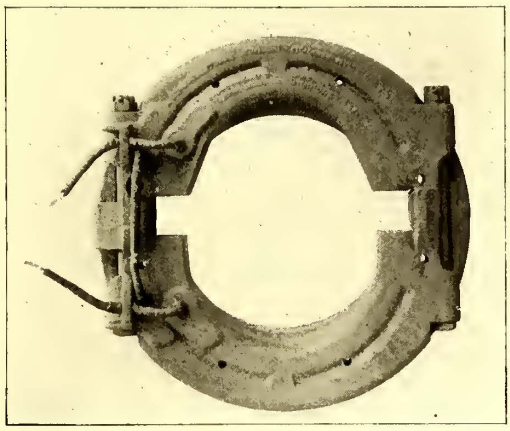
The brake disc which is keyed to the axle is the AK-18 and is, of course, of the same diameter as the shoe. The hub of the disc butts against the end of the motor axle lining, and the end play of the motor is limited by the disc which is provided with a suitable adjustment.

The controller used on these equipments is the B-23, designed for operating two 50 h.p. motors with electric brakes. The braking is accomplished in the usual manner by converting the motors into generators and passing the current thus generated through the brake shoes and regulating resistance. With this method of braking, it is immaterial whether the trolley is "on" or not. The braking effort is due to the "back" torque of the motors (acting as generators) and the friction between shoes and discs.

A good idea of this controller may be obtained from the photo-engraving showing the interior. The controller has a single operating cylinder which is rotated in one direction for power and in the opposite direction for brake.

The various motor and brake connections for power and braking are made by the small commutating cylinder shown on the right hand side of the controller. This cylinder is moved by means of a cam secured to the main cylinder shaft which engages with the lever seen at the bottom of the controller. The reversing cylinder is shown at the top of the controller on the right hand side, and is of the usual construction.

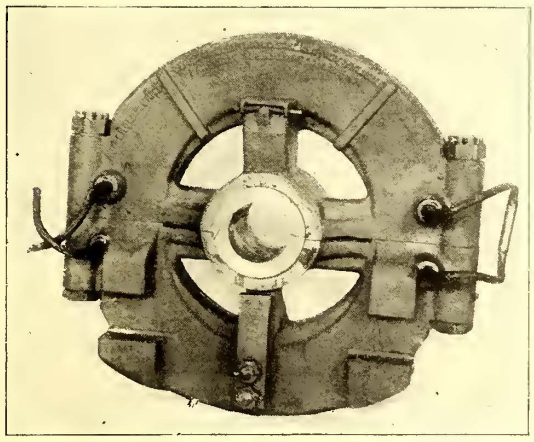
The main cylinder serves to series parallel the motors on



MOTOR CAR BRAKE SHOE (TYPE A J-11)

the "power" side and to regulate the resistance both for power and brake. As the usual interlocking mechanism between cylinders is used, all arcing takes place on the main cylinder where the efficient magnetic blow-out embodied in all controllers of General Electric manufacture, provides for its prompt and complete extinguishment.

This controller differs from some of the earlier types in the arrangement of braking connections and enables the



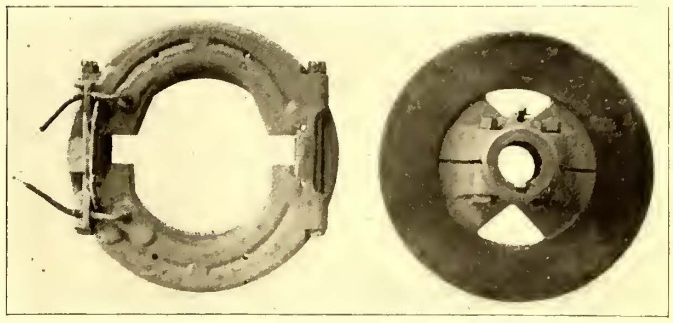
TRAIL CAR BRAKE SHOE (A J-13)

motormen to make a much quicker stop without skidding the wheels than was possible with the other types of controller, or with any form of power brake. The diagram on p. 138 shows the development of the controller and the connections of the apparatus for both power and brake.

It will be observed that the brake shoe on each axle is directly in series with the armature of the motor on the same axle. If either brake tends to lock, due to a too rapid application of the brake, the axle will cease to turn, or, at least, slow down, with the result that the armature in series with the shoe ceases to generate as great a voltage as the armature of the other motor.

The natural result is, that current will pass through the locked shoe in the reverse direction and demagnetize it, allowing it to release. As this action is entirely automatic, it is practically impossible to skid the wheels for more than a foot or two, which is not sufficient to cause a flat wheel. The maximum braking effort that can therefore be applied is dependent solely on the friction between wheels and track.

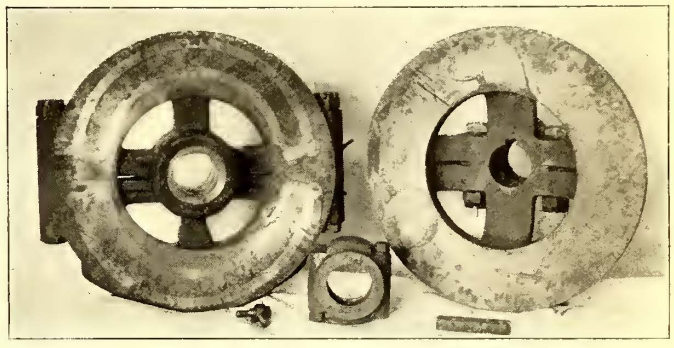
The shoes are demagnetized in the usual manner by



MOTOR CAR BRAKE SHOE AND DISC

shunting a portion of the current on the first power point through them in a reverse direction. This current allows them to release and drop away from the disc.

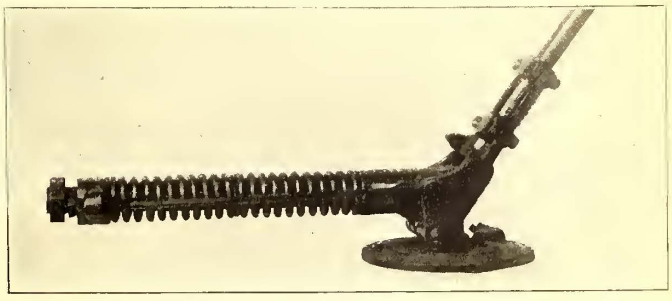
Provisions are also made for the use of electric brakes on the trailer cars. The shoe used is of the axle suspended type, being mounted directly upon the car axle. This shoe is the AJ-13 and is provided with brass axle lining and grease cup. The brake disc is the AK-13. Both shoe and dics are 28 ins. in diameter and they are mounted on each axle of the trail car truck. The shoe is adjusted by an axle collar and an adjusting screw, passing through a U bolt which is screwed into the axle. The shoes are kept from



TRAIL CAR SHOE AND DISC

revolving by means of a bar which passes between the horns shown on the lower half of the shoe.

Connection between motor and trail car is made by means of a special coupler which contains the lighting connection as well as the two brake connections. The



U. S.-6 TROLLEY STAND

sockets are secured to the dashers of the two cars and connections made by means of a flexible lead with a plug at each end. The trail car shoes are connected in series, and when in use are connected between the common lead from

the two motor car brake shoes and the equalizing connection of the motor fields. Referring to diagram of the controller, these shoes are connected in the wire marked BB.

The trolley bases are of the new type recently brought out by the General Electric Company, and known as the U. S.-6 base. The interesting feature of this type of base is the use of a single compression spring which serves the double purpose of a pressure and a buffing spring. A view of this trolley is shown on page 139, from which the action of the base will be readily understood. The buffing collar is seen on the inner end of the spring guide and is forced against the spring by the two lugs on the inside of the swivel head. The stud is very long, insuring an easy swiveling action and allowing the wheel to follow the wire exceptionally well. The inside of the swivel head is fitted with a brass bushing, which reduces the swiveling friction and can be easily replaced when worn out. The minimum height of this base is 6 ins. with the pole in a horizontal position. The cars are provided with circuit breakers connected according to our latest method, the circuit breaker at either end of the car being in circuit only with the controller at the same end. These circuit breakers are of the "MQ" type and contain a magnetic blow-out and other features found in circuit breakers of the General Electric manufacture.

ORGANIZATION

The business affairs of the Consolidated Traction Company are chiefly under the direction of C. L. Magee, president, while the operating department, as well as the electric and mechanical features, are in charge of G. F. Greenwood, with the title of chief engineer and general manager.

CONTRACTORS, ETC.

Some of the contractors and manufacturers of the material required for the erection of the new buildings, and the equipments noted in the accompanying description include the following: The Pennsylvania Iron Works Company of Philadelphia, engines and the auxiliary steam equipment; Babcock & Wilcox Company, boilers; Westinghouse Electric & Manufacturing Company, generators; Jones & Laughlin, Pittsburg, structural steel for roofs and coal bin; Alfred F. Moore, Philadelphia, lead covered cables; John A. Mead & Sons, New York, coal conveyors and automatic weigher; Electric Storage Battery Company, Philadelphia, storage batteries; The U. Baird Machinery Company, Pittsburg, some of the iron working tools; J. A. Fay & Co., Cincinnati, wood-working tools; Marlin & Co., Pittsburg, exhaust steam headers, roofing and ventilators; Pawling & Harnischfeger, Milwaukee, electric traveling cranes; Laclede Car Company, American Car Company, Union Car Company, cars; A. French Spring Company, Pittsburgh, car springs.

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It has been proved that it is usually a waste of time, and very little has been accomplished, by attempting to instruct motormen and conductors other than in the simplest ideas of electrical problems, for while on some roads there may be a number of old motormen who have a fair idea of electrical equipments and whom it would probably be safe to allow to locate existing troubles, it would be difficult to draw the line between the men competent in this direction and those wholly lacking in such knowledge. I know of nothing more distasteful to passengers unwillingly detained than sitting in a car impatiently waiting while a motorman works over some part of the equipment in a vain endeavor to locate some trouble, the very nature of which he has not the faintest idea, and quite likely, at the same time, interfering with the movement of several other cars. From paper at the Boston Convention, 1898.

Interurban Electric Railway in Titusville, Pa.

A 10-mile electric railway has recently been completed in northwestern Pennsylvania, connecting the towns of Pleasantville, East Titusville, Titusville and Hydetown. The road was built and is operated by the Titusville Electric Traction Company, which, in 1897, obtained a 999-year charter from the State. It was opened for business on June 3 of last year, carrying passengers from Pleasantville to Titusville, and in November, the 4 miles to Hydetown were finished. Titusville is the largest of the four towns, and has a population of 10,000. Pleasantville, with its population of 1200, does its shopping and marketing in Titusville, as does East Titusville and Hydetown. The total population of the four towns is about 15,000.

Titusville is famous for having been the center of the great oil excitement of the early sixties. Petroleum was discovered here, and in a few years, what had been a straggling hamlet, became a bustling young city. Gradually the production of oil has lessened in the vicinity of Titusville, and the city has suffered a reaction. Several years ago, however, a Board of Trade was organized, and through its efforts and those of the Industrial Association the city is now enjoying a more wholesome and lasting prosperity. Among its leading industries are several large iron-working establishments; a tannery, which employs several hundred men; oil refineries, and a silk mill.

For a number of years the people of Pleasantville and Titusville have been desirous of having the two towns in closer communication than was afforded by a stage line and George B. Dunham, of Pleasantville, took the initiative and succeeded in interesting R. D. Stoelzing, of that place, M. B. Dunham and A. J. Hazelton, of Warren, Pa., and a corporation was formed with a capital of $100,000. A survey was immediately made and work was begun in July, 1897. Pleasantville is 6 miles from Titusville, and the new company was obliged to purchase the right of way for almost the whole distance from the eastern city limits of Titusville to Pleasantville. Two miles of the road run through a deep gorge along the path of a small but turbulent brook. The engineers at first thought it would be an impossibility to build the road through this gorge, and it was only accomplished after much blasting and bridging were resorted to, and finally the course of the stream was changed near the entrance of the gorge. About 1 mile from the entrance of the gorge the company has leased 60 acres of woodland, which is being converted into a park. The place is one of great natural beauty, and, with the attractions that the company offer, it is expected that it will become a favorite resort, and will do much to increase the road's earnings. Next summer it is proposed to construct, near the park, an artificial lake, in the center of which will be a large electric fountain. The lake will be large enough to afford boating and bathing.

The company's power station is at East Titusville. It is a substantial brick building 74 ft. x 58 ft., of which the engine room occupies 58 ft. x 35.5 ft. and the boiler room 38 ft. x 39 ft. A steel stack 4 ft. in diameter is used. The floor of both rooms is of cement. Since the road has been in operation one engine has been employed. It was built by the Atlas Engine Works, of Indianapolis, and is of the Corliss type, 16 ins. x 32 ins. During the past month a larger engine, 24 ins. x 48 ins., of the same type and make, has been installed and is now running. The smaller engine will be used as auxiliary in case of breakdown or when the load is too heavy for the newer engine. The bed plate is of the girder form, known as the "Corliss bed plate." It is cast in a single piece, unusually massive and rigid, the main shaft-bearing having removable parts with

wedge adjustment. The ends of the cylinder, which contain the valve chambers and the steam and exhaust parts, are cast and finished separately from the cylinder proper, through which the piston traverses. The parts are so constructed and bolted together that the piston travels over no joint, while the clearance remains as low as in the usual form. The advantages afforded by this construction are a more perfect bore free from flaws and shrinkage strains, which the presence of small cored passages is apt to engender, and that, being made to gages on the interchangeable plan, it is possible to renew, without delay and at small cost, a part injured by accident, which otherwise might mean the loss of the entire cylinder. A steel plate lagging, which leaves a space packed with non-conducting material, covers the cylinder. The steam and exhaust valves are of the usual rocking or Corliss type, but are so constructed that they open their ports in two places, thus giving the full opening with half the usual motion.

In the valve gear of the engine a wide departure from the ordinary is seen. The steam valves are operated from the usual wrist plate, driven by an eccentric on the main shaft, but a separate eccentric is used for the operation of the exhaust valves. The cross-head and crank-pins are of steel, and have unusually large wearing surfaces.

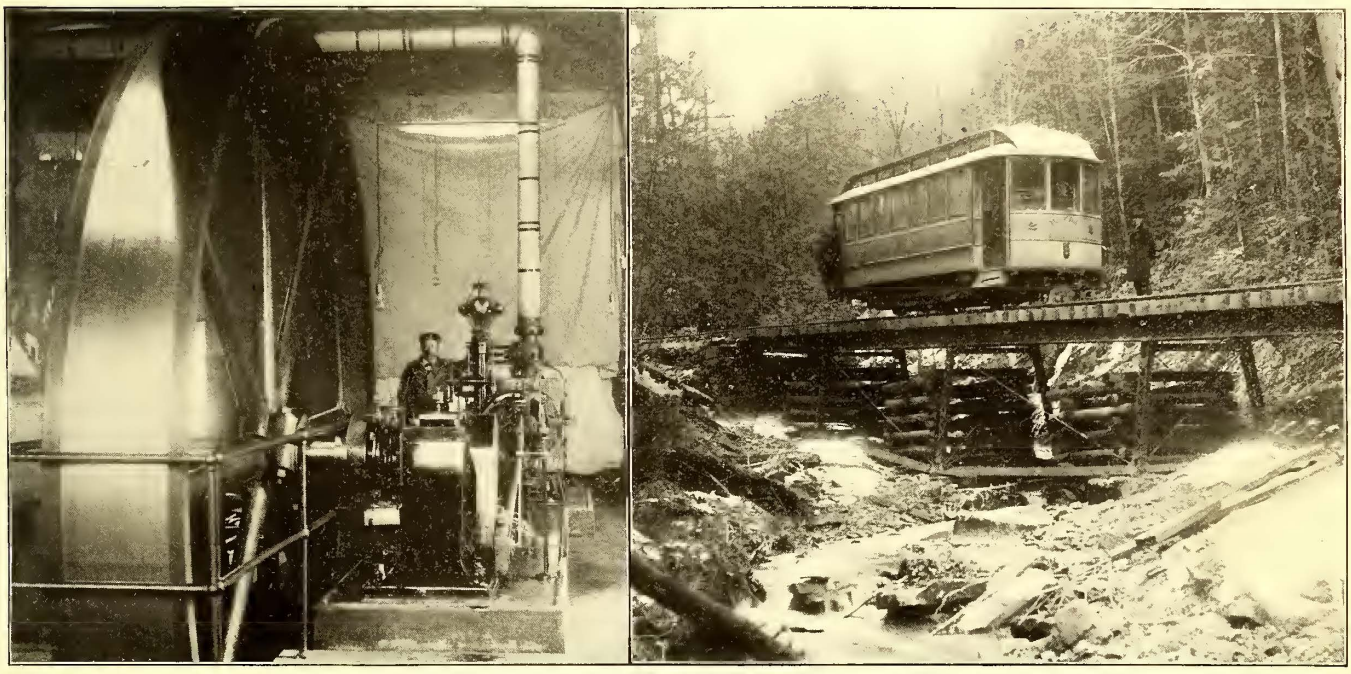
The main shaft is of hammered iron, and the engine is provided throughout with the most improved automatic sight-feed oiling devices and is adapted for continuous working.

Two of the General Electric Company's generators have been installed, and are belted to the engines. The smaller one, a 110 kw., has furnished the current since the completion of the road. The new engine is connected with a 325-kw. generator, which is now in operation, the smaller one being reserved for emergencies. A General Electric Company's switchboard is used, fitted with instruments made by the Weston Electrical Instrument Company.

The fuel used in the three 150-h.p. boilers is natural gas furnished by the Oil City Fuel Supply Company. This is a much cheaper fuel at Titusville than coal would be, costing 10 cents per 1000 cubic feet. The average monthly consumption of gas since the road began operation is 52,000 cubic feet. The steam pressure carried averages 100 lbs. The gas requires but little attention, one man only being in attendance in the boiler room. The feed-water heaters and a 7-in. x 4½-in. x 10-in. pump in the boiler room were made by the Stillwell-Bierce Company.

The trolley wire used was made by Washburn & Moen, and is No. 00. The poles are of chestnut, 50 ft. long, with a 7-in. top, and bracket construction is used almost entirely. The track in the city is laid with 60-lb. girder rails 60 ft. long. Outside the city 70-lb. T rails are employed Hewn ties, 7 ins. x 7 ins. 8 ft., are used generally in the country. Within the city limits the ties are sawed 6 ins. x 8 ins. x 8 ft. The cost of track construction averaged $10,000 per mile.

A temporary wooden car barn adjoins the power house and accommodates the four cars. The American Car Company made the four closed cars now in service. They are full vestibuled, with 20-ft. bodies, 30 ft. over all. Three of the cars are finished in cherry, the other is in white ash. Extra-heavy extension Peckham trucks are employed, each being equipped with two No. 49 Westinghouse motors. The New Haven registers are used, and the cars are heated by the Johns system. The New York Car Wheel Company's wheel 33 ins. in diameter, with 2¼-in. tread are used. The average life of the wheels on this road is about 20,000 miles.



VIEW IN ENGINE ROOM AND ALONG LINE, TITUSVILLE

The cars travel at a schedule speed of 15 miles per hour, although on some parts of the road over 25 miles is reached.

The maximum grade of the road is 8 per cent, which is reached in the gorge. It is practically an up-grade from Titusville to Pleasantville. The western end of the line is mostly a light grade. Two steel bridges were built in the gorge, one 168 ft. and the other 80 ft. long.

The fare charged in the city of Titusville is 5 cents, and outside averages 2½ cents per mile. Over $6,500 net was earned in the first six months of operation.

The officers of the company are: President, B. D. Dunham; secretary and general manager, G. H. Dunham; chief engineer, A. A. Robertson. The main office of the company is at Pleasantville.

Train Resistance

BY JOHN BALCH BLOOD

I have read with interest the formula for train resistance proposed by John Lundie in the last issue of the Street Railway Journal, but think that investigation will show that the method used by Mr. Lundie for obtaining his formula, i. e., by coasting, is not new. In fact it has now been practically abandoned, as it does not make the test under conditions of service, either as regards the condition of the bearings and the forces acting, or as regards the speeds. All engineers who are acquainted with the subject will know the benefits and disadvantages of this method, and the predisposition would be against it rather than in its favor. It is mentioned that the results indicated in Fig. 1, in the article last month, are obtained directly from 150 or more observations. It would seem that the results should check better within themselves, if such were the case. In the case of the 80-ton train the variation of the tangent of the angle is about 6 per cent.

Train resistance has been a subject which has figured largely in mechanical engineering. A great many men in this country and in Europe have made attempts to formulate it in some convenient manner. Some of these men have been eminent technically, while others have been interested in the subject more from an operating or practical standpoint. Most have desired to make an empirical form of an equation which would best represent the results obtained by experiment, irrespective of the different factors which go to make these results; few appreciated that train resistance was a combination of factors, and therefore if any one factor was pre-eminently above the average, the whole empirical formula would fall. Probably most of the people, who have worked on this subject, appreciated the different factors which go to make up resistance as such, but judging from their formulæ they did not appreciate the function of these factors, and their relative amounts, and also that they were liable to occur in different proportions under different conditions.

There are two methods of measuring this resistance. One, by observing it as a function of the retardation or acceleration, and the other by measurement direct as the resistance pull. The first mentioned was the original method, and the one almost universally used for twenty years. Recently actual measurement by dynamometer or indicator cards on the engine has been more frequent. The first method can be applied in three different ways: First, by bringing the train to a known velocity and measuring the distance to a full stop, then by calculation with averages the train resistance can be computed. After a while it was found that the average should be calculated as an average of the square of the velocity rather than the direct function.

Another method used was to bring the train to a known velocity and measure the loss in velocity at stated intervals until it came to a standstill. Still another method was by calculation from acceleration or retardation in connection with a force of gravity, on an up or down grade. In the second method of determining this resistance, namely, by direct measurement of the pull, this is done in three ways, namely, by use of a dynamometer, by calculation from indicator cards on steam engine, or by calculating from the power curves of an electric motor. The dynamometer and indicator have been used with very good results. The method of calculating from an electric motor has not been used to any great extent, principally from reasons that the speed attained in present installations are not high enough to give reliable points for use in a formula.

The writer made some calculations a few years ago from tests which were conducted quite accurately on the Metropolitan West Side Railway in Chicago. The tests were not conducted for this purpose, and therefore the results are all the more gratifying because they check so accurately. The tests show that between 22 and 26 miles per hour the resistance was from 17 to 18 lbs. per ton.

With regard to the different methods of computing, it can be said that the second general method of measuring absolutely the pull is by far the best, as the conditions are as in practice. The first general method has been practically discarded, because the bearings are not in normal condition on account of the fact that during retardation the force goes from the track and the friction of the bearings is constantly diminishing with the speed, whereas in the case of direct measurement with the speed constant the power is transmitted through the car, and the resistance force is constant at the time of measurement. If the speed is not constant during measurement, allowance must be made for the acceleration or retardation.

Calculations from electric motors seem to me to present the best chance for accuracy.

We will now consider a number of the formulæ in a chronological order:

In 1854, D. K. Clark published a formula based on the experiments of Mr. Gooch, during some previous years. The formulæ given out by him were as follows:

$$R = 8 + \frac{M^2}{171}$$

$$R' = 6 + \frac{M^2}{240}$$

M = Speed in miles per hour.

R = Total resistance of engine tender and train in lbs. per ton of 2240 lbs.

R′ = Resistance of train above in lbs. per ton of 2240 lbs.

The formula now referred to as Clark's formula with tons of 2000 lbs. and giving resistance for train only is

$$R = 7.14 + \frac{M^2}{191.5}$$

Experiments were conducted at low speeds, and condition of the bearings and tracks was not by any means as it is at present. It was soon found that the locomotive had more resistance than the ordinary train.

Rankine proposed a formula which was as follows:

$P = [5.35 + .27 (v - 10)] (T + 2E)$.

P = resistance in pounds.

v = speed in miles.

T = weight of train in tons.

E = weight of engine in tons.

Transposing and using our nomenclature, we have for resistance, exclusive of engine

$$R = 2.6 + .27\ M$$

It will be noted here that he assumed that the locomotive would have just twice the resistance of the rest of the train, a very arbitrary assumption. This formula was based on low speeds.

Searles proposed:

$$P = 4.82\ W + .005\ v^2\ W^2 + .00047\ v^2\ E^2$$

W = weight of train plus locomotive.

E = weight of locomotive.

v = speed.

P = resistance in pounds.

This reduced to the form as follows if we assumed weight of locomotive 35 tons:

$$R = 4.82 + .005\ M^2 + .6\frac{M^2}{T}$$

This formula has been complimented and recommended quite largely. He appreciated that there was a factor in the resistance which was not a direct function of the weight, and also that the locomotive gave more resistance than ordinary cars. The third factor of the formula takes these two facts into account. This formula was developed when low speeds were in vogue:

Welkner in Bavaria as a result of his experiments gave the following formula:

$$W = 3.125 + .00079\ v^2$$

W = kilograms per tonne (1000 kg.)

v = speed of train in kilometers.

Transposed into English units

$$R = 6.25 + .004\ M^2$$

These tests were made with low speeds.

The Eastern Railway of France conducted quite elaborate tests and as a result gave four formulæ as follows:

(1) $W = (1.65 + .05\ v)\ Q$

(2) $W = (1.8 + .08\ v)\ Q + .009\ A\ v^2$

(3) $W = (1.8 + .08\ v)\ Q + .006\ A\ v^2$

(4) $W = (1.8 + .14\ v)\ Q + .004\ A\ v^2$

Q = weight of train in tonnes of 1000 kg.

v = speed of train in km.

A = cross section train square meters.

W = resistance in kg.

Stating that the first for use with freight trains from 12-32 km. per hour; the second for use with mixed freight and passenger trains run from 32-50 km. per hour, the third for passenger trains run from 50-65 km. per hour, and the fourth for express trains running 70-80 km. per hour.

These engineers appreciated that there was a factor due to wind resistance which was independent of the weight of the train, and which varied as the square of velocity multiplied into the cross section of the train.

Transposing, and bringing these formulæ into form for comparison we have as follows:

(1) $R = 3.3 + .161\ M$

(2) $R = 3.6 + .258\ M + .259\ \frac{M^2}{T}$

(3) $R = 3.6 + .258\ M + .173\ \frac{M^2}{T}$

(4) $R = 3.6 + .451\ M + .115\ \frac{M^2}{T}$

R = lbs. per ton.

M = miles per hour.

T = weight of train tons (2000 lbs.)

Cross section of train taken constant as 10 sq. yards.

First for 7.5-20 miles.

Second for 20-31 miles.

Third for 31-40 miles.

Fourth for 43-50 miles.

The formula proposed by Mr. Wellington is as follows:

$$P = 4\ W + .28\ v^2 + .03\ v^2\ C + .005\ v^2\ W$$

Where C = number of cars in train and the rest as before. This reduces to

$$R = 4 + .005\ M^2 + (.28 + .03\ C)\frac{M^2}{T}$$

Or, if we take 6 as the number of cars in average train, we have

$$R = 4 + .005\ M^2 + .46\ \frac{M^2}{T}$$

The first term of this formula is for friction of the journals between the wheel and the rail, a quantity which is independent of the speed. The second factor is what he terms head resistance, or the resistance of the first car on account of the wind pressure. The third factor is to represent side resistance, or the resistance offered by the atmosphere to the side of the train. The fourth factor he terms oscillating resistance, or increase in journal or rolling friction depending on the speed. When we combine, we have here two factors which are proportional to the weight of the train, and two which are independent of it.

From the "Engineering News," 1893, results are given, which if put into a formula would be as follows:

$$R = 2 + .25\ M$$

D. L. Barnes has given as result of his observations

$$R = 4 + .16\ M$$

These two formulæ have been developed in connection with higher speeds up to 100 miles per hour.

Dodd proposed, STREET RAILWAY JOURNAL, September, 1898:

$$P = (18 + .2v)\ E + (7 + .2v)\ T$$

This is equal to the following if the train only is considered:

$$R = 7 + .20\ M$$

Lundie gives as a proposed formula:

$$R = 4 + S\left(.2 + \frac{14}{35 + T}\right)$$

Or, transposed,

$$R = 4 + .20\ M + \frac{14\ M}{35 + T}$$

Mr. Lundie's formula was gotten from tests with the

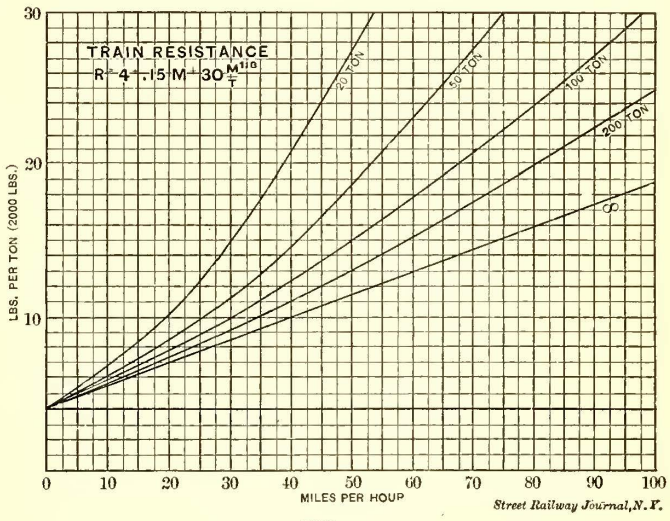


FIG. 1

cars using electric motors. The friction of the electric motor gears and eight extra bearings per car is a considerable factor in the total friction. His formula, therefore, would give too high results.

In ordinary train resistance there are three factors. The journals of the cars, the friction of the wheel on the rail, and the air resistance. In Mr. Lundie's test he should also consider a fourth, namely, the friction of the gears, and the bearings of the motors. All of the cars which he tested had mounted on one of the trucks two 60 h.p. motors. The friction of gears and bearings of these motors when running at 20 miles an hour is about 1400 watts, or 2800 watts per car. This is equivalent to 3.74 h.p., or, reduced to the term of train resistance, would be equivalent to 3.5 lbs. per ton. From Mr. Lundie's curve the train resistance at 20 miles is 12 lbs. per ton, with a 20-ton unit; subtracting this factor of motor friction, we have as an actual train resistance, according to the ordinary understanding, 8.5 lbs. per ton. We therefore see that in this case Mr. Lundie's error by assuming motor friction as nil, is 41 per cent. of the actual train resistance.

Journal friction, according to the laws of friction, should be practically constant in torque at all speeds. The friction of the wheel on the rail varies as first power of the speed. The resistance due to air varies as a higher power than the

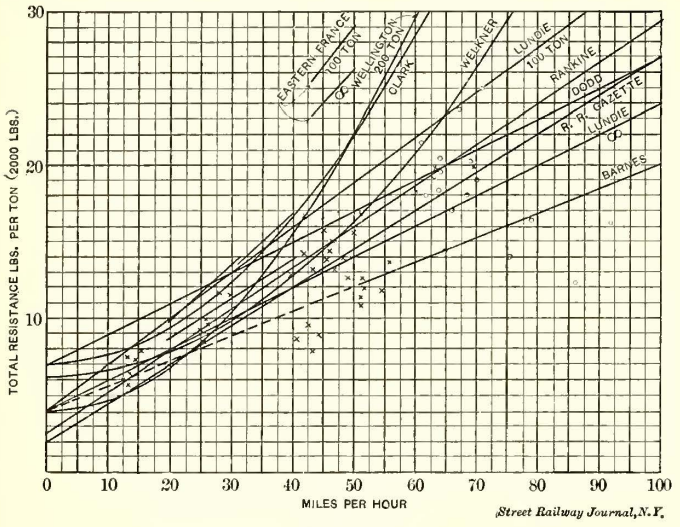


FIG. 2

first of the speed, and is independent of the weight of the train. The resistance due to the motor friction is compound, the motor bearings which would be practically independent of the speed and the gears which would increase with the speed.

From the best information which I have at hand, the calculation for the friction due to the motor would be

$$G = .1\,M + 1.5$$

where G is equal to the motor friction in lbs. per ton, and M is equal to the speed of the car in miles.

For comparison we present all these formulæ in a table:

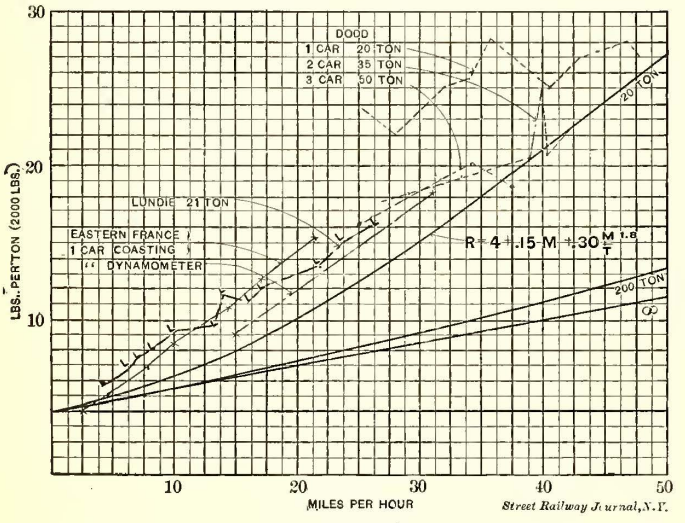


FIG. 3

COMPARISON OF FORMULÆ.

Clark, 1854,	$R = 7.14 + .006\ M^2$
Rankine,	$R = 2.65 + .27\ M$
Searles,	$R = 4.82 + .005\ M^2 + .6\frac{M^2}{T}$
Welkner,	$R = 6.25 + .004\ M^2$
Eastern Ry, France, 1885,	$R = 3.6 + .258\ M + .29\frac{M^2}{T}$
Wellington,	$R = 4 + .005\ M^2 + .46\frac{M^2}{T}$
Engineering News, 1893,	$R = 2 + 25\ M$
Barnes,	$R = 4 + .16\ M$
Dodd,	$R = 7 + .20\ M$
Lundie,	$R = 4 + .20\ M + \frac{14\ M}{35 + T}$

R = resistance in lbs. per ton (2000 lbs.)
M = miles per hour.
T = weight train in tons (2000 lbs.)

We note that at the start the speed in the second power was used. Rankine, however, used the first power. The errors of experiments were so large that at low speeds it was almost immaterial whether the first or second power was used and the coefficients. Most of these formulæ with the second power were found to give too high results at speeds above 50 miles per hour, therefore a reaction came and new formulæ with a speed as the first power are being recommended. Various modifications have been suggested. The engineers of the Eastern Railway of France had formulæ with both a first and second power of speed as a factor. They apparently appreciated that the second power was too high a power for the wind factor, and therefore have given out formulæ with small coefficients for the higher speeds. These engineers may not have appreciated that the power of the air resistance component should have been between one and two, but they certainly did find that

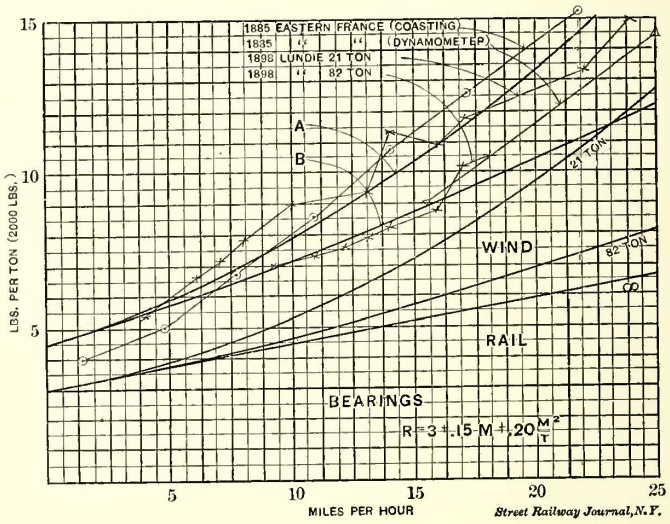


FIG. 4

using the same formulæ for high and low speeds was impracticable.

If we analyze the case we will find that there are three main factors which go to make up this resistance. First, the resistance of the journals, which is approximately constant at all speeds. Second, the friction between the rail and the track which varies approximately with the speed. Third, the wind resistance which is independent of the weight of the train, and which varies as a function of the speed to a power between the first and second.

The general form of the formula would then be as follows:

$$R = B + W\,M + A\frac{M^n}{T}$$

Where

R = resistance.
M = speed.
T = weight train.

The coefficients

B = journal coefficient.
W = wheel and rail coefficient.
A = air resistance coefficient.
n = exponent of air factor, which should be determined by experiment. It is between 1 and 2.

It is folly to attempt to give a formula which would be universal. We must place a proper coefficient in our for-

mula depending upon the quality of the different pieces of apparatus in connection with the friction. If we have well-worn, nicely made bearings, with low surface pressures, the factor B can be taken from 3 to 4. If the cars are new, bearings not worn, or the pressures abnormal, this factor would have to be taken as 5 or 6. With rails of a proper shape, of sufficient weight, well laid, and a wheel with proper flanges, and perfectly round and the right size, the second factor W would be .15. If these conditions were discounted this factor would increase. In the third term of the right hand member of the equation the factor A would depend upon the cross section of the train, and the exponent n, should be determined by experiment. The exponent n is certainly greater than 1, and in all probability is less than 2. Of course, if we make this exponent anything from an even number it makes the formula hard to use in calculation. At the same time, in high speeds the air resistance becomes of considerable moment, and must be determined accurately.

In Fig. 4, I have attempted to suit this equation to the results of Mr. Lundie, using in the air resistance term the

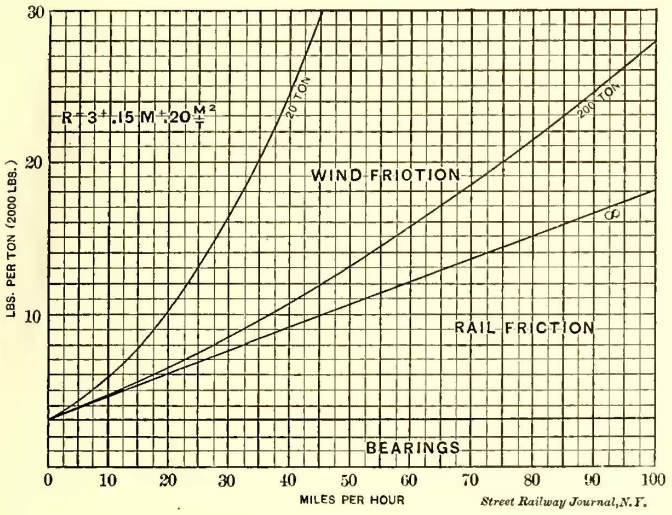


FIG. 5

second power in order to get a simple equation, and I have as a result the following:

$$R = 3 + .15\,M + .20\,\frac{M^2}{T}$$

Fig. 5 shows the equation plotted for all speeds up to 100 miles per hour.

The following table will show the relation of the friction to the different component parts, both with a 21-ton and an 82-ton train:

TRAIN RESISTANCE WITH MOTORS.

			Air.			Total.	
M.P.H.	Bear.	Rail.	21 T.	82 T.	Motor.	21 T.	82 T.
0	3	0	0	0	1.5	4.5	4.5
5	3	.7	.2	.06	2.0	5.9	5.8
10	3	1.5	.9	.2	2.5	7.9	7.2
15	3	2.2	2.1	.5	3.0	10.3	8.7
20	3	3.0	3.8	1.0	3.5	13.3	10.5
25	3	3.7	6.0	1.5	4.0	16.7	12.2

It will be seen that the motor friction is a very important factor throughout the whole range.

To the best of my knowledge in applying the most reliable data which I have at hand, I would say that the formula which would represent good practice would be as follows:

$$R = 4 + .15\,M + .30\,\frac{M^{1.8}}{T}$$

This is given in curves in Fig. 1. Fig. 2 shows how the various formulæ compare, and also shows points from best results which I have at present at hand. This figure will show how the curves compare with the results and with themselves. From this it will be seen that it is immaterial for trains over 200 tons, and running at less than 40 miles an hour, whether the exponent of the speed term in the equation was of the first or second power. The variation from the curves is less than the accuracy of the experiments among themselves. Again, the variation of the proper coefficients would, in all probability, be greater than the variation from the curve itself.

Fig. 3 shows how this formula agrees with tests of trains of light weight. I have plotted here in this figure results of some tests made on the Eastern Railway of France, some ten years or so ago. These were made with single cars; in all probability 6-wheel cars, and of a weight considerably less than 20 tons. I have also plotted results of a test by Mr. Lundie on the Chicago and South Side Elevated Railway. These results contain, beside the usual resistance, an additional resistance of the gears of the motors, and of the bearings of the motors. There are two motors on each car, and this resistance is quite material compared with the total. From calculations from absolute tests at 20 miles, this resistance would amount to 3.5 lbs. per ton. Taking this into account, it will be seen that these results agree quite well with this formula.

I have plotted also, in Fig. 3, results of some tests mentioned by Mr. Dodd in a paper read before the Civil Engineers' Club of Cleveland, published in the STREET RAILWAY JOURNAL for September, 1898. These tests, on account of their variation, would not seem to be very accurate. In all probability, although it is not directly stated, there is a motor friction to be taken from these results.

[For a further discussion of this subject, see pages 149 and 150 of this issue.—Eds.]

A French Account of an English Accident

One of the French electrical papers thus humorously describes a recent accident in one of the underground railways in London:

Even under ordinary circumstances, it is far from reassuring for the timid traveler to traverse tunnels, especially when these tunnels are some 60 ft. below the surface of the earth, but when the box in which he is enclosed stops suddenly with no indication of ever starting again, no passenger ought to be considered a coward if he begins to feel cold chills run up and down his back. The situation is certainly one which does not have many cheerful features in it. This is what happened the other week to a crowd of Londoners who were going to see a procession of the Guards returning from the Soudan. The trains, heavily loaded, were passing slowly through the single tube which extends under the Thames, and were approaching Waterloo station, when, all of a sudden, they came to a stop. Immediately the ventilation in the tunnel, which is secured by the rapid movement of the trains, ceased. The poor passengers began to get suffocated, the lights went out and the darkness added still more to their terror. Finally, half-asphyxiated, they climbed out of the cars in a crowd and on foot traversed the distance through the tunnel to Waterloo station, about half a mile away. The trouble was caused by the electric motors, which, not receiving sufficient current to propel the heavily loaded cars, refused entirely to work. It is fortunate that the accident happened in England, where stolidity is so common and everyone is cold blooded, as otherwise the accident might have had a more serious termination.

In dealing with the inspection of cars in the car house, we believe better results can be obtained by giving to each man some particular branch of the work, rather than assigning to him a certain number of cars and expecting him to do all the work required thereon. From paper at the Boston Convention, 1898.

LETTERS AND HINTS FROM PRACTICAL MEN

Notes on the Standard Rules and Regulations as Reported by the A. S. R. A. Committee

II.

SCHENECTADY RAILWAY CO.,
SCHENECTADY, N. Y., Feb. 18, 1899.

EDITORS STREET RAILWAY JOURNAL:

In an article in the February number of the STREET RAILWAY JOURNAL, the qualifications and limitations necessary for a set of "general" rules for street railway employees were outlined, with the intention of judging by them the set of "Standard Rules and Regulations" as submitted by the committee of the A. S. R. A. and published in the December JOURNAL.

In this and succeeding articles this test will be made, and where the rules of the committee do not fulfil the conditions, criticism will be made, changes and amendments suggested and reasons given therefor.

Taking the qualifications and conditions as enumerated in the February JOURNAL and submitting the report to them, we wish to know—

First—Are they all *rules?* Several of them are not, as a whole, and many of them are not in part. General Rules Nos. 1 and 2 are announcements regarding the rules, their place is on the title page or closely following. No. 7 is a notice to the employees of the policy of the employer in regard to promotion, etc. Its place is in an "Introduction" to the rules, or in a "General Notice." No. 8 is not a rule at all, it comes under the head of "unnecessary and axiomatic remarks." Any reasonable being knows that a wilful, repeated or inexcusable act of the kind therein specified should cause his dismissal from *any* position, and especially from a service that deals with the public as a common carrier, where the consequences of such acts are liable to be so serious to the employer. Of a similar character are the third paragraph and the last part of the fourth, under "Depot Masters." For what general reasons are the heads of departments hired except for "properly conducting" their part of the "company's business," looking after the "safety of the property intrusted to their care," and seeing that employees under them are "prompt and efficient in the discharge of their duties?" These are not the peculiar duties of a "depot master," they are the well-known and thoroughly understood principles of duty of *all* heads of departments or sections of departments. They are all the very axioms of duty, and to put such truisms in as rules is to insult the intelligence and common sense of the employee. General rule 15 and rule 13 for conductors and motormen are other similar cases, they contain the stereotyped phrases, "will be held responsible for the care and protection of the property of the company coming into his hands" and "will be held responsible for any damage caused by their neglect or carelessness." Of course they will be; *all* employees are; not only those of street railways, but those of "the butcher, the baker, the candlestick maker!" Care of the employer's property is a necessary qualification of *any* employee and cannot be too carefully fostered, but it must be done in other ways than by repetitions of bald-headed truisms. If it is really the intention or practice of the employer to penalize carelessness or negligence, such practice should be stated in positive terms under a "general notice" or should form one of the "general rules" and should read as follows:

"Any damage done to company or other property, or any loss or expense incurred by the company by reason of neglect or disobedience of these rules will be charged to the account of the employee or employees responsible for the damage, loss or expense, and the amount so charged up will be deducted from their ———." (Pay, deposit or bond, as the case may be.)

Rule 14 for inspectors is not a rule, it is very good advice and might be put into a note at the end of the inspector's rules, or into the "General Notice."

Under rule No. 3 for motormen the words, "and accidents can and must be avoided," and the paragraph following them are not only unnecessary remarks, but they are *not true.* The employer and the employees are both aware that by no amount of human foresight or care and by no use of appliances, can *all* accidents be avoided. Even the law—and coroner's juries—do not go that far; therefore, to make such an unqualified statement, and to put it in capitals, is to make the whole rule ridiculous instead of impressive, as a "safety rule" should be. These paragraphs should be cut out of the rules and only put in the "General Notice" in an amended and truthful form.

The first part of rule 1 for conductors is objectionable in many ways; its intent seems to be that even around the depot—away from passengers—profane and filthy language is not to be used, but the wording of this part is unhappy, as—by inference—it says that other employees may use such language around the depot and—as there is no other rule to the contrary—conductors may swear and use "improper language" in other places. Again, by placing such a rule under "Special Rules for Conductors" and nowhere else, it would be apt to give the impression that either the conductors were the only employees with foul mouths, or that they used the depot as the only available place in which to express their feelings! These remarks have no place in this rule or in this section of rules. If it is thought necessary to touch on this matter, it should be placed in the "General Rules" for all employees, and worded about as follows:

"They will—while on duty or about the premises of the company—*entirely abstain* from profane or indecent language and from improper or ungentlemanly conduct, and they will, in *all* cases, be polite and courteous in their dealings with one another and with everyone with whom they come in contact in the performance of their duties."

Rule No. 15 for conductors is mostly unnecessary remarks. The specific part of it in regard to "waste, etc." should be amplified and elaborated into a rule as will be shown further on, and the "good judgment" part entirely cut out. Good judgment is common sense applied to cases where experience or specific directions are lacking, and in a matter as important as the care of his car, specific directions—either by rule or by oral directions from his depot master or inspector—should *not* be lacking.

Rule 19 is of the same style—only worse. It should not reflect on the other employees by making the conductor the only person who—under the rules—is allowed to use his own judgment! It should be completed and made a "general rule" and should read:

"They (all employees) will—in the absence of officials to whom they may apply for advice, assistance or authority—exercise common sense and discretion in dealing with matters not provided for in the rules."

Finally—as regards their being rules—the first paragraph under "General Requirements"—in fact the whole of this section, and the three paragraphs under "Penalties" (following rule 23 for motormen) are not rules. As they stand, they are recommendations and suggestions by the committee to employ*ers*, and should be put into the report as such, or incorporated into the "General Notice," or put

into shape as rules. As they are placed they are out of place, especially the matter under "Penalties" (about which something will be said further along) and the location of which under "Special Rules for Motormen" might suggest that this generally excellent body of men were the black sheep of the flock!

By a difference of wording and arrangement most of the "General Requirements" would make excellent and necessary general rules. A uniform and generally known and understood set of "requirement rules" for certain employees would be a blessing to all who had the hiring of them. They would make a "standard," and as such would save much trouble with labor organizations, with nepotic directors and with politicians who had a "pull" and needy relations and friends, and they would save the labor of sorting out a lot of "dead-wood." These rules would use the word "must," they come under the "imperative case" spoken of, as they fix a standard. The raw material *must* come under rule and measure—afterward, when it is licked into shape, when it has been tested—flexibility may be allowed, but the "requirement" section of the rules should be absolutely positive.

