Street Railway Journal

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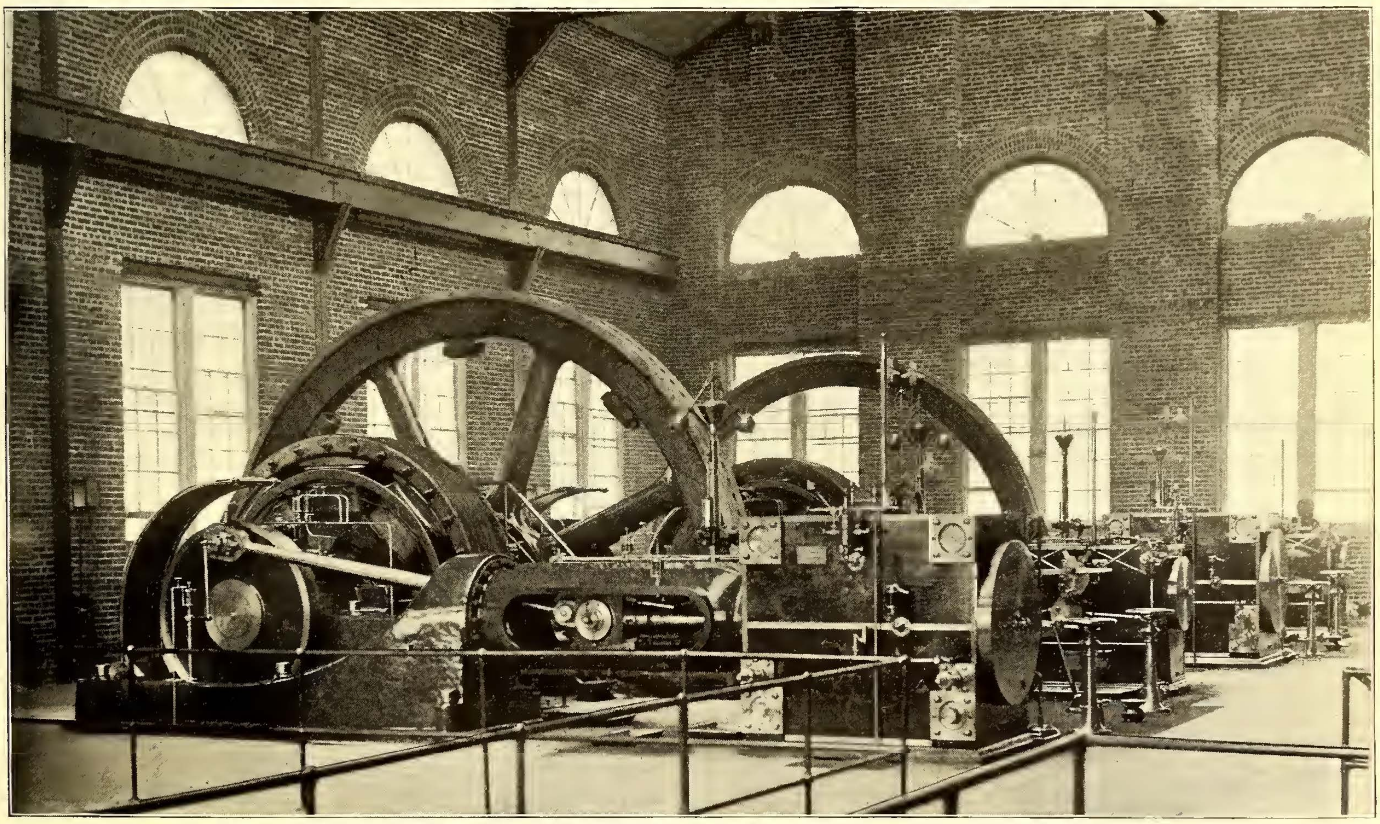
ANALYSIS OF THE OPERATION OF AN INTERURBAN RAILWAY