Second—Are they "general" in the sense of being of universal application within a certain territory—in this instance the United States? Could any road in either Maine or Florida, California or New Jersey, single or double track, urban, suburban or interurban, high-speed or low-speed, big or little; could any one of these roads pick out from these rules a full quota of general rules (those not local) for its use, or for guidance in formulating a code of rules of its own? It is, of course, thoroughly understood that the most complete and perfect set of general rules could not be used as a whole by every road, nor hardly by any one road—snow storm rules would be slightly out of place in Southern California or Florida—but in such a complete set of rules any and every rule not caused by peculiarly local conditions should be found complete, or its spirit and principle should be indicated.

On the ground of passing away, the committee has excluded rules "especially applicable to street railways operated by horse or cable power," and it has also—whether on the same grounds or not, is not stated—excluded rules especially applicable to single track roads, to roads operated by open or closed conduits, by third rail, by storage batteries, compressed air or kinetic motors; while it has included rules especially applicable to roads operated by overhead trolley and on double track. These rules are not general therefore in the sense of being universal, and cannot be so until they can be used as general rules by every street railway in the United States, no matter what its motive power or the character of its track, traffic or equipment. If such cannot be done without bringing in rules especially applicable to some one system of motive power or to some special method of using it, then it would be better to leave out of *these* rules those that relate to such subjects except as they may be applicable to *any* motive power or method of using it, and to put the special rules for each system under separate heads. It is conceded at this present time that the overhead, under-running trolley is largely in the majority, but with the advances made in other methods and motive powers, it is not safe to say that such majority may continue for any great length of time, and it would therefore be wiser in the beginning to avoid in any general set of rules those applying to any special and transitory method, or apparatus.

Third—Are they "general" in the sense of not being local or individual? This is best answered by asking a few questions. Is it general, or, is there a reason, good and sufficient enough to make it general, to exact $10 for a badge or $20 for a uniform? Or to use one tap of the signal bell as a signal for the motorman to stop at the next crossing or trolley station? Or to call a rheostat or resistance coil a "diverter"—a name used by one special manufacturer? Or to charge *5 cents* for every adult passenger or *3 cents* for every child between the ages of three and twelve? Or to permit only five policemen, firemen or employees on a car at the same time? Or to allow smoking on the *three* rear seats of open cars? Or to make an employee send an excuse by *special messenger* if he is absent through sickness? Yet all of these, and some others not noted, are specified in the rules, and all of them are local and individual. If the idea has been in each case to suggest a principle, it should have been done by giving the skeleton of the rule and leaving the specific name, number and amount to be filled by each road according to its local conditions. For instance, it is a wise thing and one of general use to formulate a general rule limiting the number of "dead-heads" that should ordinarily be carried on any one car at one time, but it reduces a general rule to a local one to make such a number fixed and specific, as local conditions would govern that point absolutely.

These rules are stated in the report as being for conductors and motormen, but the committee have included in the report those for "depot masters," "receivers" and "inspectors." Leaving out the receivers, whose duties are dismissed with a curt paragraph, the division of the officials immediately in authority over the conductors and motormen into "depot masters" and "inspectors," and the defining of their duties as such is an arbitrary and local action and not a general one. It is true that there must be some one in direct authority over the conductors and motormen when they are *not* on the cars, and there must also be some one in like authority when they *are* on the cars, and that on a road of any size at all, these officials cannot be one and the same man. It may also be true that the division of these officials into depot masters and inspectors and the arrangement and division of their duties as suggested by the committee is a correct one for certain roads, but it can never be a general one and certainly could never be made a standard one, even within a State, as local conditions would influence the duties and division of duties of these officials so greatly as to prevent any such arrangement as is suggested by the committee being made general even by roads of similar size or number of employees. As a matter of fact, the office of "inspector" is quite different on different roads. Originally they were what their name implies, "inspectors" of men, cars or motive power, but, as street railways have enlarged both in size and aims their duties have been increased, broadened and changed until they are more "supervisors" than "inspectors" on some roads. Even on the same road the duties and authority of one so-called inspector will be totally different from another one bearing the self-same official title. It is, therefore, to be easily seen that any attempt to generalize the title or to divide and specialize the duties of the officials directly in authority over the conductors and motormen, would be at this time an impossible task.

Fourth—Are they comprehensive? Do they cover every point in regard to the general duties of these employees in relation to their superior officers and officials, in relation to one another, to the property they are intrusted with and to the public? On some of these points they are fairly full and complete, on others they are not, and on others they are almost lacking. This may seem a strong statement but—as this head will be more fully treated under No. 11 ("Classification and Arrangement")—a single instance will be given to prove the statement. The property intrusted to the care of the conductor—the car itself—is a valuable

one and the proper care of it by him will be an important item in the maintenance account. The neatness and cleanliness of the inside of the car, the proper adjustment of the ventilation, temperature and lighting, will all tend to increase the comfort of the passengers and, consequently, their satisfaction with the service. Therefore, on both these points, the rules should instruct him and guide him to the fullest extent. In relation to these duties, the rules as reported by the committee are conspicuous by their absence, as they consist of the last sentence of rule 28 for conductors and motormen, and Nos. 15, 25, 31 and 33 for conductors, in all, a matter of a dozen lines on this subject, and of this dozen lines nearly a third are *not* instructions. As a matter of comparison, the following in relation to this point is given as a suggestion of a more complete rule:

SPECIAL RULES FOR CONDUCTORS IN RELATION TO CAR

Rule No. —. CARE OF CAR.—As the conductor will be held solely responsible for the condition of car while in his charge, he will, when taking it from depot, from an inspector or from another conductor, make certain that it is clean; that no parts, such as windows, shades or seats, are broken; that the signal bells and register work properly; that oil lamps (if used) are trimmed and in order; that .... spare incandescent lamps (if used) are in their receptacles, and that all .... (implements or tools used by conductor or in his charge) are in good order and in their proper place. In case the car is dirty or any apparatus, tools or appliances, or parts of car are missing, broken or defective he will at once note the fact on ..... (form or portion of form for that purpose).

He will see that car is properly and thoroughly swept and dusted at least ..... (once, twice or thrice) during his swing or run, or oftener if the weather necessitates it.

(Or) He will thoroughly sweep the car and platform floors and the steps when on stand.

He will take care to adjust the ventilation of the car according to the weather. In closed cars the doors must be kept closed in cold weather as much as possible, and ventilation given when needed by the ventilating sash in roof. In hot, sunny weather the blinds (or shades) should be closed on sunny side of car.

He will not allow the blinds and windows to drop when handling them, but will raise or lower them carefully; he will not slam the doors, and will turn the signs and all reversing seats carefully.

(If used) He will keep the oil lamps turned low when first lighted; will not allow them to smoke, and will relight them AT ONCE if they become extinguished.

He will keep all gloves, overshoes, rubber coats, waste, etc., in their proper lockers, and NO WHERE ELSE.

He will not allow any person to put their feet or dirty articles or bundles on the seats; to put their feet on the dasher or the woodwork of the car; to spit on the floor or platforms or behind the seats; to scratch matches or write on the car; to throw paper, nutshells or other rubbish behind the window-blinds or on the floor, or to in any way UNNECESSARILY damage, disfigure or dirty the car.

He will allow no advertisements, notices, show-cards or circulars to be placed in or on the car without direct order or written permission from his ..... (proper officer for this purpose).

He will not allow newsboys, peddlers or solicitors of any kind to ply their vocation on his car.

Finally: He will, in all other ways, take good care of his car, and do everything possible to preserve it and to keep it neat and clean, and make it comfortable and attractive to passengers.

Fifth—Are they clear and explicit in language? General rule No. 5 says: "No one will be excused for violation of the rules even though not included in those applicable to his department." What is "not included," the employee or the rules? It can be read either way equally well. What is evidently meant is "No employee will be excused for violation of a rule even though such rule is not directly applicable to him or his department." Of the reasonableness of this, something will be said further along.

Rule No. 6, following above, has, in capital letters, "Ignorance is no excuse for neglect of duty." This is probably intended as a paraphrase of the legal maxim, "Ignorance of the law excuseth no man," but it goes wide of its mark in its present form, for ignorance by itself would be an excuse. As nearly as can be guessed from the preceding part of the rule, the intention has been to state that "ignorance of the true meaning of a rule or order will not be received as an excuse for the neglect of it," but that would be highly unreasonable and unjust and would be bettered but little by placing the word "wilful" before "ignorance." As a matter of fact, any and every ordinary and general rule or order should be so plain and explicit that any employee of average common sense and in the class or group of employees for which the rule is intended, should be able to rightly comprehend it. If a rule or order is one that deals with technical or special matters which might be beyond the understanding of the employee, or of a new employee, care should be taken that such rule or order should be diagrammatically or orally or practically explained before being enforced. Given an ordinary or general rule as carefully, plainly and clearly expressed as possible, and the employee who cannot or will not understand it without oral explanation, is not, as a rule, the proper employee to work under that rule.

Paragraph 17, under "Depot Masters," says: "They must arrange to sand the rail when necessary." Rule 16 for inspectors, says: "They should give special attention to sanding the track on hills," etc. In both cases, being officials or in authority, it means that they are to have it done, and the rules should read: "They must arrange to have the rail sanded when necessary" and "they should give special attention to the sanding of the track on hills," etc. Of course, it is understood that in an emergency case, there being no one else to do it, a depot master or inspector would sand the rail himself, but that is not the intent of the rule.

General rule No. 9 for conductors and motormen says: "Under no circumstances must a conductor and motorman be away from a car at the same time unless properly relieved." What is meant is, "Under no circumstances must *both* motorman and conductor be away from *a* car, unless properly relieved."

Rule No. 12 says: "The official badge must never be worn by anyone except to whom it is issued." This was probably intended to have the words "the employee" inserted between "except" and "to." It is even then not complete, the rule in regard to badges should be: "The official badge must be worn in plain sight so as to be readily seen and read at all times. Under no circumstances will employees exchange badges with one another, nor will they lend them to *any*one for *any* purpose. The official badge must never be worn by anyone except the employee to whom it is issued."

Under rule 5 for inspectors, they are required to "keep themselves informed of all instructions issued by the officials of the company and see that they are complied with." This is a "big order" for an "inspector,"—in the first place, to ask them to "keep themselves informed," in the next place, to keep informed "of all instructions issued by officials of the company," and, lastly, to "see that they are complied with!" If this were really the intent of the rule an inspector's life would be like that of the policemen in the "Pirates of Penzance," "*not* a happy one!" As a matter of fact, no official or minor official should have to "keep informed" as to any orders which affect him or his department. Such orders or instructions should reach him directly in writing or printing, should be posted in a place that he is expected to examine regularly for them, or, in case of emergency or of trivial matters, may be given verbally. In no case should he be expected to hunt up orders or instructions, nor should he be expected to be familiar with or responsible for the "compliance with" any orders

or instructions not affecting himself, his department or the employees under his charge. The rule should read: "They will make frequent examination of the bulletin board for orders or instructions affecting themselves, their department or the employees under their authority, they will make themselves fully conversant with them and see that they are complied with."

Under rule 13 for motormen the words, "passing men on the street," should read "passing men *at work* on the street." Under rule 9 for same the word "junction" in second line should be "curve," and the word "the" before "junction" in the third line should be "a."

Some of these may seem like trivial items to criticise and it may be that some of them—together with a lot more which have been criticised—may be due to the "intelligent compositor" or his able coadjutor, the typewriter, but there are many of these items that are evidently not the handiwork of these two, and are therefore subject to the criticism that in matters where a word or sentence misplaced, omitted or wrongly used may alter cases of vital importance and lead to very harmful results, there should be nothing used but the clearest and most explicit language, brevity must be sacrificed to perspecuity in rules, especially in "safety rules." H. S. Cooper.

(*To be Continued.*)

Method of Keeping Accounts

Baltimore, January 23, 1899.

Editors Street Railway Journal:

I have carefully considered the article on "An Ideal System of Street Railway Accounts," in your January issue, and it gives me pleasure to say that it seems to me thorough. Of course, its use involves much work, but without that work some detailed showing would be necessarily omitted. A simple system would give results but omit much desirable analysis. De Courcy W. Thom.

The local conditions should govern the type of double truck used, the bolster type in most cases being preferable for long cars on high speed, suburban service, while for city service, where heavy grades and quick starts demand maximum traction, and short curves make it necessary for the wheel to turn under the sill, the bicycle type must necessarily be used. From paper at the Boston Convention, 1898.

Power Station Records

Trenton Street Railway Co.,
Trenton, N. J., Feb. 17, 1899.

Editors Street Railway Journal:

I enclose the report of our power station for the year ending Dec. 31, 1898. The low cost in fuel consumption in April and October was due to our taking account of stock of coal on hand those months. The cost of power includes the expense of lighting our park and of heating and lighting our cars.

In our station we have one 100 h.p. and two 400 h.p. Watts-Campbell tandem compound condensing engines; six 100 h.p. return tubular boilers; four Short 100 kw. generators, and one G. E. 750 kw. generator. The generators are belted with the engines. Our boiler pressure is 100 lbs. Henry C. Moore, President.

Statement of the Cost of Operation of the Trenton Street Railway Company for the Year 1898.

	Superintendent.	Engineers.	Oilers.	Firemen.	Helpers.	Repairs to Engines.	Repairs to Boilers.	Repairs to Dynamos.	Repairs to Piping.	Repairs to Pumps.	Fuel.	Oil, Waste and Packing.	Light.	Extra Labor.
January	50.87	120.49	86.85	91.93	38.75	170.60	33.67	3.77	....	1.05	836.19	105.45	1.25	6.00
February	46.92	110.80	78.44	83.04	35.00	4.17	25.97	3.09	....	....	849.32	166.77	4.42	15.00
March	50.88	122.67	86.84	91.94	38.75	....	74.73	....	....	18.75	801.96	43.03	....	10.50
April	49.56	118.71	84.04	88.97	37.50	22.50	52.09	....	....	....	639.90	130.22	4.73	19.45
May	50.87	122.68	86.85	91.94	38.75	10.50	5.00	....	....	10.95	703.85	92.00	....	7.79
June	49.56	118.71	84.04	88.97	37.50	2.81	10.94	1.50	....	....	698.57	106.87	4.25	7.50
July	50.88	122.67	86.84	91.94	38.75	10.65	60.80	....	....	....	753.14	76.48	....	17.89
August	50.87	122.67	86.85	91.93	38.75	12.07	17.75	....	33.93	....	727.61	116.16	....	38.64
September	49.56	118.72	84.04	88.98	37.50	49.47	81.10	....	16.57	23.75	927.67	173.68	4.34	68.50
October	50.87	122.67	86.85	91.93	38.75	7.80	178.18	....	....	...	600.61	145.81	2.10	17.89
November	69.57	118.71	84.04	88.97	37.50	59.90	11.17	9.75	....	....	897.20	121.49	4.55	31.50
December	50.00	122.67	86.84	91.94	38.75	30.04	17.02	2.19	17.09	61.73	1,059.61	146.42	3.58	65.13
Total	620.41	1,442.17	1,022.52	1,082.48	456.25	380.51	568.42	20.30	67.59	116.23	9,495.63	1,424.38	29.22	305.79

Total cost, 1897..... $15,301.60
" " 1898..... 17,031.90

Car miles, 1897..... 1,484,885
" " 1898..... 1,612,108

Cost per mile..... $.01
" " " 01.1

A Formula for Train Resistance

Massachusetts Institute of Technology,
Department of Engineering.
Boston, Mass., Feb. 2, 1899.

Editors Street Railway Journal:

I should like to know more with reference to the original data of Mr. Lundie's experiments before I can make up my mind regarding his formula. I am inclined to agree with the remarks from "Locomotive Engineering," which you quote at the beginning of your article. Trains differ very much as regards every element in the problem. With reference to Mr. Lundie's method, of course you are familiar with the tests which were made in connection with the Burlington brake tests, by which trains were allowed to run until they came to a stop, so that Mr. Lundie's work is not new in this respect. I do not think that it is shown very conclusively that these lines *ought* to "intercept each other with surprising accuracy at a single point," since the lines as drawn are plotted from the equation and must, of course, meet at this point. I think the form of Lundie's equation is better than that of Clark's, although S should not appear to the first power or to the second power, but to some intermediate power. The same result might be attained with two terms, one with S and one with S^2. Cannot you publish an article giving all the details of Lundie's experiments, or does he wish to keep them for publication

in some original paper? They would, no doubt, be of much interest, and I should be glad to see them.

Geo. F. Swain, Professor of Civil Engineering.

The Chicago City Railway Company,
Electrical and Engineering Departments.
Chicago, Ill., Feb. 3, 1899.

Editors Street Railway Journal:

I am much interested in Mr. Lundie's formula for train resistance. The figures given by him are much lower than anything we are able to get in street railway practice owing to the difference in the conditions, as you have mentioned. We have in street railway work a rail almost buried in dirt, especially in this city, and you can readily appreciate that there is double, and more, the track resistance on such a rail than there is on a steam railroad rail lying high and dry; and I quite agree with you when you say that it is probable that no formula can be devised for street railway work where the conditions vary so largely.

I remember a few years ago making a test in order to determine when it is time to replace a badly worn rail, and the wide range in differences in draw bar pull per ton may be observed in the following table:

	Average Speed in Miles Per Hour.	Total Weight of Car Tons.	Draw Bar Pull Per Ton.
1. On badly worn rail...	12.9	4 1/3	43.8 lbs.
2. On badly worn rail...	10.	4 1/3	40. lbs.
3. On nearly new rail....	12.	4 1/3	26. lbs.
4. On nearly new rail....	11.4	4 1/3	30. lbs.
5. On badly worn rail...	8.6	4 1/3	37.5 lbs.
6. On nearly new rail....	8.8	4 1/3	24.2 lbs.

The rail was dry and comparatively clean, and the resistance small. In test No. 5, the time consumed in starting and stopping was eight minutes and forty seconds; and in test No. 6, nine minutes and forty seconds. The rate of speed attained in these two tests includes the time consumed in making stops and starts. With "badly worn rail" the flanges of wheels were, in many instances, running on the tram of the rail. In noting the difference in draw bar pull per ton with a new rail and an old one, it can readily be appreciated that it is false economy to try to operate a street rail after it becomes badly worn.

I doubt if it is possible to adopt any given formula; that is, for practical use, for train resistance, no matter how carefully determined, when, in the majority of cases, the joints of steam railroad rails are very poor and irregular in the matter of alignment, and this difference alone would, in my opinion, vary the results very materially, to say nothing of the variations which would be caused by "spongy" sub-grades, etc. As I understand it, Mr. Lundie made all of the observations, from which he worked out his formula, on the Alley "L" or South Side Elevated Railway. He had, of course, in that track, ideal conditions existing in the way of a solid road-bed and well aligned and rigid joints and rails such as are rarely found with surface steam railways.

Mr. Lundie certainly deserves great credit for his efforts and their results in working out this formula, and the method he used gives an accuracy which has not heretofore been obtained.

G. W. Knox,
Electrical Engineer.

New York, Feb. 14, 1899.

Editors Street Railway Journal:

While I have a very limited knowledge of the subject, I would say on general principles, that the formula which does not contain the square of the speed in one of the terms, cannot be true for widely different values. But if, as you say, the practical results within certain limits agree with the values found according to Mr. Lundie's formula, his work will not be the less welcome to engineers.

Nikola Tesla.

Sibley College, Cornell University.
Ithaca, N. Y., Feb. 13, 1899.

Editors Street Railway Journal:

I am very much interested in the question of train resistance, and am entirely convinced that some of the recently proposed formulæ that did not take into consideration a variation of the traction coefficient with the speed were wrong, but did not find it convenient to take up the matter at that time. A comparison of actual acceleration curves and those deduced from other formulæ would indicate that Mr. Lundie's formula is more generally applicable than any yet proposed. S. B. Fortenbaugh.

The Lake Shore & Michigan Southern Railway Co.,
Engineers Department.
Toledo, Ohio, Feb. 15, 1899.

Editors Street Railway Journal:

We have never made any scientific train resistance tests, so far as I know. Mr. Lundie's formula is certainly very interesting. Such an empirical formula, if carefully made from a sufficiently large number of observations, ought to have good results within those limits, and under conditions similar to those under which the observations were made. But it is difficult to pick out the value of the different causes which have contributed to make up the numerical factors of such a formula, or the effect upon these causes when the conditions under which they operate may be changed, so no one can say whether these numerical factors are correct outside the limits of actual observation. Fortunately, however, most cases will come near enough within these limits, and consequently all such formulæ have a value. I hope this one will have a large one.

Samuel Rockwell, Engineer M. S. Division.

University of Wisconsin,
College of Mechanics and Engineering,
Madison, Wis., Feb. 2, 1899.

Editors Street Railway Journal:

Mr. Lundie's formula appears to agree unusually well with experimentally deduced results, and it may rightly be looked upon as a decided improvement upon the older formulæ. The insertion of the train weight as a variable in the formula follows the line of argument set forth, for instance, by Searles, when he premises in his field book that a formula of the kind here considered "must include at least the velocity and weight of the train and engine;" and it is a substantial service to engineering to put a formula of this nature into useful shape. Mr. Lundie is to be congratulated upon deriving a formula of so apparently wide application, but no fixed formula can be fitted to the widely varying conditions met in street car (surface) traction as it now exists. D. C. Jackson, C. E.

From the information before us, we feel sure that we can safely assume twenty-four years as the life of a creosoted tie, and with this assumption we will determine the cost of keeping the different kinds of ties under sections of track for twenty-four years. Creosoted ties will cost 24 cents per lineal foot of track; therefore, 60 cents (36 and 24) will represent the cost of labor and ties per lineal foot in rebuilding. Principal and interest on 60 at 6 per cent for twenty-four years, $1.46—which is the actual cost per lineal foot of keeping ties under this track for twenty-four years.—From paper read at the Montreal Convention, in 1895.

The Next Convention.

The eighteenth annual meeting of the American Street Railway Association and the third annual meeting of the Street Railway Accountants' Association of America will be held in Chicago, Ill., Oct. 17, 18, 19 and 20, 1899, at "Tattersall's," State and Sixteenth Streets. This building contains 50,000 sq. ft. of floor space, without a post or obstruction of any kind.

Friday, Oct. 20, has been set as a day for an examination of the exhibits. No session of the association will be held, so that all may have plenty of time to view the exhibits. The association will especially request that managers have their heads of departments present on that day.

President Charles S. Sergeant, of Boston, Secretary and Treasurer T. C. Penington, of Chicago; Walton H. Holmes, of Kansas City; Albion E. Lang, of Toledo; George A. Yuille, of Chicago; Frank G. Jones, of Memphis; John I. Beggs, of Milwaukee, and Ira A. McCormack, of New York, members of the executive committee of the American Street Railway Association, met in Chicago, Feb. 6 and 7, and completed all the preliminary arrangements for the convention. The hall is well suited to the purposes of the exhibit, having a clear floor space, without columns, of 50,000 sq. ft. The meeting rooms of both associations will be under the same roof as the exhibit, with ample retiring and committee rooms. The last day of the convention will be set apart for the systematic and careful inspection of the exhibits by the delegates, a fact which will be appreciated by all exhibitors. The banquet will be given on the night of the last day of the convention, at which the installation of the newly elected officers will take place. The committee resolved to make unusual efforts to secure the attendance of representatives of the mechanical, operating and auditing departments, which will make the convention of great practical value to those branches of the service; the attendance having been largely confined to delegates from the administrative departments. The hall will be well lighted and heated; the light during the hours of the day leaving nothing to be desired. All the exhibits will be on the same floor, and there will be little choice as to location. All electric power necessary will be furnished. The hall is within 300 ft. of the steam railroad tracks, and a special siding will be laid to the rear door of the hall so as to bring the heavy exhibits direct to the hall.

The following subjects were selected, upon which papers are to be read at the meeting: "Maintenance of Car Equipment;" "The Modern Street Railway Shop; Its Design, Machinery and Shop Practice;" "Train Service, and Its Practical Application;" "Investment in Street Railways; How Can They Be Made Secure and Remunerative?" "Construction and Maintenance of Railway Track."

The annual banquet will be held Friday evening, when the officers elected will be installed.

The headquarters of the association will be at the Auditorium Annex. The Auditorium is across the street and is under the same management. Chicago is noted for its good hotels, so no trouble will be experienced in securing good accommodations. The rates charged at the hotels mentioned are: Auditorium, American plan, $5 per day each person; Auditorium Annex, European plan, $2 to $4 per day.

All of the leading hotels in Chicago are within a radius of one-half a mile. They include the Victoria, Wellington, Great Northern, Grand Pacific, Palmer, Tremont, Sherman and Clifton and all are within ten-minutes' ride of the hall.

The executive committee advises all who desire rooms to apply at once. The rooms at the Auditorium will not be assigned until Mar. 15, and will be assigned in the order in which applications are received.

Railroad rates will, in all probability, be as before—one and one-third fare for the round trip, due notice of which will be mailed the members of the association in time.

The representatives of the association who reside in Chicago intend to make the visit of all a pleasant and profitable one, so that no one will regret attending this convention.

The following organization has been effected for the entertainment of the delegates and other attendants:

GENERAL COMMITTEE

Chairman, M. K. Bowen, president, Chicago City Railway.
Secretary and treasurer, Geo. E. Yuille, second vice-president, West Chicago Street Railroad.
J. M. Roach, vice-president and general manager, North & West Chicago Street Railroad Company.
Geo. C. Nagle, superintendent, Chicago City Railway Company.
H. M. Sloan, general manager, Calumet Electric Street Railway Company.
H. H. Windsor, Editor "Street Railway Review."
F. L. Fuller, general superintendent, West Chicago Street Railroad Company.
Jas. R. Chapman, general manager, electrical department, North & West Chicago Street Railroad companies.

ENTERTAINMENT COMMITTEE

J. M. Roach, chairman, vice-president and general manager, North & West Chicago Street Railroad Co.
T. M. Henderson, superintendent, N. C. Street Railroad Company.
A. S. Littlefield, railroad contractor.
Geo. C. Bailey, John A. Roebling's Sons Company, Chicago.
Harry Keegan, assistant superintendent, N. C. Street Railroad Company.
Frank R. Green, secretary, Chicago City Railway Company.
Geo. A. Yuille, second vice-president, W. C. Street Railroad Company.

EXHIBIT COMMITTEE

Jas. R. Chapman, chairman, general manager, electrical department, North and West Chicago Street Railroad companies.
C. E. Moore, master mechanic, Chicago City Railway Company.
John Miller, master mechanic, North Chicago Street Railroad Company.
F. T. C. Brydges, master mechanic, West Chicago Street Railroad Company.
A. C. Heidlberg, assistant superintendent, Chicago City Railway Company.
Geo. W. Knox, chief electrician, Chicago City Railway Company.
W. F. Carr, superintendent, electric and track dept., W. C. St. R. R. Co.
W. A. Harding, master mechanic, Calumet Electric Street Railway Company.
N. C. Noe, engineer, General Electric Company.

TRANSPORTATION COMMITTEE

F. L. Fuller, chairman, general superintendent, W. C. St. R. R. Co.
W. Worth Bean, president and general manager, St. Joseph & Benton Harbor Electric Railway & Light Company, St. Joseph, Mich.
Wm. Walmsley, superintendent, South Chicago City Railway Company.
Wm. J. Cooke, McGuire Manufacturing Company.
T. D. Miles, with West Chicago Street Railroad Company.
J. M. Atkinson, of J. M. Atkinson & Co., of Chicago.
John O'Keefe, with Chicago City Railway Company.

PUBLICITY AND INFORMATION

H. H. Windsor, chairman, Editor "Street Railway Review."
C. S. McMahan, Western manager, STREET RAILWAY JOURNAL.
D. B. Dean, Terre Haute Car Manufacturing Company, Terre Haute, Ind.
J. A. Hanna, Peckham Truck Company, Chicago.
C. J. Riley, chief engineer, Chicago City Railway.
John O'Keefe, Chicago City Railway Company.

HALLS AND HOTELS

Geo. O. Nagle, chairman, superintendent, Chicago City Railway Company.
A. S. Littlefield, railroad contractor.
T. M. Henderson, superintendent, North Chicago Street Railroad Company.
Maurice Coster, Westinghouse Electric & Manufacturing Company.
T. C. Penington, treasurer, Chicago City Railway Company.

BANQUET COMMITTEE

M. L. Bowen, chairman, president, Chicago City Railway Company.
D. G. Hamilton, Chicago City Railway Company.
M. B. Starring, assistant general counsel, Chicago City Railway Company.
B. E. Sunny, General Electric Company.
H. H. Windsor, Editor "Street Railway Review."
C. S. McMahon, Western manager STREET RAILWAY JOURNAL.
Geo. C. Bailey, John A. Roebling's Sons Company, Chicago.

LADIES' COMMITTEE.

H. M. Sloan, chairman, general manager, Calumet Electric St. Ry. Co.
Theo. P. Bailey, General Electric Company.
Joseph Leiter, Chicago City Railway Company.
Frank R. Green, secretary, Chicago City Railway Company.
F. L. Fuller, general superintendent, West Chicago Street Railroad Company.
M. K. Bowen, president, Chicago City Railway Company.
C. K. Knickerbocker, Griffin Wheel Company, Chicago.
L. S. Owsley, secretary and treasurer, North Chicago Street Railroad Co.
J. Chas. Moore, secretary and treasurer, North Chicago Street Railroad Co.

FINANCE COMMITTEE

Geo. A. Yuille, chairman, second vice-president, West Chicago St. R. R. Co.
C. R. Penington, with Chicago City Railway Company.
J. Chas. Moore, secretary and treasurer, North Chicago Street Railroad Co.
W. S. Bell, assistant secretary and treasurer, West Chicago Street R. R. Co.
H. B. White, secretary and treasurer, Calumet Electric Street Ry. Co.

Mr. John M. Roach, representing the local street railway interests, entertained the committee during their stay in Chicago. On Monday night, at 6 o'clock, there was a dinner at the Union Club, at which the following gentlemen were present: F. L. Fuller, William Walmsley, T. A. Henderson, Albion E. Lang, John I. Beggs, H. M. Sloan, John M. Roach, Frank R. Greene, T. E. Crossman, H. H. Windsor, Ira A. McCormack, W. Worth Bean, A. L. Plimpton, H. F. Grant, Walton H. Holmes, T. C. Penington, Chas. S. Sergeant, Frank G. Jones, George A. Yuille, George O. Nagle and J. R. Chapman. After the dinner the party attended the performance at Powers' Theatre. On Tuesday afternoon, upon the conclusion of the work of the committee, a visit was made to the office of the North Chicago Street Railway Company, where President Yerkes received the gentlemen. Subsequently a visit was made to the Western Avenue power station and other points of interest connected with the company.

The Brown Hoisting & Conveying Machine Company, of New York and Cleveland, Ohio, has just been awarded a contract by the Navy Department for coal handling machinery for the coaling station at Mare Island Navy Yard, California. This is the sixth coaling station for the United States navy to be equipped with the Brown Company's machinery, and constitutes all the stations so far awarded. The Brown Hoisting & Conveying Machine Company has also been awarded a contract for a 100-ton steel floating crane for the Brooklyn Navy Yard. This crane will weigh over 1000 tons.

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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 Directory, our Financial Supplement, or our news columns.

All matters intended for publication in the current issues must be received at our office not later than the twenty-second of each month.

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The power stations of practically all of the large street railway systems of this country, and of most of the smaller ones, have been in operation now for at least two years, and many of them for a considerably longer period. During this time many improvements in the economical generation of current have been made, so that the question as to what extent reconstruction should be engaged in is an important one. In many cases the need is intensified by a radical change in location of the "center of gravity," or center of the distribution circuit, caused by the construction of new lines or consolidation with old ones, which has often put the existing power station far away from the most economical point for distribution. Whether, when the station becomes thus antiquated, either in equipment or location, it is better to reconstruct or to continue the old equipment is a special problem of each situation. The best way is to carefully calculate the cost of operation in each case, including that of depreciation and loss of power, and compare the possible saving with the interest on the cost of new investment required. The operating expenses of modern power-house machinery are now so well known to engineers that, if the expenses of the existing plan have been carefully kept, this comparison ought not to be a difficult one. In some cases the economy will be considerable, as in that of the Consolidated Traction Company of Pittsburgh, mentioned elsewhere, where it was found a saving in cost of generating power of 56 per cent could be made by the substitution of one modern station for several older ones.

The advantages of the "loop" idea in terminal arrangements, long well known and appreciated in street railroad practices, are about to be demonstrated in steam railroad suburban service on a large scale. Hitherto the loop has not been used to any extent, if at all, in railroad city termini, because of the impossibility of getting the necessarily large radii of curvature within the limits of the terminal station, but in the enormous South Terminal station, just completed in Boston—the largest station in the world—sufficient room is found to use loop, instead of stub tracks, for suburban trains, and, as a consequence, the ultimate train handling capacity of the entire station is more than 2000 trains per day, of which the twenty-four stub tracks will handle 750 trains, while the two-track route will handle 1250 or more. This is a quite unprecedented capacity. The effect of this terminal arrangement on the traffic conditions in Eastern Massachusetts is far reaching—much more so than might at first appear on the surface, for there is now no doubt that it is the intention of the two great railroad systems which will use this terminus to run their suburban trains by electricity, and to give a frequent service at regular short-time intervals. With the advantage which comes with ownership of right of way and with possibility of high speeds, based upon the complete abolition of grade crossings, which is now rapidly going on in Massachusetts under compulsory legislation, it is much to be feared—or hoped, according to the point of view,—that the keenest kind of competition will come between the railroad and street railway services in the same territory, and the result will quite probably be the usual one, namely, that the public as a whole will ride much more freely and frequently than ever before, the street railways will get the short-distance travel, and the railroads the longer hauls.

The consolidation of properties in the same lines of business seems to be the order of the day, not only in industrial enterprises, but also in those engaged in transportation. The economies obtained in consolidating steam railroad properties have attracted capitalists interested in street railway companies, and press dispatches announcing the union of interests in some new city have been almost a matter of daily occurrence during the last two months. Among the most important events of this kind which have been consummated or announced during

the last month are the street railways around Buffalo, in Jersey City, Baltimore, Lexington, Ky., and the two principal railway systems of Brooklyn, while there are rumors of important consolidations in other cities, including Washington and New York City. While a large system cannot receive the same personal oversight from the acting manager as a small one, there is such a large possibility for saving in many directions that these usually far more than counterbalance the few economical drawbacks, and this is especially true in electric railway systems, where the replacing of several power stations by a single large one is an obvious economy of magnitude. A street railway system of a city, like its water, gas and telephone systems, is a natural monopoly, and is recognized as such by all students of political science, independent of ideas which they may hold as to whether such a monopoly should be owned and operated by the municipality or by a private corporation. It is, therefore, not improbable to expect the final union in most cities of certainly the competing street railway lines. It has been a noticeable fact that in such cases the public has been directly benefited by the pooling of interests in this way. As a usual thing, more transfers are given by the consolidated system than by the individual companies, a result which amounts to a reduction in fare. We do not anticipate, however, that combinations of this kind will materially lessen for any length of time the total number of electric railway companies in any particular section or in the entire country. The consolidations are usually made by the help of outside capital, which necessarily releases a considerable amount of money belonging to those owners whose properties have become absorbed. These persons, whose life has been spent in railroading, will naturally tend to remain in that field, and we think in most cases will turn to interurban electric railroading, which is as yet practically undeveloped, for an investment of their capital. We have referred in previous issues to the possibilities of this field, and to the fact that many of those who have previously made a success with street railway properties are now paying considerable attention to its development. The proposition, taken as a whole, is an exceedingly attractive one, especially since the improvements in three-phase machinery, which have made the cheap distribution of power over long distances an easy task.

The blizzard of Feb. 13 severely tested the capabilities of all the electric railways in the Eastern States in keeping their tracks clear of the snow and cars running. The storm was admitted by all to have been the most severe of any experienced since the famous blizzard of 1888, and it differed from that in being more general and in being accompanied by a low temperature, which added greatly to the inconveniences of the men in removing the snow from the tracks. All of the cities on the Atlantic seaboard, from Portland as far south as Washington, and even Richmond, were practically snowed in for several days, and traffic on most of the steam railroads in this section was brought to a standstill. As may be expected, the street railways were also affected most seriously. Being the furthest north of any of the large cities on the coast, Boston probably suffered more than any city, but in spite of this fact the Boston Elevated Railway Company had clear on Tuesday, Feb. 14, 320 of its 325 miles of electric track. The railway company in Boston has to cart away the snow which it clears from its tracks, and a good idea of the immense facilities which this company has for removing snow is shown by the fact that it had 175 snowplows in use on Monday night, together with 400 sleds and carts of its own for removing snow, with 600 others engaged for the purpose. According to General Bancroft, it was a test in which as much pluck and endurance were required to win as were ever seen in a football game, but the record made forms an excellent commentary upon the vigilance of the officials and men, and the foresight of the company in being prepared for emergencies of this kind. In New York the underground system received its third severe winter test. The new equipment of plows, which were purchased the first part of the winter, came into good use, and, although the traffic on the electric lines was discontinued for nearly twenty-four hours, the company did not suffer any more in this respect than the neighboring trolley lines. The trouble, as stated by Mr. Vreeland, president of the Metropolitan Street Railway Company, was due to track causes, and not to any interference with the electrical part of the equipment. The snow was light and dry and the wind blew it upon the tracks in drifts immediately after the passage of a plow or sweeper, so that the wheels of the electric cars could not obtain traction. It is interesting to note in this connection that the cable cars on Broadway, which do not depend upon the contact between the wheels and the rails for their ability to move, made a showing much better than the electric lines, and for this comparative immunity to snow which the cable system possesses it should receive due credit. Philadelphia, like the other cities, suffered a more or less complete blockade, but with the aid of some rotary snowplows recently secured and a large number of ordinary plows and sweepers the company succeeded in keeping some of its lines in continuous operation. Washington also suffered severely by the storm, but by constant and energetic work the tracks were kept comparatively clear and cars running. It is a remarkable fact that comparatively little damage is reported from the breakage of wires during the storm, even of those of telegraph and telephone companies, which, falling on a railway wire, often create as much, or more, trouble than the breakage of the trolley wire itself. Absence of trouble of this kind is attributed to the intense cold which prevailed, and to the consequent dry condition of the snow, which, as a result, did not remain on the wires. The past season has been remarkably prolific of heavy storms, and if coming seasons are to be as severe in this respect, the snow-fighting equipment of an electric railway company in our Northern cities will necessarily have to be as complete and elaborate as that of a steam railroad company. As a matter of fact, however, the average fall will be considerably below that which we have experienced during the present winter. Snowstorms are expensive, both in actual outlay and in the diminished traffic which results from them, and their expense to a street railway company soon runs into a large sum.

A good example of the way in which unreasonable prejudice is excited against electric railway companies by false and misleading statements was furnished last month by a circular issued by the National Board of Fire Underwriters upon the subject of electrolysis of water mains by

the electric railway current. Strange as it may seem, this report was afterward printed without comment or criticism by one of the best-known engineering papers of New York City, and was there credited to the engineer of the National Board of Fire Underwriters, although we understand that the author of the report does not occupy that position. The subject of the report, which was made by Fremont Wilson, was the bursting of a 4-ft. water main in Brooklyn, caused, it was alleged, by the effect of the return current on the pipe, and some idea of the writer's qualifications to pass judgment upon the subject is shown by the following extract:

> Intelligent expert engineers have proved beyond peradventure that 1.5 volts difference in potential between the water pipe and rail is dangerous; and here we have a railroad company deliberately transmitting an enormous current at a voltage anywhere from 250 to 400. If they were simply transmitting a current with a difference of potential of 15 or 20 volts, enough facts have been presented to prove that this amount of voltage carries with it a current that would, of necessity, under the natural laws, cause enormous destruction. And in proof of this, permit me to call your attention to another exhibit and complete report recently published by the trustees of the Dayton, Ohio, waterworks. I will quote from that report for your information: "At 4.5 volts it has been shown that 6-in. pipe can certainly become useless in five years." Query: What is now the condition of the 6-in. water pipes in Brooklyn, if what the employee has said is true, that a 6-in. pipe has been used as a return feeder with from 200 to 300 volts pressure upon it?

This is utter nonsense, from an engineering standpoint. The arguments as to the danger to the public sound familiarly like those employed when overhead wires were first installed, and which predicted tremendous loss of life to pedestrians who should happen to be in the way of falling wires. We make the following quotations:

> The undersigned begs to state that a careful inquiry made among the employees of the water board of Brooklyn brought to light the fact that they (the employees) were fully aware of the conditions as they existed and do exist at the present time, as they have been knocked down by the current while working upon water mains and, in some cases, severely injured, and in other cases badly burnt; and yet in this community such a state of affairs is permitted to exist, and, as far the records show, no effort has been made on the part of the insurance authorities to prevent it. And yet it could have been prevented, and if I may be permitted to say so, must be stopped now or the community at large will inevitably meet with nothing less than a conflagration when the conditions for such an event happen; and when they do happen the events will be coincident, and it may not only be a large loss of property by fire, but it may mean the loss of a great number of lives.
>
> Let us suppose, for instance, a case that can be readily imagined. What would have happened if a fire had occurred in Brooklyn among the frame buildings in the neighborhood of the break in the 4-ft. water main? This particular locality, as far as the buildings are concerned, would have been completely wiped out of existence, and lives would certainly have been lost in the general panic. This statement is not made by the undersigned for the purpose of appearing as an alarmist, but simply as an actual state of affairs as they exist to-day, only in far worse condition in other parts of Brooklyn.

The rest of the report is about on a par with the portion quoted. It is made up, as shown, for the most part of hearsay evidence as ridiculous as that contained in the paragraph given, together with opinions of the writer, based presumably upon this class of testimony. Nowhere in the report, so far as we can discover, has any attempt been made to determine the actual cause of the deterioration, or defect, in the pipe in question, the only point in which either the railway or the water company is really interested. If any injury had been done by the railway current, a thing which we very much doubt, what is wanted are *facts*, not opinions or hearsay, and such facts constitute the only evidence which merits consideration or would be admitted in a court of law.

There seems to be a lamentable effort on the part of interested persons to prejudice the position of the railway companies on this question in the minds of the public, and to create a feeling of anxiety by giving wide publicity to statements of this kind, without a word of comment. For instance, the report of Mr. Wilson, as published in the engineering paper already mentioned, has recently been widely circulated by some anonymous person or persons. On the back of the sheet containing the report is a scare photo-engraving of the break in Brooklyn. This throws no light on the *cause* of the disaster, but, coupled with the report, is undoubtedly intended to create popular distrust of the safety of the use of rails as return conductors, which is entirely unwarranted by the actual facts in the case.

Electrical World and Electrical Engineer

On and after March 11, "The Electrical World" and "The Electrical Engineer" will be merged together in a single publication under the name of the "Electrical World and Electrical Engineer." The "Electrical World" dates from 1874, and has just finished its first quarter century of life, during all of which time it has been owned and managed by W. J. Johnston. The "Electrical Engineer" dates from 1882, and was purchased from its former owners in 1890 by T. Commerford Martin and Joseph Wetzler, formerly editors of the "Electrical World." Mr. Johnston retires from the field of electrical journalism, and Mr. Wetzler will hereafter devote his energies to the building up of the Electrical Engineer Institute of Correspondence Instruction, organized a short time ago under the auspices of the "Electrical Engineer."

The editorial management of the "Electrical World and Electrical Engineer" will be in the hands of W. D. Weaver, until now editor of the "American Electrician," and T. Commerford Martin, editor of the "Electrical Engineer," both of long experience in electrical journalism, and with world-wide friendships and connections.

The business interests of the new paper will be in charge of J. M. Wakeman, long and favorably known in connection with the "American Machinist," while A. C. Shaw, until now business manager of the "Electrical Engineer," will be associated with Mr. Wakeman in the work of the paper in New England.

The "Electrical World and Electrical Engineer" will be built on broad lines and to high standards, and it is believed that it will easily take rank among the great technical and engineering periodicals of the world. The field of electrical engineering is constantly widening, and it is generally conceded that in the practical application of electrical science to utilitarian purposes America is in the lead among the nations of the world. It is intended that the best practice in all departments of electrical science shall be reflected in the columns of the new paper, and, with the concentration of editorial effort, until now divided between the two constituent periodicals, it is believed that the union of interests will be obviously advantageous to readers and advertisers.

The purchase of these two properties and their consolidation has been brought about by James H. McGraw and his associates of the Street Railway Journal, and among others who will be largely interested in the "Electrical World and Electrical Engineer" will be Messrs. Wakeman, Martin and Weaver and Shaw.

Three-Phase Transmission for Electric Railway Work in Maine

The growing number of interurban electric railways in which the power for operating the cars has to be transmitted over considerable distances has made the subject of high potentials an extremely important one. While no road in this country has yet attempted the use of three-phase motors on its cars, the high economy of distributing power by the three-phase system has led to its careful investigation by a number of companies. Among these is the Lewiston, Brunswick & Bath Street Railway, which has recently put in operation a line 30 miles in length, from Lewiston to Bath, Maine, with urban branches at both ends, making a total of 60 miles of track. The entire system is supplied with power from one hydraulic power station in Brunswick, and contains a number of novel features, including the distribution in Brunswick from one type of generator only.

The Lewiston, Brunswick & Bath Street Railway Company was formed July 1, 1898, by the consolidation of the Lewiston & Auburn Horse Railway, the Bath Street Railway and the Brunswick Electric Railway companies, and is capitalized for $500,000. It has a bonded indebtedness of $1,000,000 in 5 per cent bonds, of which $300,000 are held in the treasury for future construction and purchases. Among the chief members of the syndicate which organized and built the road are I. C. Libby and A. F. Gerald, both of whom are prominent in electric railway interests in Maine. The power for operating the line is obtained from a fall in the Androscoggin River, owned by the Cabot Company, and largely used for industrial purposes. From this company the railroad leases 1000 h.p. at the rate of $10 per h.p. per annum.

The power station at Brunswick is a small brick building near the mills, and contains four Victor wheels, all mounted on the same shaft and operating under a 17-ft. head. These wheels are controlled by Lombard governors, and, by means of a rope drive, operate the main countershaft, to which the three main generators are belted. The generators, illustrated in Fig. 2, are double-current machines, designed to deliver from one winding both alternating and direct currents, being the first machines in the country to be used in this way. Each generator is of 250 kw. capacity, the whole of which may be delivered from the commutator at one end of the armature, from the collector rings at the other, or in any proportion through the two simultaneously. They were built by the Westinghouse Electric & Manufacturing Company, have twelve poles, and run at 1600 r.p.m., delivering alternating current therefore at sixty cycles per second. The direct current voltage is 500 to 550, and the alternating three-phase voltage runs from 300 to 330 volts, as it comes from exactly the same windings.