The district around Cleveland, Ohio, has become widely known from the number and extent of the interurban electric railways which radiate from that city as a center. The growing number, throughout the country, of railways of this character makes a study of the results secured on some of the older interurban lines a particularly interesting problem. The subject differs in a number of particulars from that of the ordinary street railway, owing (1) to the distance over which power is transmitted before reaching the cars, (2) to the size and weight of the cars operated, and (3) to the high speeds attained. The road selected for study in this article is that of the Lorain & Cleveland Railway Company, one of the more recent of the Cleveland interurban lines. The length of this road from Rocky River, the terminal of the Cleveland City Railway, to Lorain, is 18.5 miles. The track is built over private right of way. There are practically no grades or curves. The schedule running time between these terminals is three-quarters of an hour, and as there are numerous stops, a speed of from 45 to 50 miles or more is often made over a considerable portion of the route. To keep up the schedule it is not only necessary for the cars to make the high speed mentioned, but also to accelerate rapidly. For this reason, each car, which weighs about 22.5 tons, is equipped with four General Electric 50-h.p. motors. Upon reaching the eastern terminal of the line at Rocky River, the cars pass over the tracks of the Cleveland City Railway Company, a distance of 8.5 miles, to the Public Square in Cleveland. On this portion of their route the cars are supplied with current from the power station of the Cleveland City Railway.

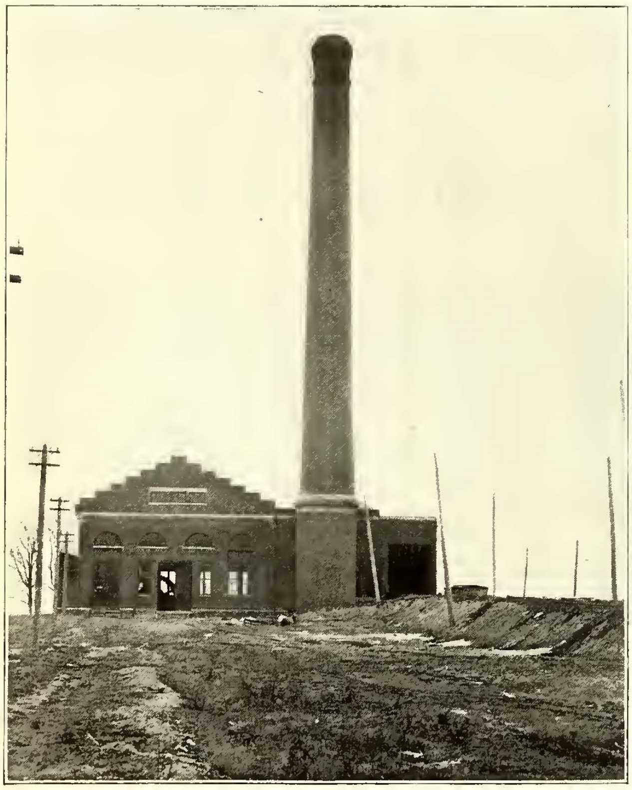
During the winter months, the cars operate on an hourly schedule, and during the summer run every half hour. When running every hour there are only from two to three cars at any one time between Rocky River and Lorain, which is the section fed from the power house of the Lorain & Cleveland Railway Company. When the cars are run on the half-hourly schedule, there are from four to five on this section, with the addition often of excursion cars. It is very evident that with a few cars, each equipped with four motors geared for high speed, and starting with a rapid acceleration, the fluctuations of load in the power house must be large, and the machinery installed must necessarily be designed for a wide range of load, and be reliable when operating under large overloads.



INTERIOR OF POWER STATION, LORAIN & CLEVELAND RAILWAY

ROAD AND LINE WORK

The road being on private right of way, the roadbed was built similar to steam road practice, being ditched on each side and gravel ballasted. The ties are of 6-in. x 8-in. x 8-ft. oak, spaced 24 ins. on centers. The rails are 70-lb. A. S. C. E. standard, with suspended joints and standard four-bolt splice bars. The sidings are 1500 ft. long, with combination spring and throw switches, supplied by the Cleveland Frog & Crossing Company, and fitted with regular steam railroad night and day signals. The curves into these sidings are very easy, so that the cars run into the switches and out again at nearly full speed, with very little swaying. The overhead material is very heavy in all its parts. The poles are 30 ft. 7 ins. in height, with all poles on curves trussed to an anchor behind them, and all poles are braced with a 4-in. x 6-in. x 8-ft. brace placed against the pole about 4 ft. above the ground, and



EXTERIOR OF POWER STATION

the other end against a 4-ft. stake driven with a piledriver. This has been found necessary, as the two No. 000 trolleys suspended over the track make a very heavy load on the cross suspension. It was found almost impossible to keep the poles from springing in without this additional brace, but by means of it the line has gone through an exceptionally hard winter and the soft weather of the spring with very few repairs.

The line extends 12 miles east from the power house and $6\frac{1}{2}$ miles west. The feeders are all of 300,000 c.m., one going 11 miles east, one 10 miles and one 9 miles; and one going 2 miles west, and one 5 miles. By using the double trolley all overhead switches are avoided, so that the cars enter and leave the turnouts without danger of the trolley leaving the wire.