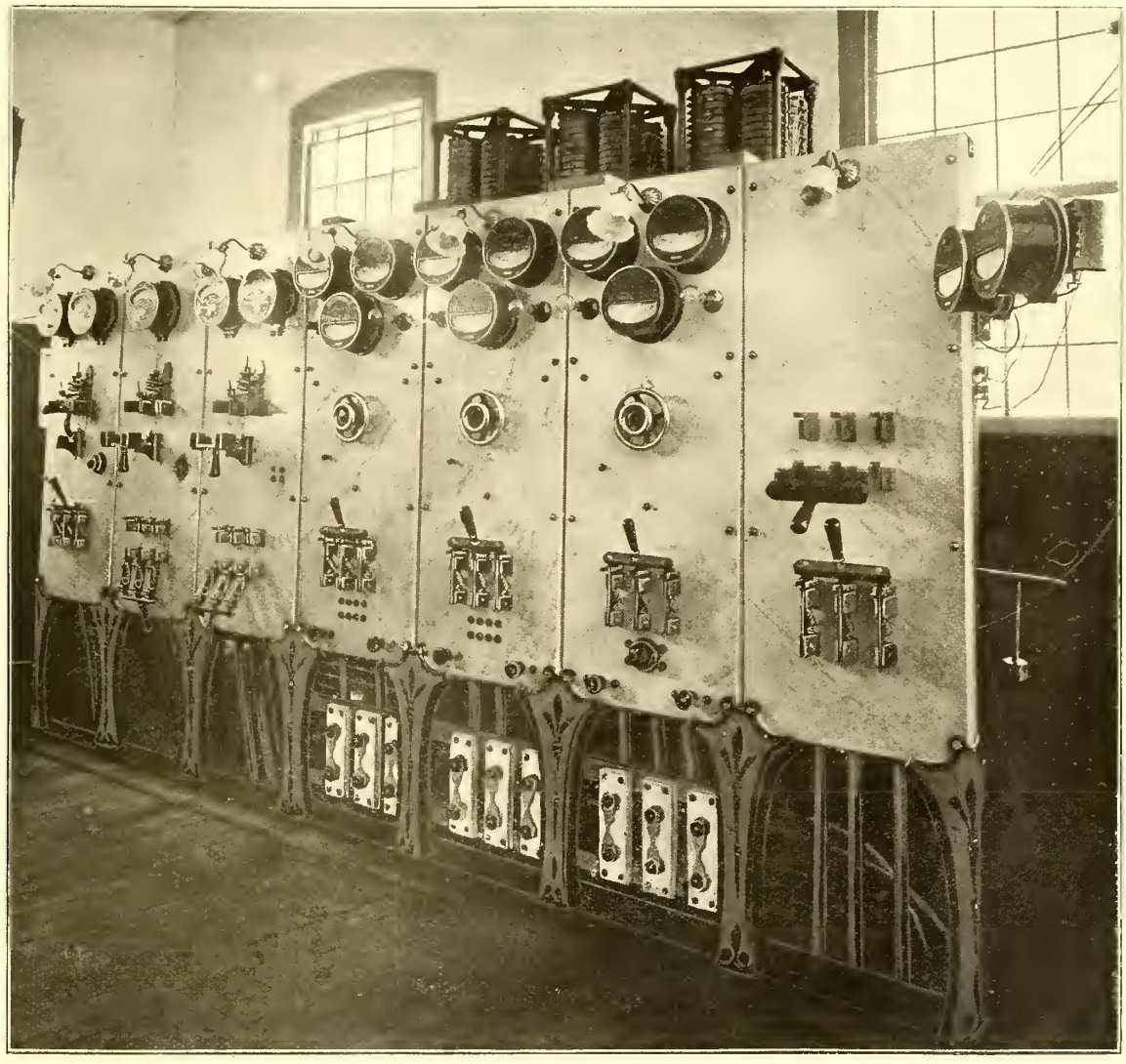


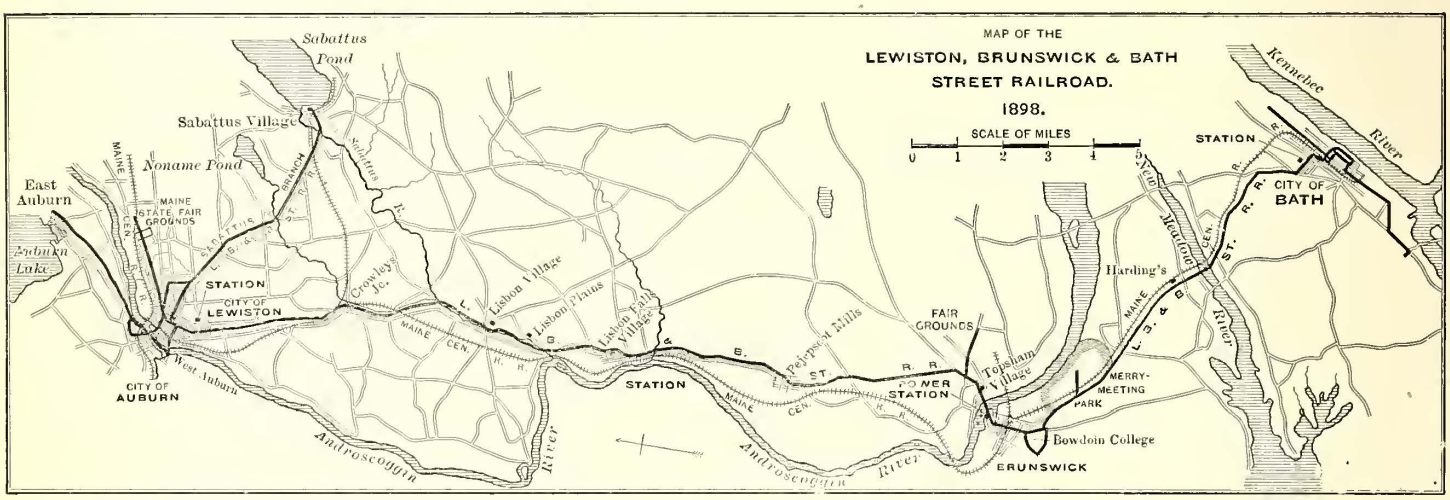
FIG. 1.—SWITCHBOARD AT MAIN GENERATING STATION

The switchboard, which is illustrated in Fig. 1, is made up of two types of panels, one closely resembling standard

railroad generator panels, and the other standard alternating panels. There are three of the former, located at the left end, as shown in the accompanying illustration, each equipped with circuit breaker, ammeter, pilot lamps, voltmeter receptacle and triple-pole, quick-break main switch, but with no field rheostats. Each of the alternating panels, of which there are three, carries three alternating ammeters, one for each phase; a triple-pole, single-throw main switch, for throwing the machine on to the one set of three-phase bus bars, the field plugs and field rheostat.

the latter of No. 1 wire as far as Lisbon Falls, where there is a rotary substation, and No. 3 copper wire for the balance of the distance. The wires are carried on porcelain insulators, mounted on the same poles which carry the brackets for supporting the trolley wires.

There are three substations, one at Lewiston, having two 200 kw. rotary converters, fed by three 150 kw. transformers; and one each at Lewiston and Lisbon Falls, each containing one 200 kw. rotary converter fed by three 75 kw. transformers. The latter are of the oil-insulated, self-



There are, of course, no ground detectors on these panels, as the winding is grounded through the direct current end.

The transformer house for the alternating current is located about 45 ft. from the station, on account of insurance requirements. It is a two-story brick building, about

cooling type, and, like the generators, are connecting in the star or Y grouping. The rotary converters are ten-pole machines, running at 720 r.p.m., and are similar in winding and details to the generators. Overhanging the bearing at one end of the shaft is a small three-phase induction motor for starting, and overhanging the bearing at the other end is a pulley by which the machine can be driven

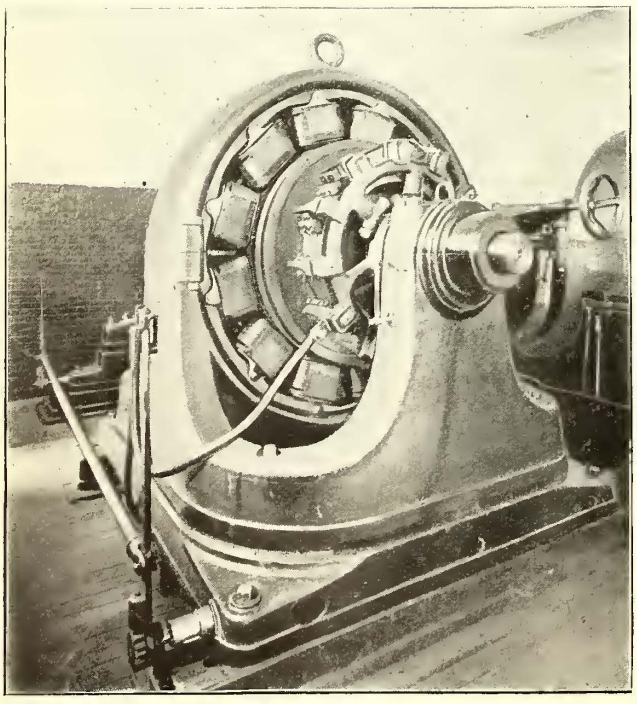


FIG. 2.—A. C. D. C. GENERATOR AT MAIN POWER HOUSE.

FIG. 3.—ROTARY CONVERTOR AT BATH

18 ft. x 24 ft., and the current is carried to it by lead-covered cables. The step-up transformers are six in number, of the Westinghouse oil-insulated, self-cooling type, of 125 kw. capacity each, and raise the current to a line pressure of about 10,000 volts. From this transformer house two high tension lines are run, one to the city of Bath, 10 miles distant, and the other 20 miles, to the city of Lewiston. The former consists of No. 6 wire, and

by steam engine, which will be installed later for emergency work.

The 30 miles of main line consists of a single track laid with 60-lb. T rails in 60-ft. lengths. About 7 miles is on private right of way 33 ft. in width, the balance following the side of the highway. The country is quite hilly, and the track follows the contour, its maximum grades being about 10 per cent. The cost of

the track, exclusive of right of way and inclusive of the overhead work, was about $10,000 per mile. The overhead line is thoroughly put up on 30-ft. poles with 7-in. tops, placed 115 ft. apart. At the top they carry four-pin cross arms supporting the high tension line, another similar line below carrying the 500-volt feeders, which are of bare copper wire, all copper in the system, including trolley, feeders and 10,000-volt lines, being uninsulated. The trolley wires are two in number, one for the up and the other for the down cars, of No. 0 copper, supported in special hangers consisting of one rigid piece, carrying the caps and cones for both trolley wires. One No. 0000 feeder is carried the whole length of the line, constituting a short distributing main or side feed. The section breaks are short-circuited through switches on the poles, thus tying all 500-volt copper together.

The main line traffic is carried by nine cars, giving a half-hour service, the run of 30 miles being scheduled at 2¼ hours. The cars are mounted on single trucks, with two Westinghouse No. 49 motors, and fitted with extra wide bodies and cross seats. Each car makes four round trips, aggregating 264 miles per day, with a change of crew each round trip. A dozen cars more run on the local lines in Lewiston and Bath. The through line has been running since the middle of August, and doing a very satisfactory winter business. For summer service it is equipped with ten fourteen-bench open cars, on Peckham double trucks, fitted with two Westinghouse 50-h.p. motors geared for medium speed. Ten more such cars will be added before the summer season begins. During the winter season these motors are used for snow plows, of which there is naturally considerable need in the wintry climate of the State of Maine. Besides six Taunton-nose plows, there are two Ruggles rotaries, each fitted with two 50 h.p. driving motors and one 50-h.p. motor to run the centrifugal fans. The latter are very powerful, fitted with cutting blades to draw in the snow and centrifugal paddles to throw it to one side, both being 88 ins. in diameter.

FIG. 4.—STEP UP TRANSFORMERS AT TRANSFORMER HOUSE

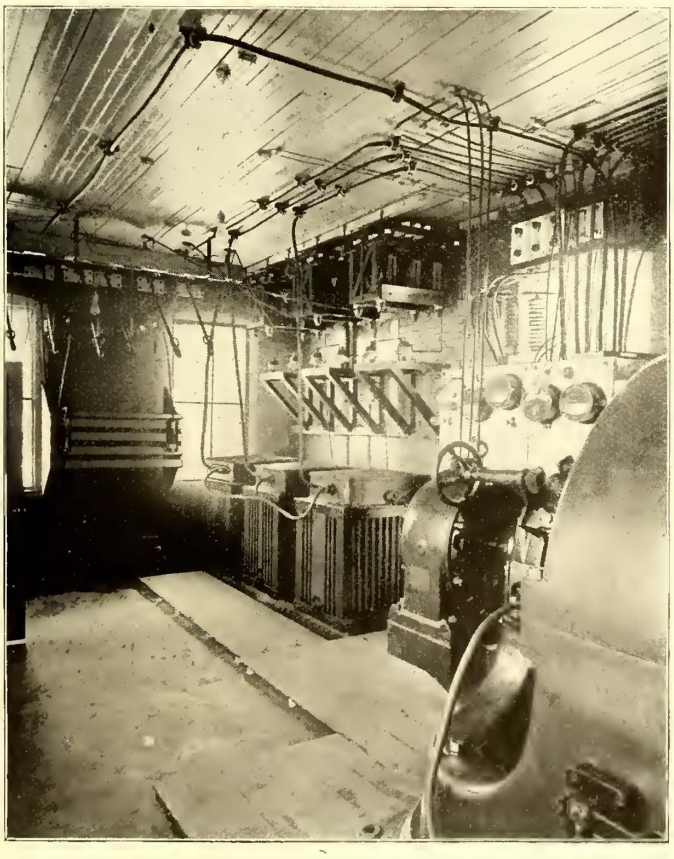


FIG. 5.—INTERIOR OF CONVERTOR STATION AT LISBON FALLS

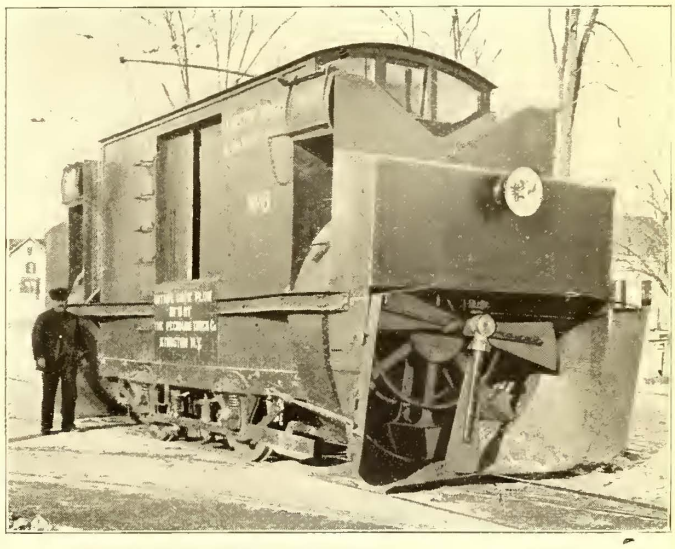


FIG. 6.—ROTARY SNOW PLOW

The through fare for the 30 miles is 35 cts., the route being divided into seven sections, with fare of 5 cts. per section. The road shows gross earnings during the winter months of from $350 to $700 per day, its cost of operation and interest on the bonds being $350 per day. It is expected that the daily earnings will run up to $5,000 per day in the summer months, when the pleasure travel is at its maximum. The company owns a large park on Merry-Meeting Bay, which will attract considerable travel. It has also entered into an agreement with the Kennebec Steamboat Line, running from Bath to Boston, to carry through passengers, freight and express matter,

and will put on special cars for the carriage of baggage and other inanimate traffic.

The officers connected with the line are: President, A. H. Shaw, treasurer, I. C. Libby; general manager, A. F. Gerald, and general superintendent, I. L. Meloon, to whom thanks are due for the information given above.

The electrical apparatus was installed under the general

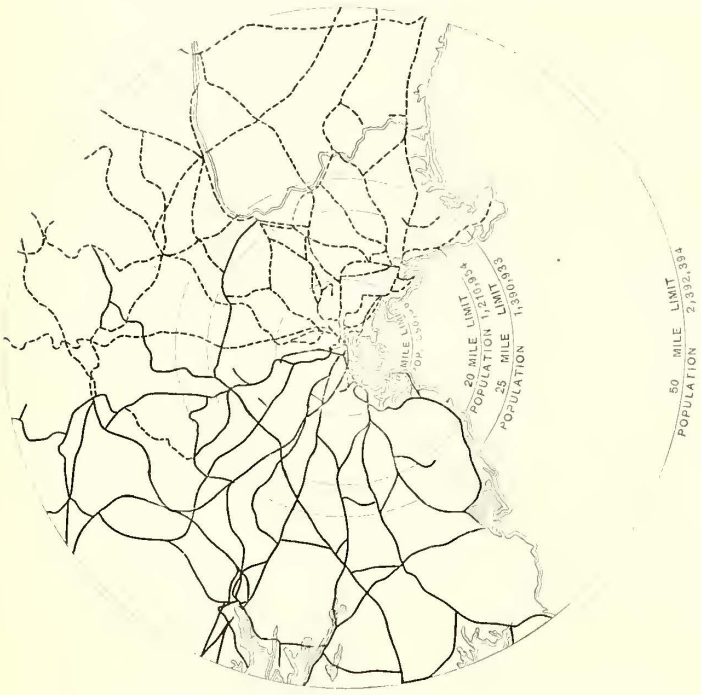


FIG. 1.—MAP SHOWING SUBURBAN (STEAM) RAILROAD LINES AROUND BOSTON

—— Lines Entering Southern Union Station
..... Lines Entering Northern Union Station

direction of E. Chesrown, representing the Westinghouse Company, who lately left to take a position with the Snoqualmie Transmission plant in the State of Washington. His successor is W. G. McConnan.

New York City Quarterly Reports

The trend of traffic in New York City is indicated by the following reports of the Metropolitan (surface) and Manhattan (elevated) companies for the quarters ending Dec. 31, 1897-8:

METROPOLITAN STREET RAILWAY COMPANY

Quarter ending Dec. 31,	1897.	1898.
Receipts from passengers	$2,383,458	$3,092,756
Receipts from other sources	150,919	175,190
Receipts, total,	2,534,377	3,267,946
Operating expenses	1,208,770	1,467,580
Earnings from operation	1,325,607	1,800,366
Deduction from earnings—		
Interest on bonds	107,500	263,750
Taxes	130,431	159,617
Rentals	551,075	649,690
Net income	536,601	727,310

MANHATTAN RAILWAY COMPANY

Quarter ending Dec. 31,	1897.	1898.
Receipts from passengers	$2,597,186	$2,356,896
Receipts from other sources	45,625	47,500
Receipts, total,	2,642,811	2,404,396
Operating expenses	1,358,085	1,341,090
Earnings from operation	1,284,726	1,063,306
Fixed charges	774,855	731,784
Net Income	509,871	331,522

The New South Terminal Station in Boston and its Effect on Traffic Conditions in Eastern Massachusetts

It appears that the New York, New Haven & Hartford and the Boston & Albany Railroads are determined to regain the rich suburban traffic in and out of Boston, which they have been steadily losing to the electric street railways of Eastern Massachusetts during the past few years, and that they mean to fight the enemy with its own weapons, so far as may be possible. No other interpretation can be put upon the building, at great expense, of the new Southern Terminal Station in Boston, at a point more convenient of access to the heart of the business section for the large majority of the users of the railroad systems than are the present stations; upon the elimination of grade crossings in the suburban district, and an increased number of suburban stations; and upon certain peculiar features found in the plan of the new South Terminal Station in Boston, by which its train-handling capacity is enormously increased. Literally, as well as figuratively, one may look below the surface of things at the new terminal and find food for reflection and for predictions as to the future. A brief description of this new station, with its peculiarities, and a discussion of its certain influence on the transportation conditions of Eastern Massachusetts will reveal some things of the greatest interest and importance to railroad and street railway managers and engineers, and to the general public.

A few years ago there were four railroads serving Southeastern and Western Massachusetts, entering Boston from the southern side. These railroads were the Boston & Albany, the New York & New England, the Boston & Provi-

FIG. 2.—MAP OF BUSINESS SECTION OF BOSTON, SHOWING NEW SOUTH TERMINAL AND ITS APPROACHES

.....Abandoned lines

dence, and the Old Colony. Now, the three latter have been purchased and practically consolidated with the New York, New Haven & Hartford Railroad, which has three stations—the Providence Station, located at Park Square; the Old Colony Station, on Kneeland Street, and the New England Station, at the foot of Summer Street. The Boston & Albany Station was also on Kneeland Street, near the Old Colony Station. The locations of these stations are shown in Fig. 2. The lines of the Old Colony, Providence and New England Railroads parallel each other to a certain extent in Southeastern Massachusetts, the Old Col-

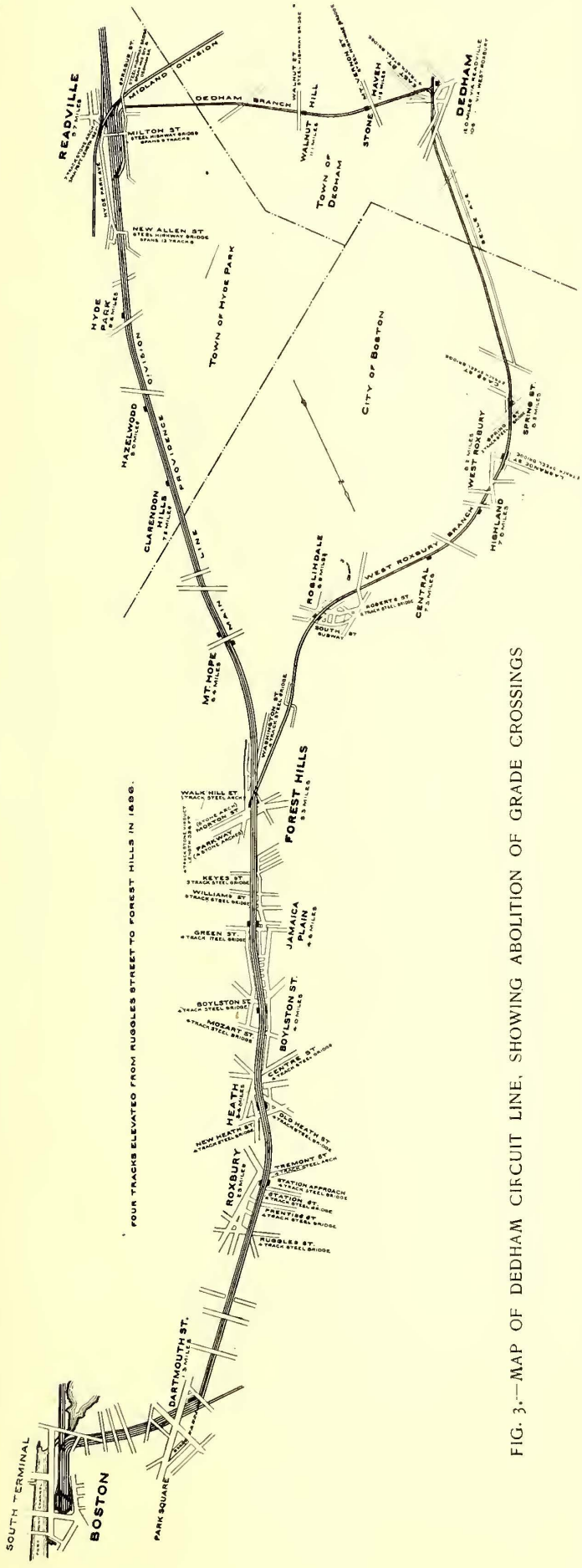
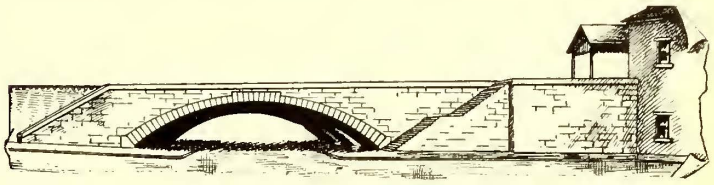


FIG. 3.—MAP OF DEDHAM CIRCUIT LINE, SHOWING ABOLITION OF GRADE CROSSINGS

ony, however, serving many portions not reached by the other two.

These four stations are all to be given up, and a new terminal station, constructed on the site of the former New England terminus, with additions, will replace them. The station is now completed, and the Old Colony and New England trains are using it, the Albany and Providence trains still running into their old stations. The new station location and the changes in the lines leading there-



ARCH CROSSING AT HYDE PARK AVENUE, DEDHAM CIRCUIT

to are noted in Fig. 2. The new station is nearer the financial, business and shopping districts of the city than the old stations, and it will be within quicker reach of the Northern Union Station and the northern ferry lines. When the new elevated structure is built, and with additional surface railway accommodations, the terminal facilities as a whole, including the new and large outlying station at Dartmouth Street, will inevitably be far more convenient to the mass of suburban residents doing business in Boston proper than are the present stations.

The map, Fig. 1, shows the network of railroad lines in Eastern Massachusetts which will use this new station, and gives an indication of the number of people resident in the district within 50 miles of Boston. The world is too apt to consider Boston as a fourth or fifth rate city, forgetting that in addition to the half million people contained within the city limits proper there are from sixty to seventy cities and towns in the immediate neighborhood which swell the population of the metropolitan district to about 1,250,000, while there are nearly 2,500,000 people within a 50-mile radius of the Statehouse. It will easily be seen from this map how intimate is the relationship between the railroads and the townships of Eastern Massachusetts, scarcely one of these towns being without good railroad connection to Boston. It must be equally evident that if the railroads adopt what may be called modern methods in the conduct of their suburban business they will be dangerous competitors indeed to the street railway companies. These modern methods include cars or trains run at regular and frequent intervals throughout the day, so that a would-be passenger may always know, without looking at a time-table, when an inbound or an outbound train is due; higher average speeds than are possible with present steam locomotive service; the doing away with the smoke, cinder, gas and noise nuisances incident to steam railroad operation; the cultivation of pleasure travel; a reduction of fares, made possible by greatly increased business; and uniformity of fares with zone limits, so far as this desirable feature can be introduced.

In other words, modern methods mean primarily electricity as a motive power, and electricity is surely going to be the motive power of the suburban railroad system of Eastern Massachusetts. The physical conditions are all favorable, especially since the passage of the grade-crossing bill in Massachusetts, under which the State, the different cities affected, and the railroads are joining hands for the abolition of the grade crossing evil. The increasing competition of the electric street railway lines compels it, and the railroad companies have realized the situation and taken steps accordingly, as will presently be seen.

Glancing again at the map, Fig. 1, it will be seen that

there are numerous loop lines already established in this suburban area, adapted to a service of the kind just spoken of. Loop lines are a decided advantage in that trains can be kept constantly in motion, without delays and lost time for switching and other purposes, and a regular short interval schedule can easily be kept up. The line which will probably be the first around Boston to be equipped by electricity is that known as the Dedham circuit, one branch of which is made up of the four-track main line of the Providence division, New York, New Haven & Hartford Railroad, between the new Southern Terminal Station in Boston, and Readville, while the loop leaves the main line at Forest Hills and passes through a succession of pleasant residential settlements to Dedham, joining the main line again at Readville. A plan of this line is given in Fig. 3, from which it will be seen that grade crossings have been entirely eliminated from it, and it is now "cleared for action," as it were, ready for electric traction. On this Dedham Circuit line trains run, at present, at hourly intervals, though with greater frequency during the rush hours. Under the new conditions it is quite probable, though no decision has yet been made, that a regular train service at ten or fifteen minute intervals will be kept up throughout the day, using single cars or two-car trains only during the lighter hours, while three, four, or five car trains may be run at other hours, according to the demands of traffic. Another line on which a service of this general character can be put, to the advantage of the steam railroad companies and the people, would be the Newton Circuit line of the Boston & Albany Railroad, which passes through the richest suburban territory in the vicinity of Boston. Several other loop lines could be made along the South Shore, and the Nantasket Beach electric line, if extended to Boston, would, it is hardly necessary to say, be highly popular, and probably far more profitable than is the present mixed steam and electric service.

All these plans for reorganizing suburban transportation methods necessarily involve terminal facilities far greater than can be ordinarily obtained by a stub-track system, where switching of locomotives and delays of one kind and another are inevitable. As a consequence, the new South Terminal in Boston has adopted a plan unique in the annals of steam railroading. It is planned that all suburban trains shall eventually enter the terminal and pass down depressed tracks into a subway loop, where, at properly located platforms of large area and length, they will discharge and receive loads, and will thence pass up out of the subway on inclined tracks to the surface again, on their return journey. By this simple plan the total train capacity of the South Terminal Station is increased from some 750 trains per day, which is all that the twenty-eight stub-tracks entering the terminal could handle with safety, to over 2000 trains a day—a station capacity larger by far than that of any railway terminus in the world.

A plan of the Southern Terminal is seen in Fig. 4, and a section in Fig. 6. From these the location of the loop can be readily understood, and it will be seen also from the curvature of the outer loop (262-ft. radius) that it is only in a station of such enormous size that a scheme of this kind is feasible. The platform capacity of the two-track loop in the subway is sixty cars, each 40 ft. in length, a capacity greater than will probably be called for for some years to come; and the inner loop will be used only if the traffic should eventually exceed the capacity of the outer. Passengers will enter the main station and pass down stairways to the loading platform, which is that between the two tracks, and which will accommodate 25,000 people at a time. Here will be gates and penstocks, from which the trains for given lines will depart, and these penstocks can be filled before the arrival of the train. The unload-

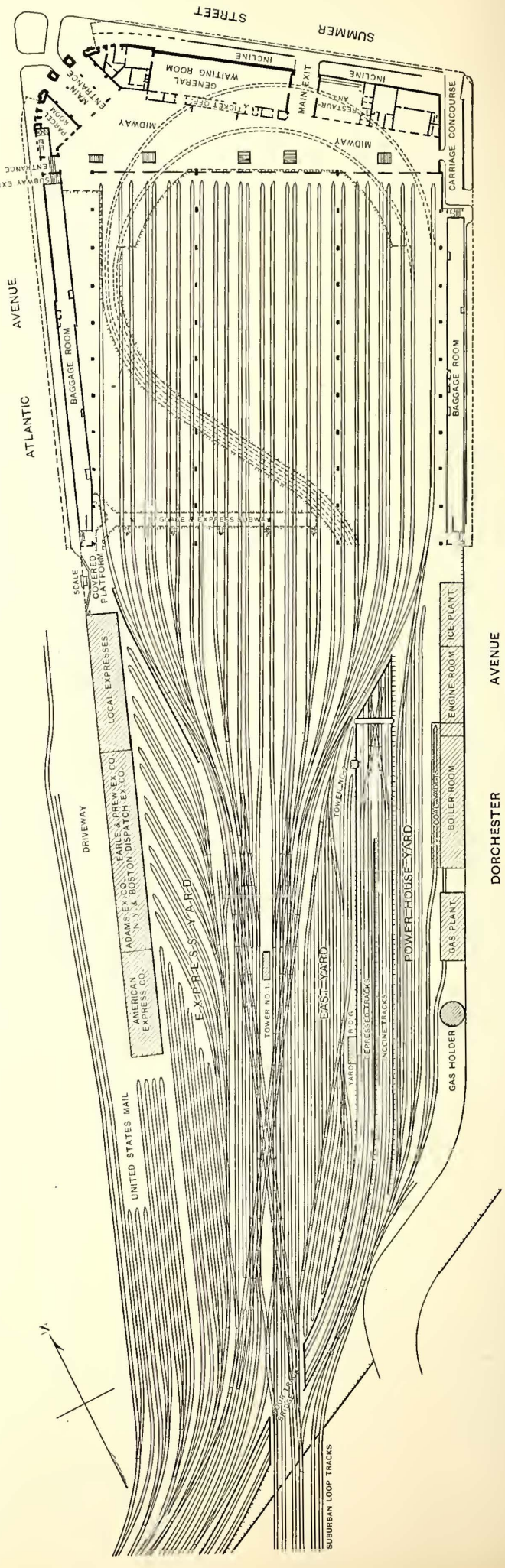


FIG. 4.—TRACK AND STATION PLAN OF THE NEW SOUTH TERMINAL, BOSTON

ing platforms will be on the outside of the loop, and from it passengers will find an exit directly to the street, with little obstruction to the outward flow. When the inner track of the loop is used it will, of course, be necessary to make the innermost platform an unloading one also, and from it passengers will have to find an exit to the midway above, or over stairways and bridges to the outer unloading platform. This plan is, of course, less desirable than the first, but is a necessity of the situation. The inter-

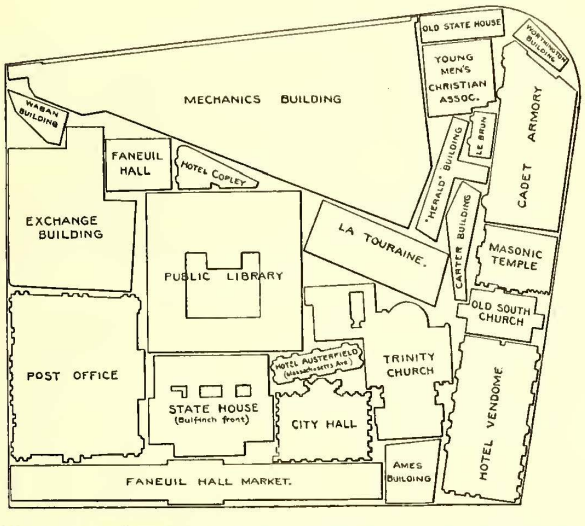


FIG 5.—DIAGRAM SHOWING SIZE OF HEAD HOUSE, NEW SOUTH TERMINAL

locking switching arrangements in the yard above are such that a train can be passed out of the subway every sixty seconds, and as there is platform space for four trains on each track, there is thus provided ample time for loading and unloading.

The terminal building itself is a magnificent and imposing structure, particularly when seen from above in a "bird's-eye view." It is difficult to form a conception of the immense area covered by the building itself unless in some such way as that shown in Fig. 5, where it is seen that no less than twenty-four large Boston buildings could be contained within the limits of this single one. The building alone, exclusive of the yards, extends south along Atlantic Avenue 792 ft., and east on Sumner Street 672 ft., while the frontage on Dorchester Avenue is 725 ft. The train shed is 602 ft. long x 570 ft. wide, and contains twenty-eight tracks having an aggregate length under roof of 4 miles. These tracks are arranged in pairs, with a passenger platform between each pair, and between the pairs are seven platforms devoted exclusively to the trucking of baggage and express matter. The baggage is handled by elevators, which pass up and down from the baggage platforms to a subway below, whence they are trucked to and from the baggage rooms.

The midway at the end of the train shed is a magnificent stretch of platform space, containing 60,000 sq. ft., extending the entire Summer Street length of the building and reached from the street by broad inclined walks, and from the waiting rooms through many doors. Eleven windows of the central ticket office open toward the midway, and sixteen windows open into the waiting room. The station accessories in the matter of waiting rooms, lavatories, restaurant, barber shops, telegraph and telephone offices, electric elevators, etc., are well planned for the comfort and convenience of passengers, and little is left to be asked for by the traveling public. The inward baggage rooms are on the east side, and the outward on the west side.

Never before has a great railroad station been provided with such extensive and elaborate equipment requiring the use of power, and as a consequence never before has a station power plant been so interesting. Much time has been spent in the study of other terminal stations at home and abroad for the purpose of introducing the best features found therein, but in addition to these, others entirely unique are met with here for the first time. There is an elaborate system of interlocking switching and signaling apparatus for the yards and train shed, all worked by compressed air, and requiring, therefore, a suitable compressed air plant; steam for heating and for various other purposes; electricity for elevators, the ventilating system, fans, and a half-hundred other purposes; an ice plant for the manufacture of ice used in the cars, restaurants, etc.; a refrigerating plant for cooling the provision boxes and storage rooms in the headhouse; a plant for filtering and cooling drinking water for the public and for use in the offices; mains for heating cars when standing in the train shed and yards when locomotives are detached; charging apparatus for air-brake appliances; a fire protection service for the terminal buildings; a pumping plant for disposing of water which may find its way into the portions of the terminal situated below tide water;—all these depend upon the general power plant, which is located on the Dorchester Avenue side of the building. The building devoted to this purpose is 460 ft. long and 40 ft. wide.

A general contract for practically the entire engineering and power equipment of the terminal was placed by the Terminal Company with Westinghouse, Church, Kerr & Co., who have in turn sublet contracts for all the detail appliances not manufactured by themselves. The entire equipment is as follows:

There are ten horizontal tubular boilers, built by Edw. Kendall & Sons, of Cambridgeport, Mass., each 72 ins. in diameter x 18 ft. long, with 130 3-in. tubes. Each boiler is equipped with Roney mechanical stokers operated by two standard Westinghouse engines.

There are two economizers of the Westinghouse steam

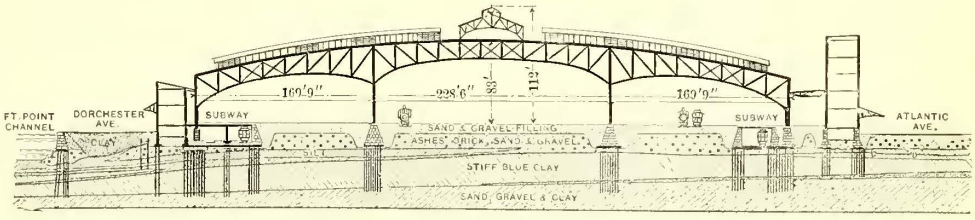


FIG. 6.—TRANVERSE SECTION, NEW SOUTH TERMINAL

circulating pattern, manufactured by the Fuel Economizer Company, of Matteawan, N. Y.

There is no chimney to the plant, but forced draft is used and is supplied by two blast wheels 14 ft. in diameter x 7 ins. wide, designed by Westinghouse, Church, Kerr & Co.

In the engine room are four 375-h.p. Westinghouse automatic compound condensing engines, each direct connected to a Westinghouse 8-pole, 220-volt direct current dynamo of a peculiar type, each dynamo being capable of generating a 220-volt current for power purposes and a 110-volt current for arc and incandescent lighting, both currents being deliverable in any desired proportion from the same machine.

The heating of cars waiting in the train shed in cold weather when the locomotive is detached is provided for by a complete system of steam mains leading to the ends

of the stub tracks, steam at boiler pressure being passed through a reducing valve which supplies the mains with steam at 70 lbs. pressure.

A thirteen-panel switchboard is another feature of the power plant.

The air compressors were made by the Ingersoll-Sergeant Drill Company, and have 12-in. steam and 10-in. air cylinders with 24-in. stroke. A constant pressure of 100 lbs. is kept in the pneumatic signaling apparatus and interlocking system.

A positive hot-water circulating system is used for heating the station.

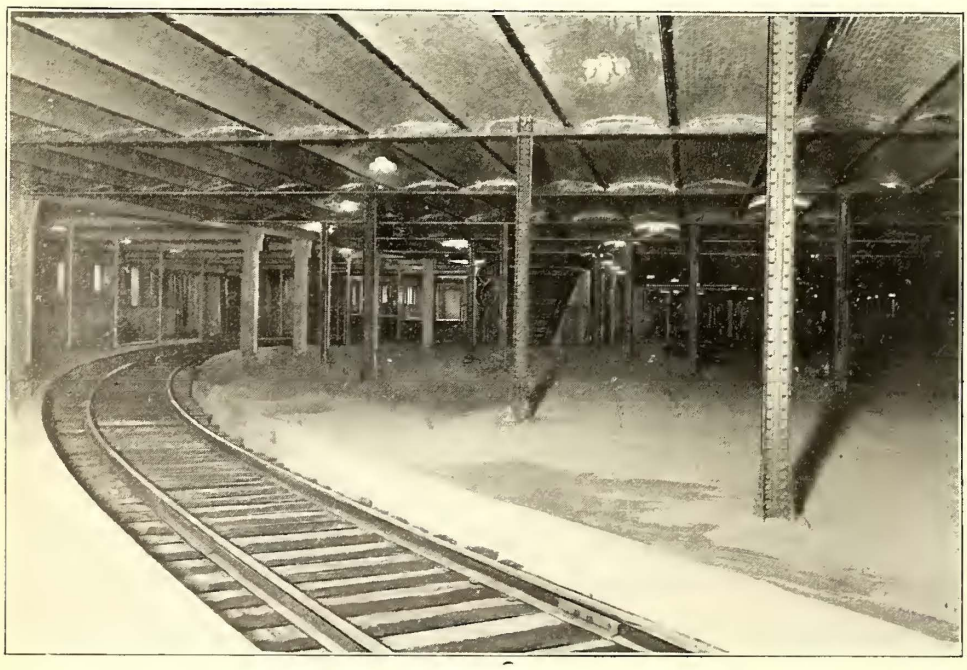
The ice and refrigerating plant was designed by Westinghouse, Church, Kerr & Co., and is especially complete and interesting.

The Sprague Electric Company has furnished four electric passenger elevators of its Z type, two freight elevators of the Q type, and twelve baggage lifts of type P, the last named operating between platforms in the train shed and the baggage subway below.

The electric pneumatic interlocking system was furnished by the Union Switch & Crossing Company, a Westinghouse corporation.

A complete gas plant for supplying compressed illuminating gas on the "Pintsch" system has been installed in a separate brick building at the south end of the power house. Its capacity is 120,000 cu. ft. per day.

The exceptional completeness of the equipment of the South Terminal Station and the perfection of the plans in every detail is due, of course, to the combined intelligent effort of many men on the magnificent staffs of the Boston & Albany and New Haven Companies, but among those especially to be mentioned as bearing the final responsibilities are President Charles P. Clark, of the New Haven system and the Boston Terminal Company; General Manager John C. Sanborn and Resident Engineer George B. Francis, of the Terminal Company, and Chief Engineer Curtis, of the New Haven Company. The advantages of making a bulk contract for the entire engineering equipment have been well exemplified in the care and celerity with which the work has been carried out by Westinghouse, Church, Kerr & Co.



LOADING PLATFORM ON LOOP IN SUBWAY

Consolidation in Buffalo

On Feb. 27 it was announced that all the electric railways in Buffalo and vicinity had been purchased by a syndicate, and would be consolidated into one company having a capital stock of $25,000,000. The roads purchased are the Buffalo Railway Company, the Buffalo Traction Company, the Buffalo & Niagara Falls Electric Railway Company, the Buffalo & Lockport Electric Railway Company, the Buffalo, Bellevue & Lancaster Railway Company and the Niagara Falls Park & River Railway Company, of Niagara Falls, Ont. In addition to the purchase of the electric railways the syndicate gains control of two bridges crossing the Niagara River below the falls, one of them being the upper steel arch bridge, and the other the new suspension bridge now being erected over the river at Lewiston.

SOUTH TERMINAL STATION, BOSTON

A verdict for $400 has been given to a gentleman in Brooklyn, N. Y., who was ejected from a car by a conductor. The gentleman received a transfer from one line to another, but as the cars of the second line were crowded he decided to wait until he could secure a seat. A car containing empty seats did not pass for half an hour, and when the gentleman presented the transfer on this car it was refused on the ground that the time limit had expired. He was ejected from the car, and brought suit, with the above result.

A decision has been handed down by the full bench of the Massachusetts Supreme Court in the suit against the Warren, Brookfield & Spencer Street Railway Company, holding that a landowner cannot recover damages for injuries caused by the construction of an electric railway in front of it. The court holds that the law granting damages is not applicable to street railway companies, but only to companies organized for the production of electricity for power or lighting.

The Brooklyn (N. Y.) Rapid Transit Company reports passenger earnings for February, 1899, as $370,544.

Park Amusements

BY HENRY PINCUS

The entire success or failure of a park is almost entirely dependent upon the proper selection of attractions, and yet many park owners look upon this as a mere secondary consideration. I have known large corporations to invest many thousands of dollars in park property, and, after months of preparation for a season's business, never give their amusements a thought or consult an amusement manager until the last moment, and oftentimes not at all. In their opinion, the amusement manager does not count for much—he is only a "showman"—and what are his suggestions and advice worth, compared with those of the engineer, architect, landscape gardener, and such persons?

Why is an amusement manager so necessary, particularly at the start? What does he know about the details of laying out a park? These are the questions I propose to answer.

A man who understands the business of park amusements should have a general knowledge of the entire subject. By this I mean that he should see at a glance where to locate this or that attraction with a view to getting the best results, make it easy for the people to see and hear, and, at the same time, make it easy for them to spend their money. This is a science, and an expert amusement manager knows all the tricks that go to accomplish this end. The park is designed for amusement and should be built upon amusement principles, and the larger and more pretentious the park, the greater the need of an experienced man. Why? Because in all enterprises, everything revolves around one pivotal point, that for which it was organized. For instance, who would think of exploiting a mining scheme without a mining expert? Just imagine a large department store without a competent buyer for the various departments. All the magnificent buildings, handsome decorations and perfect surroundings would amount to very little, if the right kind of goods were not there. So it is with amusement parks—beautiful grounds, fine structures, and unlimited capital to operate them, do not make successes—the "attraction" is the thing, that magnetic "something" which you must depend upon to draw the people.

Strange as it may seem, the park proposition differs from almost every other form of amusement enterprise. Let me explain. In a theater, for instance, the entire audience are really all in and seated when the performance begins. Their admission fee, which is all the revenue the owner expects to get from them, has been paid. It is now the desire of the proprietor to entertain the patrons to the best of his ability for the entire evening and give them the worth of their money. If the attraction is strong enough to draw the people, it certainly must be interesting enough to hold their attention for the entire length of performance. This is what is wanted. It is not so with parks, however. In out-door amusements, the successful manager must keep his patrons "on the go" all the time. The entertainment must be of such a character as to be sufficiently strong to draw the people, and, at the same time, to keep them entertained *at intervals only*. Why? Because they must be kept moving. The "show" is only the "bait" to catch the crowd, it is the expensive end from which the owner receives no revenue, or very little.

What are the profitable sources of income? The merry-go-round, the toboggan, the thousand and one catch-penny amusements; they are the money earners. The candy, ice cream and soda water stands and such must get their share also. They are scattered all over the grounds. What chance have they to do business if the people are all seated in the amusement pavilion and kept there for the entire evening? Yet there they will stay, afraid to leave their seats for fear of losing them. That is the objection in parks to comic operas, plays and similar attractions—they hold the attention of the audience from beginning to the end. In other words, it is a "story" which they are interested in hearing all through.

The park owner will naturally ask then, "What on earth should I give them?" That depends entirely upon the originality of the manager, style of place he is managing and class of people he is catering to. To illustrate, in a general way, if you have a large place, where crowds are to be amused, and, at the same time, separated from their money, I would suggest the following: In the pavilion put a first-class band of music (I mean one of reputation with drawing power) with occasional solos and novelties interspersed. In another part of the grounds, say some fireworks—elsewhere, maybe, a balloon ascension (illuminated) or other sensational act. This will keep the crowd moving and, at the same time, enable the park owner to catch the nimble nickel. Take, for instance, Washington Park on the Delaware, that I have been managing for several seasons; a matter of the greatest concern was how to entertain the crowds, and, at the same time, get their money. It is hard to do both. For instance, our park covers many acres of ground—we have two carousels, two toboggan slides, a shoot the chutes, Ferris wheel, maze, electrical building, refreshment stands and many other sources of profitable income. Now, to get the people distributed among these points, while the non-profitabe counter attractions are so great with only a few hours to get their money, is a problem. In the evening, it is after 8 o'clock before the people can get to Washington Park from their homes and suppers, and by 11 o'clock they commence to go home. This makes the time very limited. We have two bands, electric fountain, fireworks, etc., all of which are free. After considerable experimenting, we settled on the following method:

At 8 o'clock the big band commenced their concert, which lasted until 8:40 (introducing special features). At 8:50 sharp (ten minutes later to give the people time to get there) commenced the electric fountain display, with its wealth of spectacular effects, living pictures and dances, in the midst of the falling waters. At the conclusion of this entertainment was a display of fireworks. This entire exhibition was all over at 9:20, just one half hour. One hour's show crowded into half that time and why? To keep the people from going home, as 9:20 was comparatively early, while at 10 o'clock they would make a rush for the cars or boats. Immediately at the finish of the fireworks display, the big band in the pavilion would strike up some lively march to attract the attention of those who had been watching the fireworks; this would have the effect of moving the crowd in that direction. Then there would be another concert with some novelty introduced, and the other band would play in the lower pavilion, which, together with the many other attractions distributed all over the park, would keep up the excitement until the end of the evening.

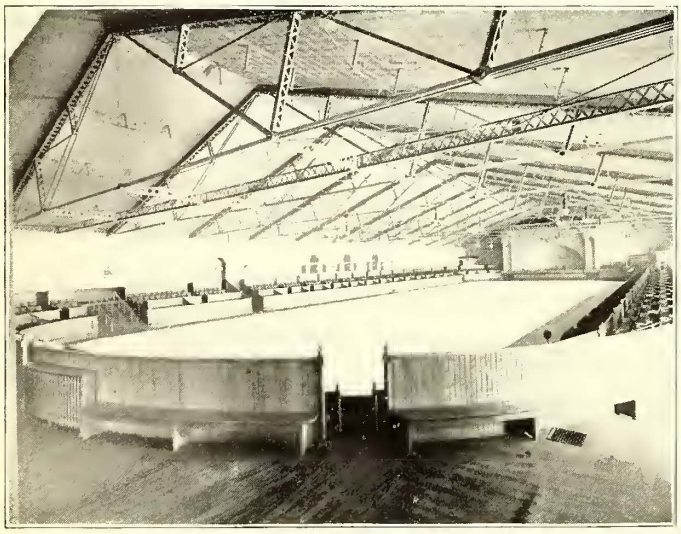
I have tried operas, concerts, vaudeville, big spectacles and water shows, as well as balloon ascensions, by day and night, in fact, almost every kind of attraction, all with the same result; *give it to them at intervals*. It is better to give operettas or selections from operas, with concert selections between, than one continuous show.

Remember I am speaking only of large parks covering great area. If you have a small park with nothing but a stage with seats in front of it, as the *only* attraction, as many of the small trolley parks do, then it is a very different proposition. In such cases a vaudeville, operatic or any other continuous evening's entertainment is just what is wanted.