In this connection it is interesting to note that on account of the high speeds and large current taken from the wire the tension of the trolley against the wire has been fixed at from 35 lbs. to 40 lbs., which is much higher than common practice. The trolley wheels are 6 ins. in diameter, with $\frac{5}{8}$-in. pin, 2 ins. long, but they are now being changed to wheels 7 ins. in diameter. The life of trolley wheels will not exceed one week, which shows the excessively hard usage to which they are subjected.

ROLLING STOCK

The car equipment at present consists of ten regular passenger cars and two combination passenger and baggage cars. These are equipped with Brill No. 27 trucks, and weigh about 4800 lbs. each. The wheels are 33 ins., with $2\frac{5}{8}$-in. tread and 1-in. flange. As electric brakes are used, which are applied direct to one wheel of each pair, the wheels themselves differ in weight, the brake wheel weighing, when new, 520 lbs., while its companion weighs 460 lbs. The motors have thirty-three teeth on the pinion and fifty-two on the gear, which gives a ratio of 1.579.

The car bodies are also of Brill make, and are 34 ft. 6 ins. long and 42 ft. 6 ins. over all, 8 ft. 4 ins. wide, and 12 ft. 6 ins. from track to trolley base. Each car has a telephone with extension rod, for connecting at the contact boxes placed every quarter of a mile along the line, and there are also stationary telephones at every switch, at the ends of the line, at the power house, shops and superintendent's residence.

To carry out the analogy of the steam road practice still further, the cars are equipped with regulation railroad signals. Each car runs a total of 340 miles per day, 240 of which is on the company's tracks, the rest being in the city limits. This gives a total of 720 car miles per day on hourly service, which requires three cars, and 1440 car miles per day on half-hourly service, which requires six cars.

A record of the current and voltage of the car gave an average for one trip of 140 amps. and 565 volts. The record of speed test taken at the same time gave as follows:

LORAIN & CLEVELAND RAILWAY, SPEED TEST, DEC. 30, 1898.

GOING WEST		Distance	Time	Miles Per Hour
Lv. Rocky River double track	12:10.5	3.56	5½ min.	39
Ar. Dover Switch	12:16			
Lv. Dover Switch	12:17	4.52	6 "	45.1
Ar. Mitchell Switch	12:23			
Lv. Mitchell Switch	12:24	2.44	3 "	48.8
Ar. Avon Beach Park	12:27			
Lv. Avon Beach Park	12:28.5	1.39	1.5 "	55.5
Ar. Sheffield Switch	12:30			
Lv. Sheffield Switch	12:31	4.91	7 "	42.2
Ar. Reverse Curve	12:38			
		16.82	23m.	43.8
GOING EAST				
Lv. Reverse Curve	1:48	4.91	6 min.	49.2
Ar. Sheffield Switch	1:54			
Lv. Sheffield Switch	1:54	1.64	2 "	49.2
Ar. Avon Beach Park	1:56			
Lv. Avon Beach Park	1:59	2.44	3 "	49
Ar. Mitchell Switch	2:02			
Lv. Mitchell Switch	2:15	4.52	6 "	45.1
Ar. Dover	2:21			
Lv. Dover	2:21	3.84	6 "	38.5
Ar. Double Track	2:27			
		16.28	23m.	43.8

Increased distance going east over that going west is due to including the length of two switches on the trip east which were not counted in on the trip west.

This was a special test, and was not taken under operating conditions, as no stops were made between switches to take on or let off passengers. The records show a maximum of 55.5 miles per hour from Avon Beach Park to Sheffield switch, and a minimum of 38.5 miles per hour from Dover switch to Rocky River double track. The first is a straight, level track going west from the power house, and the latter is the last stretch before reaching the city tracks, and contains two trestles, a drop under the Nickel Plate track combined with a reverse curve, all of which necessitate slowing up.

Referring to the power house report for week ending Jan. 1, 1899, the kw. hours for Friday were 2450, and the car mileage 720, which gives an output of 3.40 kw. hours per car mile, and at the rate given, of 6.4 lbs. of coal per kw. hour, this requires 21.8 lbs. of coal per car mile.

The average for the week was 823 car miles per day and 3227 kw. hours, which gives 3.9 kw. hours per car mile, and 21.5 lbs. of coal per car mile.

POWER STATION

The power station was illustrated and described in the STREET RAILWAY JOURNAL for April, 1897, and was then in course of construction. The plant was put in operation on Oct. 1, 1897, and has given very satisfactory results. The superintendent states that at no time has any part of the machinery had to be stopped because it was out of order, and that during the first year there was no expense for repairs.