Transformation of a Street Railway Repair Shop into a Skating Rink

As mentioned elsewhere the Consolidated Traction Company of Pittsburgh, has recently built extensive new repair shops, and this has allowed the company to remodel its former shops and to lease them as an ice skating rink. The building, which is of brick, has a ground dimension of 400 x 136 ft., and the ice surface utilized for skating aggregates 26,000 sq. ft. The skating floor is oval in shape, and is provided on three sides with rows of opera chairs and boxes. One end is fitted up with a stage or a band stand, and at the entrance or front end there are a large soda fountain, cloak rooms, parlors and smoking roms, as well as check rooms for skates.

The building is brilliantly lighted with arc and incandescent lamps, the latter being installed in great numbers along the steel arches which support the roof, there being



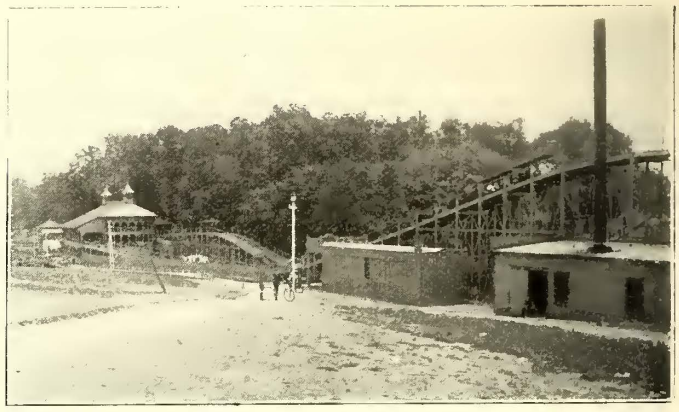
TRANSFORMED CAR HOUSE

but a single span. There are also artistic designs in incandescent lamps, and all the auxiliary equipments usually found in a rink of this character. The power for operating the ammonia compressors is derived from two 200 h.p. motors, which are converted generators, formerly employed in one of the power stations. These each drive a 150 h.p. compressor by means of individual rope belts. There is the usual tank and cooling apparatus through which the brine circulates, and the steam pump by which the brine is pumped through the tubes in the floor of the rink. The brine is returned through two large pipes located in the basement under the rows of seats on each side of the building. A portion of the basement is also occupied by one of the 248-cell storage battery stations of the chloride accumulator type, which are employed as auxiliary to the main power station. This battery is connected with the lighting circuit of the rink, so that the lamps burn very uniformly indeed. The switchboard for controlling the lights and power is also in the basement, the whole equipment being very liberally designed.

Every employee of a street railway should be considered as an agent with possibilities of harm to his employer. It is not enough that he be intelligent, sober and industrious. He should be of good judgment and sound thinking; and neither communistic, socialistic or anarchistic in his views; not discontented and at cross-purposes with the whole social order, but of cheerful disposition and content to make the best of life as he finds it.—From a paper read at the St. Louis Convention, 1896.

Woodside Park, Philadelphia

The Fairmount Park Transportation Company owns one of the most elaborate pleasure resorts to be found in this country. This is located a short distance from Fairmount Park in the city of Philadelphia, and nearly a half-million dollars have been judiciously expended in making it one of the most charming spots that can be imagined. The natural beauties of the place have been carefully pre-

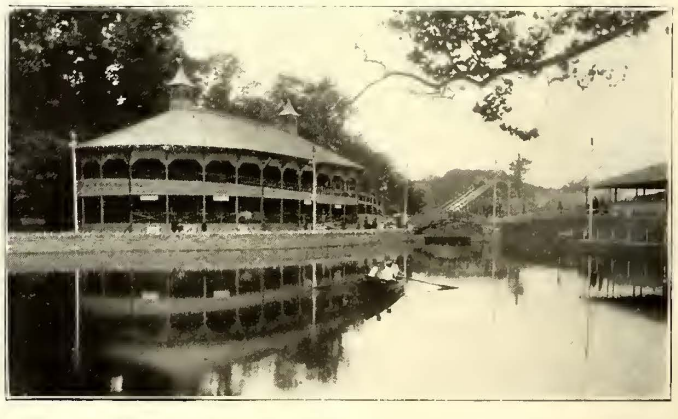


SCENIC RAILWAY AT WOODSIDE PARK

served, and have been enhanced by artificial means wherever possible. The place is known as Woodside Park.

Among the many attractions are a Dentzel merry-go-round, a revolving tower, a large casino, from whose balconies magnificent views of Fairmount Park and the city can be secured, a well-managed theater, scenic railway, owned and operated by the L. A. Thompson Scenic Railway Company of New York, etc. These are only made adjuncts, however, to the natural beauties of the place, which consist of attractive woodland and groves, a very beautiful lake, numerous walks and drives, etc. Thousands of seats and tables have been scattered through the woods for the use of picnic parties, and these are always well patronized on pleasant days.

The scenic railway was the first attraction to be installed at this place, and was, in fact, nearly completed before any



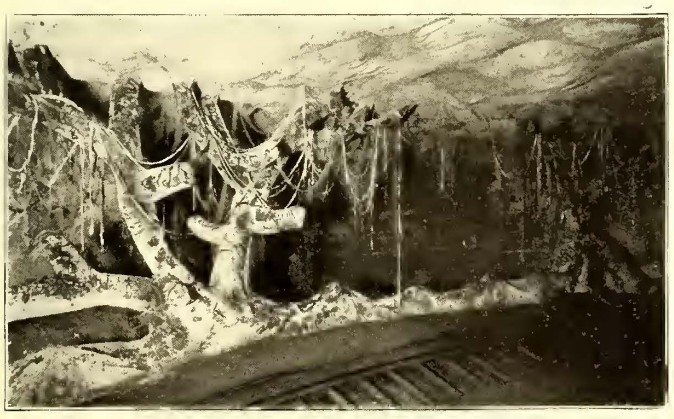
LOOP BUILDING FOR RAILWAY

other improvements in the neighborhood had been undertaken. The railway is supplied with a power plant, which can be either steam or electric motor. The structure is built on the four-track plan, with loops at each end. The length of the structure is about 800 ft., 24 ft. wide, except at the loops, which are 62 ft. to 70 ft. across at the widest points. Each car travels four times the length of the structure, making a ride of about 3500 ft. Sidewalls are built along the structure the entire length of the track, making derailment impossible. The force used for the

greater length of the line is gravity. There is also a cable section centrally located in the structural roadway, where short sections of ¾-in. steel rope are driven up the main elevations by the application of steam or electric power. These running sections of cable pick up the cars while in motion by the use of an automatic grip attached to the bottom of the truck of the car, and the cars are carried up and over the elevations without the slightest jar or jerk, and automatically released at the top, so that the motion

GROTTO IN SCENIC RAILWAY

of the car is not checked. Here gravitation and momentum alternately supply the necessary force that propels the car over the roadway to the next cable section. At one terminal of the railway is a large pavilion, and at the other a circular building, through which the cars pass. Here,



GROTTO IN SCENIC RAILWAY

by means of painted canvas, etc., a number of very beautiful scenic effects are secured. These vary in character, from representations of distant views of mountains, hills and water effects to tunnels, from the roofs and walls of which depend imitations of coral, stalactites and grotesque formations of various kinds. The sensation, while passing through these tunnels and bits of scenery in the rapidly-moving cars, is novel and pleasing.

L. A. Thompson, the inventor of the attraction, was one of the first to study the question of developing the possibilities of gravity railways, and he has devoted fifteen years of his life to the problem. The company of which he is the head now operates over $200,000 worth of scenic railway plants in the United States, and is constantly increasing this amount. It is also receiving numerous inquiries from foreign countries, and has just sent two shiploads of material for scenic railways, one to Europe and one to South America. The company is now negotiating for a new site at Coney Island, where it expects to build the largest and finest gravity railway ever erected.

Electricity on the Manhattan Elevated Railway

George J. Gould, president of the Manhattan Elevated Railway Company, of New York, has issued to the stockholders of the company a circular, of which the following is an abstract:

"Pursuant to the request of the board of directors of the Manhattan Railway Company, I have been conducting during the past year a most exhaustive investigation relative to a change of motive power on the railways of this company.

"These investigations have embraced the generation, distribution and use of electric power on both elevated and surface railways by every important plant in this country, particularly those in New York, Brooklyn and Chicago. They represent, therefore, the combined experience of the largest producers and consumers of electricity in the world. The most conservative estimates made by experts show a saving of 2½ cents per car-mile on the entire car-mileage of the elevated roads. As we are now running over 40,000,000 car-miles annually, the saving in operating expenses alone will be over $1,000,000 a year, which, with other economies possible, is sufficient to pay 5 per cent on the $18,000,000 capital which it is proposed to put into the elevated roads, and 1 per cent additional on the present capital.

"This result will be effected merely by the decrease in expenses of operation, even if the effect of the change of motive power and other improvements connected therewith should not add one additional passenger to the present traffic. An equally strong reason, in my judgment, for the change of motive power is afforded by the increase in traffic, which will result as a consequence of the proposed change. When the change has been made, we should be able to run 20 per cent more cars to a train, the speed of the trains will be increased from 16 to 18 per cent, and the number of trains that can be sent out in any given time will likewise be largely increased, thus enabling the company to handle more traffic, and handle it more expeditiously and better than at present. During those hours of the day when the traffic is light our trains now run on some of the lines on a six-minute headway; when the proposed change is made we will be enabled to run cars without any additional expense on a headway of a minute and a half, thereby enabling persons who will not now risk waiting for four or five minutes for a train to travel by our road, induced thereto by rapid and expeditious service."

The circular mentions as additional advantages to be derived from the equipment of the elevated roads with electricity, the ease with which cars can be handled at terminal points, the better lighting of cars and stations, the operation of passenger elevators at the principal stations and the running of open cars in summer.

The circular continues in substance: "I repeat that after careful and deliberate consideration, the board of directors and executive officers concur in the opinion that the proposed change, by reason of the decreased operating expenses, the increased carrying capacity of the road, and the comfort and convenience of passengers, is one which ought not to be longer delayed

"In order to provide the means for making the change, the directors have concluded, as the best method, to create and issue $18,000,000 par value of additional stock, first to be offered to the stockholders at par.

"This will be issued, in order to provide for the necessary new plant and equipment and to modernize all facilities for the comfort and convenience of the public, thereby increasing the efficiency and economy of the service, as well as the earning capacity of the system.

"Stockholders will be given the right of taking the new stock at par on the basis of 60 per cent of their holdings, concerning which further communication will be made to the stockholders at an early date." (Signed) GEORGE J. GOULD, President.

It is interesting in connection with the above circular to notice some of the bills introduced into the City Council and the Board of Aldermen within the past few weeks, and which have as their object the regulating or improving of the service on the elevated railways of Greater New York. Among these are two which were passed on Feb. 22, one requiring all elevated roads in Manhattan and Brooklyn to put drip-pans under their entire structures (over 170 miles of single track), and the other compelling the Manhattan Elevated to run at least one train every five minutes, day and night, in the Borough of Manhattan. In addition to these, bills have been introduced compelling the Manhattan to inclose all its station platforms, and to run express trains every fifteen minutes, made up of vestibuled parlor cars with reclining chairs and Welsbach gas lamps, the fare to be three cents, and the penalty for violating the ordinance $1,000; also one prohibiting the storage of cars on elevated structures. In addition to all these, the Park Board has ordered the Manhattan Railway Company to remove its elevated structure from Battery Park.

LEGAL NOTES AND COMMENTS*

Edited by J. Aspinwall Hodge, Jr., and Robert Ernest, of the New York Bar

Liability to Linemen for Accidents

Accidents to linemen and repair crews whose duties call them to the top of poles and ladders must necessarily be frequent, and when they happen the liability of the railroad company as between master and servant is involved. A recent case in New York is typical and suggestive and its facts are closely analogous to facts which must constantly arise. *Gibbons* vs. *Brush E. I. Co.* There an electric light company, after finding that the arc lights on its poles in one or two instances, between Fourteenth and Thirty-fourth Streets, on Broadway, in New York, had become insecure, ordered a new set of fastenings and hoods, and when these were obtained sent out a foreman with the plaintiff as one of his men to set them up.

Upon removing one of the old lights and while acting under the directions of his foreman, the fastenings gave way and he fell from the top of the pole, and was seriously injured. The accident occurred because of the way the plaintiff removed the light, in accordance with the foreman's instructions.

The Appellate Division of the first department held that these facts established the proposition that the accident occurred through the negligence of the foreman, who was acting as a co-employee of the plaintiff, when he gave the order which the plaintiff obeyed, and therefore the defendant was not liable.

The risks assumed by an employee are stated to be not only the risks incurred in the handling of lamps in perfect order, but in handling damaged equipment. This is in accordance with cases where the same rule has been applied to the handling by employees of defective cars where it was necessary to couple them so that they might be removed from the track in use. *Arnold* vs. *Canal Co., 125 N. Y., 15; s. c. 25, N. E. 1064. McCosker* vs. *R.R. Co., 84 N. Y., 77.*

According to the opinion of Appellate Division in this case, where a lineman is employed to assist in repairing electric lines, and in the removal of the lamps, hoods and frames, he is bound to assume that they may be defective and to govern his actions accordingly. H.

CHARTERS, ORDINANCES AND FRANCHISES

ALABAMA.—Injunction Restraining Trespass—Remedy at Law—Electric Railway—Additional Servitude.

1. Where a street railway was not authorized to extend its line on a street the fee of which was owned by another company, such company cannot restrain such proposed extension, since it is merely a threatened private trespass, which may be adequately compensated at law.

2. It is only where a party authorized by law to exercise the right of eminent domain proceeds to take property without compensation that equity will enjoin such act, without reference to the question of irreparable injury or the adequacy of legal remedies.

3. The operation of an electric railway with municipal consent along a public street, conforming to its grade, is not an additional servitude outside the public easement, for which the owner of the fee of the street is entitled to compensation.—(Birmingham Traction Co. *et al.* vs. Birmingham Ry. & Elec. Co., 24 So. Rep., 502.)

ALABAMA.—Street Railroad Corporations—Implied Powers—Eminent Domain—Contest of Corporate Right to Hold Real Property—Contracts—Consideration—Specific Performance.

1. From the naked power to construct a street railroad no authority can be derived to construct a freight belt railroad in and around a city, solely to transfer freight cars to and from factories and other railroads.

2. If any power of condemnation can be implied from the authority to construct a street railroad, it is limited to its right of way and necessary structures incident to its business.

3. A corporation authorized to construct a street railroad has no authority to receive, by condemnation or grant, property for a freight belt railroad which it had no power to construct and operate.

4. Where it has acquired title and possession, a corporation's right to hold real property can in a direct proceeding be questioned by the State only.

5. An interested individual may contest the claim of a corporation where it seeks the necessary aid of equity to perfect title to real property, but not where a deed has been executed and delivered or the consideration paid, or the question involved is not the right of the corporation to hold property of a particular kind or for a particular purpose, but its right to hold property in excess of a definite quantity or value.

6. Where a railroad granted the right to use its right of way to a corporation unauthorized to take such a grant, the grantee's successor, though not incapacitated, could not secure the aid of equity to perfect its title to, or obtain possession of, the property, unless the grantor has acted so as to estop himself from denying the successor's right under the agreement.

7. The performance of acts required by statute to be performed does not constitute a valid consideration for a contract.

8. A railroad company, under the mistaken supposition that a land company was authorized to construct a railroad and condemn a right of way across its tracks, and to prevent the land company's threatened crossing of its tracks at inconvenient points, granted the land company the right to cross at certain other points, and to use a certain part of its right of way. The land company's undisclosed object was to secure a right of way into the railroad company's passenger station, under the mistaken belief that it was legally entitled to enter and use the same, and that it owned and could cross a certain 35-ft. strip of land in doing so. In consideration therefor, the land company was to repair the crossings, pay for erecting and maintaining signals and employing watchmen thereat, and grant to the railroad company the privilege of crossing and building its tracks on the 35-ft. strip of land it was supposed to own. Possession of its grant was never acquired by the land company, or its successor, further than to lay a part of its track, which was subsequently occupied by other railroads for passenger traffic, with the railroad company's permission. This traffic, if the agreement was enforced, would be interrupted, to the great injury of the railroad company and the interests of the public; but neither the land company nor its successor, seeking to enforce the agreement, were legally authorized to construct railroad tracks over the right of way leading to the passenger station, and which the agreement was intended to secure. Held, that specific performance of the agreement would not be enforced.—(South. & N. A. R. Co. vs. Highland Ave. & B. R. Co., 24 So. Rep., 114.)

MICHIGAN.—Location—Jurisdiction.

Where the power to locate the road of a street railway through a township is conferred by statute upon the supervisor and highway commissioner, courts have no power to review their action.—(Silsley *et al.* vs. Lyle, commissioner of highways, 75 N.W. Rep., 886.)

MINNESOTA.—Car Barn—Nuisance.

1. The defendant has for some years maintained and operated by public authority a street-car system, the motive power of which is electricity, in the city of St. Paul. As a necessary incident to such operation it has maintained a car barn in a residence district, for the purpose of storing a part of its cars when not in use on the streets. The barn fronts on Ramsey Street, with its sides abutting on Thompson and Smith Avenues, respectively. It is not authorized to operate its system on these avenues, but it has, without any negligence in the premises, laid tracks and curves thereon, over which it runs, from early in the morning until late at night, its cars to and from the barn. Such operation of its cars over such tracks and curves causes loud and disagreeable noises, whereby the rest and comfort of the plaintiff are disturbed, and the rental value of his real estate abutting on the street and avenues is materially reduced. Held, construing the city ordinances granting to the defendant the right to operate its street-car system, that it is authorized to so lay and operate the tracks and curves on the avenues.

2. Held, further, upon the undisputed evidence, that the location of the barn is not an improper or unreasonable one, and that the acts of the defendant do not constitute a private nuisance for which the plaintiff can recover damages.—(Romer vs. St. Paul City Ry. Co., 77 N. W. Rep., 825.)

* Communications relating to this department may be addressed to the Editors, Johnston Building, 30 Broad Street, New York.

MISSOURI.—Franchises—Public Sale—Construction of Statute—Vagueness—Impossibility to determine Meaning.

1. Act, April 9, 1895, provides that the municipal authorities to whom application may be made for consent to the construction, extension, maintenance, occupation, or use of, inter alia, any street railway or railroad for the transportation of freight, passengers, or mails, must provide, as a condition precedent to the granting of such consent, that the franchise shall be sold at public auction to the responsible bidder who will give the largest percentage yearly of the gross receipts derived from such occupation and use, with adequate security for the payment thereof, and for the prompt construction and completion of the proposed plant, provided that such payment shall in no case be less than 2 per cent of the gross earnings uring the first five years of said occupation and use, and thereafter for each period of five years such percentage shall be increased to correspond with the increase in value of the land thus occupied and used. Held, that the act is void, in that its meaning cannot be determined by any known rules of construction, because, if it means that the company must pay at least 2 per cent of its gross earnings for the first five years to each municipality over whose streets it may build, and to each county whose highways it may cross, the railway company may in many cases be compelled to pay more than its total receipts.

2. It is also void if it means that the percentage should be computed only on the gross receipts of that part of the road located on the streets of the city or across the highways, as the case may be, because there is no method provided by which the actual gross receipts of that particular part of the road can be ascertained.

3. A continued line of railroad cannot be subdivided so as to permit competition for the privilege of constructing and operating separately the portions thereof lying within the municipalities and across the highways on its route.

4. The act cannot be practically enforced, since, in the case of street railroads, there is nothing to show on what gross earnings the percentage is to be computed, the act evidently contemplating that the bid shall be a percentage only of the receipts derived from the use and occupation of the "public" property, and a portion of the earnings being attributable to the capital invested in power stations, machinery, etc.

5. The percentage is to be increased in "each period of five years to correspond with the increase in the value of the land thus occupied and used," but the act gives no intimation by whom or in what manner this increase is to be settled and determined.

6. If the provision for increased payment for the franchise after five years is meaningless, in the case of street railroads, the proviso is practically eliminated, so that it is highly improbable that the Legislature would have passed the act with the clause increasing the percentage in each term of five years omitted.—(State *ex rel.* Crow, Atty.-Gen., vs. West Side St. Ry. Co., 47 So. W. Rep., 959.)

NEW HAMPSHIRE.—Incorporation—General Law—Additional Routes—Public Good.

1. Laws 1895, c. 27, sec. 3, providing for the organization of street railway corporations by general law, and authorizing the court to determine whether the public good requires a proposed street railway corporation to build on a proposed route, does not authorize the courts to determine whether the public good requires a street railway corporation organized by a special law before said chapter was passed to build on a proposed route that is not an extension of its road, which, by the act incorporating it, it was authorized to build.

2. A street railway corporation incorporated under a special law prior to the passage of Laws 1895, c. 27, providing for incorporation by general law, need not procure a reincorporation under the general law; section 1 providing that the specially chartered companies shall continue to exercise the powers granted by their charters except as modified by said chapter.—(*In re* Keen Electric Ry. Co., 41 Atl. Rep., 775.)

NEW YORK.—Greater New York Charter—Street Railway Franchise—Legality of Municipal Grant—Certified Questions.

1. Laws 1897, c. 378, sec. 73 (Greater New York Charter), providing that, "after the approval of this act," no franchise or right to use the streets, avenues, parkways, or highwas shall be granted by the "municipal assembly" for a longer period than twenty-five years, etc., became operative on May 4, 1897, the date of the approval of the act, and applied to the board of aldermen then in office of the city of Brooklyn, notwithstanding its reference to the "municipal assembly," which was not to come into existence until January 1, 1898.

2. A perpetual charter, granted by the authorities of Brooklyn after the approval of the Greater New York Charter, to a street railway, is not valid as a charter for twenty-five years.

3. Where a case is sent to the Court of Appeals on special questions otherwise not reviewable, the questions should be so framed that the answers may determine the particular controversy involved in the appeal, and not merely a part of it.—(Blaschko vs. Wurster, Mayor, *et al.*, 51 N. E. Rep., 303.)

NEW YORK.—Mandamus—Peremptory Writ.

A peremptory writ of mandamus is issued in the first instance only in case of a clear legal right on uncontested facts.—(*In re* Forty-second M. & St. N. Ave. Ry. Co. vs. Collis, 53 N. Y. Suppl., 669.)

NEW YORK.—Construction and Operation—Consent of Abutters.

Laws 1839, chap. 218 (re-enacted as Laws 1890, chap. 565, sec. 78), providing that any railroad corporation may contract with any other railroad corporation for the use of their respective roads and thereafter use the same in such manner and for such time as may be prescribed in the contract, is not in conflict with Const., art. 3, sec. 18, providing that no law shall be enacted permitting street railroads to construct their lines without first obtaining the consent of the owners of one-half in value of the abutting property; or with Laws 1890, chap. 565, sec. 91, as amended by Laws 1896, chap. 855, providing that a street railroad or extensions or branches thereof shall not be built or "operated" unless the consent of abutters is obtained; or with Id., sec. 102, providing that no street-surface railroad shall construct, extend, or operate its tracks in that portion of a street where such a road is already constructed without consent of the other road, but that the two railroads may unite in the use of tracks on the condemnation thereof in the manner prescribed for the benefit of one of the companies. Hence consent need not be obtained by a street railroad company operating under a contract over a portion of another company's tracks.—(Ingersoll vs. Nassau Elec. R. Co., 52 N. E. Rep., 545.)

NEW YORK.—Conversion—Removal of Electric Wires—Damages.

1. Though the erection of wires on housetops, the householders consenting, be illegal, the city is liable for conversion where, without offering the owner a reasonable opportunity for reclaiming them, it cuts down the wires and carries them away.

2. It is no defense that the value of the wire could not be accurately determined where the evidence tended to show the wire to be worth a certain sum per foot.—(Electric Power Co. vs. Mayor, etc., of the City of New York *et al*, 55 N. Y. Suppl., 460.)

NEW YORK.—Construction—Injunction—Abutters—Extension—Validity—Municipal Consent—Retroactive Effect.

1. An abutting owner may enjoin the unauthorized construction of an electric railway in a street without showing that the benefits from the railway will not offset the injuries.

2. A street railroad company, whose articles contemplate a single, connected road, carrying from end to end for a single fare, cannot construct an independent line, not connected with its original line, under extension proceedings.

3. Where an extension of a street railroad was invalid because it was disconnected from the line authorized in the original franchise, a second extension proceeding, providing for a line to connect the extension with the original, does not validate resolutions of municipal authorities authorizing the first extension.—(McLean vs. Westchester Elec. Ry. Co., 55 N. Y. Suppl., 556.)

TEXAS.—Trust Mortgage—Foreclosure.

Where a corporation issues a series of bonds to a trust company, and at the same time executes to it a mortgage conveying to it property to secure the payment of the bonds, and providing that, on default in the payment of the interest, the trustee may declare the entire principal of bonds due, and bring suit to foreclose, bonds of such series transferred to an individual are merged in a judgment, if obtained by the trustee in a suit to foreclose and for personal judgment for the debt evidenced by the bonds, so that such individual owner cannot thereafter maintain a suit on his bonds.—(Laing vs. Queen City Ry. Co., 49 S. W. Rep., 136.)

LIABILITY FOR NEGLIGENCE

ALABAMA.—Electric Cars—Injuries at Crossings—Negligence—Name of Motorman—Pleading—Contributory Negligence—Question for Jury—Instructions.

1. A complaint against a street railroad company to recover damages for injuries to one not an employee need not state the name of the motorman whose negligence is alleged to have caused the injury.

2. Where a driver had the right to drive across an electric railroad track at a certain point, the company is guilty of negligence in running its car at so great a rate of speed as to be unable to avoid running into him.

3. It is not negligence per se for a driver to cross over a railroad track whenever he may have occasion so to do for the pur-

pose of going from one side of the street to the other, whether in the open country or in the limits of a city or village.

4. Where an electric railroad company was negligent in running its car at such a speed that it could not stop it in time to prevent hitting a horse which had balked on the track, assuming that the driver's failure to attempt to back the horse off the track was equivalent to permitting it to remain on the track, it is for the jury whether such act contributed to the injury.

5. An instruction assuming as a fact a matter not proven is erroneous.

6. An act of contributory negligence not charged in the answer cannot be made the basis of an instruction.

7. An instruction that if an ordinarily prudent person would not have tried to pull the horse forward as the plaintiff did, but would have backed him off the street-car track, the verdict must be for defendant, is properly refused, as assuming that an effort to back the horse off the track would have been successful.—(Birmingham Ry. & Elec. Co. vs. City Stable Co., 24 So. Rep., 558.)

CALIFORNIA.—Collision with Street Car—Negligence and Contributory Negligence—Question for Jury—Instructions.

1. Evidence for plaintiff showed that, just before driving his wagon across defendant's street-car track, he looked and listened, but did not see an approaching car until he was nearly on the track. The car was then about 50 yds. away, and he could have crossed, if those in charge, after he called to them, and after they saw him, had lessened its speed, as they could have done. Owing to obstructions he could not see the car, or be seen by those in charge of it, until he reached the street from an adjoining lot. Held, that the question of contributory negligence was for the jury.

2. Evidence showed that the defendant's street car was traveling faster than the prescribed limit, and there was evidence that those in charge, after they discovered plaintiff on the track with a wagon, could, with ordinary diligence, have stopped the car before it reached him; and plaintiff testified that the car was 50 yds distant from the crossing at the time he was discovered by those in charge of the car. Held, that the question of defendant's negligence was for the jury.

3. An instruction, in an action for injury to a person crossing the track, that a street railroad has only an equal right with the traveling public to the use of the street whereon its track is built, was not improper because omitting some few exceptions not material in the case, such as that when an ordinary vehicle meets a car on its track it must give way to the car.

4. There is no error in refusing an instruction sufficiently included in instructions given.—(Clark vs. Bennett, 5 5Pac. Rep., 908.)

INDIANA.—Carriers—Injury to Passenger Riding on Platform—Contributory Negligence—Directions of Conductor—Damages—Pleading—Variance—Questions for Jury—Instructions—Depositions—Appeal.

1. Whether a passenger in a street car is negligent in giving his seat to a woman and riding on the platform, at the general request of the conductor, is for the jury.

2. There is no variance where the evidence fairly tends to prove the substance of the issue.

3. Where the testimony is conflicting, and there is evidence which fairly tends to support the verdict, the judgment entered thereon cannot be disturbed on appeal.

4. A request by a conductor of a street car for a passenger to ride on the platform amounts to a direction to ride there.

5. Under an allegation that plaintiff rode on the platform of a street car at the request of the conductor, and was injured through the negligence of the company's servants, plaintiff may recover without proving that the conductor requested him to ride on the platform.

6. A refusal of an instruction that plaintiff could not recover for fright, suffering, and nervous shock, unless they were the result of the "bodily injuries" received, is not error, where an instruction was given that there could be no recovery for such injuries, unless they were the result of "personal injuries" received.

7. Where instructions, taken as a whole, state the law correctly, and are not misleading, the case will not be reversed for inaccuracies of expression in some of them.

8. Where a witness whose deposition had been taken testified in person, and the opposite party introduced a portion of his deposition to impeach him, the party taking it might introduce the entire deposition, although it did not all bear on the subject matter of the impeachment.—(Terre Haute Elec. Ry. Co. vs. Lauer, 52 N. E. Rep., 703.)

INDIANA.—Pedestrians—Contributory Negligence.

A passenger got off a moving street car before it reached a crossing, and, without stopping to look, walked rapidly behind the car to cross the street and walked against the side of a car coming from the opposite direction, on a track five feet distant from the other. This car had its lights lighted, and could have been readily seen, except as the view was obstructed by the other car. Held, that he was negligent.—(Stowers vs. Citizens St. R. Co., 52 N. E. Rep., 710.)

INDIANA.—Personal Injuries—Action by Administrator—Abatement—Statutes—Appeal.

1. Where the Legislature re-enacts a statute of the State it adopts also the construction given thereto by the courts of the State before the re-enactment.

2. Under Burns' Rev. St., 1894, sec. 283 (Horner's Rev. St., 1897, sec. 282), providing that causes of action arising out of an injury to a person die with the person, except actions given for an injury causing the death of any person, an administrator cannot sue for damages for physical pain and suffering of intestate, since the right of action abates.

3. By failing to discuss an assignment of error appellant waives the error.—(Hilliker vs. Citizens St. R. Co., 52 N. E. Rep., 608.)

KENTUCKY.—Carriers—Injury to Passenger in Alighting from Street Car—Instructions to Jury.

1. In an action to recover damages for injuries to a passenger in alighting from a street car it was error to refuse to instruct the jury that the law made it the duty of defendant's agents and servants operating the cars "to observe the utmost care and skill which a prudent man would exercise under like circumstances in the management and control thereof while she was alighting therefrom, and to afford her reasonable opportunity to alight in safety."

2. It was error to give an instruction requiring the jury to believe, in order to find for plaintiff, that the negligence of defendant caused all the injuries to plaintiff complained of; it being doubtful, from the evidence, whether some of the injuries resulted from defendant's negligence.—(Lutz *et ux.* vs. Louisville Ry. Co., 48 S. W. Rep., 1080.)

LOUISIANA.—Weight of Evidence—Carriers—Injury to Passenger.

1. In case the positive statements of two witnesses are exactly in opposition to those of two other witnesses—said witnesses testifying on different sides of a cause, and all of them being equally entitled to credit—the physical situation of the rest may be treated as having the effect of turning the scale.

2. If a passenger, in alighting from an electric car at point of destination, is thrown to the ground by the suddenness with which same is either stopped or started, and this result is caused or contributed to by those in charge of same, a case of negligence of the railroad company is made out, for which it must respond in damages.—(Bourque vs. New Orleans City & Lake R. Co., 24 So. Rep., 622.)

NEW JERSEY.—Death by Wrongful Act—Elements of Damage—Excessive Verdict.

1. In an action based upon the act entitled "An act to provide for the recovery of damages in cases where the death of a person is caused by wrongful act or neglect," approved March 3, 1848, the plaintiff is entitled to recover nothing but the pecuniary loss sustained by the person for whose benefit, as next of kin, the action is brought.

2. Where the deceased was a boy fifteen years of age, with an earning capacity of about $20 per month, and the cause was tried on the basis that the pecuniary benefit to the father could only continue during the minority of his son, if his life had continued, and the instructions of the trial court were to that effect, held, that a verdict of $3,000 was excessive, and that, as the verdict of the jury was based upon only a misapprehension of the instructions of the court as to the measure of damage, the plaintiff could have the option of accepting the sum of $1,500; otherwise the verdict be set aside and a new trial ordered.—(May vs. West Jersey & S. R. Co. *et al.*, 42 Atl. Rep., 165.)

NEW JERSEY.—Wrongful Death—Elements of Damage—Services of Wife.

1. In an action under the death act (1 Gen. St., p. 1188), where it is contended that the advice and counsel of the deceased to the next of kin is an element of damage, it must be shown by the facts and circumstances that such advice and counsel would relate to the pecuniary affairs of the next of kin, and that such advice and counsel would probably result in a pecuniary benefit, and that by the deprivation of such advice and counsel a pecuniary injury would accrue.

2. The services of a wife in her husband's household in the ordinary work thereof, or in aiding and assisting him in his occupa-

tion is due and belongs to the husband; and her continued services during the life of her husband cannot be a pecuniary benefit to the next of kin, and the deprivation of such services cannot be a pecuniary injury, nor afford ground of recovery of damages under the death act of this State. Whether such services after the death of her husband would be a pecuniary benefit to the next of kin is a question too remote to be considered by the jury as a basis of a verdict of damages under such act.—(May vs. West Jersey & S. R. Co. *et al.*, 42 Atl. Rep., 163.)

NEW JERSEY.—Injury to Passenger—Question for Jury.

A boy twelve years of age was about to take passage on an open electric street car, having a bar across the side next to an adjoining track. Under the conductor's eye, he stepped upon the footboard at the barred side, and, before he was fairly on, the car was started on the conductor's signal, and the boy was thrown down and injured. Held, that the question of the conductor's negligence and of contributory negligence in the boy were for the jury, and that a nonsuit was wrong.—(Kelly vs. Consolidated Traction Co., 41 Atl. Rep., 686.)

NEW JERSEY.—Injury to Person on Track—Contributory Negligence.

The plaintiff, at a little after 9 o'clock on a dark night, was approaching on foot a trolley road having a single track, which he intended to cross. His line of approach was northwesterly, and diagonal to the track. When he had somewhat more than 50 ft. to walk before crossing the track, he saw a car somewhat more than 250 ft. south of the place of crossing. He testified that, when from 4 to 6 ft. distant from the track, he turned his head, looked for the car south along the track 75 or 100 ft., and did not see it; that he was then going diagonally across; that the first thing he knew the car was on him, and knocked him down; and that he was about the middle of the track when he was struck. The track to the south was straight for more than 250 ft. and the view of it was unobstructed. It is to be assumed that the plaintiff moved at the rate of an ordinary walk. Three witnesses observed and testified as to the car's rate of speed. Held, that facts within the plaintiff's knowledge and observation made it probable that the car, coming from a quarter towards which his back was partly turned, would be dangerously near to him before he got across the track; that it was therefore his duty to look for the car before he attempted to cross; that the car, moving at any rate of speed that is attributable to it under the evidence, must have been so near to the plaintiff when he looked for it before going on the track that, if he had not looked carelessly, he would have seen it, and have been warned of imminent danger; that his failure to receive warning was therefore due to his own negligence, and that the nonsuit was properly granted.—(Jewett vs. Patterson Ry. Co., 41 Atl. Rep., 707.)

NEW YORK.—Joint Tort Feasors—Stipulation not to Collect from One.

A stipulation not to collect from one joint feasor who agrees not to exact costs, will not discharge a judgment against a co-defendant. To discharge all joint tort feasors, the instrument must be a technical release under seal.—(Schramm vs. Brooklyn H. R. Co. and Consolidated Ice Company. Appellate Division, second department, Dec. 14, 1898.)

NEW YORK.—Joint Tort Feasors—Dismissal of Action against Co-Defendant—Street Railway Company—Injury to Passenger—Evidence—Question for Jury—Boarding Moving Car—Contributory Negligence—Instructions—Corroboration of Plaintiff by Defendant's Witnesses—Death by Wrongful Act—Damages.

1. A joint tort feasor cannot complain of the dismissal of the complaint as to his co-defendant.

2. Where the evidence on the part of plaintiff tended to show that defendant's car, as it approached a crossing, was brought nearly or quite to a stop to allow plaintiff's intestate to step aboard; that, after he had partially entered, the car, without any notice to him, was suddenly started with a jerk, throwing him to the ground, causing the injuries complained of—it was not error to refuse to dismiss.

3. It is not error to refuse to dismiss where plaintiff's evidence shows that the injuries complained of were caused by negligently starting the car with a jerk after her intestate had boarded the same, and defendant's evidence shows that he fell before reaching the car.

4. Attempting to enter or leave a moving street car is not contributory negligence per se.

5. A request to charge that, if the accident happened as testified to by defendant's witnesses, the verdict should be for defendant, is properly refused, where the testimony of some of such witnesses tends to corroborate plaintiff's witnesses.

6. A verdict of $9,000 is not excessive where deceased, at the time of his death, was forty-three years of age, in good health, received a salary of $1,250 a year, and left five children, who had been dependent upon him for support.—(Wallace vs. Third Av. R. Co. *et al.*, 55 N. Y. Suppl., 132.)

NEW YORK.—Injury to Person on Track.

Plaintiff's intestate, while playing with other boys in a street on which were two street railway tracks, started to run across the street near the middle of a block. He passed in the rear of a car going north, but, seeing a car coming south at a rapid rate on the other track, he stopped between the tracks, then suddenly attempted to cross the other track, and was struck by the southbound car. Held, that there was no proof of negligence on the part of defendant's servants.—(Greenberg vs. Third Ave. R. Co., 55 N. Y. Suppl., 135.)

NEW YORK.—Dismissal—Evidence—Construction—Electric Road—Speed—Testimony—Negligence—Statute—Court and Jury.

1. On an appeal from a dismissal the evidence must be construed on all doubtful questions in favor of the plaintiff.

2. Testimony of a high rate of speed of an electric car may be accepted by the jury where there is nothing in the evidence showing it to be incredible.

3. There is no statutory rate of speed for a car in New York city, and negligence, as a matter of law, can be laid down only in extreme cases.

4. Whether a street car is running at a dangerous speed in any locality, is ordinarily, a question for the jury.—(Fullerton vs Meteropolitan St. Ry. Co., Supreme Court, Appellate Division, First Department, Feb. 10, 1899.)

NEW YORK.—Imputed Negligence—Driver of Vehicle—Collisions—Appeal—Harmless Error—Instructions—Special Damages—Pleading and Proof.

1. The contributory negligence of a driver of a carriage which occasioned a collision with a street car cannot be imputed to a person in the carriage, where the driver was not subject to his direction.

2. A mistaken statement of the court that it had charged that plaintiff might recover if the collision with defendant's street car occurred as described by plaintiff's witnesses is harmless where such charge would have been correct.

3. Where plaintiff alleged that a nervous shock was occasioned by injuries, evidence that she suffered from curvature of the spine is not inadmissible as constituting special damages not pleaded, if there is evidence that such curvature was caused by the nervous shock.—(Kleiner vs. Third Av. R. Co., 55 N. Y. Suppl., 391.)

NEW YORK.—Rights of Pedestrians—Contributory Negligence—Accidents at Crossings—Instructions—Care Required in Operation.

1. A person is not at liberty to take even doubtful chances of being able to cross a street in front of an approaching car, or to assume that the motorman will be able to successfully stop it.

2. In an action for damages for being run into by a street car, an instruction that plaintiff is chargeable with negligence if he saw the approaching car and did not take "proper steps" to avoid it, and that he was not at liberty to take even doubtful chances in attempting to cross the street in front of the car, is not erroneous by reason of the use of the term "proper steps," since, construed as a whole, it only requires reasonable care.

3. The degree of care required in operating a street car is to be reasonably careful, to keep the car under proper control, and to be vigilant in approaching crossings.—(Harvey vs. Nassau Electric R. Co., 55 N. Y. Suppl., 20.)

NEW YORK.—Master and Servant—Personal Injuries—Proximate Cause—Fellow Servants.

1. An injury caused to a carpenter by being knocked down from a ladder by a loose horse and cart striking it was not proximately caused by the absence of a vice principal who was to guard the ladder against passing carts or cars.

2. A driver of a cart removing rubbish from a building under construction is a fellow servant of a carpenter on a ladder, the foot of which was near a door where the cart had to pass.—(Byrnes vs. Brooklyn Heights R. Co., 55 N. Y. Suppl., 269.)

NEW YORK.—Injury to Passenger—Contributory Negligence.

Under a complaint alleging that plaintiff was injured while attempting to board a car which had stopped to receive him and was suddenly started, it was error, where the evidence as to whether the car had stopped or not was conflicting, to refuse an instruction that if the car did not stop, but, while moving, plaintiff attempted to board it, and was injured, the verdict must be for defendant.—(Anderson vs. Third Ave. R. Co., 55 N. Y. Suppl., 290.)

NEW YORK.—Carriers of Passengers—Negligence—Joint Tort Feasors—Appeal—Reversal—Measure of Care and Skill—Appeal — Review — Instructions —Witnesses — Bias — Evidence —Harmless Error—Competency—Physicians—Damages—Materiality—Pleading—Amendment—Discretion.

1. A passenger of a horse car having been injured in a collision between it and a cable car, the horse-car company was not relieved of liability by the fact that its car had the right of way, where the cable car was moving toward the crossing at a rapid rate, and there was no appearance of any disposition to check speed before it reached that point.

2. Where a passenger sued the respective owners of colliding street cars for injuries, neither defendant was entitled to an instruction as to the negligence of the other, further than that each of the persons in control of the cars had a right to assume that the other would not proceed over the crossing negligently.

3. In an action against joint tort feasors, wherein plaintiff recovered, either defendant is entitled to a reversal if the charge was erroneous as to him, though it was given at the request of his co-defendant.

4. A horse-car company is bound to exercise all the care and skill which human foresight can suggest to secure the safety of a passenger at a cable-car crossing.

5. The court will not reverse for technical error in a charge disposing of forty-three requests made by defendants, when the charge as a whole is fair and correctly expounds the law.

6. In an action for personal injuries, wherein plaintiff's father testifies in her behalf, his bias may be shown by evidence that he has sued for loss of her services.

7. Where the testimony in an action for personal injuries showed that witness was plaintiff's father, and the jury were informed that he might sue for loss of her services, error in rejecting evidence of that fact to show witness' bias was harmless.

8. When a patient waives the privilege a physician may be compelled to testify to matters concerning the professional relation.

9. In an action for personal injuries evidence of the cause of peritonitis, from which plaintiff suffered before the accident, is properly rejected, where it does not appear to be material and counsel do not state what they expect its bearing will be.

10. It is in the discretion of the court to permit a complaint for personal injuries to be amended on the trial so as to ask $50,000 instead of $10,000.—(Zimmer vs. Third Ave. R. Co. *et al.*, 55 N. Y. Suppl., 308.)

NEW YORK.—Passengers—Alighting from Moving Car.

A passenger on a street car signaled the conductor to stop the car, and, as it was slowing down, he prepared to get off and was injured by the gripman suddenly increasing the speed of the car. Held, that he could not recover in the absence of proof that the conductor signaled the gripman, since the latter may have slackened the speed in the exercise of reasonable care in the operation of the car.—(Armstrong vs. Metropolitan St. Ry. Co., 55 N. Y. Suppl., 498.)

OHIO.—Damages—Personal Injury to Child—Impairment of Prospects of Marriage—Pleading—Special Damages—Setting Aside Verdict—Excessive Damages—Province of Court and Jury —Railroads—Injury to Person on Track—Trespassers—Presumption as to Rights in Street—Permitting Public to Use Track—Measure of Care Required—Contributory Negligence of Child—Negligent Handling of Cars—Injury to Children.

1. Where a personal injury to a little girl is such as to seriously impair her prospects of marriage when she reaches a marriageable age, such fact may properly be considered by the jury as an element of damages resulting from the injury.

2. While the loss of a particular prospect of marriage by a woman must be specially pleaded to entitle it to be considered as an element of damage, the loss of a general prospect of marriage, in the case of a child by reason of an injury which disfigures her, is a natural, and not a special, consequence of the injury, and may be, and in fact can only be, taken into consideration as an element of general damages, and a special allegation with regard to it is not required.

3. A verdict should not be set aside simply because it is excessive in the mind of the court, but only when the excess is shocking to a sound judgment and a sense of fairness to the defendant. Where there is any margin for a reasonable difference of opinion in the matter, the view of the court should yield to the verdict of the jury, rather than the contrary.

4. Where a railroad occupies a street with its tracks the ordinary presumption is that of a joint use by the public and the railroad company; and although the municipal authorities may, under the statute, have power to grant the exclusive right to the use of the street to the railroad company, in the absence of proof of such grant, or of the exclusive use of the street by the company for such a length of time as to give it the right by prescription, a person injured upon the track in the street cannot be regarded as a trespasser.

5. Even where the track of a railroad is on its private property, if it permits the public, including children, to habitually cross its track at a given point without objection, it is bound in the operation of its trains to exercise care with due regard to such probable use, and to the probable danger to persons so using the crossing.

6. While it is the duty of children to exercise ordinary care to avoid injury, ordinary care for them is that degree of care which children of the same age, of ordinary care and prudence, are accustomed to exercise under similar circumstances.

7. To permit a loaded railroad car to run down a grade alone on a track laid in a street, without the exercise of any care or attention to see that no children are in danger therefrom, constitutes negligence which renders the railroad company liable for the injury of a child too young to take care of itself, which was on the track without the fault or negligence of its parents.—(Smith vs. Pittsburgh & W. Ry. Co., 90 Fed. Rep., 783.)

PENNSYLVANIA.—Accident—Negligence—Evidence.

The questions of negligence and contributory negligence are for the jury; there being evidence that a boy on a street car intended and attempted to get off at a certain street crossing, but was prevented from doing so by the car not stopping long enough, and the evidence being conflicting as to whether he was jolted from the car, or fell off or jumped off; he having in some way got off and under the car between that and the next street.—(Moran vs. Versailles Traction Co., 41 Atl. Rep., 652.)

PENNSYLVANIA.—Trolley Cars—Excessive Speed—Evidence.

Verdict should be directed for defendant in an action against a street railway company by one whose horse was frightened by a trolley car, the negligence alleged being the excessive speed of the car, and his testimony that it was "not less than 15 miles an hour," being a mere guess, and his further testimony that not till the car was alongside the horse did it turn into the gutter, and that it then backed against the car, showing, as testified by defendant's witnesses, that the car was running slowly.—(Smith vs. Holmesburg T. & F. Elec. Ry. Co., 41 Atl. Rep., 479.)

PENNSYLVANIA.—Injury to Passenger—Negligence.

A street railway company is liable to a passenger who, without any contributory negligence, following the invitation and direction of the motorman, leaves the car from the front door, on a dark night, and where the ground was broken, and, after taking a few steps, catches her feet in some way, and falls.—(41 Atl. Rep.. 743.)

TENNESSEE.—Injury to Employee—Vice Principal—Contributory Negligence—Assignment of Error.

1. Assignment of error that the verdict is "against the charge" is superfluous, there being one that it is against the evidence.

2. It is not negligence as matter of law for one working under a track foreman to attempt at command of the latter, to board a train, consisting of a flat car and trolley car, while going at the rate of 3 or 4 miles an hour.

3. A track foreman who is at the time running a trolley car and flat car attached, carrying tools and materials to a point on the road, and is controlling the cars, and is in charge of the motor as conductor, is a vice principal as regards his negligence in ordering one of the track hands to board the cars while in motion, or in failing to stop them while such employee is hanging onto the railing, which he caught hold of in his attempt to get on board.—(Chattanooga Elec. Ry. Co. vs. Lawson, 47 So. W. Rep., 489.)

Electric Railway Motor Patent Decision

The Thomson-Houston Electric Company and the General Electric Automobile Company have secured an injunction in the United States Circuit Court, Southern District of Ohio, restraining the Steel Motor Company and the Johnson Company from making or selling any combination of electric railway motors and motor circuits and resistances combined with controllers, like controllers covered by Claims 20, 21, 22, 27, 28 and 30 of Letters Patent No. 393,323. Claims 20 and 31 of this patent are as follows:

"20. The combination of a source of electric energy, the coils of one or more electric motors, a switch for connecting said coils in different ways to vary the motor resistance, one or more resistances, and a switch to put said resistances into or out of the motor-circuit without changing the motor-connections to vary the power of the current flowing through the motors.

"31. The combination of two motors. a source of electric power, a motor-circuit, a switch for coupling the coils of the motors in series or multiple to vary their internal resistance, a resistance, a

switch to insert the resistance when the motor-switch is being shifted, and a connection between said switches to operate both simultaneously."