The power house is located on the shore of Lake Erie, on a bluff, the top of which is about 22 ft. above the lake level. In order that the coal should fall by gravity from the coal bunker into the furnace, it was necessary to excavate about 16 ft., the excavation on the bluff side being carried right out to the beach.

The coal cars are run up an incline which brings them about 12 ft. above the ground level. The coal drops through the bottom hoppers in the cars into the coal storage. From the storage bins it passes through inclined chutes into the hoppers of the Murphy stokers. The inclined chutes are suspended from scale beams, and each chute load is weighed by Fairbanks scales. The average load is about 500 lbs. The ashes are removed from the pits by manual labor, as it was not considered advisable to install ash conveyors in a plant of this size.

The boilers now in place are four 300-h.p. Stirling boilers. The stack is of brick, 100 ins. in the clear, and 200 ft. high. In the breeching is a damper controlled by a Locke regulator. The water fed to each boiler is controlled by a Thomas boiler feed governor, and on each boiler there is also a Reliance column with high and low water alarm. In the pump pit are two Blake vertical condensers, and a Blake pump for fire and water works service, and which pumps to a 50,000-gal. tank located next the Park system. There is also a small Blake pump which draws from the hot well and discharges into a Stillwell & Bierce open heater; this pump is automatically governed by a Fisher governor. The water is drawn from the heater and fed to the boilers by either one of two Blake outside packed plunger pumps; these are also controlled by Fisher governors. The fire service pump and these two feed pumps are cross connected, and the low service pump drawing from the hot well is also cross connected with one of the feed pumps.

The water in the condensers is obtained through a 20-in. pipe, leading from the cold well outside the building. From the condensers the overflow discharges into a 20-in. pipe, and from the bottom of the pipe leading to such discharge a smaller pipe leads to the hot well.

The steam from the boilers passes through semi-circular bends, each of which has two valves, to a 20-in. header, and thence through Cochrane separators to the high pressure cylinder of the engine. A butterfly valve is placed in each line, and if the speed of the engine increases more than 10 per cent above the normal, the special governor operates this butterfly valve, shutting off steam from the engine, and at the same time making electrical connection which trips the generator circuit breaker on the switchboard. This prevents a flow of current from the switchboard to the generator, which would tend to make it act as a motor. This device was installed at the suggestion of Mr. Wason.

Each engine is a 20-in. and 36-in. x 48-in. C. & G. Cooper cross compound condensing engine, fitted with double eccentrics, and with Tripp's metallic packing. A Musgrave column is used in connection with the sight feed lubricator for the cylinders, and hand pumps are also provided.

BOILER ROOM AND COAL SCALES

From the engine the steam passes through a Cochrane exhaust separator to the condenser, with a Blake relief valve in the connection to the atmosphere.

There is a complete system of lubrication of all machinery by gravity pressure from tanks in the boiler room above the boilers. These tanks are fed by pumping from barrels, or a Cross oil filter placed on the floor below the engine room floor and between the engine foundations.

The high pressure piping is all extra heavy flanged, tongued and grooved, and with copper gaskets. It is covered with Keasby & Mattison's magnesia sectional covering. The low pressure pipe is standard pipe covered with magnabestos. The valves are Crane extra heavy bronze seated, and all the larger ones are by-passed. The angle and globe valves are Jenkins'. The water of condensation from all the live steam piping is returned to the boilers by the Holly gravity system.

The generators are two 400 kw. Siemens & Halske, with outside armature and separate commutator. The switchboard has the usual number of instruments, those for measuring the current being of the Weston type. In addition there is a General Electric recording wattmeter and a Bristol recording voltmeter.

On the gage board there are, in addition to the usual gages, a recording steam gage and a recording draft gage, both made by the Bristol Company.

The traveling crane has a capacity for 15 tons and has two 10-ton trolleys, each fitted with triplex blocks. It was built by the Cleveland Punch & Shear Works.