Patent Decision in the Electric Railway Motor Suspension Case

The Sprague Electric Railway & Motor Company has been granted an injunction in the United States Circuit Court, Eastern District of New York, against the Nassau Electric Railroad Company, restraining that company from infringing Letters Patent No. 324,892, which was granted to Frank J. Sprague on Aug. 25, 1885, for improvements in electric railway motors. The claims of this patent, which the court holds were being infringed are Claims 2 and 6, and read as follows:

"2. The combination of a wheeled vehicle and an electro-dynamic motor mounted upon and propelling the same, the field magnet of said motor being sleeved upon an axle of the vehicle at one end, and supported by flexible connections from the body of the vehicle at the other end, substantially as set forth.

"6. The combination, with a wheeled vehicle, supported upon its axles by springs, of an electro-dynamic motor flexibly supported from such vehicle, and centered upon a driven-axle thereof, substantially as set forth."

This patent is owned by the General Electric Company, which controls the plaintiff company.

Commutator Bars of Tempered Copper

The tempering of copper has long been considered a lost art, but has been recently rediscovered, or, at least, a process has been devised for tempering copper and rendering it especially suitable for making solid castings for commutator bars. The secret of the process is known only to Theodore F. Frank, superintendent of the Mansfield Tempered Copper Company, Mansfield, Ohio, and this company has been engaged for the last four years in casting commutator bars of all descriptions and has now built up a trade which extends to all parts of this country and to foreign countries, shipments being made frequently to the Siemens & Halske Company, of Vienna, Austria. In the process of casting the pure copper is melted in retorts in about the same manner as is the custom in ordinary brass and copper furnaces, and when melted is treated by the secret process, and is poured quite hot into the molds. After being formed the bars are placed under a drop hammer, when they are ready for assembling, and are so accurate to size and gage that when assembled they form a perfect cylinder. The company enjoys the patronage of a large number of the manufacturers of generators and motors throughout this country and Europe, and makes patterns of special designs to suit its customers. It has now in stock patterns of more than 2500 different styles of commutator bars. These are kept in suitable cases and all the different types belonging to any electric company have a special compartment and are labeled with the name of the company. The company not only manufactures bars, but has recently engaged in the manufacture of assembled commutators for street railway motors. These are turned up and finished for any of the standard types of motors, all ready to be put in service.

In the manufacture of commutator bars the works consume about ten tons of copper per month, and the bars are made from all sizes from those so small that it requires thirty-five or more to the pound, up to single bars weighing from 5 lbs. to 6 lbs. each. In the manufacture of the large size bars the groove for the connections is cored out, which saves milling, and when so ordered, bars are cored without extra charge. The works have been enlarged two or three times since they were first established, and now fifteen molders are employed in making bars.

The patterns for these are duplicated and formed in nests of six or more, so that a number of bars are formed at one pouring. The equipment of the foundry is very complete, being up to date in every respect. The company not only manufactures commutator bars, but also makes brass castings of almost every description and babbitt journal bearings. The rapidly increasing trade of the concern is due to the fact that the products, especially the commutator bars, are superior in material and finish, being dense, entirely free from blow-holes, smooth and accurately finished.

Power for operating the drop hammers and emery wheels is derived from an electric motor of the card type, the current for operating the same being derived from the plant of the Card Motor Company, which adjoins that of the Tempered Copper Company.

The affairs of the company are operated under the direction of S. N. Ford, president, and S. Glen Vinson, secretary, while, as noted above, Theodore F. Frank superintends the work in the foundry. Mr. Frank has had twenty-five years' experience in general foundry business, and over ten years in the manufacture of tempered copper, so that he is well fitted for making castings of every description from copper or brass.

NEWS OF THE MONTH

Perhaps one of the most interesting features of the new passenger station of the New York, New Haven & Hartford Railroad at Boston, is the electrical switching apparatus for handling the 750 trains that pass through the station daily. To connect the station sidings with the main track, there are fifty-two single switches, thirty-five double slip switches and thirty-five movable frogs, and any one of these can be thrown by simply pressing a button in the switching tower.

It is stated that the syndicate headed by Alexander Brown & Sons of Baltimore, which has recently secured control of all the street railway properties of the city, has also purchased all the electric lighting companies of Baltimore.

It is expected that 60 miles of electric railway will soon be built in the island of Porto Rico by a Massachusetts concern, known as the International Construction & Power Company. This company will have a capital stock of $5,000,000, and a number of the incorporators are prominent Massachusetts citizens. Among the largest holders of stock in the new venture are the Hon. E. P. Shaw, State treasurer, and his two sons, E. P. Shaw, Jr., and James F. Shaw.

Part II. of the 1899 report of the Board of Railroad Commissioners of Massachusetts has just been issued. The report contains the returns of the street railway companies of that State for the year ending September 30, 1898, and from it the following statistics are taken. The figures for 1897 are also given herewith for the sake of comparison.

	1897.	1898.
Gross receipts	$15,898,839	$18,247,236
Operating expenses	10,904,040	11,692,731
Earnings from operation	4,994,799	6,554,505
Fixed charges	2,401,652	4,020,503
Net income	2,593,147	2,534,002
Dividends	1,965,243	2,076,233
Surplus	627,904	457,769

The annual report of the Board of Railroad Commissioners of New Hampshire, just received, gives the following interesting information regarding the street railways of the State: Total number of roads reporting, 10; total mileage, 93.7; capital stock, $1,222,000; funded debt, $756,000; earnings, $354,304; expenses, including taxes and interest, $330,092. None of the roads paid dividends.

The annual dinner of the Northwestern Alumni Association of the Massachusetts Institute of Technology, which took place on February 3, in Chicago, was made the occasion for a very interesting long distance telephone "occasion," by means of which the Technology Club in Boston, and the New York, Philadelphia, Washington and St. Louis Alumni Associations were put into connection with the Chicago association, so that verbal messages, brief addresses, speeches and the institute cheer were sent over the wires.

A bill has been introduced in the United States Senate providing for a three-cent fare over all the lines of the Capital Traction Company of Washington, D. C., within the hours of 6 and 9 A. M. and 4 and 7 P. M. The bill will be vigorously opposed.

In a recent communication, the Sprague Electric Company calls attention to the remarkable comparison between the cost of operating the South Side Elevated Railroad in November and December, 1897, when that road was operated by steam locomotives, and the same months for 1898, when the Sprague multiple unit system was employed. These months are stated to be the first months in which a comparison can, strictly speaking, be made be-

tween steam and electric operation. In considering the following figures, it should be remembered that each of the elevated railways of Chicago, which run around the Loop, is charged its pro rata proportion of the running expenses of the Loop, including cost of power, of station service, of repairs and of management, and, in addition, a rental charge of 10 per cent of the gross passenger receipts of the road is made. This latter charge is really applicable to interest on the Loop investment, and is not, properly speaking, an operating expense. The first column of the following table gives the ratio of expenses to earnings of the South Side road; the first includes the Loop rental, and the second column when the Loop rental charge is excluded, while the final column gives the actual net earnings in the months under comparison:

	Per Cent. Operating Expenses to Gross Receipts.		
	Including Loop Rental (a)	Excluding Loop Rental (b)	Net Earnings.
November, 1897, steam.....	87.3	77.7	$10,604
November, 1898, electric.....	57.3	47.7	39,449
December, 1897, steam.....	83.6	73.3	14,692
December, 1898, electric.....	55.0	45.4	45,356

It is stated that large orders for electrical machinery have recently been received by American manufacturers from Manila and the Philippine Islands.

The first arrest in Boston made for the violation of the new law prohibiting expectorating in street cars occurred recently. The arrest was made on the complaint of a conductor of the Boston Elevated Railway Company, who testified that the prisoner continually violated the law in spite of repeated warnings. The prisoner was fined $5.

Charles L. Bonney, vice-president and general counsel of the Chicago General Railway Company, has issued an open circular to the horse and dummy railway companies of Illinois, in which he pledges the support of his company to forty-five independent companies of Illinois to contest in the courts any law the legislature may enact reducing the fares of street railway companies to four or three cents. The circular calls attention to the Seaman decision in the Milwaukee Railway & Light case, in which the court held that a reduction of fares in Milwaukee would amount to confiscation.

The annual reports of the street railways of the District of Columbia for the year 1898 have been submitted to Congress. The reports in the main are satisfactory and show considerable increase over previous years. The receipts of the Capital Traction Company from passengers during the year ending December 31, 1898, were $932,171; receipts from other sources, $61,006; total receipts, $993,177. The total operating expenses of the system were $537,991, and dividends and fixed charges were $411,107, making the surplus for the year $44,079. This is considered to be a very good showing in view of the fact that a number of the company's lines were in process of conversion to the conduit electric system, and have only just been completed. The Metropolitan Railroad Company reports receipts from passengers as $822,439, and from other sources, $14,379, making a total of $836,819. The operating expenses were $471,358, making earnings from operation $365,461. The taxes were $38,566, interest $143,691, and dividends $74,921. The operating expenses include $46,776, which was expended for the construction of the Connecticut Avenue extension and for other improvements. The surplus for the year is $108,285. The Columbia Railway Company reports gross receipts as $171,397, operating expenses, $76,180; earnings from operation, $95,217; taxes, $7,386; interest, $30,000; dividends, $24,000; for real estate purchase, $2,800, and for construction of the Benning Division, $22,121. The surplus for the year was $8,909.

International News Notes

The Perth police commission, in dealing with the request of the Perth & District Tramway Company for permission to use electric traction and for an extension of time before the undertaking can be purchased under the tramways act, has consented to the use of electric traction, but refused to consider any extension of time.

Both at a meeting of ratepayers and of the District Council of Tipton has it been decided to oppose the bill whereby the South Staffordshire Tramways Company seeks to hand over the rights and working of the undertaking to the British Electric Traction Company. The Town Council of Walsall will also oppose.

At a special meeting of the Sunderland Town Council last month it was unanimously resolved to give notice requiring the tramways company to sell the undertaking, pursuant to the tramways act. Further, it was resolved to procced with a bill to enable the Council to acquire, work, extend, or lease tramways in the borough or neighboring districts, to supply electric current, and extend existing power station.

St. Helens.—The electric supply and tramways committee of the St. Helens Corporation has been busily pushing forward the work of laying down and equipping the tram lines for electric traction. On the Prescot section the work has been stopped at Cropper's Hill for some time, owing to a request being made by the tramways committee that double lines should be laid in order to insure the safety of the cars on this hill. The committee has now resolved to lay double lines. In answer to the tramway company the committee has stated the order in which it will carry out the proposed extension of the tramways provided for by the local act of 1898. The extension to the Rams' Head, Haydock, will be carried out first, and this will be followed by the extensions to Nutgrove, St. Helens Junction, Derbyshire-hill, to the boundary of Prescot and to Windle City.

Nottingham is solving the difficulty of stopping tramcars by having notice labels "Cars stop here" hung up at stated intervals along the routes.

The Lowestoft Town Council has practically decided to permit the East Anglian Light Railway Company to construct a system of electric tramways in the borough. The proposed line will run from Gorleston to Kessingland. The company will take its current from the corporation, which is about to construct works. Powers are to be reserved that the Council may acquire the undertaking at the end of seven, fourteen, or twenty-one years. The company is also required to make various street widenings.

The question as to whether the Lincoln Town Council should take over the tramways when the company's powers terminate in 1902 was discussed at the February meeting of the Council. It was decided to let the question stand over for a while.

The recent expansion of the Leeds tramway system can be gathered from the following figures: When the corporation took over the business there were 22¼ miles of track, or 14 miles of route. Now there are 42 miles of track, or 23 miles of route. The number of cars has increased from 69 to 127, and 50 more will be added during the next six months.

The tramways committee of the Manchester corporation recently reaffirmed its recommendation in favor of the overhead trolley system as the best suited in every way to meet the requirements of the city and district.

Representatives of the governing bodies of Plymouth, Stonehouse and Devonport are still conferring, and are unable to come to a decision on what lines to purchase and work the tramways in the three towns. The company now working the lines offers to lease and work them if they are purchased. Stonehouse District Council proposes to purchase such portions of the lines as are within its boundary if the corporations of Plymouth and Devonport will undertake to lease the lines on certain terms, which, however, were unacceptable. Devonport will probably proceed to purchase its lines, but Plymouth is doubtful.

The Dundee Town Council has rejected the proposal for a cable tramway in the borough, but has recognized the need for traveling facilities in the district—the North End—by deciding to extend its own system on similar lines to those proposed by the cable company.

The Urban Council of Bexhill has given its consent to the British Electric Traction Company to lay tramways from Kewhurst to St. Leonards.

The Barking District Council has decided to apply to the Board of Trade for a provisional order to construct electrical tramways throughout the town. The estimated cost is £73,284, exclusive of buildings.

A movement is completed for a new electric line from Blackpool to Fleetwood, and should the proposed bridge across the Ribble at Lytham be sanctioned by Parliament, cars will be able to run from Morecambe through Heysham, Pilling, Blackpool, South Shore, St. Anne's and Lytham to Southport. There is already through communication between the four towns in the Fylde, and the new line will run along the coast from Knott End to Pilling, past Cockerham Sands to the Rabbit Hills, where it will bend north, cross the river Lune, and so to Heysham and Morecambe. It is expected to be a popular trip for visitors in the summer months.

Bury, Rochdale, Oldham and several smaller towns are combining to municipalize the train system of that section of Lancashire, and will take over the lines at the expiration of the existing leases in 1901 and 1902, and run the cars with the overhead trolley system.

The electric lines to Phœnix Park are finished and now opened for traffic. The horse cars have been withdrawn, and the section amalgamated with the Dollymount line.

Sir Francis Marindin, one of the Board of Trade inspectors, has announced as a result of his recent inquiry that the speed of the electric trams on the Dalkey & Kingstown section of the Dublin United Tramways Company may be increased to 10 miles an hour on wide roads.

As a result of its recent visit and inspection of the electric train system of Glasgow, the tramways committee of the Aberdeen Town Council has expressed a unanimous opinion in favor of the overhead trolley system. The borough surveyor and electrical engineer have been instructed to report as to the cost and method of carrying out the work of converting existing lines. Cars will be purchased similar to the double-decked cars in use in Glasgow.

Since the beginning of the year the "Birmingham Argus" has been conducting a crusade in favor of an improved train service for the great midland city. Nearly every town councillor has been interviewed, and the result is a wonderful unanimity of opinion in favor of municipalization. The public works committee has just issued a report upon the tramways question, which will be considered at a meeting of the City Council on the 7th of March. The document, which includes numerous tables, embodies a report of a subcommittee appointed to obtain information as to the working of tramways in other towns. This subcommittee addressed a series of questions to thirty of the principal towns of the United Kingdom. In those which have a population of 200,000 and upward, the corporations own and work the lines —Bradford, Glasgow, Leeds, Liverpool, Nottingham and Sheffield. At Edinburgh, Hull, Manchester, Newcastle-on-Tyne and Salford the corporations own the lines, but let them to companies to work. At Glasgow there was a net profit last year of £44,434. Liverpool horse trams, with experimental length of electric trolley, have a capital expenditure of £889,711, and there was a profit last year of £9,553. At Sheffield horse tramways are being converted into electric trolley. The capital expenditure has been £159,377, and last year's net profit was £15,183. There has lately, in the towns referred to, been no material alteration of system. As far as Birmingham is concerned, the question of traction does not immediately arise, and before it becomes necessary for the Council to come to a decision on the subject it is possible that new inventions and improvements will be available. Many corporations have constructed, or are about to construct, tramways on the overhead electric trolley system. In York the construction of underground electric conduit is being considerably extended. That additional tramway facilities are urgently needed in Birmingham can be gathered from the report on the vehicular traffic just presented to the watch committee. In 1896 there were 160 tram cars, 199 omnibuses and 535 cabs in the city; in 1898 there were 162 trams, 235 omnibuses and 700 cabs—an increase of 165 cabs and only two tram cars in the last two years.

In consequence of the purchase of the local tramway undertaking, the Derby Town Council has appointed a permanent tramway committee to take charge of the operation of the lines. It consists of the mayor and eleven members.

The Grimsby Corporation has pased plans for an electric lighting and power station. It will oppose the Grimsby Tram Company's bill in Parliament, as this bill gives the company power to generate its own electric power for traction, and the corporation wants to insist on the company obtaining power from its works.

At a recent meeting of the Edinburgh Town Council the lord provost stated that he had every reason to believe that the whole of the system would be opened by June 1.

J. Clifton Robinson, managing director of the Imperial Tramways, who own the Darlington tram system, has recently had an interview with the representatives of the Darlington Corporation, who desire an improved tram service. Mr. Robinson proposed to equip the Darlington lines on the overhead trolley system, and promised if the corporation would give a free hand and come to terms he would have electric cars running as in Middlesborough by Sept. 1. The matter is under consideration by the Town Council.

J. Shaw, electrical engineer, has been promoted to the managership of the electric tramways of the Isle of Man, in place of John Aldworth, who succeeded Mr. Baker at Nottingham.

A new line 4 miles long, running to Outlane, has just been completed by the Huddersfield Corporation, and has been passed by the Board of Trade inspector. The rails have been bonded, so that when electric traction is introduced the line will not have to be relaid.

The extension of the Halifax Corporation Electric Tramways from Commercial Street to Salterhebble has been completed.

The tramway committee of the Glasgow Corporation recently approved the recommendations of the general manager as to the conversion of the whole of the city tramways to electric traction. The route to follow the Springburn, High Street and Govanhill will be the line from Whitenich to Dalmarnock and London Roads. The route will be by Bridgeton Cross, and will put out of service about 800 horses now used on this line. About fifty-six motor cars will be wanted, and it is proposed to erect a car shed at Partick and Dalmarnock. The next extensions will be from Parkhead to Paisley Road, Maryhill to Mount Florida, Dennistown to Kelvinside, Woodlands Road line, and Possilpark to Govan. The corporation has decided upon a superannuation scheme for the employees in the tramway department. The scheme will be worked in connection with the Tramwaymen's Friendly Society, and the members are to contribute at the rate of 3d. per week for those whose wages are under 18s., and 6d. for those over that amount. For each member the tramways committee will pay 1d. a week, which will amount to £400 per annum. The superannuation will only come in force through temporary or permanent disablement, and the allowance is to be 10s. a week for members of fifteen years' standing, ranging up to 20s. for those who have been members of the society for twenty-five years.

The engineer of the Weston Super-Mare, Clevedon & Portishead Tramways Company has prepared the parliamentary estimates of the cost of constructing the proposed light railway extensions for which this company is seeking permission this session. The total length of these extensions will be about 6 miles, and the new line will run from the termination of the company's existing

road at Clevedon to the siding of the Great Western Railway at Portishead. The cost is put down at £20,250. The extensions will be constructed as single lines.

Sheffield.—The following tenders have been accepted: Cole, Marchant & Morley of Bradford, for two engines for the extensions at Kelham Tower Station, at the total sum of £6,796; John Brown & Co. of Sheffield, for four boilers, at the total sum of £6,250. The British Thomson-Houston Co., Ltd., for two tramway generators of 500 kw. capacity, for the total sum of £5,280 12s. 6d. An extended contract has been signed for the construction and erection of extensions to the power sation at Kelham Island, the city engineer estimating the cost at £10,000. The tramways committee is obtaining tenders for the thirty double-deck cars and the twenty single-deck cars authorized to be purchased. Slipper brakes and trailing wedge blocks are to be provided for all cars.

The prize awarded by the Institution of Electrical Engineers to H. F. Parshall for the best paper presented during the session of 1898, consisted of 25 guineas' worth of books suitably bound and inscribed by the institution.

Mr. Wiseman, C. E., of Birmingham, engineer to the promoters, explained a scheme for an electric light railway between Nuneaton, Chilvers Coton, Attleborough, Stockingford, Ansley, Hartshill and Whittleford to the local authorities of the district, which abounds in coal, clay, stone works and manufactories. A resolution that the scheme had the general approval of the authorities interested was carried.

The British Electric Traction Company is negotiating with the Bath corporation with a view to acquiring the right to lay down electric tramways, and has suggested that the current required might be supplied from the corporation power station. It is not unlikely that this proposal will be carried out.

The Ipswich corporation has decided to open negotiations for the purchase of the tramways in the borough. It will oppose the proposed bill of the company, applying for permission to sell the undertaking to the Drake & Gorham Electric Power & Traction Company, Ltd., which desires to introduce electric traction. The corporation has referred the matter to the parliamentary bill committee to negotiate for the purchase of the undertaking by agreement.

La Société Anonyme de Tramways, d'Eclairage et Entreprises Electriques en Hongrie is the title of a new company organized in Brussels to build electric railways and lighting stations in the western part of Hungary. The company has purchased the large central power station at Steingamanger, which supplies the electric lighting in that city and the power for operating the electric tramways there. It also owns the station at Sarvar, and owns a number of important concessions, including that for the tramways of Oedenburg. M. Lacomble, of Brussels, has been appointed electrical engineer of the company.

At a meeting of the Trambahn Gesellschaft of Metz, Ger., held January 7, it was voted to equip the line with electric power.

The Mannheimer Pferdebahn will be changed to electric power during the next two years, and the system considerably extended.

According to statistics published in the "Electro-Techn. Zeitschr.," the electric railways in Germany in operation on September, 1898, had a total length of track of 1939 km., covering 1429.55 km. of street. At that time there were electric railways in 68 cities. On the same date in 1897 there were electric railways in only 61 cities; in 1896, in 44 cities; in 1895, in 32 cities; in 1894, in 19 cities; in 1893, in 11 cities, and in 1892, in 5 cities. The total number of motor cars Sept. 1, 1898, was 3190, and trail cars 2828.

The Waterford (Eng.) Corporation is about to open negotiations for the construction of an electric tramway system within the town limits.

The electrical equipment of the Calcutta (India) Tramways is being prevented by the City Council, who have expressed an unwillingness to grant the necessary permission requested by the tramway company until the latter carries out certain repair work considered necessary by the council.

Part of the new electric railway system of Ghent, Belgium, has been put in operation, and the remainder of the system will be completed soon.

Three of the principal tramway lines in Naples, Italy, are being equipped with the trolley system. One of these, formerly operated by steam, has a length of 5651 m., a gage of 1.435 m., and a maximum grade of 6.8 per cent; the second has a length of about 3050 m. and a maximum grade of 7.9 per cent; and the third has a length of 5500 m. and a maximum grade of 7.2 per cent. The installation is being carried out by a Belgian company.

At the last meeting of the Dessauer Strassenbahn, Ger., it was voted to equip the line with electric power in place of the present gas motors.

The Metropolitan Tramway Company of Buenos Ayres, Argentina, has been authorized to change its system from animal to electric traction.

The Société Generale des Chemins de Fer Economique, the Empain Bank of Brussels, Belgium, and the Société des Tramways, have purchased for 10,000,000 francs the tramways in Salamanca, Spain, which formerly belonged to an English company.

M. Passedoit, representing Rigaud & Co., has petitioned the Municipal Council of Cahors for right to build an electric railway in that place.

The Whitefield (Eng.) Town Council has created a special committe to consider the erection of an electric lighting station and the construction of a tramway system.

A syndicate of capitalists propose to provide a complete system of electric tramways in Antwerp, Belgium. Arrangements have been made with the existing tramway companies to apply for one general concession for the whole of the lines. The same syndicate is aplying for a concession for a new line from the docks to the Gare du Sud.

The Grösser Berliner Strassenbahn, Berlin, Ger., is planning to equip a number of its important lines with electric power during the coming year.

The firm of Siemens & Halske has closed a contract to build an electrical line between Metschiapu and Pekin, China. It is hoped that the line will be ready for operation during the early part of 1899.

The Saxon Ministry of the Interior has granted the Elektricitätswerke and Strassenbahn Gesellschaft of Zurich, Switzerland, franchises for three new lines.

The Municipal Council of Carcassonne, France, is considering a proposition from the tramway company of that city to equip the lines with electricity.

It is reported that the Brussels Cômpagnie Mutuelle des Tramways will secure control of all the tramway companies of Antwerp and will introduce electric traction on the 42 km. of tramway track in that city.

The municipal council of Bordeaux, France, has granted the petition of the Tramway and Omnibus Company of that city to equip the tramway lines with electricity.

The Oberschlesischer Strassenbahn Gesellschaft, of Upper Silesia, Ger., which is equipped with electric power, is proposing to make a number of extensions.

M. Robi, manager of the Société des Tramways de Tiflis, Caucasia, has recently obtained permission from the authorities for the equipment of the line with electricity.

The Westinghouse Electric & Manufacturing Company has been awarded a contract for the electrical equipment of fourteen cars for use in the city of Cairo, Egypt.

Storage Batteries and Railway Power Stations *

BY ROBERT MC A. LLOYD.

The difficulty confronting us is that very few operators of railway power stations have any data showing what they are doing. Electric light managers seem to take more interest in the output of their stations, and in many cases maintain a system of records of work done, but the manager of a trolley road is usually contented with superficial observations of the switchboard and the comforting fact that the cars are running.

We always find these managers greatly surprised when the actual state of affairs is shown to them on paper, and I believe that this institute would be astonished at the results of a thorough research into the load curves of the railway plants of the entire country. You are, of course, prepared for the statement that the average load on a railway power station for a given period is much less than the maximum load occurring during that period and much more than the minimum, but it is not generally understood that the maximum load for the same period is apt to be far below the capacity of the generating plant in operation. As an illustration of this fact I show some data on a typical railway plant when thirty-five cars were running. We have not discovered any railway plant where this is not true and I believe that the data on most of the railway plants of this country will confirm my statement. The first explanation of this would be that such a surplus capacity is necessary for reserve to meet emergencies, but I do not find it to be a useful reserve, and shall refer particularly to the diagram, taking this station because, from the standpoint of the manager, engineers and attendants, it is dangerously overloaded and has no reserve. In fact it was necessary to add to the capacity at once to make it safely operative. (See diagram on next page.)

I obtained these data on the day of heaviest travel in the whole year. It will be noticed that the highest point reached was within the capacity of the main station, and yet it was necessary to start up an auxiliary station. The central solid line shows the average load, and the upper and lower lines show the limits of the fluctuations occurring from moment to moment. The method pursued in getting these curves was to divide the day into half hours, and during the first five minutes of each half hour take the highest and lowest ammeter reading in each minute; these readings are plotted in the upper and lower curves; also to take ammeter readings every five seconds and obtain the average of these readings as the point in the curve of averages. Another convenient method of obtaining the curve of averages is by wattmeter readings. Among some of the interesting features in this diagram may be noticed the fact that the nominal capacity of the generating apparatus was about 400 kw. in excess of its maximum output occurring at about 8 o'clock in the evening, and that the average output at this time was about two-thirds of the maximum. The excess of nominal capacity was not so great at 7 o'clock in the morning, or 2 in the afternoon when other high points occurred, but as it was known that the morning peak would be of short duration the engineer decided to run through it without the auxiliary station, and in the afternoon the load increased more rapidly than was expected, and the auxiliary was not ready to go into operation on short notice, consequently obliging the main station to groan under a dangerous load for an hour or so.

It will doubtless occur to some that this station apparatus has been overrated, or that the engineer was incapable or over cautious, but the fact remains that similar data are obtained in very many stations, and that in many cases the apparatus has been subjected to satisfactory tests before acceptance by the purchasers. It may be possible to build engines which regulate at all conditions of load and at the same time use steam satisfactorily at maximum load, but I do not find such engines commonly in use. Further than this there are many very good engines in use which cannot be safely operated at anything like maximum load if that load is liable to sudden variations. I realize that you may suggest all sorts of schemes for getting a better output from the plant illustrated by this curve, and you may wish to ask some questions about this apparatus, but experience convinces me that the men who are most likely to be consulted about such a station will recommend more generating plant, and the truth is that there are so many good salesmen pushing engines and dynamos that station managers frequently fail to get full duty from the machinery which they are operating already. It is not merely that the storage battery has been neglected, but any of us can see in railway power houses throughout the country, where the managers have been persuaded to increase their generating plant when attention to a few details such as steam piping would have brought their output up to requirements. Assuming, however, a station equipped with the best obtainable apparatus, and operated under the most advanced laws of station practice, in the absence of a storage battery, there would still be much more apparatus running than would appear necessary from the load diagrams.

The generator salesman says in reply to this proposition that his apparatus is cheap and that it is good to have plenty of it, but one generally finds that where there is plenty of apparatus available the engineer is tempted to keep too much of it running, and therefore running at low efficiency.

Of course railway power stations have individual characteristics, and it will not do to assume that they all need storage batteries, but there are certain features of railway power requirement which are common to the problem everywhere, and which invite consideration for the storage battery.

The curve characteristics of electric light supply are well known, and much information about electric lighting has been brought out in the committee reports of the National Electric Light Association for 1896 and 1897 and by Mr. Hammond in his paper before the British Institution of Electrical Engineers in March, 1898, but the possibilities are more varied in railway work, and, as far as I know, there has yet been no systematic research into the economy of railway power stations, the only published data on the subject being contained in the paper read before the Street Railway Convention at Boston last September by R. W. Conant.*

In my endeavor to point out some of the uses for a storage battery I shall take as a typical station that shown in the diagram. It is located in a Pennsylvania town of 50,000 inhabitants. The railways radiate from the center of the town to distances of 3 to 9 miles. There are six branches and the power station is located 2 miles out on the longest branch. It has railroad and water frontage. The small auxiliary power house is the result of a recent consolidation and is close to the main house. There are three distinct ways of using a storage battery with this power plant. Taking up the figure we find first the great fluctuation between night and day load; second by the fluctuations occurring from hour to hour; and lastly the superimposed fluctuations occurring from moment to moment. We shall call a battery of sufficient capacity to level off the night and day fluctuations "large;" a battery for leveling the hour-to-hour fluctuations "medium," and a battery to level the momentary fluctuations "small." It will be seen at a glance that the small battery will reduce the requirements of the generating plant to a capacity sufficient to meet the demands of the average load shown in curve A. The battery must be able to discharge at 650 amps. for momentary periods, but its capacity in amp. hours is unimportant. It will cost less in generating capacity for the same work, and a large part of the excess of capacity over requirements shown in the diagram will be saved. It will save some depreciation on the generating apparatus, and its own depreciation will not cost more than the depreciation of generating apparatus of similar capacity. It will have sufficient storage capacity to run a few night cars and lights when the engines are shut down. If located at a point nearer the center of feeder distribution than the location of the generating station, a saving in copper will be effected. Inasmuch as the investment will not be increased by including such a battery in this railway outfit all the saving in fuel due to a steadier load and the operation of less generating machinery will be clear gain to the credit of the battery.

Line B, at 810 amps., shows the average load for 18 hours of the day, and a "medium" battery to reduce the load to this straight line would have a capacity of 1300 amp. hours. It will cost about twice as much as a "small" battery, but will not add enough to the cost of the installation to bring the investment up to the total now in generating apparatus alone and presumably necessary if no battery is used. This battery will have all the advantages of the small plant with wider limits of operation. The station circuit breakers may be set 650 amps. higher, and there will be greater convenience throughout the station in operating at a fixed load. There will be a marked effect on the efficiency of all departments of the station, and all the apparatus will yield a higher output in proportion to investment and cost of operation.

Line C, at 650 amps., shows the average load for 24 hours and a "large" battery capable of leveling off this load will have a capacity of 3000 amp. hours. It will cost approximately twice as much as the "medium" battery and will have all of its advantages. It will cost as much as the generating machinery displaced by it. It will add largely to the flexibility of the station. This battery could be discharged momentarily at 3000 amps., which will put the circuit breaker limit of the station at about 3600 amps. instead of 2300 with all the present apparatus. It may be discharged at 1500 amps. for one hour, which will be sufficient to cover load peaks that would stall the 1150 kw. generating plant completely.

In cases of extreme necessity the entire system might be carried

* Paper read before the American Institute of Electrical Engineers, Feb. 15, 1899.

* See STREET RAILWAY JOURNAL for October, 1898.

by this battery for several hours. The ability to carry sharp peaks is a distinct addition to the earning power of the system. Such peaks often signify the collection of fares which would be lost if the system were not flexible, and some managers keep up enough station capacity to carry a few holiday crowds while for 99 per cent of the whole year it is carning nothing. Other managers do not attempt to carry special crowds. The large battery will give the manager an opportunity to get all the money that can be made out of such business without feeling that he has made any investment for the purpose. Of course the capacity of the system is limited also by the investment in copper, but in many cases the battery may be located so as to facilitate the distribution of power.

There is no reason why a railway power station of this capacity running night and day at a constant load should not attain a fuel economy as high as that of the well-known Chestnut Hill pumping station at Boston, which would be equivalent in electrical work to 557 watt hours per pound of coal. Curve A shows for one day's work 7,800,000 watt hours which required at the above rate 7 tons of coal, and assuming that the battery would only have 75 per cent efficiency, and that 25 per cent of the entire day's work would go through the battery, ½ ton of coal would be added to this consumption, making 7½ tons of coal per day for this plant, running with a large battery.

The battery efficiency in such service as this has been found in most cases much higher than 75 per cent, and in some cases over 90 per cent, so my estimate is clearly on the safe side.

Table I.—Comparison of First Cost.

	Lay Out With	Cost of Generating Apparatus.	Cost of Storage Battery.	Total Cost of Station Plant.	Cost of Coal per Day.	Cost of Coal per Annum.	Saving in Coal.	Saving in Coal and Saving in Int. 5 p. c.
		$	$	$	$	$	$	$
1	No battery...	115,000	------	115,000	30	10,950	----	----
1	Small battery.	60,000	20,000	80,000	25	9,125	1,825	3,575
3	Medium "	50.000	35,000	85,000	20	7,300	3,650	5,150
4	Large "	40,000	70,000	110,000	15	5,475	5,475	5,525

Table II.—Comparison of Operating Expenses.

	Cost of Real Estate and Buildings.	Repairs and Depreciation.	Saving in Labor per Annum.	Saving in Water, Oil, Waste, etc.	Total Saving.	Estimated Addition to Receipts.	Net Advantage in Operation.
			$	$	$	$	$
3	All the Same.	All the Same.	----	100	3,675	----	3,675
4			----	200	5,350	1,000	6,350
1			1,200	300	7,025	5,000	12,025
2							

save anything in the cost of operating the road, but that they could not run without it, and I take the liberty of making the following

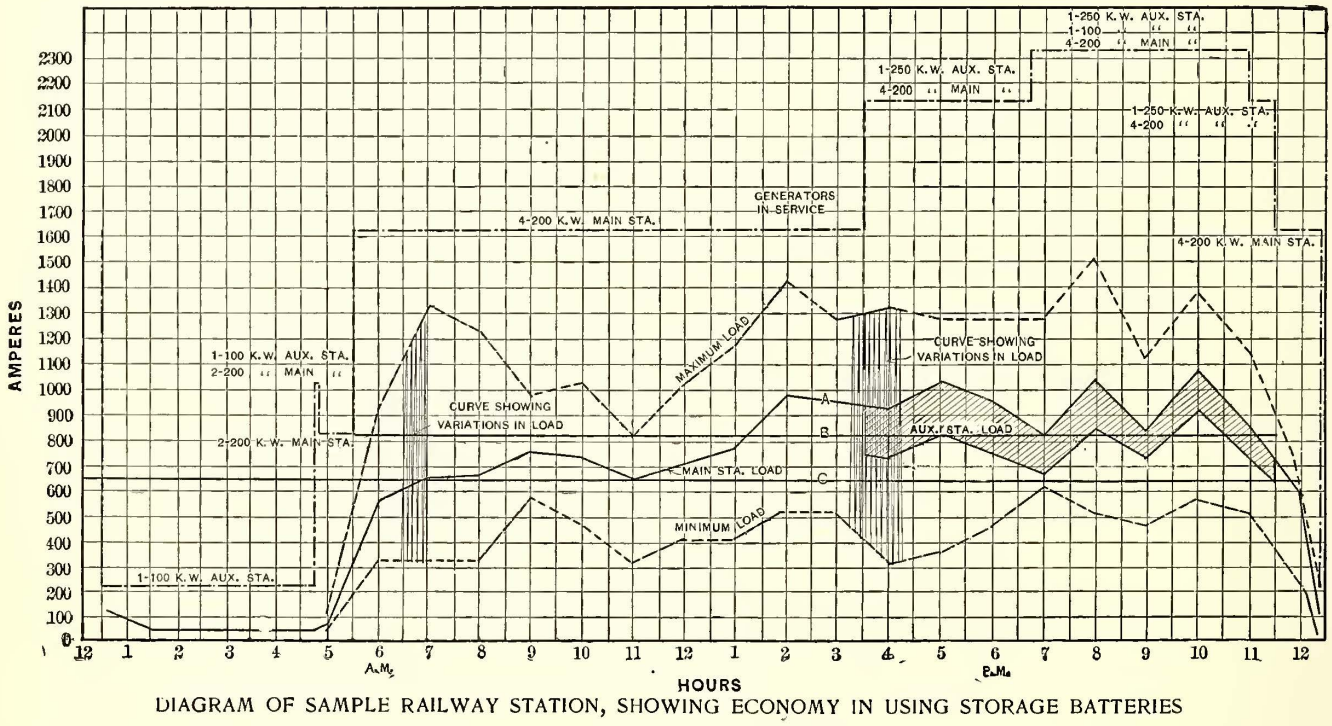


DIAGRAM OF SAMPLE RAILWAY STATION, SHOWING ECONOMY IN USING STORAGE BATTERIES

On the day when these data were obtained 15 tons of coal were burned, or twice as much as would be necessary with the battery outfit. The battery would, therefore, save at $2 a ton, $5,474 per annum in coal alone.

The number of men in the station is now the same night and day, and there would certainly be no increase in the labor item, whereas it is probable that one man on each shift might be dispensed with if the plant were reduced by the battery, in which case there would be another saving of $1,200 per annum. The battery would also save water, oil, waste, etc., and there would be minor advantages such as more constant potential on the line; less annoyance from circuit breakers; no fear of sudden demands on the generating apparatus and the disagreeable possibilities incident thereto.

In the following table some figures are tabulated for the purpose of comparing four different layouts to meet the requirements of the railway system referred to in the diagram:

I have assumed $100 per kw. as the cost of complete station apparatus without batteries. This figure might have seemed high a year ago, but in view of the rising prices of such material I think it is only conservative.

In regard to the "small" battery, there is no doubt of its advantages in many cases, but for new installations it is not always the most economical battery. I understand that Leslie Carter, the president of the South Side Elevated Railroad Company in Chicago, said recently, that, as far as he knew, their battery did not extract from his annual report to the stockholders, which has since been published:

> While the amount of current used per car-mile is low, and has produced gratifying results in all tests and comparisons made, the fluctuations of power above the average requirements are large, and the sudden demands on the power-house compelled us to prepare promptly for the heavier business of the winter, which, with increased number of cars in service, heat, and light loads, would have been beyond the capacity of the power-house. Additional Twelfth and Sixty-first Streets, respectively. These batteries have greatly re-engine capacity could not be obtained in the time at our disposal, would have cost more money, and have been expensive to operate. We accordingly installed two batteries of 750-kw. each, equidistant from the power-house, at duced the fluctuations and the maximum load at the power-house. While the output at the power-house is the same, the batteries charge at times of light traffic and discharge at times of heavy traffic, thus equalizing the work at the power-house, and relieving the engines and generators. This is certainly an economy, and it is further claimed, with what correctness I am not yet convinced, that they cheapen the cost of production. But I do know that they keep up the voltage at the ends of the line, enable your road to operate more cars, furnish increased facilities to patrons, and prevent damage to power-house machinery in case of sudden demand for increased power.

That battery was, of course, put in for regulating purposes only, and the load curves give an impression that the battery must certainly be useful. It seems to me hardly worth while in laying out a new station to put in a battery for the purpose of reducing the railway power curve to the characteristics of electric light practice, when by going a few steps further it may be refined to a practice comparable with marine engineering.

It might appear at first thought that a battery of sufficient capacity to insure a full load for the generating units at all times, would save as much fuel as a battery large enough to level off the 24-

hour service, but it is very difficult to follow the power requirements from hour to hour in such a way as to make ideal use of a battery, whereas with a "large" battery it would be possible for the ordinary station engineer to adjust his load so as to operate all of his apparatus to the best advantage all the time.

I have carefully analysed the figures in Mr. Conant's very interesting paper above referred to, and am compelled to differ from him at some points, and refer to them in order to meet in advance any criticism of my paper which may be based on his tables. In the first place he assumes that his standard station can be worked all the year round with a load factor of 33 1/3 per cent, which is entirely too high; 20 per cent or 25 per cent would be more normal. I suspect that Mr. Conant's load factors have been obtained by indicator cards instead of wattmeters. In Mr. Conant's table none of the stations shows a better figure for coal than 3 lbs. per kw. hour, while his standard station is put down for 2.2 lbs., without any intimation of the process for attaining such a good result. The question as to how the cost for repairs and depreciation of the entire plant would be affected by a large battery is particularly debatable ground. Mr. Conant allows 2 per cent for depreciation beyond the normal running repairs. He estimates the entire plant, including buildings, to last 50 years. His statement that the machinery now being installed will last much longer than that with which we have been familiar in the last decade has nothing to back it up except faith in the promises of the builders.

I propose to allow 10 per cent per annum for repairs and depreciation, on the entire station apparatus, including batteries. I have not seen any boilers that are likely to last 50 years, and there is plenty of evidence that all the best engines and boilers in this class of service to-day will go to pieces in a life of from 10 to 20 years. The particularly hard usage to which most of them are subject is not only steadily wearing them out, but producing a state of constant danger and not infrequent accidents. I am sure this is becoming well understood among railway men, and some of the best managers are writing off to depreciation 10 per cent per annum. Moreover, who can say that improvements will not be made in the next 10 years as in the past, and that engines and boilers may be out of date before they are used up.

It is, of course, well known that whatever the rate of depreciation may be without batteries, it will be lowered by giving the generating apparatus a constant load; my belief is, therefore, that the storage battery will not increase the rate of depreciation for the entire plant. If it can be shown that interest and depreciation for a plant of given load dimensions are practically equal with or without a large battery, it is evident that the great saving in fuel alone will determine the superiority of the battery system.

I have so far considered the battery only at the central generating station so that all the advantages due to locating it at proper points in the distribution system are additional arguments in its favor. In many cases the saving in copper may be greater than the sum invested in the battery, and the flexibility of the system improved in places where it would not pay to install sufficient copper to meet the irregular demands of travel.

The reserve qualities of the storage battery are unique. It might be supposed that a mere reservoir which is quickly drained would be of little value compared to a lot of extra generating apparatus standing idle, but experience is demonstrating every day in existing plants that the reserve which is needed most is the reserve which is not only ready for emergencies, but actually alive to any demand without the direction of a human mind.

Most of what has been said of the storage battery as applied to the power station illustrated by the curves is true of its application to railway power stations in general. The use of water power introduces a factor in the problem more variable than fuel, and I shall not attempt the discussion of it. Alternating currents lend themselves readily to the development of storage battery applications on account of the mutually helpful combination of battery and rotary at sub-stations. Up to the present time, each of the large batteries installed for railway work has been obliged to meet different conditions and requirements, but they are all serving their respective purposes well and showing many different fields of usefulness. I shall not refer to these plants, because Mr. Appleton in a recent lecture to the New York Electrical Society has ably described those of most importance.*

Most of us feel that the electric railway and electric lighting interests are destined to get into closer relations, and the generating station of the future may be required to furnish all the electricity used within large areas for every purpose.

Coming finally to a problem which has been the subject of some newspaper discussion of late, I trust you will pardon me for treating of work with which I have no connection. Electricity has so many advantages over any other medium for transmission and storage of energy that I assume its use to be firmly established and cannot conceive of any lasting rivalry by the other contestants now in the same fields. Further than this, without saying anything for or against monopolies, I believe that all the energy supplied by means of electric currents to consumers of every nature in the greater New York should radiate from two or three central stations, and that these should be electrically tied together. The sub-stations would naturally consist of rotaries and storage batteries. It may not be possible to lay out each sub-station so that the rotaries would run at a constant load for 24 hours a day, but it seems to me quite probable that such an arrangement would eventually be reached, and this would, of course, give the generating stations a constant load.

At the present time the load curves of the electric railways are very uncertain, and peaks are likely to occur at almost any time of day, while the addition of the peak due to electric lighting in the early evening would not add in large proportions to the railway peak, but electric lighting is capable of more general application and it is possible that within a few years the distribution in the Borough of Manhattan may reach from 300,000 to 500,000 kw. at the highest part of the lighting curve, which will probably be as great as the railway load when the elevated railway and the underground rapid transit are included. These peaks will often occur at the same time of day, and so there is no possibility of improving the load factor of either system by splicing the two together. It follows, therefore, that what is true of the relation of a storage battery to the economy of the generating station for power or light separately will be true of the resultant of their combination.

The railway and light people recognize the importance of leveling up some portions of their load curves, but I estimate that the greatest saving is to be obtained by operating for a constant load twenty-four hours per day. However high would be the economy of such large stations I am sure it would be higher with large batteries than without. Certainly the economy of the Boston pumping station as to fuel consumption should be surpassed. It must not be assumed that a high load factor for the system is an advantage. It is all right for the generating plant and for the copper feeders, but the kw. hours that bring in the most money may spoil the looks of the load diagrams and kill the load factor. What is required to earn dividends is a *profitable* load factor outside of the stations, whether high or low, and the highest possible load factor at the dynamo terminals. The large storage battery meets these two requirements perfectly. A load factor of 100 per cent may be maintained at the dynamo, and current may be sold to the consummer regardless of the time of day.

With 1,000,000 kw. in view for the Borough of Manhattan it would be necessary to generate an approximately constant force of 300,000 kw. A million kw. in station plant without the battery factor would cost $100,000,000. The same capacity, including the proportion of battery now deemed advantageous by some of the engineers in touch with these problems, would be divided as to cost into $70,000,000 of generating plant and $30,000,000 of battery plant. Finally the same capacity, if divided in the same proportions which seem to me most productive for the investment, would cost $30,000,000 in generating plant and $70,000,000 in battery. This is quite a large battery plant, and as there would be more than two parts battery to one part generator, I am fearful of the jealousy which such a reversal of engineering practice would create.

In conclusion I wish to state that nothing in this paper should be regarded as emanating officially or unofficially from the company with which I am connected.

* See Street Railway Journal, February, 1899.

Completion of St. Anthony Falls Transmission Plan

The equipment of the power house at the lower dam of the Falls of St. Anthony at Minneapolis, Minn., is about to be completed, and the necessary arrangements have been made by the St. Anthony Falls Power Company with the General Electric Company, which manufactured and installed the plant now in operation.

The hydraulic work and the power house, which were described in the Street Railway Journal for May, 1898, were finished in the spring of 1898, and five three-phase alternators of 700 kw. each and two direct-current generators of the same capacity, with the necessary rotary converters and static transformers, were installed. The full equipment of this power plant, as originally laid down, contemplated the use of eight alternators and two direct-current machines of the total capacity of 10,000 h.p.

The additional equipment will consist of three 700-kw. three-phase revolving armature alternators, with rotary converter, step-up and step-down air blast transformers, and switchboards for the generators and converter. The installation of this machinery will raise the generating capacity to the 10,000 h.p. originally contemplated.

Some General Observations on Electric Traction*

BY H. F. PARSHALL

It is a natural thing for engineers to reason from experience with electric lighting plants as to how best to design plants for electric traction purposes. Such reasoning, however, is likely to be defective and lead to wrong results. A primary difference between electric lighting and electric traction, so far as the station is concerned, relates to the difference in the nature of the load—one being approximately constant from moment to moment, and the other varying between wide limits, and at such a rate that many engineers liken the strains upon traction apparatus to those upon rolling-mill engines. Another difference of great importance is, that in a plant of a given nominal horse power from three to five times the quantity of electricity would be generated for traction as for lighting purposes; consequently a greater capital investment, greater refinement in the machinery, and greater margins in the individual machines, or in the number of spare machines, are commercially permissible in the case of electric traction. In general, lighting machinery is called upon to work at full load for a few hours in the day, whereas traction machinery is generally called upon to work at approximately full load for many hours in the day.

The steam generating plant for either lighting or traction of the same capacity need not differ in character to be equally efficient. Having reference, however, to the better load factor of the traction plant, and consequently a greater consumption of coal and a lesser ratio of cost of labor to that of material, better arrangements as to coal handling machinery and coal storage are justified. More elaborate arrangements of steam piping are also justified, since the loss due to condensation in steam pipes is determined by the number of hours the pipes are under pressure, rather than by the quantity of steam carried by them.

Steam engines have been the subject of frequent discussions. It has been a much debated point as to whether or not an engine should have a heavy fly-wheel. This question resolves itself into the most economical way, average loads considered, of getting the maximum effort from the steam engine to take care of the temporary overloading incident to traction work. The dimensions of the cylinders of engines for good economy are determined with reference to average loads. For best economy then at good regulation, heavy fly-wheels are necessary to assist during overloads in traction work. The question of governing has also been frequently discussed. I do not understand why this should be, since nobody is of the opinion that an engine that governs closely is at a disadvantage. Such engines do not cost appreciably more, and are now generally manufactured. In reading such discussions I have frequently wondered why the electrical conditions met in parallel running have not been taken into consideration. The necessity of close regulation of steam engines was first demonstrated in the case of generators running in parallel, where the load did not properly divide with rapidly varying loads unless the engines governed with fair accuracy.

Another matter frequently discussed is that in respect to the speed of engines. Here, also, the electrician is entitled to some voice, since experience has clearly demonstrated that each size of dynamo has a range of speed through which its performance either as to efficiency, regulation, or sparking, is best, and dynamos built outside of this range of speed are made at the expense of efficiency, regulation, or commutation.

The speed of the 1500-kw. dynamos which I designed some years ago was limited to 75 r.p.m.. Experience since then has not demonstrated the advisability of increasing the speed beyond this figure for this size of machine. My own experience justifies the statement that the mechanical and electrical conditions, in the case of the larger direct connected generators, generally coincide in the matter of speed.

The system of transmitting mains for distribution, on account of the better load factor in traction installations should be designed, for most economical working, with a greater cross section than in the case of lighting, with its smaller load factor. This is obvious from Lord Kelvin's law, in which the interest that goes on perpetually is balanced against the cost of the energy wasted in the mains. Clearly, then, as the cost of energy does not vary in the simple ratio of load factor, if mains *are* to be utilized three or four times as many hours in the year at rated capacity in one case as in another, a large cross section cable is required, if the cost of wasted energy is to balance the interest account.

Apart from the proper designing of a given system of transmission and distribution, there remains the broad question as to what will be the nature of the transmission, that is, whether continuous currents shall be used, or whether the distribution shall be multiphase with substations. The solution is to be determined in respect to the amount of power and the distance to which it is to be transmitted, and in particular cases to the conditions of distribution. Thus, where a very small voltage drop is permissible in the consumer's circuits, as in the case of earth returns, multiphase transmission, with frequent substations, becomes a necessity, where under less restricted conditions continuous current transmission would be more economical.

For comparison between continuous current high tension transmission and multiphase transmission, see Proceedings Institution Civil Engineers, Vol. CXXXIII, Paper No. 3090. It appears from this that the distance at which multiphase currents become efficient as compared with continuous currents is somewhat less at 500 volts than has been frequently thought.

The fixed losses in a multiphase system for the distribution of power for traction work are determined largely by the maximum momentary load which may come upon the substations. When the ratio of the average to the maximum temporary load is comparatively large, the distance at which continuous currents become more efficient than multiphase currents is increased. In very large traction installations in which the ratio of the average to the maximum approaches unity for average working, the distance beyond which high tension currents are more advantageous is lessened. What method of transmission will be most efficient in a particular case cannot be determined without knowledge as to the nature of the load. In the Dublin installation which I have recently designed for 250 cars, the power station is approximately in the center of the system. The average distance of transmission is about 2½ miles. I have used 500 volts continuous current with so-called "boosting machines," taking the current out of the rails at certain points, so as to restrict the maximum drop in the earth to 2 or 3 volts. For two lines extending some 8 miles from the power station I have, at a distance of about 6 miles, planned to install a rotatry converter station. The multiphase load, however, being such a small fraction of the whole, I have not installed multiphase generating machines in the station, but have used a special design of rotary converter, run from the main machines. Such rotaries have to be very specially designed, since, in the case of the current becoming displaced in phase, they are apt to race dangerously. This is a particular case, designed after determining the average current consumption in any part of the system, when the ratio between the average and the maximum is approximately known from experience, so as to impose the minimum fixed losses, or, in other words, to insure under average conditions maximum efficiency. Were the number of cars doubled I would locate substations approximately at the feeding in points and would use multiphase transmission.

An advantage in the use of rotary converter stations is that at constant speeds such machines will give constant voltage, regardless of the load or the drop in the lines (provided this be limited to an economical amount), or the regulation in the transformers, so that such machines can be made to supply simultaneously and satisfactorily both traction and lighting installations. To justify this statement I instance tests recently made on some 900-kw. rotary converters, from which full load could be thrown on or off from one to the other machine without any perceptible variation of the continuous current voltage.

In the designing of a multiphase system selection has to be made between quarter and three-phase. The three-phase system has the important advantage that but three-quarters of the weight of copper is required as with either single or quarter-phase transmission. Considered, therefore, with the energy factor common in multiphase working, the three-phase system gives better transmission efficiency with the same section of copper in the average case as continuous current.

Another advantage is gained when the transformers are delta connected. Any one of the three can fail, and the other two will deliver triphase currents to the rotaries. There is practically no difference as to efficiency or working between the rotary converters in the two cases. In installations making general use of rotary converters feeding into a network at constant voltage it is necessary to observe some care in selecting the high tension mains, and in securing engines with approximately constant angular velocity. An engine, to be entirely satisfactory, should not produce by variable velocity a phase displacement of more than 5 degrees per half cycle from that of constant velocity. The transmitting mains should be designed with comparatively small drop, so that the rotary converters work properly in parallel in different stations, and so that the rotary converters can generate constant voltage with a varying load without too great phase displacement. If proper precautions are not taken in these matters rotary converters will not operate satisfactorily in parallel, and are likely to give a great amount of trouble from sparking and irregular variation of voltage.

* Paper read before the Northern Society of Engineers Jan. 24, 1899.

For working with rotaries I would also point out the necessity of arranging the mains so that the current in each phase is delivered approximately at the same voltage. I have recently been conducting some tests on rotaries, working on triple concentric mains, and the results were far from satisfactory until a phase equalizing arrangement was used. At first the current in the different phases varied by about 10 per cent, and the rotaries worked unsatisfactorily; when, however, the e.m.fs. were equalized the rotaries worked with entire satisfaction. The conclusion to be drawn from this for three-phase working is that the cables should have equal inductance, equal capacity and equal resistance in each circuit.

In installations which I have designed I have used cables drawn in conduits and with manholes approximately 150 yards apart, so that the cables can be readily replaced or supplemented to meet the demands of the service. Armored cables laid in a common trench are objectionable, in that the burning out of one is quite likely to destroy its neighbor.

By far the most difficult problem to solve at the present moment in large multiphase stations is in conection with the switching apparatus. Circuit breakers have been devised for continuous currents that will open at any current to be met with in practice. In the case of alternating currents the same progress has not been made. I recently examined the plans of a 70,000-h.p. station, and could not but feel that the success of the whole installation was dependent upon the switching arrangements.

In this discussion I have assumed that the distribution in a traction system would be by continuous currents. I have seen nothing that would lead me to believe that any other course will come into general use.

The next point for consideration is as to what form of apparatus should be used for conducting the electricity from the distributing mains to the car; whether it should be the single-wire, overhead trolley system with earth return, the two-wire system with return overhead, or with this last connected up as a three-wire system, with the middle pair of trolley wires acting as a neutral, or whether a conduit system should be used. The valid objection to the single overhead trolley system, neglecting the æsthetic one, is in the use of the earth as a return circuit. Troubles from electrolysis have been frequent in the United States where the e.m.f. drop in the earth return is not limited by legislation. Owing to the stringent regulations of the Board of Trade little trouble has yet been experienced in England or on the continent, where similar regulations are in force. I pointed out in a paper which I read before the Institution of Electrical Engineers,* that with even very little e.m.fs. a certain percentage of the current in all cases leaves the rails. With amounts of copper commercially permissible, either substations at frequent intervals, or boosting machines, such as have already been described by Major Cardew and myself at the Institution of Electrical Engineers, are necessary to bring the e.m.f. drop down to two or three volts, which in most cases of municipal working is the safe limit. If the e.m.f. exceeds this limit trouble from electrolysis would probably occur at some date more or less remote, according to the local conditions as to the location of the earth return in respect to the gas and water pipes and the nature of the soil.

The double overhead trolley system eliminates the possibility of trouble from electrolysis. In the case, however, of most cities where numerous lines converge at certain points, the double overhead construction would be complicated and objectionable in appearance. The same applies to the double overhead three-wire system. This last system has great advantages, however, and when used in connection with rotary converters, which act both as converters and equalizers, it is possible to operate tramways over very long distances from the generating stations. It happens in such cases that the three-wire overhead system is rarely objectionable, since overhead networks are not necessary to meet the traction conditions in outlying districts.

The conduit system has been used in various American and continental cities with a considerable degree of success. The advantage is that it can be a doubly-insulated system, avoiding danger from electrolysis, and that there are no overhead wires. An additional rail at the side, or pair of rails between the tracks, along the slot, has to be set off against the overhead wires on making comparison between the two systems as to appearance in the street.

In general, city corporations are in a better position to install conduit systems than private companies, since the city corporations can borrow money at low rates of interest and have not so great amortization to consider. Further, city corporations frequently having the control of gas and water pipes, can arrange matters so that the conduits can be put in at a less first cost. In some cities I believe the installation of conduits under a dual management would be impracticable, since the conduits would interfere with the gas and water pipes to such an extent that the conduits could not be installed except by such general rearrangement that local arrangements could not be made. Undoubtedly, in the case of heavy storms the conduit system is more troublesome than the overhead system. I had some examples of this in my recent visit to the United States. In New York it has been found necessary to employ an elaborate system of double-throw switches, so that if a part of the positive side of the system goes to earth it can be put on the negative side, and the negative on the positive side.

In conclusion, I would point out that the mistake most frequently made has been in underestimating the amount of power that may ultimately be required in a traction system. Both the size and type of machinery in a generating station should be determined in respect to the maximum output of the station. Having regard to the present regulations of the Board of Trade and to economy in transmission and distribution, the limit for a 500-volt continuous current station is usually reached at 5000 kw. output. Beyond this a multiphase system of transmission, with rotary transformers for continuous current distribution, becomes necessary for most economical working, since experience has fully demonstrated the greater economy of working from a single central power station. The "universal" station is the multiphase station, since it can meet every condition with a single type of generating machinery. As pointed out in the paper, however, the distance of transmission, amount of power, and the nature of the load are the factors determining whether a continuous current or a multiphase system is best in particular cases.

Having regard to lighting experience in the large American cities in which the three-wire system was originally installed, and which is now being replaced by a three-phase system with substations to secure greater economy in working, it would seem wiser in many cases to sacrifice somewhat in electrical efficiency at the beginning, and provide for a plant suitable for practically unlimited growth, either as to amount of power or area of district supplied from a central power station.

* STREET RAILWAY JOURNAL, June, 1898.

The Electrical Inspection of Street Car Equipments*

BY ALBERT B. HERRICK

As electrical machinery is becoming such an important factor in modern civilization, the maintaining of this machinery requires indirect methods in order to make visible, through the means of instruments, the electrical conditions of the apparatus or machinery. Nowhere in the application of electricity is electrical inspection more necessary than in street railway equipments; here the motor is operated with exposure to weather, mechanical jars, heating and severe electrical and mechanical strains, and when the first roads were operated there were many predictions that this system was impractical, and a preposterous engineering proposition. The development of accurate methods for finding these hidden electrical troubles in an equipment has been urged upon me by reason of the high cost of the electrical repairs on street-car equipments. These aggregate many million dollars per annum in the United States, and to bring this forcibly to your minds, in two of the roads which I have examined I have found the cost of the electrical repairs of a 22-ft. car with double equipment to be the same as an 80-ton locomotive running on the Pennsylvania Railroad the same distance and carrying a full train of freight cars.

The wiring of a car, by which the current is conducted through the equipment, is of necessity not a fixed nor rigid system. The resistances which are used to control the flow of current through the equipment, on account of their limited weight and space, will not carry the current continuously, and careless motormen may injure the resistance by improper handling of the controller. The latter, which is practically the nerve center of the equipment, reflects in its depreciation all the latent defects in the equipment. After carefully inspecting, electrically, a large number of equipments, one feels very much like diagnosing the different diseases which are inherent in the various equipments, and also separating from these diseases those which are developed by forcing or the improper handling of the controller, and which are attributable to poor motormen. There is another class of diseases which have their origin in careless inspection and careless maintenance of the equipment.

It is not so much my intention to analyze the diseases to-night as to describe the means by which they are detected and located.

Following out our original anatomical idea, it is easiest to look at the various ramifications of the current flowing through the

* Paper read before the Franklin Institute, Philadelphia, Feb. 14, 1899.

equipment as a circulating system, with the controller as a deflector for these different circuits through the equipment. Fig. 1 shows a very common form of series parallel controller, with the connections it makes with the apparatus on the first notch; with each movement of the controller handle the current is changed in its path. The sequence of changes made by the controller as it passes from the first position to the last, including nine positions in this case, is as follows: The first position starts the current flowing through the electrical circuits of the car, and the car should now move. A large amount of energy is lost now in the resistances R_1, R_2, R_3, R_4, which choke down the initial current on the motors. An advance from the first step to the second cuts out 4½ ohms in a standard equipment of this type; from the second to the third step cuts out 1½ ohms, and from the third to the fourth step cuts out one-half an ohm. The motors are now both in series and across the full potential between the trolley wire and the ground. The rheostat, which is the resistance that has just been cut out by the first three steps of the controller, is usually given very little attention after it has been installed on the car. Its resistance generally increases with age, however, and I have found in many rheostats over four times the resistance they should have had when new. The result of this increase in resistance is that the car will not start on the first step of the controller when the rheostat is hot or the car heavily loaded, for the resistance is so high on this step that the current is cut down below starting value, and when the second step on the controller is reached the car will have what is known as the "kangaroo" start. The result of this defect in the equipment is to increase the temperature of the motors and the strains on them, as well as the current demand on the station, and to give a disagreeable acceleration to the car. This defect is more noticeable on those motors having a large starting torque. The motors which have a small starting torque do not show this defect so much in the start and car accelcration, but struggle along under this excessive condition until they retire to the repair shop damaged.

I have expanded on this point somewhat, because it does not seem to be generally known that this condition is primarily the cause of a large number of breakdowns in equipments, which condition may be caused by burnt-open or high resistance in rheostats. A low resistance on the first step of the rheostat has identically the same effect on the equipment as if the first step is too high and the second step is normal. Where repair accounts have been kept against individual cars in street railway operation I have often found the high cost of repairs on some cars due to just this rheostat trouble, the controller, armature and fields being continually repaired, while the rheostat, which is the real cause of the trouble, is left unmolested.

Rheostats are also much more heavily strained on roads possessing considerable grades, and, consequently, on these roads tend to increase in resistance more rapidly, and thus prevent the most effective operation of the equipment; this condition increases materially the watts per car-mile required on grades where starts are frequent.

In the type of controller under consideration the resistance between the second and third step, R_2 and R_3, being high, is not of much importance in this part of the operation of the controller, provided it is not so high that the car loses acceleration; but if we follow the operation of the controller shown in Fig. 2, it will be noticed that on the sixth notch the motors are connected in multiple, and this second to third step in resistance is again put in series with the two motors in multiple. Here, if the second step is high, the equipment will lose acceleration, and when arriving on the seventh notch the motors will again be subjected to an abnormal flow of current.

It is evident that these conditions can only be determined by the direct measurement of the resistances of these circuits as made by the controller, but the resistances of these circuits possess peculiar features which are not common to a purely metallic circuit. We find contact resistances in the controller, and carbon-brush resistances in the motor. The contacts give extremely variable and unreliable results when measured with a low potential test current. The carbon-brush contact will often appear as an insulator under this condition, and a poor controller contact will give a constantly varying resistance.

In order to bring the contact resistances down to normal it is necessary to pass considerable current through the equipment when testing, and it is most convenient to obtain the current from the railway circuit. But when we use a current varying as the ordinary railway current varies, and yet discover the variation of resistance as low as .005 of an ohm, another difficulty confronts us, and neither a bridge method nor fall of potential method is applicable to this work.

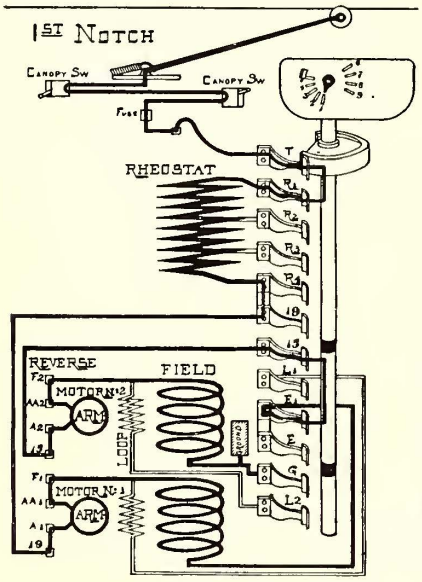


FIG. 1

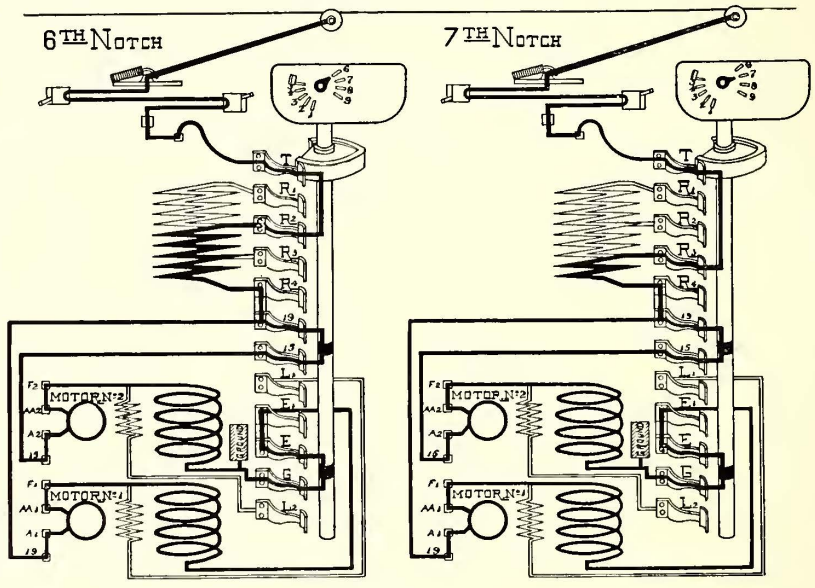


FIG. 2

In any bridge method the measurement of a resistance also includes the contact resistances by which this resistance is placed in the measuring circuit, as at Fig. 3, and due to this varying quantity introduced into the bridge method it is not a reliable instrument under 0.1 ohm, nor at the other extreme can the bridge give quantitative results over 500,000 ohms. For these reasons the method is useless in measuring low resistances with any degree of accuracy which will admit of a definite analysis, especially in those resistances met with in fields and armatures. No multiplying arrangement can increase the accuracy of any measurement external to this instrument.

Thompson's method of measuring resistances, which is applicable to low resistances, is extremely delicate and of general use for this purpose; but there is one very important condition necessary in using this method. That is, there cannot be any appreciable resistance between standard and the resistance under measurement, as at *D* in Fig. 4, for in that condition there would be considerable fall of potential along the measuring lines, which will interfere with the accurate comparisons of the resistances, *A* and *X*, under measurement (and in car inspection it is impossible to have the standard and resistance under measurement adjacent to each other.) The volt-meter and ampere-meter method, where connected as at Fig. 5, will give the resistance sought by dividing the volts read by the amperes flowing. But in measuring an inductive circuit, such as a field or armature of a motor, we find that with the voltage falling the resistance between any inductive terminals is apparently lower than its true resistance, and with the potential rising the resistance will be apparently higher than the true resistance measured. This method is too tedious and unreliable for the purpose of accurately diagnosing equipment troubles, as we have to balance our circuits inductively as well as ohmically in using the trolley circuit in equip-

ment testing; but to make all this practical and of general utility the system must be so devised that the measurements and determinations can be made quickly, and not neeessarily by one skilled in the art.

The author, after years of experience, has had to abandon these methods, for they did not produee sufficiently eoneordant

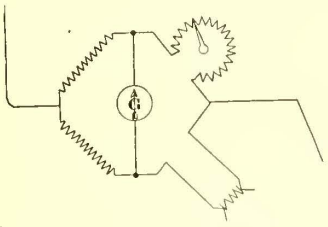


FIG. 3.—BRIDGE METHOD

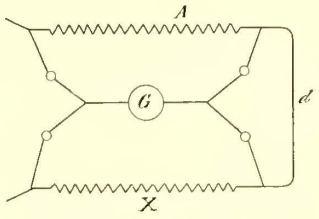


FIG. 4.—THOMPSON'S METHOD

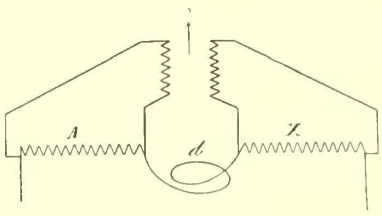


FIG. 6.—DIFFERENTIAL METHOD

results to make the analysis of equipment positive, and he has developed the differential method shown in Fig. 6. This is nothing more than separating the differential eoils of Kelvin's method, electrically, so the resistance between A and X would not interfere with the accurate comparison of two resistances.

Another condition necessary in the development of a system is the keeping independent from each other the different tests requiring different connections made to the testing apparatus, so an interlocking system had to be devised by which means the test

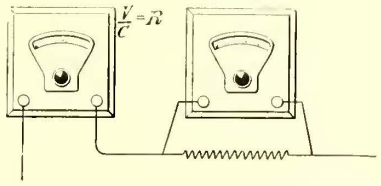


FIG. 5.—VOLT METER AND AMMETER METHOD

under eonsideration eould only be eonnected up when the dial was turned so the pointer was opposite that test, then the holes for inserting the plugs in this test registered with the proper receptaeles, and the plugs could be inserted for this test, and no interconnections could be made which would injure the instruments used in these tests.

The semi-portable apparatus known as form D is shown here, Fig. 7, which combines, besides the inspection tests, all other well-known ampere-meter and volt-meter tests which are required on the line, car operation and electrolysis. The testing set, including only the inspectors' test, is a much more portable affair, and can be readily carried from car to car. It is very easy to make an eleetrical inspection of an equipment in one minute, when proper arrangements are made to expedite the test, and a testing set can be taken to any part of the road where the ears can be delayed, and this test ean be made on each car by holding it for one minute.

The inspeetion test consists simply of measuring the equipment up on eaeh notch of the controller, and every road fixes its maximum and minimum standard for each type of equipment, there being considerable range at first between the allowable maximum and minimum.

To maintain an equipment means the keeping of the different controller points within standard values, and any part which departs from standard value ean immediately be repaired at small cost, before the more serious secondary effects have rendered the equipment a eripple.

I show in Fig. 8 a plotted curve of ten identical equipments which were inspected on a fairly well operated road, and it shows quite a variation in rheostats, and also two burnt-out fields and a poor brush holder. A straight line is drawn through these tests in order to show where the standard should be. It will be noticed that there are high rheostats in several equipments, and it will also be noticed that in equipment No. 2 the high rheostat has resulted in the burning of the field of No. 1 motor. It will cost five times the amount to replace the field that it would to repair the rheostat; and it is only by careful inspection that these primary troubles ean be detected in time to prevent a more serious loss.

The ageing effect on the different types of equipments tends to lower in some and to raise in others the resistance of the rheostat. The field resistanee will fall slightly, owing to the annealing effect on the wire, but if the resistance falls below 1 per cent it is due to turns being short, or the carbonizing or "baking" of the wire insulation, which allows the eurrent to pass between the adjaeent turns through the carbonized eotton insulator instead of around the turn to produee the magnetic effeet on the field. The result of this is to make the armature revolve faster in the weakened field, and the armature will become overloaded in its effort to run the car, and also to carry the other motor; in this way if the equipment is operated the result will be an armature burnt out.

In one ease where I inspected the ears, the armature winder, who was an excellent worker, had been discharged for the reason that his armatures would not run more than a few hundred miles before being burnt out. I found that defective fields were the cause, and after replacing the bad fields in these equipments the armature winder was reinstated, and there has been no trouble since.

An undiscovered baked field is one of the most prevalent causes of motor troubles. A number of methods of winding and treating fields are now in use, whieh have for their purpose the preservation

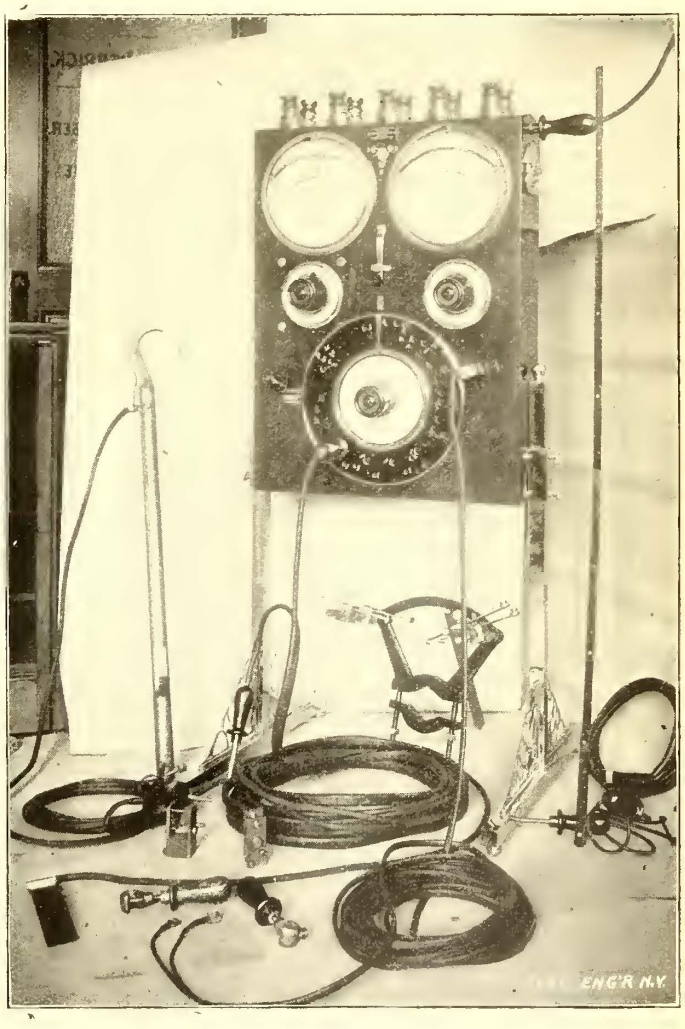


FIG. 7.—TESTING SET

of insulation between adjacent turns of wire, such as winding the wire with asbestos under the cotton. Care must be exercised in using this wire, as some of the forms will not hold the proper number of turns with this increased size, due to the asbestos covering, and if the proper number of turns are put on the form the field spools will not fit in the motor.

Another method used is to slush these coils as they are being wound or to dip them, after they are wound, in a solution made up of chalk, magnesia-oxide and water to the consistency of whitewash. This foreign material, when introduced into the winding

and baked, hardens and forms a mechanical barrier between the adjacent turns and prevents their short circuiting.

Other methods are practiced, such as dipping the field coil into varnish or insulating compounds. These different methods all have for their purpose the introduction between the adjacent turns of wire of a noncarbonizable insulator.

The field coils must be well baked after the application of any of these methods in order that any moisture or alcohol may be driven off before the coils are used. It has been the practice to pass current through these coils and heat and bake them in this way, but when water or alcohol is present internal electrolysis is set up, which forms internally a conducting copper salt, and this destroys the insulating properties of the mediums employed. Another point may be mentioned here in regard to baking where armatures and fields show low resistance to ground after being baked. The baking oven is often completely inclosed, and any moisture excluded from the coil is held in the air; a baking device of this kind, which has no ventilator, is really a steam box, and not a baking oven, and high insulation cannot be obtained unless ventilation to the oven is provided.

The best way to measure the temperature of a motor is to measure its resistance when hot, and for each degree centigrade rise in temperature of the field the resistance will increase 0.38 of 1 per cent. Fig. 9 gives the increase of resistance for each 0.1 of an ohm to 1.5 ohms, and up to 100 degs. centigrade. The drop in volts across one field when the equipment is running is the best method of testing whether the two motors are taking their loads equally when they are connected to a series parallel controller. When the motors are in series they are both taking the same current and the drop across the field should be reduced one-half when the motors are thrown to multiple, and the same current passing in both cases. If, under this condition, the voltage drop is not cut in half the motors must be out of equalization, 8 per cent being the maximum difference in equalization allowable. With the differential method each coil takes the drop off of one field of each motor, and the hand stands at zero in case of equalization. If the hand departs from zero as the speed of the equipment increases the lack of equalization is due to difference in air gaps of the two motors. If there is a constant deflection for all speeds, the non-equalization is due to the unequal resistance of the two motors in multiple.

In the tests on the armature and its commutator, which are the most delicate part of the equipment, the first succumbs to ill usage or lack of proper inspection of the equipment. The different diseases met with in this part of the motor are grounds, short circuits, open coils, broken leads, broken down insulation in the commutator, and especially short circuiting through the commutator ring. Their detection is rendered easy by a bar to bar test on the armature. Fig. 10 shows the method of applying this test to the armature; a brush-holder yoke is clamped to the shaft of the armature, and insulated brushes bear on the bars of the commutator; by moving these brushes around the commutator the indication of the instrument will be constant in all positions of the brushes; but if an armature is wrongly connected there will be a

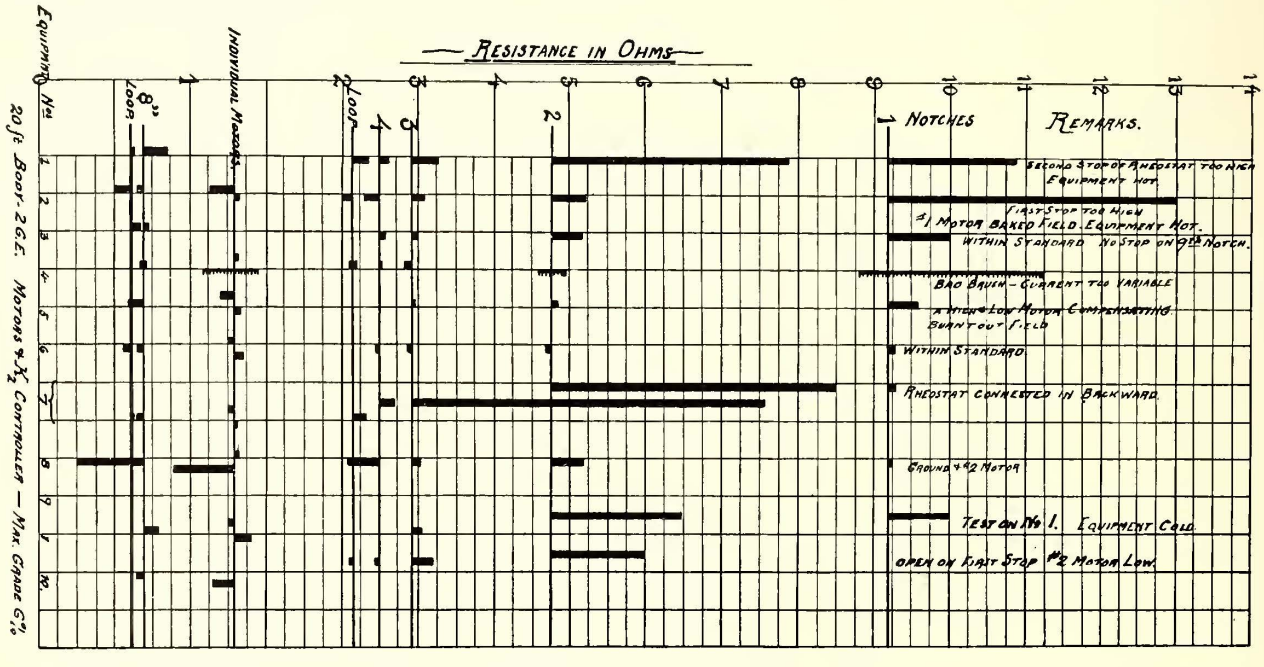


FIG. 8.—RESULT OF TEN DIFFERENT TESTS

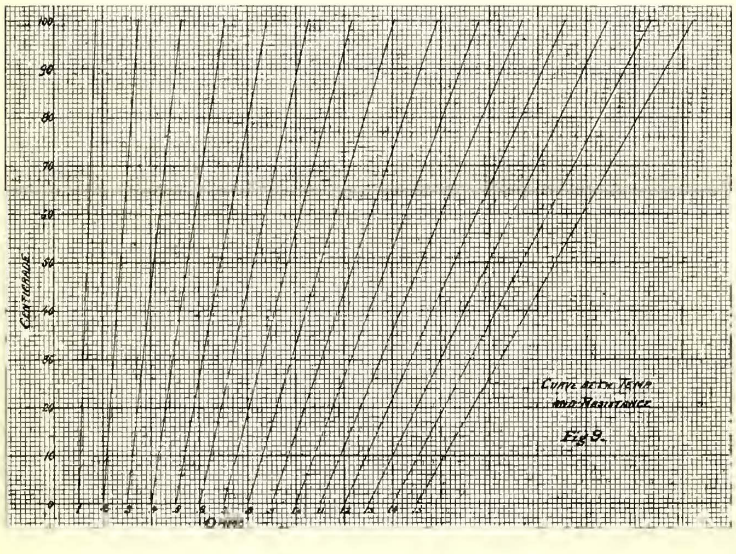


FIG. 9.—TEMPERATURE AND RESISTANCE CURVES

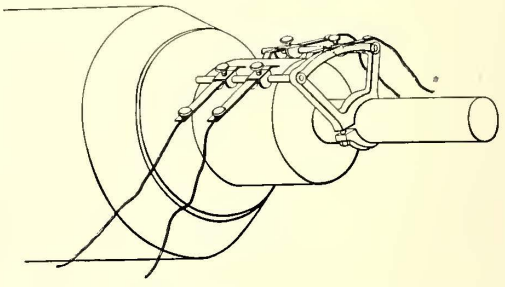


FIG. 10.—METHOD OF TESTING ARMATURE

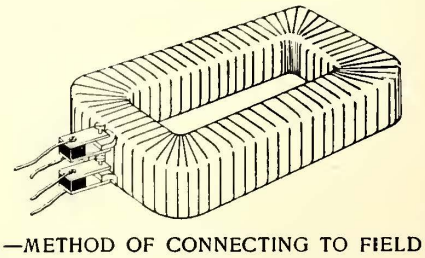


FIG. 11.—METHOD OF CONNECTING TO FIELD COIL

change in values when the brush rests on that commutator bar to which the misplaced lead is connected. Two bars which are short circuited together will give readings lower than normal when they lie between the four testing brushes. A ground on an armature can be located when one of the measuring terminals is connected to the shaft. The grounded coil connects to that commutator bar which gives the lowest reading on the measuring instrument when the measuring contacts are revolved around the commutator. Where the insulation is to be measured the same connections are kept on the armature as for ground, the test plugs are removed, the dial turned to insulation test, and plugs inserted in the exposed receptacles; the insulation is then read directly in megs. on the insulation scale of the instrument. Fig. 11 shows the method of connecting to the field.

The controller has troubles of its own, such as poor contacts of the fingers, short circuits between fingers, grounds, burnt-out segments and misconnections; the insulating partitions between fingers also may become carbonized and cause an arc which destroys the contact fingers. Many imperfections in the controller circuits leave their imprint on the controller. Several of the most prevalent indications will be mentioned, such as the burning of the second resistance contact and an open connection in the first resistance step, indicated by the first resistance contact being bright. A bad flash at either loop contact; where the loop is cut around the field, indicates an open or poor field connection. In this way many things can be observed in connection with the equipment, and it requires that a successful inspector be keenly alive to all the little external evidences of the internal troubles. To aid him I have produced diagrams of connections, divorcing the essential apparatus of the equipment from the intricate wiring system, so that the conditions of cause and effect can be quickly arrived at.

The controller diagrams that we have studied in Figs. 1 and 2 are two of five different types. Placing them historically, we have, first, the rheostat control, which consists of a resistance in series with one or two motors, as the equipment requires. The function of the controller in this case is to close the circuit and vary the resistance in series with the motors, and in this way control the current delivered. The next step in the art of equipment regulation was to first place both motors in series, and also in series with the resistance; after this resistance is cut out the motors are automatically placed in multiple. At this point there is a divergence in connection, one type, such as the *K* controller, places part of the resistance in series with both motors in multiple. The type known as *G* controller, in passing to the multiple position, places one motor directly across the line potential, and the full resistance in series with the other motor, which is cut out in the succeeding notches of the controller, until both motors are directly across the line. The type known as No. 14 controller has a separate resistance step in series with each motor; when the motor is in series these resistances are cut out alternately, both in the series and multiple positions of the controller. Type *C* controller comprehends somewhat the same general arrangement, the relation of the parts only differing in reference to the controller contacts. Each of these controllers has its peculiarities, but to go into them in detail would require too lengthy a discussion.

The wire for car wiring has not been selected large enough in those circuits which lead directly from the motor to the controller. Due to the circuitous route that the current takes in a two-motor equipment with a 20-ft. car body, the length of this circuit is 217 ft., which of No. 6 wire gave under the condition of equipment tested 12 volts drop in this circuit only. This drop occurs under the conditions when the motor requires the maximum potential delivery at its terminals, and a few additional dollars spent in the internal wiring of a car would accomplish the same results as hundreds of dollars spent on the line.

The application of electrical inspection of equipments brings out some very queer conditions caused by the car wiremen not fully comprehending the wiring diagrams furnished. In one case I found a number of equipments with both loop boxes connected in series around the fields of one motor. In another case I found all the rheostat boxes connected in backwards; that is the low resistance step connected to the first step and the high resistance step cut out just before the motors were put across the line. In another case of No. 14 controller I found that one resistance had always been short circuited by a misconnection, and the equipments had been working under this connection for several years.

Briefly summing up my experience of the testing of over a thousand equipments, including nearly all types extant, I find the principal weak points are, first, the two-way connecters are responsible for a great deal more than their share of trouble, and that every break in the continuity of the conductor system reduces their liability of the equipment for continuous operation. Second, that a motor is not any better than its field. Third, that careless brush inspection is responsible for more burnt-out armatures than those caused by poor motormen. Fourth, that the maintenance of an equipment is much more economical and satisfactory than trusting to Providence and awaiting the time until it breaks down; in other words, it is far better for a street railway manager to operate a sanitarium for his equipments than a hospital.

The vitality of an equipment rests entirely upon the excellence of its insulation, and the trend of recent improvements in the equipment is to abandon those insulators which in time either oxydize or carbonize and become conductors.

One final point I would like to mention in regard to high potential alternating insulation tests for railway apparatus. This is generally considered a satisfactory method, because it shows so many faults not indicated by other tests, but the application of this high potential method, with depleted insulation, usually develops the fault which it detects, and curtails the natural life of armatures and fields.

A Large Suburban Car

The Pennsylvania Traction Company of Lancaster, Pa., is one of the largest suburban roads in the State outside of the Philadelphia interurban lines. The practice of the company is especially interesting, because it has tried many different kinds of cars, with a view to finding out which will accommodate its heavy traffic to the best advantage. It is also interesting as showing the general direction or tendency of electric railways in the matter of car construction and design. The car is 28 ft. long and 38 ft. 8 ins. over all, built by J. G. Brill Company. It has curved sides, and is 7 ft. 5 ins. wide at the sill, and 8 ft. wide at the posts. The platforms are 4 ft. 6 ins. long, and the height to the sill from the head of the rail is 30 ins. The step is 17 ins. from the head of the rail, and has a 12-in. riser to the platform.

LONG CAR—LANCASTER, PA.

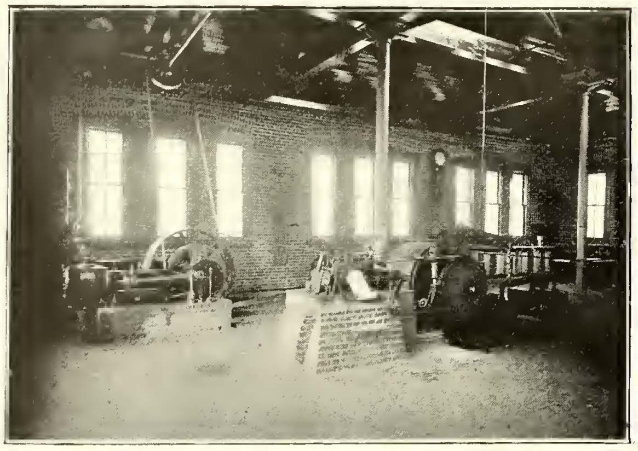
Each end of the car is provided with a stationary round-end vestibule, with doors folding against the vestibule. This is a complete inclosure, and there is no entrance to the car until it has stopped. The completely inclosed vestibule incidentally increases the profits of the road by encouraging riding through the winter weather by making it perfectly comfortable.

The car is mounted on Brill Eureka maximum traction trucks. The wheel base is 4 ft. and the wheels are 33 ins. and 20 ins in diameter. There are two Westinghouse No. 38 motors. The gage is 5 ft. 2½ ins. The car is furnished with twenty reversible-back seats, covered with spring rattan. This gives a seating capacity for forty persons. The inside finish is of cherry with bird's-eye maple headlining. The trimmings are of bronze throughout. There are two electric headlights and two Brill sand boxes. The buffers are of the Brill angle-iron type. The weight of the car without motors is 20,500 lbs. The trucks weigh 3500 lbs. each.

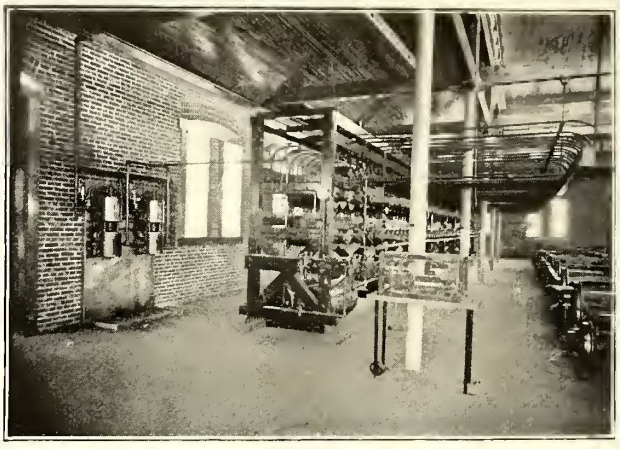
Testing of Apparatus at Purdue

The engineering laboratories of Purdue University have recently been augmented by the addition of a new room, measuring 50 ft. x 100 ft., in which is installed an experimental equipment of considerable importance. The apparatus is, for the most part, devoted to railroad testing in some of its numerous branches. One of the larger pieces of apparatus is the Master Car Builders' brake shoe testing machine, shown in Fig. 1. This machine was built in 1893 at Wilmerding, Pa., for the M. C. B. Association, and has recently been deposited at Purdue, where the future work on brake shoe testing will be done. Several notable series of tests have already been carried out on the machine by committees of the M. C. B. Association, the results of which tests have been published in its proceedings. The machine consists in its elements of a standard car wheel mounted on a shaft to which is keyed a large fly wheel, designed so as to possess at any speed a kinetic energy of one-eighth of a loaded 60,000-lb. freight car. The shoe to be tested is applied to the car wheel by means of a series of levers, so arranged as to produce between the shoe and the wheel the different pressures actually employed in service and emergency applications. Attached to the head which holds the shoe is a recording dynamometer, arranged to give a continuous record of the tangential pull of the shoe on the wheel. The recording mechanism is also provided with means for registering the speed of the periphery of the wheel, and connection is made with a chronometer for taking the time record. In making tests the double engine, shown in the illustration, is connected with the fly wheel by means of a clutch, and the wheel brought to the desired speed. The clutch is then thrown out and the levers connected with the brake shoe are tripped, thus bringing the shoe in contact with the wheel. The wheel is thus brought to rest in precisely the same manner as the car would be stopped on the road. The data derived from the machine serve to determine the relative coefficients of friction of different shoes under different speeds and pressures of application.

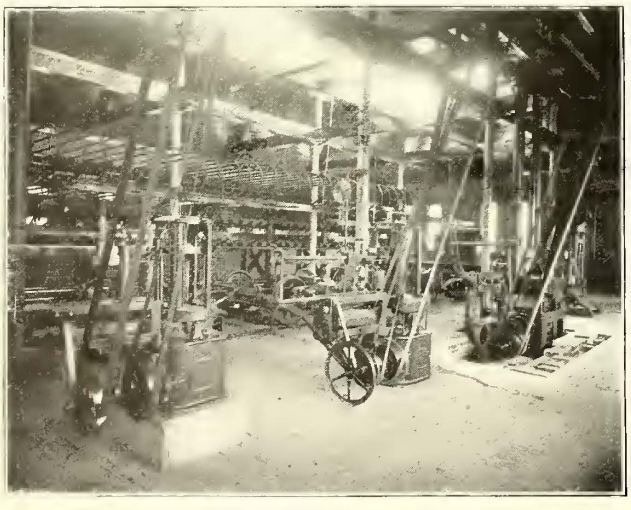
Another unique piece of apparatus is the air brake testing rack, also belonging to the Master Car Builders' Association. This rack, shown in Figs. 2 and 4, was until recently located at Altoona, Pa., and is the one upon which the notable tests conducted by the M. C. B. Association were made. This rack has been deposited at Purdue, and future shop tests of air brakes will be made at that institution. The rack consists of a complete equipment for a fifty-car train. The triples, reservoirs and cylinders are in duplicate. Referring to Fig. 4, the hose pipe shown in the illustration as connected with the upper row of triples can be disconnected and connected with the second set of fifty triples, which may be applied to the lower row of reservoirs. All the fittings, such as angle cocks, hose couplings, drip cocks, etc., found upon a fifty-car train are made a part of the train line, so that the action of the triples on the last reservoirs of the rack will be similar to that found upon an actual train of cars. The plant is provided with recording devices arranged to accurately register the time of application of the brakes in different portions of the train.



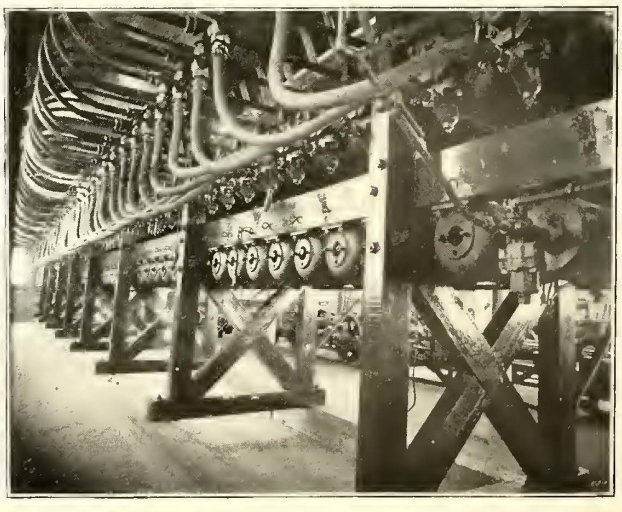
BRAKE SHOE DEPARTMENT



AIR BRAKE DEPARTMENT



MACHINES FOR TESTING STRENGTH OF MATERIALS



BRAKE TESTING RACKS

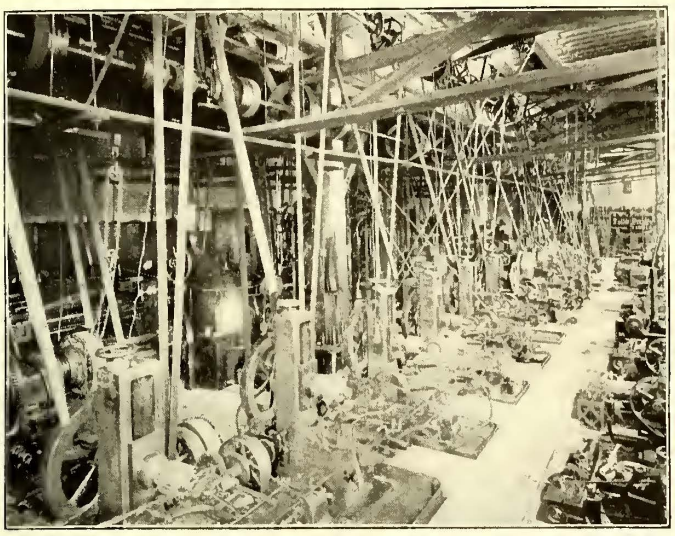
In another portion of the room are located testing machines ranging in capacity from 600 to 300,000 lbs. and adapted for the testing of iron and steel, wood, stone, cement, wire and brick. This portion of the laboratory is shown in Fig. 3. Provision is also made for, and a good deal of work has already been done in the testing of various elements entering into car construction, such as brake beams, truck and body bolsters, truck frames, etc. Among other interesting pieces of equipment may be noted a full-sized model, consisting of cylinders, smokebox and stack of a Richmond compound locomotive; this model was exhibited at the 1897 Master Mechanics' Convention, and there attracted a great deal of attention. There are also interesting and valuable exhibits of freight and street-car trucks, among which are three Brill and one "Lord Baltimore" trucks, couplers, brake beams and interlocking apparatus.

Motor Gears and Pinions

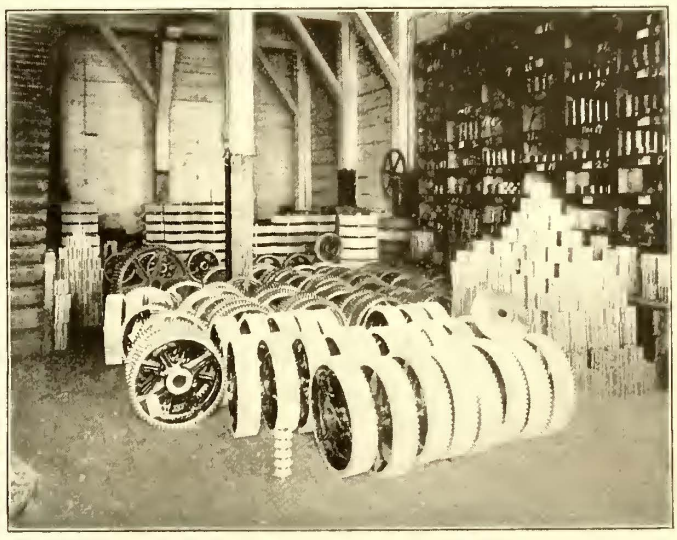
There are few industries allied to industrial traction that have grown into greater magnitude than the making of gears and pinions for street railway service. The users of machinery and appliances of any kind are naturally interested in knowing how the machines they buy are built, of what material, and the capacity and reputation of the establishment engaged in their manufacture. This is especially true of the industry of which this article treats, and in this case, is of double interest because it is found, so far as the records show, that the R. D. Nuttall Company, of Allegheny, Pa., was the first outside of the electrical manufacturing companies to engage in the making of gears and pinions. At the suggestion of one of the local street railway companies, this company, before 1890, had undertaken the manufacture of gears and pinions, and soon after began their manufacture for the general market. The business of the concern, however, was started in 1885 by R. D. Nuttall, and was directed to the making of machinery of every description. The present company was incorporated in 1891, and in 1893 came under the present management, F. A. Estep president, J. R. McGinley vice-president and Thos. Fawcus superintendent. The works are located on Grant Avenue, Allegheny, and occupy a two-story brick building, 100 ft. x 80 ft., with a new addition just completed of 60 ft. x 20 ft. This is being equipped with new machinery, not only for increasing the capacity for making motor gears, but for spur and beveled gears of every description. One of the new machines has a capacity for cutting spur gears 15 ft. in diameter up to 24 in. face, and another machine for beveled gears, up to 8 ft. in diameter, with the latest improved milling machines and key seaters, and a Betts turning and boring mill. The new shop is also to be equipped with a 20-ton traveling crane.

It is the motor gears and pinions, however, in which the reader is especially interested, and which will now be followed in detail. The gear blanks are made chiefly of cast steel, although occasionally, when specified, cast or malleable iron is employed. The blanks are cast in half circles, being split through the spoke, and the first operation in fitting them for service consists in milling the faces of the halves to an accurate male and female fit, the two halves being fastened side by side to the bed of the machine with the curved side down, so that the milling cutters for both faces are on the same shaft. From this machine the parts go to the gang drills, where holes are drilled for receiving the bolts, by means of which the two parts are united into a perfect gear. In the process of drilling, steel templates are employed, which being clamped to the face of the sections, serve as a guide for the drill. This work, as well as all the different operations throughout the shop, is done by the piece, the workmen receiving a certain price for a certain operation, and, in case of the drilling, one man is able to attend to three machines. Following the drilling, the parts are bolted together, when the hub is bored out to the axle fit. Next, the face and edges of the rim are turned to an exact diameter, and in this operation two classes of tools are employed, on one a broad knife cuts the face and edge of the rim as the blank is revolved, while in another process a milling tool runs against the face of the rim and cuts it down as the latter slowly revolves. Of course it is understood that there are a number of tools for each of these operations, so that a large number of gears are undergoing the same operation at the same time. The blanks are now ready for cutting the teeth, and this process is done on automatic gear-cutting machines, of which there are two different styles, some being of the Gould & Eberhardt type, and others of the Brown & Sharpe make. There are twenty-six of these machines, arranged on two sides of a narrow aisle and all are on the same floor with the machines previously described, together with various machines for other purposes.

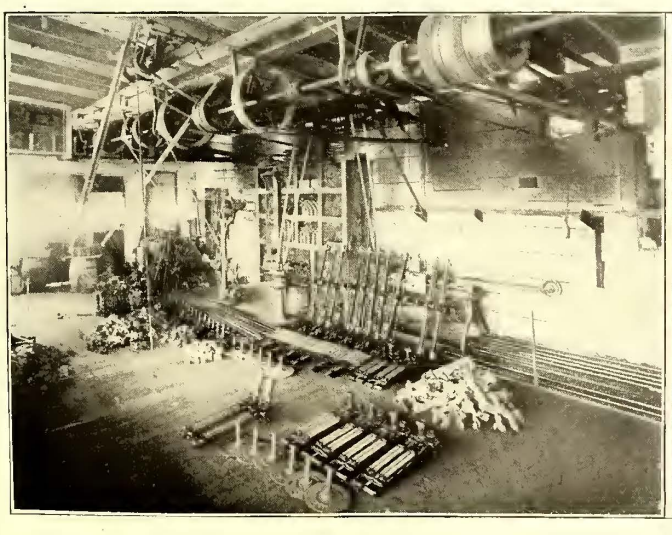
In the process of gear-cutting the blanks are set up edgewise across the face of the table, and the cutting tools work on the un-



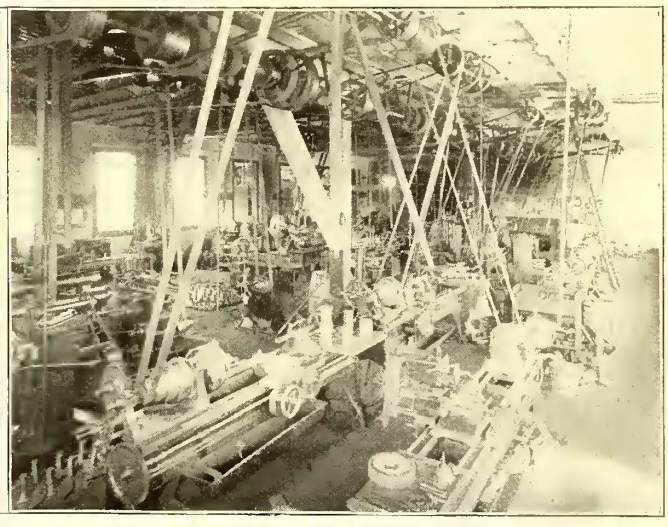
CUTTING GEARS



A CORNER IN THE SUPPLY DEPARTMENT



TROLLEY SHIPPING DEPARTMENT



MACHINE SHOP

der side of the blank, as it moves back and forth. The practice is to finish one tooth at a time. Although it is possible to cut more than one tooth, the result is less accurate than when only one tooth is cut. In the process of cutting, the milling tools are flushed with a lubricating mixture, which flows in a copious stream from small pipes through which it is pumped from a large tank located in the basement, and to which the surplus is returned by drain pipes.

The blanks for pinions are in all cases forged steel, hammered to nearly accurate size, and the first operation consists in drilling or boring out the centre to fit the armature shaft; next, the surface is turned down to accurate size, when the teeth are cut in the same manner as for the gears, the most accurate measurements being followed in all the operations. When finished, the gear and pinion are mounted on suitable mandrels for testing, and the gears are driven by means of a belt at a high speed forward and backward, to see that there is a perfect mesh of the teeth, so that they will run at high speed without noise. The same test also determines the amount of back lash. The plain surfaces are then painted with white lead, and the rough parts with japanned paint, when they go to the store room, ready for shipment. They are not found, however, in any great quantities in the store room, as the company has never yet been able to keep ahead of its orders to any great extent. A few are noted, however, one lot being the last of a hundred to fill an order from Woolwich, Kent, England, and some others, the last of an order for 200 from a city in Italy, which show the wide range of market to which the works cater.

The output of the works is not confined, however, to gears and pinions, but embraces other street railway supplies, including trolley wheels and harps, which are made by the thousands, trolley poles and bases, journal boxes and bearings, in both babbitt and bronze. The trolley bases manufactured by this concern are known as the Standard, and include five different patterns. In the manufacture of bearings, a shell of malleable iron is generally employed for both the axle and armature bearings. These are babbitted and faced down ready for service. The company manufactures many of its own small tools, and for this purpose a separate room is equipped with a fine line of machines, specially designed for tool making, and in the same room is a specially fine tool, designed for planing the teeth of beveled gears down to an accurate finish. Other operations consist in finishing the bolts for side bars of the trolley bases, and the threading of bolts for uniting the parts of the gears. The blanks for the parts are bought from the manufacturers, but the thread cutting is done in the company's shop, for which purpose a number of bolt and nut threading machines are employed.

The wood-working department, including the pattern shop, is located on the second floor, and is provided with the usual equipment of wood-working tools. On the same floor are the offices of the company, while the engine and boiler room occupy a section of the first floor. A 100 h.p. Phœnix engine serves to drive the shafting on the first floor, and a Westinghouse 35 h.p. engine that on the second floor. There is, as well, a lighting generator, incandescent lamps being located about the various tools, an essential feature, as the works are required, generally, to run night and day to keep up with the orders, a double shift of hands being constantly employed. The capacity of the works is about one hundred gears and pinions a day, besides the other appliances above noted, and the employees number usually about one hundred. The affairs of the company are under the immediate direction of F. A. Estep, president and treasurer.

Collection of Blanks and Forms of the Accountant's Association

W. B. Brockway of Toledo, Ohio, secretary of the Street Railway Accountants' Association, has announced that the department of blanks and forms of that association has progressed so far that it is almost in a state of completion, but is being held open for about thirty days in order that those companies who have not already done so may be enabled to contribute their blanks and forms, as requested in a circular letter mailed from the association headquarters on Nov. 15, 1898. As this department gives promise of becoming an important factor, it is hoped that prompt attention will be given to this appeal so that the collection may be absolutely complete.

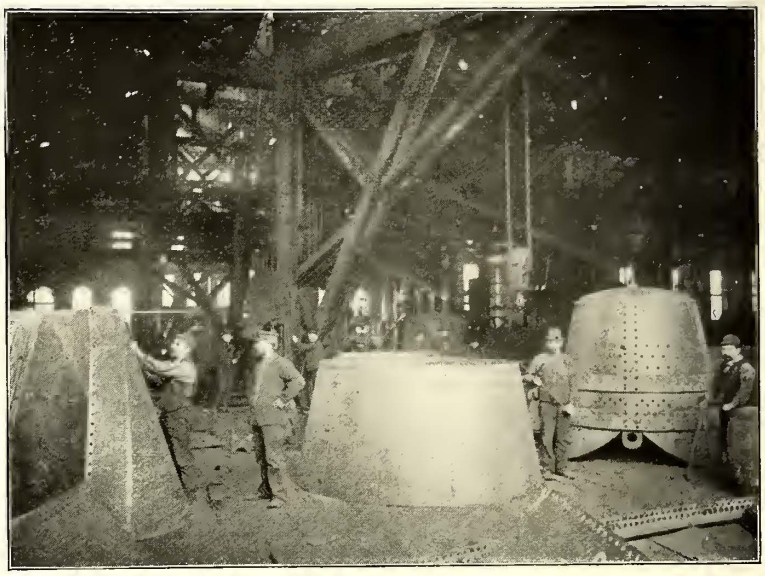
Plate and Structural Work of Steel

Although several years have elapsed since steel in plates and in bars has been employed in structural work, or for smoke stacks, smoke flues, water and oil tanks, gas holders, etc., the actual manipulation of the material is still a new industry to most people. This is not to be wondered at, however, for the products have such a wide application and the manufacturing establishments are necessarily of so great magnitude and so few in number, that unless one is in the market for some one of the various products to which steel readily lends itself, he is not particularly interested in viewing a tank, a cold storage bin or even a towering stack.

One of the largest firms engaged in this industry is the Riter-Conley Manufacturing Company, of Pittsburgh, which, in addition to its construction work, maintains a corps of expert engineers for the purpose of designing and giving expert advice on all questions of economical construction.

The works of the company occupy two plants, one in Pittsburgh and the other in Allegheny. In both about 30,000 tons of sheet and structural steel are consumed annually, and about 1200 men are usually employed. The Pittsburgh plant occupies three buildings, each extending through a block. The first fronts on Water Street, facing the river, and extends through to First Avenue, while the second, a large brick and steel structure, has 240 ft. frontage on First Avenue, reaching through to Second, and the third extends from Second to Third Avenue. The tank department occupies the Front Street building, in which are also located the main offices and designing rooms. To this department the plates are delivered by wagons, the material being purchased for the most part from the neighboring steel mills, or mills in the vicinity of Pittsburgh. The leading tools consist of punches, shears, drills, bending rolls, hydraulic flangers, pneumatic tools and cranes. Of these what are known as rack punches are of special interest. These are fitted with a table to which the metal sheets are attached, and being adjusted to the punch, the sheets are advanced a notch at a time, so that a row of holes equally spaced are punched along the entire edge of the sheet without any attention being given to centering or adjustment. At the last hole, at a corner, the sheet is swung around the punch as a center until the holes are complete on all four sides. In the same building is a blacksmith department, in which the hand flanging is done. Here the most difficult elbows and bends are designed, the workman showing marvelous ingenuity in forging the plates to accurate fit. Air and hydraulic riveters are located at intervals through the works, one a vertical machine, on which flues or tubes, 35 ft. in length and up to 8½ ft. in diameter, can be riveted in single sections, the shell being supported by block and fall from a tower and lifted by hydraulic power. There is also a pneumatic reamer which is attached to the long arm of a jib crane by means of a trolley wheel, so that it has a range of 18 ft. in every direction,

One set of bending rolls is 21 ft. in length, and is driven by an independent steam engine. Passing by the jib cranes, we come to a gang punch, an enormous machine which is capable of punching at one stroke sixty 13/16 in. holes, in ½ in. steel plate. The punches are ranged in three rows and have capacity of receiving



MAKING 40 TON LADLES

a sheet 8 ft. across. The most powerful tool, however, is a 150 ton hydraulic flanger, which has a movable bed plate 10 ft. in diameter, and which will receive plates of the same size. In this machine the upper bed is stationary, while the table is forced up by two enormous plungers, supplemented by several smaller plungers that work through openings in the bed and give a special bend to the plates as may be required. The shipping facilities of the establishment are excellent, as a siding from the Pennsylvania Railroad runs along one end of the main building, where is located a powerful steam crane, by means of which the

CONSTRUCTING A 200 FT. SELF-SUPPORTING STACK

parts or finished structures are readily loaded upon the cars. This concern has during the past year provided structural work for the power and car stations of the Dublin Tramway, of Dublin, Ireland, and more recently has made four smoke flues, each 1000 ft. in length and 12 ft. x 11 ft. sections, for the Metropolitan Street Railway Company, New York City. Among other large orders noted were the material for ten open hearth furnaces, each of 50 tons capacity, for the Alabama Steel & Ship Building Company, to be erected at Ensley, Ala. There was also noted an enormous quantity of riveted steel gas pipe, from 20 ins. to 48 ins. in diameter, designed for a plant in Everett, Mass.

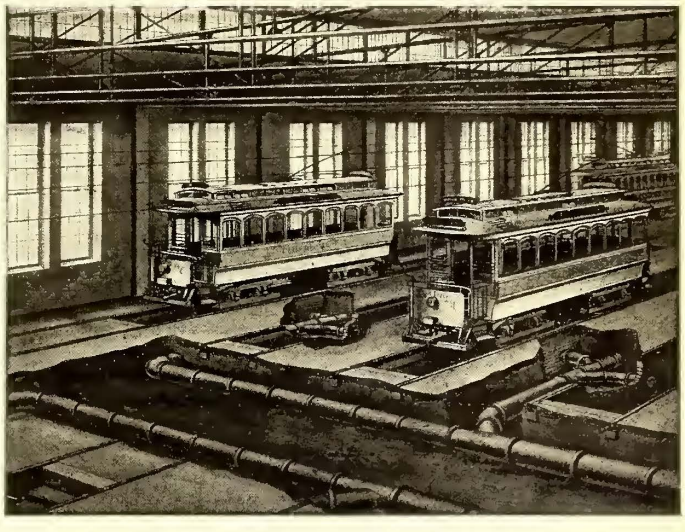
The Allegheny plant is devoted chiefly to the manufacture of structural work and gasometers, and the works occupy seven acres and consist of five buildings, located on Preble Avenue. The buildings are arranged on the four sides of a square, with the power building between. These buildings are known as the receiving shed, are 52 ft. x 175 ft., and from the ends of this lead out the gasometer building, which is 42 ft. x 370 ft., and the structural department, which is 72 ft. x 306 ft. The shipping shed, which is located a little distance from and opposite the other ends of the other buildings, is 60 ft. x 260 ft. Sidings from the neighboring steam railway lead directly into the receiving and shipping sheds. In the former the material is checked up and distributed, the unloading being done by means of an electric traveling crane of 15 tons capacity. This department also included the wood-working branch, in which templates for laying out the work are made. From the receiving shed the material is delivered to the structural department, where it is first laid out from the templates, when, by means of trolley hoists and trucks, it is progressed in regular order to the punches, shears and riveting machines, of which there are a great variety, chief among which are portable air riveters. Some of these are capable of heading a rivet 1¾ ins. in diameter. In this department are five hydraulic jib cranes of enormous capacity. Here are turned out lattice columns and girders and roof structural work of every possible design.

In the manufacture of gas holders, the material is received from the shed as for the other department and progressed in regular stages through the different classes, while in this department, in addition to the punches, are a number of radial drills for making the holes in plates that are too thick for the punches. These are frequently 1¾ ins. in diameter and take corresponding rivets, for the heading of which special riveters are used. Between the main buildings and the shipping sheds is a large area of yard space in which structural work is set up and fitted before shipment, when it is taken down and advanced to the shipping shed, which is of sufficient length for receiving seven freight cars, upon which the materials are placed by means of another traveling electric crane. The company not only manufactures the materials above described, but provides and ships with the products derricks, hoists and other appliances for their erection. The power equipment consists of three engines, the largest of which is 175 h.p. These drive two air compressors of the Rand type, a pump for operating the hydraulic machines and three generators for light and power. The electric power is used for operating three traveling cranes of the Morgan manufacture of fifteen, twenty-five and thirty-five tons capacity and for stationary motors, one of which drives a line of shafting in a gasometer department. As noted above, shipments go to all parts of the world, competing in the price and quality with the reputable high grade products of the old world. In addition to the structures mentioned in this article, the company erects blast furnaces complete, including the hot blast stoves and stacks, stand pipes and towers for water works, penstocks for turbine power stations, grain elevators and miscellaneous work of all descriptions.

The business was established by James M. Riter in 1860, and up to 1873 the work was principally that of steamboat and oil tank construction. In 1873 the firm of Riter & Conley was formed. In 1898 a company was organized under the name of Riter-Conley Manufacturing Company. The affairs of the company are conducted under the direction of the following officers: Thomas B. Riter, president; W. C. Coffin, vice-president; J. S. Craig, secretary and treasurer, and Robert A. McKean, general manager.

The Heating of Car Barns

The extent to which means are being introduced for the heating of car barns is the best evidence of the advisability of maintaining within them a comfortable temperature. They are no longer to be considered as mere storage houses, for the extent to which work is carried on within them converts them rather into work rooms. The process of washing, cleaning, removing snow and ice and making repairs necessitates a temperature which will render such work both rapid and comfortable. In barns provided with pits the old method has been to apply the heat locally by stringing steam pipes along the sides of the pits, so as to rapidly melt such snow and ice as may be upon the running gear, and to simplify the matter of making repairs. But such an arrangement is seldom sufficient to also warm the building throughout, particularly along the walls. It is a well-recognized fact that car-house workmen can perform a much greater amount of work in the same time in a warm shop than in a cold one.



METHOD OF VENTILATING A CAR HOUSE

For a considerable length of time the hot air feature of the blower system has been utilized in locomotive round-houses and repair shops, the air being discharged directly into the pits, whence it rises, passing on its way through and around the running gear,

and rapidly clearing it of ice and snow. An arrangement of this character, as applied in a car barn by the B. F. Sturtevant Company, of Boston, Mass., is shown in the accompanying illustration. The air in this case is conducted through tile pipes from the central heating plant. This plant consists of a steel pipe heater, made up in sections, inclosed in a steel-plate jacket and connected with the fan, which is driven by an independent engine.

The air is conducted from the main underground pipes through branches and sub-branches to the pits, where it is discharged immediately beneath the cars. The large volume of air which is delivered is sufficient to perform the local work required, and at the same time to effectually heat the whole structure. The deflecting influence of the cars is such that they break up the vertical air currents, and spread them out more or less horizontally, so that the building is well heated at the floor level. By this system a plenum condition is maintained throughout the whole building; all pressure is outward, preventing inward leaks at crevices, and securing thorough circulation of the air. This large supply of hot air, which is a greedy absorber of moisture, keeps the building clear, and rapidly takes up the vapor arising from damp or wet cars.

Compressed Air Cars for New York

The Metropolitan Street Railway Company is making preparations to run several of its crosstown lines by compressed air, notably, the Twenty-eighth and Twenty-ninth Streets line, between the North and East Rivers. Aside from the motive power, the compressed air cars have a number of interesting features of construction, and in their framing are entirely novel. They were built by the J. G. Brill Company, of Philadelphia.

COMPRESSED AIR CAR, NEW YORK

The crosstown lines in New York City below the Harlem River are mostly short, and the traffic, except at the most crowded hours of the day, is composed largely of short rides. The type of car, therefore, to accommodate this business differs materially from that needed in any other part of the city. With compressed air as a motive power, certain changes become necessary in construction, and the result is the car shown in the accompanying engraving. The body is 22 ft. 4 ins. long. The car over the buffers measures 31 ft. 5 ins. It is 6 ft. 6 ins. wide at the sills, and 7 ft. 6 ins. wide at the posts. The platforms, which are not inclosed, are but 4 ft. long. The car stands 27¾ ins. high to the sills, giving a step 14 ins. from the head of the rail. With a low platform, this gives a 12-in. riser. The car is mounted on a No. 21-E truck, and has an 8-ft. wheel base and 30-in. wheels. The gage is standard, 4 ft. 8½ ins.

The whole center of the truck is left open to receive machinery, etc. Three compressed air cylinders, each 9½ ins. in diameter, are to be placed under both of the longitudinal seats, with which the car is fitted. The great wheel base is not a disadvantage of any importance, since these crosstown lines have a very large proportion of tangent. Some of the lines, indeed, are perfectly straight, with the exception of the curves at the switches near the ends of the lines. This feature, of course, makes the long wheel base very advantageous, in fact, because, even with a long body, the car is very steady.

The floor framing of these cars introduces a number of special features. It consists, first, of two side sills of wood, into which two end sills are mortised in the usual way. The side sills are then plated with iron on both sides. The inside plating is turned up at the ends against the end sills, and takes a firm bearing on them. A heavy plate is also put on the outside of the end sills, completely covering the ends of the side sills also. There are in all eight crossings, or cross sills, as they are sometimes termed. Six of these are of angle iron. The two nearest the ends of the car are deep plates turned up against the side sills and bolted fast. All the other crossings are of angle iron carried by malleable iron brackets, which are bolted to both angles and side sills. This form of construction gives an enormous amount of strength and stiffness. In order, however, to obtain good fastenings for the floor and for such attachments as must be necessarily connected to the bottom of the car, each one of these angle iron crossings has a 3-in. "nailing" piece attached to it, and held in place at each end by another malleable angle. These "nailing" pieces are also properly bolted to the angles. The usual diagonal struts are introduced at the ends of the car to keep the frame square.

It will be seen that in this form of construction the wood has been used where its strength can be employed to best advantage, and the metal is introduced in places where wood has naturally its greatest weakness, namely, at the joints. It must be understood that the side sills are only mortised for the timbers at the two ends, thus the whole strength of the wood is preserved. The car body, being very long and having a great overhang, requires an unusual amount of strength to support the long ends, and this strong floor frame was designed to give the required strength.

The springs under these cars were designed to give a very easy motion. The semi-elliptics were made 36 ins. long, not only giving ample support, but making galloping entirely impossible. The side bars of the truck, being under great strain, were made accordingly heavy and stiff, to carry the weight of a heavy car body and the propelling machinery.

There are four folding gates, with solid iron hood supports. The body of the car is, in general, finished according to the Metropolitan standard, the woodwork being selected white ash, and the veneer seat covered with standard Broadway carpet. The ceiling is of three-ply maple, without decoration. The trim inside is all of bronze, and the sash have metal styles. The brakes are of the Sterling pattern.

Each of the posts are provided with a push-button for signalling the conductor, and the lighting is done by three Pintsch gas lamps. The body is supported by a deep gas-pipe truss, well anchored at each end of the sills.

Insulating Compounds

The letters P. & B., under which the compounds and material manufactured by the Standard Paint Company, of New York, are issued, continue to be recognized as synonymous with preservative and roof paints, insulating tape, armature and field coil varnish and other insulations, as well as various products of rubberoid, which are manufactured by the Standard Paint Company. This company reports that its business during 1898 in electrical compounds was considerably in excess of that in any previous year since the organization of the company. The sale of this material in Europe is particularly satisfactory, and the P. & B. electrical compounds and armature and field coil varnish are rapidly attaining as high a position in the estimation of electricians there as they have in this country. The branch factory at Hamburg, Germany, has been kept busy ever since it opened at the beginning of 1898, not only in the manufacture of materials referred to above, but also in that of P. & B. preservative and roof paints, building sheathing and insulating papers and rubberoid roofing. The company also states that the orders for P. & B. insulating tape in both Europe and America have for some months past been far in excess of that in any previous time since the company began the manufacture of goods.

Handsome Parlor Car

The accompanying engravings show a director's parlor car recently constructed by the American Car Company of St. Louis for the Baltimore City Passenger Railway Company of Baltimore, Md. The car has elicited favorable criticism from quite a number of railway officials, and the following description will be of interest.

The body is of the swell and concave panel type, 30 ft. over corner posts, with 5-ft. platforms, and is mounted upon high-speed double-motor trucks. The smoking compartment is 10 ft. in length, and the ladies' parlor 20 ft. The doors leading to either compartment from the platforms are of the twin automatic type. The eight side windows are double-sashed, and glazed with beveled crystal polished plate, two windows at the center having large observation lights. Between linings on the inside the car measures 8 ft. in the clear.

The wood for the interior finish is a finely figured East Indian mahogany, known to the trade as Padouk, and was specially imported for this car. It is solid throughout, and a few beaded mouldings and delicate carvings stand out in clear-cut bold relief on the smoothly polished surface, accentuating the rich glowing amber and vermillion tints natural to this species of wood.

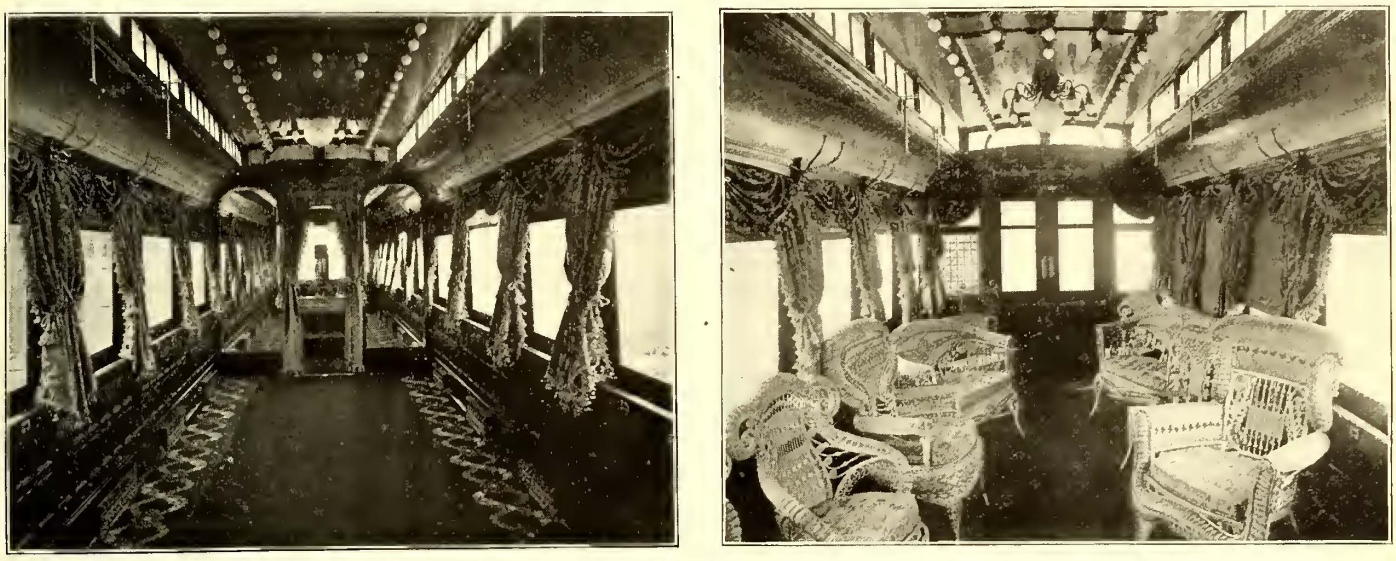
The interior lines of architecture are plain, modest and neatly elaborated into the colonial and empire style. The upper deck, being very broad, is recessed into a secondary dome, from which the opalescent center electroliers depend, surrounded and bordered seemingly by a myriad of translucent electric globes encased in bronze gilt husks.

The curtains are of green, silk-faced pantasote, mounted on spring rollers and Acme holding devices. The overhangings, portieres and upholstery are of a luxuriant texture in soft green tints, harmonizing nicely with the Royal Wilton floor rugs. The reed furniture of fantastic designs is stained and tinted to **mateh** the general color scheme. Two cheval mirrors are set in massive frames at the further end of the ladies' parlor.

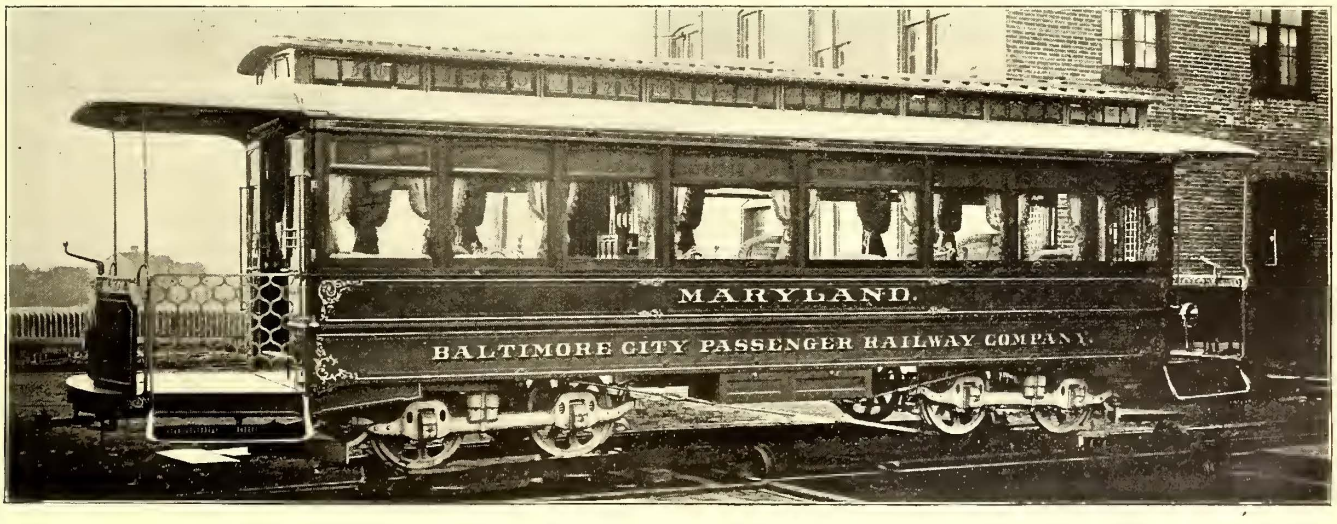
Every convenience conducive to comfort and luxury has been admirably placed and planned. The appointments include adjustable tables for games and refreshments. A folding lavatory and ice cooler, as well as a cosy buffet closet, find place in the smokers' den. The refrigerator, supply chests and tables are carried beneath the car body, being suspended between the trucks.

Twelve electric Gold car heaters are placed in the side walls, and a regulating switch turned to any of three points provides a varying degree of heat. A system of electric call bells is arranged to conveniently summon either porter or conductor, and the latter signals to his motorman by touching a push button. The other motor car accessories are of the latest and best types in use, and were specially manufactured for this car. The hardware trimmings, coat and hat hooks and parcel racks are of gold bronze. The electric headlights are 14-in. copper, silvered reflectors, incased in solid bronze frames.

The platform gates are of solid gold bronze of the grille folding type, and the dashers are capped with bronze and ornamental scroll designs. The exterior decorations of this car are in entire harmony with its interior furnishings. The color is a rich olive, the striping and ornaments gold, the lettering trim and neat. The car is called "Maryland," in honor of the state of that name.



INTERIOR VIEWS OF PARLOR CAR

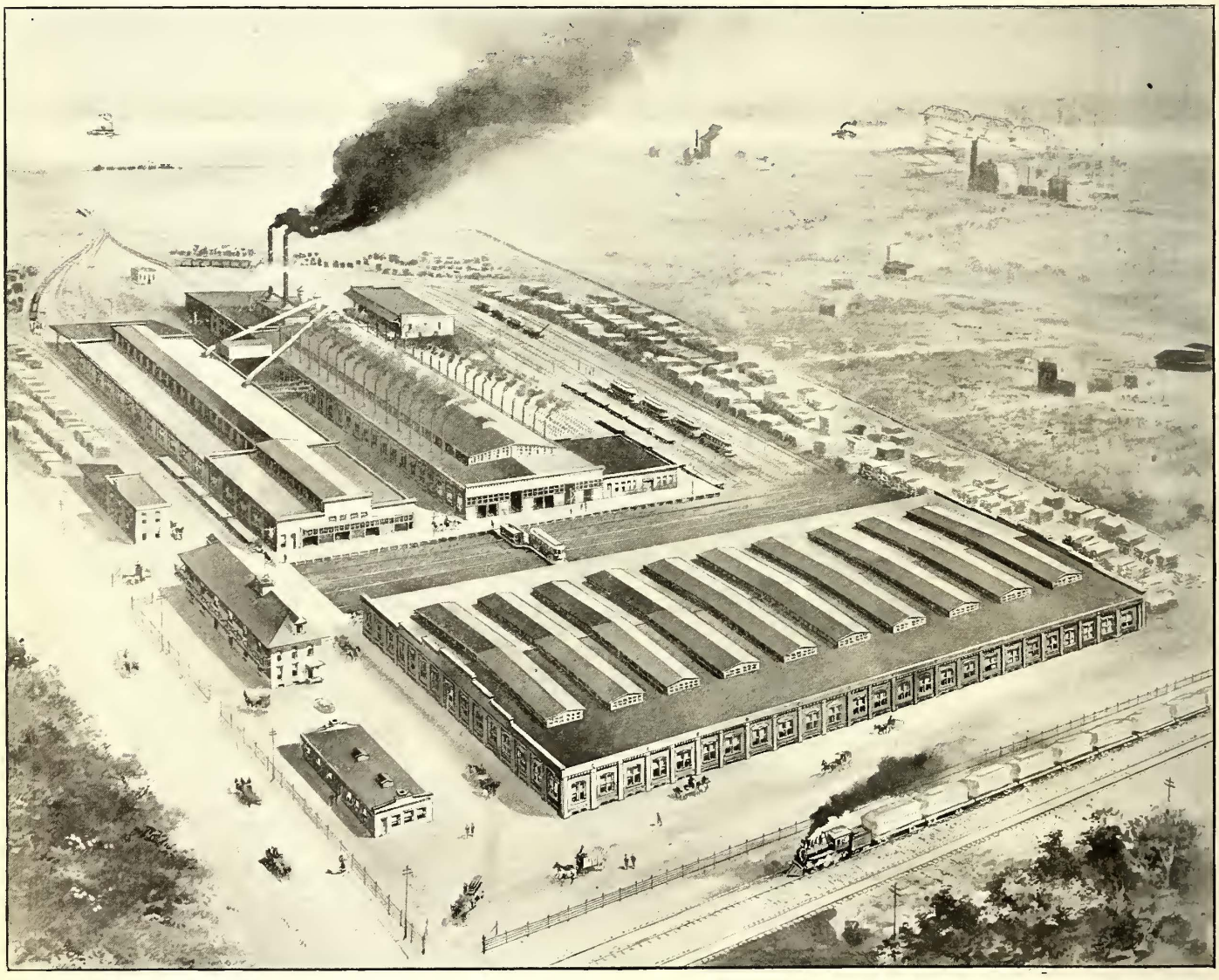


PARLOR CAR, BALTIMORE

Car Building in St. Louis

St. Louis has long held a commanding position in the lumber market, and has been regarded as a center for all lines of industry in which lumber plays a prominent part. Its leading position in the car building industry, particularly that of street railway cars, has long been recognized, and this will now undoubtedly be increased with the new facilities for building cars possessed by the city through the completion of the new works of the St. Louis Car Company.

Ten years ago the most sanguine street railway man hardly dreamed of the coming development of the street railway industry, but the introduction of electricity has so widened the possibilities of street car service that the field to-day offers opportunities to the manufacturer almost equal to those of the steam roads. With 50,000 street cars running on some 1500 different lines in the United States, and with scores of new roads being constantly added to the list, without considering the foreign demand for this class of rolling stock, the necessity of supplying this equipment and replacing worn-out or out-grown equipment has created a competitive interest between the manufacturers, and compelled them to improve their facilities, which were considered more than ample a few years ago.



WORKS OF THE ST. LOUIS CAR CO., ST. LOUIS, MO.

To this end the St. Louis Car Company, of St. Louis, Mo., has just completed the erection of the new plant mentioned, which is complete in all modern improvements. The works were planned and laid out by an experience born of years of car building, and incorporate every idea for the successful and economical building of street cars.

The site is on the north side of the city on the line of the St. Louis, Keokuk & Northwestern Railroad, at a point convenient to the North Broadway street cars, and covers some twenty acres of ground. The idea kept uppermost in mind in laying out the works has been to so plan every detail that each piece going into the construction of a car will be handled the least possible number of times and, during the various processes which it must undergo, will be carried the least possible distance.

The shops are equipped for turning out everything necessary in the construction of a car. In the rear and to the east of the buildings are the yards for the storing and curing of raw material. These are served with a system of stone ballasted tracks, 4 miles in length, and equipped with four electric motor engines or dummies, power being furnished by overhead electric system. The railroad company connected with the plant is not required to do any switching whatsoever, as all freight cars are moved with the electric dummies and all raw material is handled in this manner. As the various shops are covered with a network of tracks, it is possible to load the material from the yards or directly from the cars, by smaller dummies, which deliver the material to the very spot where it is required.

Opening into the yards on the rear are the blacksmith and machine shops and the mill. The mill is separated lengthwise into three divisions; through the first go all heavy materials, such as sills, bottom and platform materials, through the second all heavy irregular pieces, and through the third the lightest pieces. From this shop the material goes to the cabinet shop, each part passing successively from workman to workman and from machine to machine until it reaches the further end completely finished and ready for the erecting shop. In one corner of the mill is a department for sharpening and repairing wood-working tools; one man, with the assistance of several automatic grinding machines, can keep all the shop tools in good condition.

In the blacksmith shop the conditions are similar to those in the mill. Here are lines of forges, steam hammers, presses, bolt cutters, lathes, etc., and each step forward of a piece of material brings it so much nearer to its finished condition. In one end of the

blacksmith shop is the truck department, where the St. Louis Car Company trucks are manufactured. A future article will be devoted to the advantages of these trucks, which are giving the greatest satisfaction. Adjoining the blacksmith shop is the store room; in the rear of the blacksmith shop are the engine and boiler rooms. A right and left-hand engine are coupled together, making a double engine of 750 h.p., which furnishes the motive power for the plant. There is also installed a smaller engine directly connected to an electrical generator for furnishing light and power.

In case of emergency electric motors are distributed in various parts of the mill and blacksmith shop connected with outside Commercial Electric wires, which will enable the work to go on at any time should any mishap take place in the engine room. An air compressing plant is about to be put in, and will be utilized in the construction departments, and will enable a more rapid construction than can be possibly supplied by manual labor.

The boiler room has five fire tube boilers with a capacity of 750 h.p., with a refuse from the mill that will furnish an abundance of fuel in the summer time. The small quantity of coal required in the winter time is maintained at a minium cost, St. Louis being in the center of the most abundant steam coal region in the world.

Along the eastern end of the blacksmith and mill runs a wide platform, from the western end of the erecting shop projects a corresponding one, and between these runs a traveling electric table 60 ft. long. The range of this table is the full length of the erecting shop, and it is equipped with block and tackle, and a winding drum; by its means two men can load cars, trucks, or car load of material from any part of the shops and deliver them to any other part. When cars are completed for shipment with motor attachments, they are run out of the erecting shop on to the flat car in two minutes.

The erecting shop is 300 ft. x 624 ft. This immense building is entirely under one roof and contains 55,000 sq. ft. of glass; it is 20 ft. in height, has forty tracks and a capacity for 300 cars. The construction of a car body is started upon small wooden trucks and the car is not moved until it is ready to be shipped. The eastern end of the erecting shop is reserved for the painting department, where panels, head linings, etc., that require to be painted before entering into the car, are given attention. The manufacture of car seats, which is a special feature of this company, is also carried on in a part of this large building. The painting department is equipped with all modern improvements, and equal to any set apart for that purpose. A small building to the west of the erecting shop contains the storage room for oils, varnishes, etc.; the machinery here for grinding and mixing pigments is operated by a small electric motor.

The buildings are all of brick with composition roof, are made to afford excellent ventilation, and throughout the shops are distributed 1100 incandescent and 75 arc lights.

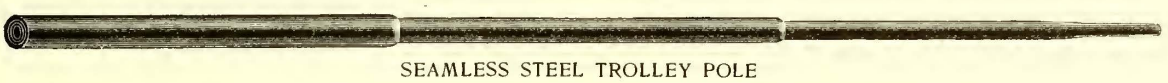
The blacksmith and machine shops are heated with a hot air system which will raise the temperature from zero to 60 degrees in an hour. In the erecting shop, the largest single building on the place, is installed the Warren Webster exhaust steam heating system. By its use it is possible to heat the entire building with exhaust steam with an atmospheric pressure and down to 3 in. of vacuum, that in the very coldest weather a comfortable temperature can be obtained, and with the additional advantage that no dust can interfere with the painting in this shop. The system requires 50,000 ft. of 1½-in. pipe, and is one of the most improved methods of heating, and at the same time the most economical.

The general offices adjoin the shops on the west. They are large, commodious, elegantly furnished. The doors, railings, fittings, desks, chairs and every article of furniture are of mahogany and in every way modern and up to date. On the second floor of the office building is the draughting department and the photographic department. The latter is completely equipped with all modern photographic appliances, dark room, etc., and every car built is photographed. A telephone system connecting all departments with the office is one of the many convenient arrangements of the new plant.

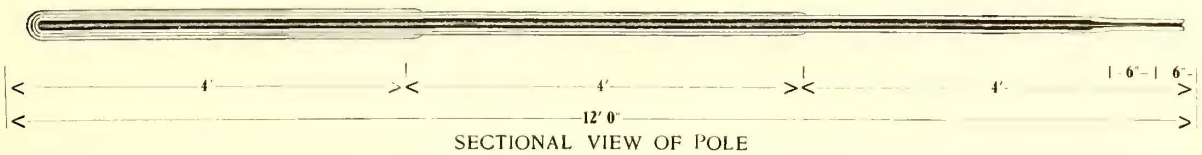
For the purpose of delivering its products the St. Louis Car Company has one hundred 60-ft. modern flat cars, which are operated over all the railroads in the country, and are especially built and designed for this service. Within the last year these cars have been loaded with street cars for almost every important city in the United States, and the foreign shipments of the St. Louis Car Company have been to Germany, England, Ireland, Brazil and various South American ports.

Cold Drawn Seamless Steel Trolley Poles

The use of cold drawn seamless steel tubes for structural and other work has demonstrated so clearly the strength of this material that railway managers have been interested in learning the application of this material to trolley poles. The accompanying engravings show a pole of this character manufactured by the Shelby Steel Tube Company of Cleveland, Ohio. The pole is built up of three pieces of cold drawn high carbon seamless steel tubing, which are put together in the manner shown in Fig. 2, after which the surfaces are cold welded. This makes, it is claimed, a pole having a maximum amount of strength with a minimum weight, and one which will meet all requirements without accident and delay in traffic.



SEAMLESS STEEL TROLLEY POLE



SECTIONAL VIEW OF POLE

Spiral Springs

One of the oldest establishments in the United States for the manufacture of spiral springs is owned by Miller & Van Winkle, of Brooklyn, N. Y. For about thirty years this firm has made steel and steel wire springs for all purposes, and its collection of dies now includes one for almost every form of spiral spring that can possibly be required.

The springs manufactured by Miller & Van Winkle go into a large variety of industries. Among the standard forms carried in stock in all sizes are trolley springs, packing valve springs, dynamo and motor brush-holder springs, upholstering springs, machinery and electrical springs; also tempered steel wire and flat steel springs. The officials of the firm give as a reason for the steady growth and increase of their business the fact that they give extremely close attention to the purchasing of all materials that enter into the manufacture of their products, an expert being employed to do all the purchasing. The same care and watchfulness are exercised throughout the entire process of manufacture, every detail of construction and workmanship being given close consideration.

As an indication that the Miller & Van Winkle goods give satisfaction, it may be stated that their springs have been in use on the Brooklyn Bridge for a number of years, and several large contracts have also been received from the United States Government.

The Frank Ridlon Company, of Boston, has made an important addition to its force by the acquisition of Charles N. Wood, who has been elected vice-president of the company, and who will hereafter combine his business with that of the Ridlon Company. This latter will, therefore, continue the important agencies in New England which Mr. Wood has been conducting so successfully under his own name, viz., the R. D. Nuttall Company, the International Register Company, the Van Wagoner & Williams Hardware Company, the Bradford Belting Company, the Monarch Stove & Manufacturing Company, the American Electric Heating Corporation, and Wilson, Thomson & Company. It is the intention of the Ridlon Company to establish in this connection and under Mr. Wood's management, a strictly street railway supply business. It will be in a position to fill orders for all street railway supplies, and its facilities for doing repair work and rewinding armatures are the very best. For the time being Mr. Wood will continue his office at 31 State Street, but as soon as the company can obtain commodious offices, of which it has leases at 200 Summer Street, the business will be consolidated in one office.

New Attraction for Street Railway Parks

The demand made by street railway managers for new attractions at parks and pleasure resorts has led a number of companies which make a specialty of supplying attractions of this kind to devise several novel and ingenious arrangements for the coming season for attracting pleasure seekers. Among the most noticeable of these is one furnished by Paul Boyton, of Brooklyn, N. Y., who is one of the best-known inventors of amusement enterprises in this country. His latest idea is known as a "Trip Down the Rivers of the World," and bids fair to rival in popularity the "shoot the chutes," of which he is the inventor.

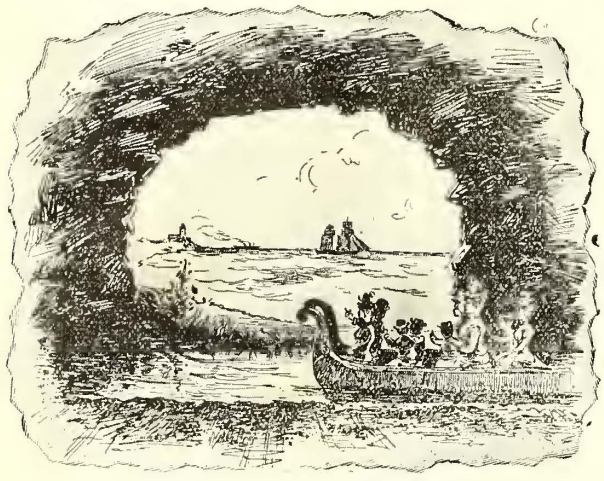


FIG. 2.—VIEW FROM CAVE

This latest attraction consists of a miniature river from 4 to 5 ft. wide and 24 ins. deep, in which is a strong current of water to carry the boats loaded with passengers for a long, cool ride through artificial tunnels, caves and rocky caverns, with openings at intervals, through which the voyagers observe the most pleasing scenery. The river way is built of wood made water-tight, so as to prevent all leakage, and can be made any length, although the best results have been obtained with a length of from 1200 to 1400 ft. The river can be built in almost any sized and shaped lot, but preferably in an oblong space about 100 ft. x 300 ft. A gentle grade is given the river bed by making one terminal about 18 ins. lower than the other. This has been found sufficient to give a fairly swift current throughout the entire length of the stream, and a small 10-h.p. gas or steam engine or electric motor-driven pump is employed at the termini to lift the water from the lower end back into the higher end. In this way the same water can be used over and over again, the only loss being from evaporation.

The boats are sent out without attendants, as it has been found that the current will take them around without any difficulty whatever, and all the employees required to operate the entire attraction are a ticket seller, ticket taker, engineer and two or three men to load the boats and take charge of them at the terminal. The boats are lifted from the lower level to the higher one on rollers. The scenic effects are secured by placing painted screens immediately in front of the openings in the wall along the river. The scenery may be varied, of course, to meet any requirements, and can be changed at intervals at slight expense. A favorite scheme is a representation of a trip down one of the principal rivers of the world, in which the prominent points of interest along each shore are seen. The impression would be, after riding in one of the rapidly moving boats, that a trip of fully a mile or more had been taken, when, as a matter of fact, the distance covered might not be more than a quarter of a mile. The accompanying diagram, Fig. 1, gives an excellent idea of the general arrangement of the river, showing the openings, with scenery screens before them. Fig. 2 shows a possible view from one of the caves.

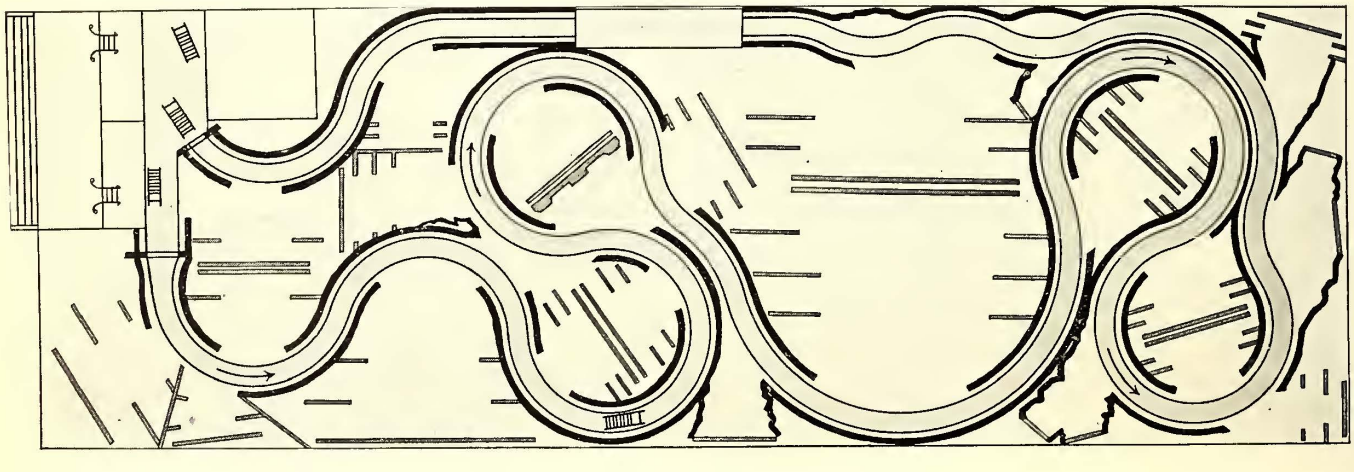


FIG. 1.—GROUND PLAN OF A SCENIC RIVER

Rolled Steel Gongs

Signal gongs and conductors' bells, cold pressed from steel plate, have been extensively used for a number of years in place of gongs made from cast metal, and there seems to be an increased demand for them. The special claims made for this type of gong are that they are not liable to crack or break, and that the tone is agreeable and can be regulated to any pitch. The Pittsburgh Steel Hollow Ware Company of Allegheny, Pa., is the principal manufacturer of this type of gong, and the gongs are made in all sizes, from 3 ins. to 20 ins. in diameter. The prevailing size for street railway service, however, is 14 ins. The products of the firm embrace in addition to gongs for street railway service, locomotive trip gongs and gongs for fire apparatus. Besides this, the works turn out large quantities of circular coulters, which are sold to the manufacturers of plows and agricultural implements.

The gongs are all pressed or stamped from circular metal plates, which are purchased, already circled, from neighboring steel mills. The peculiar tools employed in the process of manufacture press the metal into shape without forming any wrinkles or kinks, and give a uniformly smooth surface. The company has recently undertaken the manufacture, by the same process, of large church bells and bells for musical chimes, the tone being regulated by the gage of the metal and the amount of carbon it contains. The works of the company are located at Cheswick, 14 miles from Pittsburgh, and occupy two buildings, the principal one of which is 75 ft. x 200 ft., the other a warehouse, which is 25 ft. x 60 ft. The tool equipment is mostly of the company's own design and manufacture, and is of such a character as to enable it to compete in price with any other dealers. The products of the works go to all parts of the world, and as noted above, the demand for these goods is constantly increasing. The works employ about thirty-five men, and have a capacity for turning out 1000 car gongs a day. The company was organized in 1892, and the works are operated under the direction of the following officers: John S. McIntosh, president; Joseph McNaugher, secretary, and J. T. Duff, superintendent.

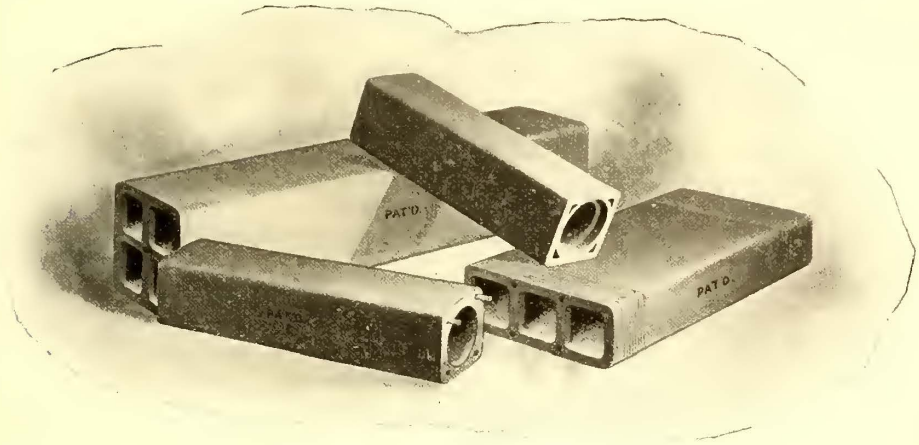
Electric Railway in Thorn

The electrical equipment of the Thorner Strassenbahn of Thorn, Germany, which was recently installed by the Electricitäts Gesellschaft, Felix Singer & Co., of Berlin, was put in electrical operation Feb. 1. The same company has also undertaken the construction of a new electric line from Thorner to Mocker, as well as the electric lighting station for both cities, and both of these will soon be put in operation.

Contracts for Conduits in Baltimore

The board of awards of the city of Baltimore, upon the recommendation of the chief engineer of the electrical commission, Charles E. Phelps, Jr., recently awarded the contract for the entire electrical conduit system for the city of Baltimore to the American Vitrified Conduit Company of New York, of which C. J. Field is general manager. This contract is for several million feet of vitrified tile, multiple duct conduits, the multiple being from 2 to 16 ducts. It was let upon specifications which were very carefully prepared by Mr. Phelps, and on which bids were received for various kinds of multiple and single duct tile conduits, cement pipe, wooden and indurated fibre, etc. The system of conduits about to be installed will include provisions for all the electric light, street railway feeder, telephone, telegraph and other wires throughout the city, and the latest practice in installations of this kind in all the large cities of the country has been carefully studied, and the best points from each adopted.

In addition to this contract, the American Vitrified Conduit Company has on hand a large number of orders, some of them from the leading cities of the country, for conduits of different patterns. Among these are one for several million feet from the Narragansett Electric Lighting Company of Providence, and an order for several thousand feet from the Edison Electric Company and the Western Union Telegraph Company at New Orleans, where some of the most difficult problems in underground construction are being worked out. The same company is taking contracts for complete installation of systems, including all details, where it is desired. The accompanying engraving shows some of the ordinary types of conduits made by this company.



DIFFERENT TYPES OF CONDUITS

A Change of Name

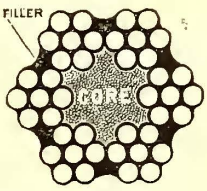
The Falk Manufacturing Company, of Milwaukee, Wis., has decided to drop the word "manufacturing" from its title, and will hereafter be known as The Falk Company. This change is made because one of the most important parts of the company's business is that of acting as engineers and contractors in the building of street railways, so that the word manufacturing does not seem appropriate. With this change of name the company has also been making other important changes, which will result in materially enlarging its facilities for business. During the last month it has acquired the plant and business of the Western Gear Company of Milwaukee, which, as is well known, has been a large manufacturer of street railway gears and pinions. As Mr. Falk, president of the Falk Manufacturing Company, has also been president and a heavy stockholder in the Western Gear Company, the combination of interests was only natural.

The Falk Company has also purchased a large tract of ground about a mile east of its present works, upon which it will immediately begin the erection of three large buildings for steel foundry, machine and blacksmith shops. The buildings will be entirely of brick and steel, equipped in the most modern manner, with open-hearth steel furnaces, electric traveling cranes, compressed air, etc. All of the machines will be driven by the independent motor system, doing away with pulleys and shafting. The company will add to its business the manufacture of steel castings for all purposes, and will also enlarge and improve its special work department. While pushing energetically the work in its manufacturing and construction departments, the company will be even more active than heretofore in the field of cast-welding, and in efforts for improvements in that direction. As stated previously, the company will appeal from the recent decision of the United States District Court in St. Louis adverse to one of its patents, and will also vigorously defend its rights in all of its other patents.

The additions to and reorganization of the company's business mentioned above have also brought about some changes in officers. Mr. Falk and Mr. Wurster will continue as president and secretary and treasurer, respectively, while Mr. Smith, who has been general superintendent and engineer of the company, will be vice-president. Adolph Quentin, late vice-president of the Western Gear Company, will be second vice-president of the Falk Company, and Charles L. Jones, secretary of the Western Gear Company, will be assistant-secretary of the Falk Company.

Preservation of Wire Ropes

The acquiremnt of a material for treatment of the manila or jute core in the process of manufacture of wire ropes possessing pliability, lubricating and waterproof qualities, and free from destructive acid, has been diligently sought by wire-rope manufacturers. There are numerous places where wire ropes are liable to become water soaked almost immediately after installation (where not specially prepared to resist moisture), such as cable railway service, wet mines, dredging machinery, power transmission, and in many other places of exposure. The wire ropes of elevators in offices, stores, warehouses, and in general buildings sometimes show an outside corrosive effect, which too often is but suggestive of the more serious hidden internal conditions. Not infrequently the interiors of wire ropes reveal disintegrated cores and corroded wires, even where there may be but little evidence of deterioration externally.



CROSS SECTION OF ROPE

The illustration herewith presented shows application of a special material, known as "wire rope filler," by which the core is lubricated and a flexible cushion interposed between it and the strands. The filler, exuding between wires, prevents abrasive wear, seals against acid, gaseous, sulphurous or water attacks, and forms foundation on which an outside coating should speedily build. Many of the prominent wire-rope manufacturers have adopted the use of this filler on all kinds and sizes of operative wire ropes. The manufacturers of this filler also make an outside coating, termed "wire rope shield," for external protection against abrasive wear, and to completely seal against exterior attacks. A substantial increase of life is evident from the internal treatment, and furthered by the external protection. The Ironsides Company, Columbus, Ohio, manufactures these materials.

International Tramways Union

The secretary of the permanent International Tramways Union, F. Nonnenberg, of Brussels, has just issued the official report of the tenth annual convention of that association, held at Geneva in August, 1898. It is also announced that the following questions will be discussed at the next convention of the union, to be held in Paris in 1900:

1. How have urban rates of fares been changed in the last five years? Why were changes made? What are the results as affecting receipts, expenses and profits? Give total figures, and figures per car mile. Do you consider your present rates reasonable?

2. What have been the consequences of electric traction upon the operation of transformed lines, as affecting traffic, expense of operating and net profits? Give total figures and figures per car mile. State nature of your electric lines as to profile, and also special circumstances influencing results, such as duration of concession, etc.

3. What are the advantages and disadvantages of narrow and

standard gages, particularly in view of the use of powerful motors?

4. What is the arrangement and equipment of your power station? (There is inclosed a list of questions covering the station, equipment and operation in great detail.)

5. What is the best system of distributing current in extensive systems using electricity—continuous, alternating, polyphase?

6. Have you used the Falk joint? For how long? On what length and what type of roadbed have you used these joints? On what technical considerations did you adopt it? What is the cost, giving items of cost in detail? What proportion of the joints break? Why do they break? Do the number of failures vary with the season? After what time do they occur? What is the maximum length of rail you have been able to cast-weld without making special expansion joints? What else can you say on this point?

7. What progress has been made concerning accumulators, as to construction, increase of capacity, decrease of weight, duration, cost of maintenance, practical and economical application on tramways?

8. Give your experience as to the best means of heating cars. Give cost of installation, operation and maintenance of the various systems you have employed.

9. What are the advantages and disadvantages of operating branch lines as compared with main lines?

No Car Vestibules in New York

The question of the advisability of compelling the street railway companies in New York City to vestibule their cars was considered at a meeting of the Board of Aldermen on Jan. 24, 1899. The proposed ordinance, which was introduced Oct. 4 by Alderman Gledhill, provided that the front platform of every car in the City of New York "operated by electricity, cable, compressed air or any other motive power except steam and horse . . . shall be vestibuled or enclosed so that no passenger shall be permitted to ride thereon, under penalty of $25, for each violation." The ordinance was referred to the committee on railroads, who held public hearings on the subject, but no advocate appeared for the measure. The committee, therefore, at the meeting Jan. 24, rendered the following report:

REPORT.

The humane purpose of the measure is fully appreciated by the members of the committee, who are in full sympathy with our vice-president, as to the necessity of devising some means to relieve gripmen, motormen, drivers, etc., from the severe hardships of storm and weather.

We feel, however, the remedy proposed is impracticable in this city, and that if applied, life and limb of pedestrians would be in jeopardy, while truckmen and others in charge of vehicles of all kinds would be in constant peril.

We have taken from the stenographer's report, and make as part hereof, the logical argument presented by one of the counsel at our hearings, to wit:

"It is really impossible to put vestibules on cars operated in the city, because, in case of a snow-storm, rain or sleet, or storm of any kind, unless the motorman drops the front glass, it is impossible for him to see more than a few feet ahead of him; and after he has gone a mile in a storm such as I have described, it would be impossible for him to see anything outside of the glass."

. . . . "It may be true that it might be tried with success in other cities, it is equally true that it would not do for traffic in the City of New York. The congested traffic in the City of New York would not allow it, in the first place. . . . Take a snowstorm like we had last week and you would find it would be absolutely impossible for a motorman to run a car even a single block with glass up in front of him. He could not run his car even at a snail's pace without striking something. You must remember that a motorman has an awful lot to do. He has got to attend to his brake. He has got to set the car in motion. He has got to start the car and stop it. He has got to listen to the bell signals. He has to look out for parties on both sides of the street. He has got to watch the track on the surface of the street in front of him. He has got to look out for small objects on the track as well as large objects, such as trucks and carriages. He has got to be alert every minute. He has got to look out for the people standing on the sidewalks wanting to get on, and he has got to listen for the conductor's bell for people wanting to get off. He has got to look out at the corner of every street for people wishing to cross the streets. He could not possibly attend to all of these things if he was enclosed in a glass case."

Another of counsel presented the following valuable opinion:

"I have heard the statement that in other cities they have tried the vestibule with success. I know they use it in Buffalo, and I have a letter in answer to one which I wrote to the manager of the Buffalo Railroad, Mr. H. H. Littell, one of the best railroad men in this country, to whom I propounded certain questions on the subject of this proposed ordinance, to wit:

" 'Do you operate vestibule cars on your road?'

"Answer—'We have about one-fifth of our cars equipped with vestibules.'

" 'Do you consider the danger of accidents to the public using the streets is increased by the use of vestibule cars in crowded cities where the climate is cold and stormy during the winter months?'

"Answer—'We find the percentage of accidents very much greater where vestibules are used than we do where they are not. They obstruct the view of the motorman when he most needs the protection afforded by the vestibule, and he is compelled to throw open the front glass in order to see. We find that during rain, sleet and soft snow it adheres to the glass and prevents him from seeing. In such cases he is forced to open the vestibule and stand in a draft which results in severe colds and sickness.'

"In other words, Mr. Littell claims that it creates a special draft, and is liable to be an injury to the motorman. He then goes on to answer the following questions:

" 'Do you think an ordinance of this character would benefit the public, irrespective of the railroad's interests?'

"Answer—'I do not see how the public could be benefited by an ordinance requiring vestibules. On the contrary, I think that vehicles and pedestrians would be subjected to a great deal more danger from vestibuled cars that obstruct the view than from open platform cars.'

"We look at this thing in exactly the same light as Mr. Littell. I am the engineer of the Nassau Electric Railroad of Brooklyn, and I know it is not a question of expense with the company that I represent in the slightest degree. Our streets in Brooklyn are narrow, as you all know; they are crowded, and they are used by a great many vehicles. We have to run our cars on a certain schedule time in order to give any rapid transit at all; and if we were to put these vestibules on our cars, I do not see how we could make time, without running the risk of a greater number of accidents than we have now. We have accidents enough now, as everybody knows, and we certainly do not want to increase the number."

The following from "The Municipal Record and Advertiser," of Feb. 26, 1898, on the subject of vestibules, sustains fully the views heretofore quoted, and has had much weight in influencing your committee to report adversely hereon, i. e.:

"The street car vestibule is, comparatively speaking, a new product in the street railway industry; as it has only been during the last four winters that it has been used to any extent. By the laws of many States the railroads are compelled to use them, and there is also a growing sentiment among managers in favor of it, even where there are no laws compelling its use. But there are also managers who will not think of adopting the vestibule unless they are finally driven to it by the courts. . . . The serious objection is the danger of running down pedestrians and running into other vehicles.

"The vestibule is simply put on the ends of the cars as a protection to the motorman, who has to face the storm, and in consequence must, in certain weather, suffer considerably; but, if he is unprotected, he is in a position to see whatever is in front of him on the street, and can manage his car accordingly. With the vestibule, at best, he can only see in front of him, and at certain angles, at the sides, as the woodwork of the vestibule shuts off his view to a great extent. In storms and snows, just when he needs the protection, he has to open the front window and stand with his face to the storm, as of old, or his view will be entirely cut off, and accidents absolutely certain to occur. If he keeps the window closed, the snow or rain will accumulate on the glass and render the operation of the car impossible. As it is, even with his face exposed, the accident possibilities are greatly increased, as the side windows are rendered nearly useless in any kind of snowstorm. Again, in very cold weather, if the windows of the vestibules are not made double, but in single panes of glass, the different temperatures of the outside and inside surfaces of the glass will cause a frosting, or thin sheet of ice, to form on the glass, through which it is impossible to see. And even if the windows are put in double, in a snowstorm where the flakes of snow are large and damp, the snow will stick to the outer glass and impair the view of the motorman.

"This one objection, on account of the greatly increased possibilities for serious accidents to the public in general, is sufficient

to condemn the use of vestibules in climates that are subject to very cold and stormy weather. The benefit is only for the few employees of the road, but the danger is for the whole public at large. This danger has been considered by railroad men to be so great that many roads have refused to equip their cars with vestibules, even though the law demands it, and they are going to let the law take what steps it may, and then fight the question out in the courts. . . ."

The importance of this subject and the desire to afford relief to the men at the front end of our cars prompted one of our members, Alderman John T. McCall, while recently at Springfield, Mass., and at Hartford, Conn., where vestibule cars are being operated, to inquire from railroad men whether they were beneficial and practicable. The responses were in the negative and the views expressed conformed absolutely to those hereinbefore quoted.

We offer the following:

Resolved, That the committee on railroads be and it is hereby discharged from further consideration of the proposed ordinances relating to vestibules on surface railroad cars, and that the said proposed ordinance be placed on file.

The recommendation of the committee was followed by the Board.

Personals

MR. H. B. WESTCOTT has been appointed general manager of the Cortland & Homer Traction Company of Cortland, N. Y.

ING. S. TIVOLI has resigned from the general managership of the tramways of Alexandria and is now engaged in the commission business in that city.

MR. H. H. LITTELL, vice-president and general manager of the Buffalo Railway Company, left Feb. 26 for a two months' trip through Mexico and California.

MR. TOLNEY W. MASON, JR., has succeeded Thos. H. Gibbon as chief engineer of the Lap Joint Railway Track Company, of New York, Mr. Gibbon's term having expired Feb. 2, 1899.

MR. W. F. D. CRANE, who for seven years has been connected with the H. W. Johns Manufacturing Company, in its electrical department, has associated himself with the Electrical Vehicle Company of New York.

MR. C. G. ADNEY, formerly assistant superintendent and chief electrician of the Northeast Electric Railway Company of Kansas City, Mo., has accepted the same position with the Ogden Electric Railway of Ogden, Utah.

MR. GEO. H. PEGRAM has been appointed chief engineer of the Manhattan Railway Company of New York, and JOHN WATERHOUSE, formerly chief engineer, has been appointed consulting engineer of the system.

MR. W. C. WEAVER has retired from the management of the Northeast Electric Railway Company of Kansas City, Mo., and has accepted a position as general manager of the Ogden Electric Railway Company of Ogden, Utah.

MR. J. F. HINES has been appointed superintendent of the Winchester Avenue Railroad Company of West Haven, Conn. Mr. Hines has been connected with this road for seven years, as foreman and inspector of the city lines.

MR. WILLIAM A. GRAUTEN, formerly chief engineer of the Hartford Street Railway Company, and later of the Middletown-Goshen Traction Company, has been appointed chief engineer of the Union Railway Company of New York.

MR. HENRY H. ARCHER has accepted a position as general manager of the Belmont Tram Company of Port au Spain, Trinidad. Mr. Archer is quite well known in the United States, having been connected with the Scranton Traction Company of Scranton, Pa., and also with the J. G. Brill Company of Philadelphia.

MR. F. L. HART, general manager of the City Passenger Railway Company of Baltimore, Md., has made a splendid record for economical and effectual management. The experts who have been examining the books of this company in the interests of the syndicate that has recently purchased the property, characterize the economical showing made as "remarkable."

MR. WM. E. BAKER has been appointed general superintendent and chief electrical engineer of the Manhattan Railway system of New York. Mr. Baker for some time has been connected with the Metropolitan Elevated of Chicago, and is therefore perfectly familiar with the engineering problems arising in the application of electricity to elevated railways.

MR. H. G. FLEMING, general manager of the Little Rock Traction & Electric Company of Little Rock, Ark., has given up that position, and will be succeeded by Mr. Walter A. Badger of Boston. Mr. Fleming voluntarily resigned for business reasons, and he was presented on his departure with a letter from the directors of the company expressing their regret that he had found it necessary to leave.

LIEUT. T. C. WOOD, president of the Ball & Wood Company of New York, and who served on the "Gloucester" under Lieutenant-Commander Wainwright during the war with Spain, has been recommended for advancement eight numbers by the board of officers appointed by the Secretary of the Navy to examine into the records of the officers of the navy who made themselves conspicuous by their bravery.

MR. ALEXANDER S. GARFIELD, consulting electrical engineer with the Compagnie Francaise Thomson-Houston, arrived in the United States late in February, and will remain here from two to three months. Among other things he will inspect and pass upon the new electric locomotives for the Orleans Railroad, now building at Schenectady by the General Electric Company, and which are to be delivered by next fall.

MR. J. CLIFTON ROBINSON of London, received a very pleasant reminder of his popularity with the employees of the London United Tramways Company, of which he is managing director, upon the silver anniversary of his marriage. A committee of the tramway men waited upon him on that occasion and presented him with an elaborately engrossed address, and Mrs. Robinson with a diamond star brooch and earrings.

MESSRS. HENRY GRAFTIO, engineer of ways of communication of the Russian Government and BRONISLAS DE MINKEVITCH, railway attaché of the Russian Government at Paris, are visiting this country to investigate the subject of the electric equipment of suburban and heavy railroads. They will visit Hartford, Baltimore, Detroit and several other cities where this class of road has reached a large development, before their return to Europe.

MR. W. F. KELLY, general superintendent of the Columbus Street Railway Company of Columbus, Ohio, delivered an interesting lecture before the Department of Economics of the Ohio State University recently upon the subject of street railways. Mr. Kelly very ably compared European and American tramway practice, showing the rapid development made in America, and also gave an account of some of the operating difficulties encountered in Columbus.

MR. W. B. BROCKWAY, in recognition of his efficient services, has been promoted to the position of secretary and auditor of the Toledo, Bowling Green & Fremont Railway Company of Toledo, Ohio. Mr. Brockway was for some years assistant secretary of this company. His energetic work in connection with the Street Railway Accountants' Association of America has made Mr. Brockway very well known throughout the street railway field, and has gained for him many friends.

MR. G. PELLISSIER, the well-known French electrical engineer, arrived in New York recently from Havana, where he has been in the interests of a French syndicate, which, with the Harvey Syndicate of New York, has recently purchased the street railway system of that city. Mr. Pellissier's last visit to this country was about a year ago, when he was on a trip to New Zealand to investigate the street railway conditions in Aukland, with a view to the electrical equipment of the system in that city.

MR. W. W. CHURCHILL has been appointed to the position of mechanical engineer of Westinghouse, Church, Kerr & Co. of Pittsburgh. Mr. Churchill has been closely associated with all of the largest engineering work of Westinghouse, Church, Kerr & Co., including the Boston terminal and Third Avenue Railway power station, and well deserves the place and title which has been given him. He is a graduate of Cornell University of the class of '89, and has been with the Westinghouse Company for nine years.

DR. LOUIS DUNCAN, long well known in engineering circles as the engineer in charge of many important electric railroad installations, including the Baltimore & Ohio Tunnel electric plant in

Baltimore, and the Third Avenue Railroad in New York (on which he is now engaged), has taken into partnership Lieut. M. K. Eyre, a graduate of the Annapolis Naval Academy, and for several years past manager of the Edison Lamp Works at Harrison, N. J., which he left to join Dr. Duncan. The new firm will be conducted under the name of Duncan & Eyre, and its principal office will be in New York city.

MR. H. F. J. PORTER of the Bethlehem Iron Company, lectured to a large audience at the 521st meeting of the Boston Society of Arts on Feb. 16. His subject was "Modern Forging," and he presented in a very interesting way, with numerous illustrations by the stereopticon, the methods in vogue at the Bethlehem works of forging such articles as hollow and solid shafts, dynamo field rings, guns, armor plate. Views were shown of the hollow shafts of the "Oregon" and of the "Brooklyn," made at these works. Defects in the old methods of forging and the steps leading to the present methods were well explained.

MR. HENRY CONANT, manager of the Boston office of Westinghouse, Church, Kerr & Co., has recently received an appointment to a much higher position in that company. He will continue to reside in Boston, but his work will be of a broader nature and will be connected with the general affairs of the concern. Mr. Conant has of late been particularly well known in connection with the execution of the large engineering contract at the Boston terminal, of which he had complete charge in both management and engineering. He is a graduate of the Massachusetts Institute of Technology, of the class of '87, and by his many years of work with Westinghouse, Church, Kerr & Co. is peculiarly well fitted for the larger duties now intrusted to him.

MAJ. RUSSELL B. HARRISON, who, at the commencement of the war with Spain, went to the front with the Seventh Army Corps, is now in Camp Columbia, and is serving as provost marshal of the Seventh Army Corps for the department of the Province of Havana. Maj. Harrison, before going to Cuba, was provost marshal of the city of Savannah, Ga., while his corps was encamped there, and he was pleasantly surprised to receive from the clerk of the council of that city, a short time ago, a set of resolutions which was passed by the council expressing the high appreciation of the people of Savannah of the thoroughly efficient manner in which he discharged the delicate and important duties of provost marshal while in charge of that city.

MR. WILLIAM A. HOUSE, president and general manager of the Baltimore Consolidated Railway Company, has been one of the most conspicuous figures in the street railway history of Baltimore, and has been more intimately connected, perhaps, with the development of the Baltimore consolidated system than any other one man. He commenced his career in 1879, with the People's Passenger Railway Company, in the capacity of general utility man, his chief occupation being to collect the fares at the end of the day from the street car fare boxes. In 1883, when the People's Passenger Railway Company was reorganized, with T. Edward Hambleton as its president, the faithful services of Mr. House were recognized, and he was made secretary and general superintendent. Under his management the system, which was operated by horses, was greatly improved, and in 1889 when the Baltimore Traction Company bought the People's Railway Company and the Citizens' line, he was made general manager of the entire property. Several additional lines of the city were absorbed, and in 1892 the work of equipping the system with electricity was begun. This work was carried out entirely under Mr. House's supervision, and the present efficient and satisfactory condition of the Consolidated Railway lines is due very largely to his engineering ability and skill.

Obituary

MR. EDWIN S. CARPENTER, assistant treasurer of the Westinghouse Electric & Manufacturing Company of Pittsburgh, Pa., died very suddenly in New York on Feb. 16.

MR. A. B. JOHNSON, father of Edward H. Johnson, president of the Sprague Electric Company of New York, died on Jan. 29 from the effects of injuries received in a runaway accident at his home in Greenwich, Conn.

MR. WM. PENN COOPER, who was probably the oldest street railway superintendent in Philadelphia, died Feb. 23, at the age of seventy-six. Mr. Cooper was superintendent of the Thirteenth & Fifteenth Streets line.

MR. JOHN H. CALLAHAN, secretary of the United Traction Company of Pittsburgh, died at his residence on Feb. 13. Mr. Callahan practiced law in Pittsburgh and Chicago until about six years ago, when he accepted a position as secretary of the Second Avenue Street Railway, which position he held until the consolidation with the United Traction Company, when he was made secretary of the entire system.

AMONG THE MANUFACTURERS

THE ELECTRICITAETS-GESELLSCHAFT, Felix Singer & Co., announce that they have moved their office to Tempelhofer Ufer 10, Berlin, S. W.

THE POWER AND MINING DEPARTMENT of the General Electric Company has now under construction twelve electric locomotives for domestic use.

W. W. BIERCE has been appointed general agent for the American Rail Joint & Manufacturing Company of Cleveland, Ohio, in the Middle Southern States, with headquarters at 1106 Hennon Building, New Orleans, La.

EUGENE MUNSELL & COMPANY, of New York and Chicago, report a very gratifying demand for their India and amber "mica," of which they make a specialty for electrical insulation. Some very large orders have been received at both their Chicago and New York addresses.

THE ELECTRICAL POWER STORAGE COMPANY, LTD., of London, has found it necessary to increase the price of all its goods 10 per cent. This increase has been necessitated by the considerable advance in the price of raw materials, especially lead, during the past few months.

HOBSON & CO., of Tatamy, Pa., are sending out an illustrated catalogue of the carts, wagons, wheels, etc., which they manufacture. The list of different types includes dumping carts for every class of service, sprinkling carts, express wagons, contractors' carts and emergency wagons.

WESTINGHOUSE, CHURCH, KERR & COMPANY, of New York and Pittsburgh, received an order from the Metropolitan Street Railway Company of New York last month for the equipment of the boilers in its new Ninety-sixth Street power station with Roney mechanical stokers.

HAROLD P. BROWN, of New York, will soon place upon the market a new tie plate plastic rail bond for rebonding roads in service and for steam roads adopting electricity. The claims made for the new bond are, conductivity equal to the rail, will last as long as the rail, improves riding of track and lengthens life of rail.

THE AMERICAN ELECTRICAL WORKS, of Providence, R. I., in commemoration of Washington's birthday, sent to its friends a handsome engraving, about 7 ins. x 9 ins., of the home of Washington at Mount Vernon. This little gift will be highly appreciated by all recipients, and it is well worth a place in any office or home.

THE VAN DORN & DUTTON COMPANY, of Cleveland, Ohio, has just received an order from the Cleveland Electric Railway Company for twenty-two trucks of its latest 99 B type. The Van Dorn & Dutton Company reports that never in its experience has it been so overcrowded with work, and all departments are running to their fullest capacity.

THE LESCHEN-MACOMBER-WHYTE COMPANY, of Chicago, Ill., has been sending to its friends a very acceptable desk calendar for 1899. The calendar for each month is printed on separate cards, which are inserted in a very suitable frame made of celluloid, prettily decorated. This company reports an excellent business in railway supplies, and it is receiving orders from companies all over the country.

THE PENCOYD IRON WORKS, of Pencoyd, Pa., have received the contract for building the elevated structure of the Boston Elevated Railway in Washington Street, Boston, and Main Street, Charlestown. This is one of the most important iron contracts let for some time, and many thousand tons of metal work will be required to complete the work. The specifications require that the work shall be completed by Oct. 1, 1899.

THE CHICAGO CITY RAILWAY COMPANY, in addition to the 100 new cars now being delivered from the Stephenson Company, will soon receive fifty from the Pullman Company, and is in its own shops rebuilding thirty of its old cars. The Moore motor truck has been adopted as standard and 165 new trucks of

this type are now being erected in the company's shops. The steps on 750 open cars are being replaced by a folding step.

THE CHASE CONSTRUCTION COMPANY, of Detroit, Mich., on account of the rapid growth of its business, has been compelled to seek larger quarters, and has removed from room 1113 to suite 1321 and 1322, Majestic Building, Detroit, where it will continue its business as general contractors. This company makes a specialty of building and equipping electric railways, central stations and municipal electric lighting plants of any capacity.

THE FIRM OF Edwin C. Jones & Co., of New York, formerly the Edwin C. Jones Company, has recently been formed by the association of Peyton C. Rogers, Henry H. Pearson, Jr., and Louis H. Roberts with Edwin C. Jones. The gentlemen first mentioned have been associated for some time with Edwin C. Jones, but have not until now been financially interested in the firm. The new company will continue to make a specialty of the purchasing and selling of high-grade bonds of all kinds.

THE CAHALL SALES DEPARTMENT, of Pittsburgh, has found it necessary, owing to the very rapid increase in the price of raw materials entering into boiler construction, to advance the prices of all boilers of its manufacture 20 per cent, to take effect March 1. This action has been delayed as long as possible, as the company hoped it could go through the season without any advance, but materials have risen so rapidly in price, and continue advancing so sharply that it announces that it is obliged to take this step in order to come out even.

ELECTRIC PUMPING.—This is the title of a very attractive pamphlet just issued by the Goulds Manufacturing Company, of Boston, Mass., which describes fully the Goulds pumping machinery adapted for use with electric motors. The different types shown include direct-connected and belt-driven apparatus for a number of different pressures, varying from extremely light work to the very heaviest pressures. Street railway companies proposing to install pumping machinery at their power stations will do well to carefully investigate the apparatus manufactured by the Goulds Company.

THE C. W. HUNT COMPANY, of New York, whose work in the developing of efficient and economical hauling and hoisting machinery is well known throughout the engineering world, has published a new catalogue devoted to the description of steam and electric hauling engines. The catalogue is well illustrated, and describes a few of the many different types of Hunt hoisting engines. The hauling machinery manufactured by this company, including the "noiseless conveyor," is also shown, and will be of interest to owners of street railway power stations where it is necessary to move coal for any considerable distance from barges or railroad cars to the boiler room.

A SUCCESSFUL CAR HEATING TEST.—The Long Car Heating Company of New York city made a very successful test of its new system of hot air heating for street cars on Jan. 27, before a number of representatives of the press, including one from the STREET RAILWAY JOURNAL. The party was taken in one of the cars of the North Jersey Traction Company from Jersey City to Newark, where an elaborate luncheon was served, after which the return trip was made. The car in which the invited guests rode was equipped with the new heating system, and although the weather was damp and chilly, the interior of the car was easily kept at a most agreeable temperature.

E. F. DEWITT & CO., of Lansingburg, N. Y., received last month an excellent testimonial to the value of their boxes through the award of an order from the Third Avenue Railroad Company, for the equipment of 160 of its new cars with the common sense sand box. One hundred of these will be equipped with four boxes each and will go on cars now being built for the Third Avenue Railroad Company by the St. Louis Car Company; the other sixty cars will be made up by combining two short cars of the company's present equipment, and these will be furnished with two boxes each. The order was given after a careful investigation of the entire subject by the officials of the Third Avenue Railroad Company.

THE ALLEN & MORRISON BRAKE SHOE & MANUFACTURING COMPANY, Fisher Building, Chicago, announces to its many friends and patrons that it has gone a step higher, and has moved its office from the fifth to the sixth floor. The brake shoes turned out by this company are making some phenomenal records, some having made 30,000 miles in heavy steam road service. Some of the company's locomotive shoes have made records of 24,900 miles. The company is just now putting a new shoe on the market, which, instead of containing chilled inserts, will have the same action through the medium of deeply chilled sections of the solid shoe. This is a tire dresser, and is meeting with much favor.

IN THE ISSUE for Feb. 1, of the "United States Health Reports," a periodical published at Washington, D. C., appears an article on "Hygienic Covering for Furniture," by A. N. Tally, Jr., M. D. This article deals with the subject of the necessity for thorough cleanliness in all articles of furniture and draping used in homes, street cars and public places generally. It also draws attention to the fact that chairs and lounges, car seats, etc., are often breeding places for bacilli of various kinds, and that therefore a hard, firm, cleanly covering for seats and furniture of all kinds is extremely desirable. It further points out that Pantasote, which is a covering manufactured by the Pantasote Company of New York, very fully fulfills all the requirements of good sanitation.

THE MICA INSULATOR COMPANY, of New York and Chicago, reports very large sales, both in the United States and in Europe. This company makes a specialty of furnishing segments manufactured from micanite for any style or type of machine, and has made some segments recently as long as 30½ ins. and 4 ins. in height. Builders of electrical apparatus will do well to have before them this company's sheet, "Insulation Manual and Data Book." It not only gives the breakdown tests of its insulations, but also contains samples of micanite. A large stock of micanite plates, cloth, tapes, paper and "Empire" and "M. I. C. compound" insulation is carried at New York and Chicago; also at the company's agencies in Cincinnati, St. Louis, San Francisco and Cleveland.

THE WESTINGHOUSE MACHINE COMPANY, of Pittsburgh, Pa., is sending out another of its very readable catalogues, this one being devoted to the Westinghouse standard engine. This type of engine is designed for those locations where the use of a simple non-condensing engine is consistent with the principles of good engineering and commercial economy, the conditions under which it is particularly economical being, of course, wherever there is a good demand for exhaust steam. Although its field is somewhat limited, yet the manufacturers state that the demand for this type is constantly increasing, and the company believes that with variable loads and light loads the Westinghouse standard is superior to the usual type of four-valve simple non-condensing engines.

THE GARTON-DANIELS ELECTRIC COMPANY, of Keokuk, Ia., has recently appointed Mayer & Englund, of 10 South Tenth Street, Philadelphia, its representatives in the Middle States territory for its line of railway lightning arresters. The Garton-Daniels catalogue for 1899, just issued, is unusually complete, and should be in the hands of every one using lightning arresters. The catalogue clearly describes the requirements of lightning arresters for all classes of service, and gives data regarding the different types of Garton arresters, and shows how these instruments have been designed to fully meet the difficulties encountered in practical operation. The last few pages are devoted to letters from customers, testifying to the perfect satisfaction given by the Garton instruments.

THE INTERNATIONAL AIR POWER COMPANY, which was organized in January with a capital of $7,000,000, as stated last month, has increased its capitalization to $8,000,000, and of this amount $600,000 is in preferred stock. This preferred stock has all been taken up and was largely oversubscribed. It is understood that the common stock will shortly be issued and placed upon the market. In addition to the works of the American Wheelock Engine Company, and the Rhode Island Locomotive Works in Providence, the company has recently purchased another large engine works. Among those interested in the International Air Power Company are Joseph Leiter of Chicago, P. A. B. Widener, George W. Elkins and Thomas Dolan of Philadelphia and J. H. Hoadley of New York.

THE ANNUAL MEETING of the Newburyport Car Manufacturing Company of Newburyport, Mass., was held Feb. 20, 1899, at the office of the company and the following officers were elected: President, E. P. Shaw; treasurer, W. F. Runnells; directors, E. P. Shaw, L. Marquand, L. W. Sargent, W. F. Runnells, all of Newburyport, and Chas. A. Haines of Melrose, Mass. The company has rebuilt its factory, which was destroyed by fire last April, and has now a complete modern plant with the latest labor saving machinery and starts once more with good prospects and several large orders. J. W. Evans, the general manager, who has been ill, is much improved and again takes an active part in

the affairs of the company. The showing made last year, considering the delay occasioned by the fire and consequent loss of orders was satisfactory and the outlook for the future promising.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, Mo., has added some very satisfactory agencies to its street railway department, and makes the announcement that it has secured the Southwestern selling agency for the Star Brass Works of Kalamazoo, Mich., for the well-known "Kalamazoo" self oiling trolley wheel, also for the Van Dorn & Dutton Company of Cleveland, Ohio, for its gears and pinions, that have been meeting with success among the street railways throughout the country. The Western Electrical Supply Company has also secured the agency for the Sterling Varnish Company of Pittsburgh, Pa., for its well-known varnish and insulating compound. With the above agencies added to its already very complete assortment of street railway supplies, the Western Electrical Supply Company believes it can handle any street railway orders to the entire satisfaction of its customers.

THE J. G. BRILL COMPANY, of Philadelphia, has received some very interesting testimonials to the value of its metal seat-end panel. One of these is from the Mobile Light & Railway Company, the manager of which writes that about four years ago he purchased some second-hand cars of the Brill make, equipped with these panels. These cars had been in use by another company for ten or twelve years, yet they are still in good condition, while two other cars at Mobile, made by another car builder, have gone to pieces within three years, largely for the want of these malleable end seat panels. The Brill Company is also in receipt of a letter from the Chattanooga Electric Railway Company, referring to the Brill 21 E truck as the smoothest riding truck on the market, and another from a railroad official of Bristol, England, referring to a parlor car built by the Brill Company for the railway in most favorable terms.

VALUABLE COLLECTION OF RAIL SECTIONS.—The American Rail Joint & Manufacturing Company, of Cleveland, Ohio, has published its new catalogue describing the American rail joint, which is well known to street railway managers in the United States. An extremely valuable feature of this catalogue, and one which will be appreciated by street railway managers, is a collection of rail sections, which includes the shapes, makers' names and weight of every rail section manufactured by all the well-known rail manufacturing concerns in the United States, with the exception of one. The cuts are all one-fourth size, and the method of adapting the American rail joint to each section is shown. As this is probably the first time that such a complete collection of rail sections has been published in so convenient a form, the American Rail Joint & Manufacturing Company is certainly to be congratulated upon its enterprise in undertaking the work. Copies of the catalogue will be mailed by the publishers on request.

WARREN WEBSTER & COMPANY, of Camden, N. J., report the following plants in which the Webster system of steam heating has been installed: Creedmore Mining Company, Creede, Colo.; Ohio State Capital Annex, Columbus, Ohio; Washington County Court House, Washington, Pa.; Steel Pier, Atlantic City, N. J.; St. George's Hotel, Evansville, Ind.; Pennsylvania Railroad Ferry, Jersey City Terminal, N. J.; J. G. Brill Company, Philadelphia, Pa.; Pennsylvania Institute for In. of Blind, Overbrook, Pa.; Toronto Carpet Company, Toronto, Canada; Fraser & Chalmers, Chicago, Ill.; Elgin National Watch Company, Elgin, Ill.; Reliance Building, St. Louis, Mo.; Dental Snuff Mill, Lynchburg, Va.; West End Trust & Safe Deposit Company, Philadelphia, Pa.; Penobscot Chemical Fibre Company, Great Works, Maine; Consolidated Fruit Jar Company, New Brunswick, N. J ; St. Louis Club, St. Louis, Mo.; Indiana State University, Bloomington, Ind.; New York, New Haven & Hartford Railroad Company's depot, Providence, R. I., and many others.

THE JOSEPH DIXON CRUCIBLE COMPANY, of Jersey City, N. J., has received the following letter from C. D. Shepard, superintendent of the Palmer & Munson Street Railway Company, to whom the credit for this new use for graphite is due: "A lubricant of some sort must be used on the cylinders of controllers on all electric cars. Every electrician having charge of electric cars knows, or has experienced, the trouble pertaining to the use of any kind of grease or oil, by dust sticking to the cylinder contacts, thereby cutting the cylinder and making poor contact, which causes the controllers to arc, thus destroying the life of the cylinder and fingers, also making it necessary to look over the controllers at least once a week, and sometimes oftener. By the use of Dixon's No. 635 graphite this trouble can be remedied. Pure graphite being of high conductivity, and at the same time the best solid lubricant known, it has been demonstrated by practical experience that it is the only lubricant which dust will not stick to, and which will not interfere as a lubricant with making a sure contact between cylinder and fingers, giving a smooth surface on cylinder, allowing controller to be turned easily and smoothly, requiring attention only once a month."

A VERY HANDSOME PORTFOLIO.—An extremely handsome and novel portfolio is being sent out by the Crouse-Hinds Electric Company of Syracuse, N. Y., manufacturers of the Syracuse changeable electric headlight. It is made of heavy green paper and is richly embossed on the outside. Contained in the portfolio are some twenty-nine letters from street railway companies indorsing the Syracuse headlight and testifying to its good qualities, but instead of printing these indorsements in the ordinary way, the Crouse-Hinds Company has had each letter reproduced in its entirety and printed upon the same kind of paper as the originals were written upon. This has been done at a very considerable expense, and the results are very pleasing and must certainly prove very effectual. The testimonials are unusually strong and, in a number of cases, in addition to expressing satisfaction, contain orders for more headlights. The portfolio will be sent on request. The Crouse-Hinds Company reports that its factory, which was lately enlarged to twice its previous size, is already overflowing with orders. The fact that the Syracuse headlight can be changed in a moment from one end of a car to the other, or from a winter car to a summer car, thus practically doing the service of four ordinary lights, makes it extremely popular.

New Publications

The Register of Lehigh University, South Bethlehem, Pa., for year 1898-99. Paper. 220 pages. Published by Lehigh University, South Bethlehem, Pa.

The Register contains the usual announcements for the coming collegiate year, a full description of all the courses and a full list of all students at the college and also of the alumni.

Fowler's Mechanical Engineer Pocket Book, Edition of 1899. Edited by William H. Fowler. Leather. 324 pages. Illustrated. Price 1s. 8d. post free. Published by Scientific Publishing Company, Manchester, Eng.

This is one of the most reliable and valuable of the engineers' pocket books published, and contains an immense amount of well digested and carefully indexed material of use to engineers.

Map Showing Street Railway Lines in Massachusetts, Rhode Island and Connecticut. Published by Robert H. Derrah of the Boston Elevated Railway Company, Boston, Mass. Mounted on cloth. Price $15.

This map is printed in four colors and shows all existing and projected street railways in Massachusetts, Rhode Island and Connecticut, as well as the steam roads. The map is drawn to a scale of four miles to the inch. To one not familiar with the situation, a glance at this map will be most surprising, as there is hardly a corner of this territory that is not already occupied by street railway lines. According to this authority, it will soon be possible to travel from Boston or points fifty or seventy-five miles east or south of Boston by electric cars, via South Framingham, Worcester, Springfield, Mass., Hartford, New Haven and Stamford, Conn. The map will be of great value to anyone interested in the development of electric railways.

Trade Catalogues

Carts, Trucks and Wagons. Published by Hobson & Company, Tatamy, Pa. 52 pages. Illustrated.

Electric Pumping. Published by the Goulds Manufacturing Company of Boston, Mass. 24 pages. Illustrated.

Steam and Electric Hoisting Engines. Published by C. W. Hunt Company of New York. 20 pages. Illustrated.

Lightning Arresters. Published by the Garton-Daniels Electric Company of Keokuk, Ia. 20 pages. Illustrated.

Catalogue. Published by the American Rail Joint & Manufacturing Company of Cleveland, Ohio. 72 pages. Illustrated.

The Westinghouse Standard Engine. Published by the Westinghouse Machine Company of Pittsburgh, Pa. 54 pages. Illustrated.