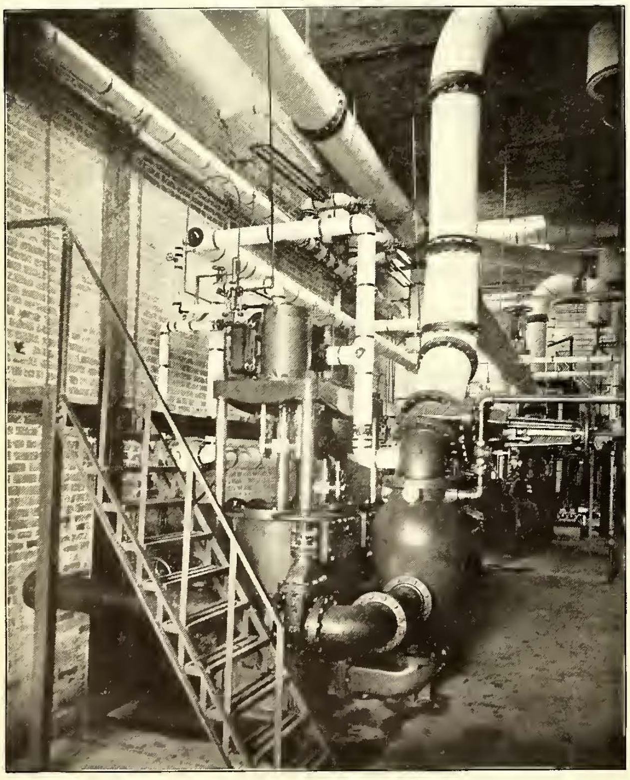
The building is a self-supporting steel structure, having steel roof trusses with steel purlins, the trusses resting on steel posts built into the brick walls. The floor of the engine-room is concrete, resting on hollow tile and supported by steel beams. The flooring between the engine foundations and the pump pit in the boiler room is concrete.

The labor in attendance on the plant consists of two engineers and two firemen and one man who unloads coal, cleans up the plant and acts as a general assistant. The chief engineer, one foreman and the general assistant are on duty during the daytime, and the second engineer and firman at night. These men will still be able to take care of the plant after it has been largely increased.

OFFICERS AND CONTRACTORS

After a considerable portion of the civil engineering in connection with the road had been completed, and the equipment of the cars decided upon, the company engaged E. P. Roberts & Company to design the power station and supervise its erection. Prominent members of the company at that time, as at present, were B. Mahler, Henry A. Everett, E. W. Moore, and C. W. Wason, all well known in electric railway circles. Mr. Wason also acted as consulting engineer for the road.

E. P. Roberts & Company engaged as architect J. N. Richardson, and to design and inspect the steel work and the steel used in the boilers, the Osborn Company. J. N.



VIEW OF PUMPS

Richardson also designed the car houses for the company, and the Osborn Company inspected the steel for the track and designed some of the bridges. The building contractors were L. Dautel, for the mason work; J. W. Vanderwerf, for the carpenter work, and the Forest City Wire & Iron Company, for the structural steel. The piping contractors were Chafer & Becker, who had all the large pipe furnished by the Crane Company, of Chicago, who made

SWITCH BOARD

the piping in accordance with the drawings of the engineers.

TEST OF POWER PLANT EQUIPMENT

The following is the result of a test made upon the plant. During the time of the test the line was operated on a one hour schedule, by three cars running between the Puplic Square, in Cleveland, and the bridge at Lorain. This schedule was such that one car was on the Cleveland City Railway Company's line all the time, leaving only two regular cars to be supplied with power by the power house. In addition, there was a work train on the road, which sometimes took more power, for short intervals, than a regular car. The time table was so arranged that four cars were used with three crews, one car being kept at the Lorain end for inspection. Thus, a crew would bring in a car at the Lorain end, leave it there and take the car that had been at that point. This, of course, necessitated the running of this extra car to Lorain in the morning and back to the car house at night, a total distance of about 12 miles.

The first test, Feb. 12, 1898, was with two boilers feeding one engine, the generator connected to which supplied current for the regular operation of the line. On the second test, Feb. 14, 1898, the same engine as on Feb. 12 was used to supply the line, and the second engine was run on a steady load provided by a water rheostat. The steam used by these two engines could not be supplied separately, as there was no valve permitting this to be done.

The objects of the two tests were, first, to get the running efficiency of the plant; and, second, to obtain the efficiency of the engines and generators, under a full rated load. In order to accomplish this, it was necessary to obtain the variable load each day and to apply the results obtained on the test for variable load on the first day, to the variable load on the second, and to subtract such figures from the totals obtained for variable and constant load and thereby obtain the values for constant load.

Although it was necessary to make assumptions as to certain steam consumptions by auxiliaries, it is thought that the results obtained are very nearly accurate, and sufficiently so for all practical purposes. That they are very close is proved by the fact that on the curve of performance for seven months the curve passes through the point obtained at the test, as described later. However, because of the assumptions made, it must not be thought that the engine performance at full load may not have been somewhat better than stated, and furthermore, it must be remembered that the cylinder ratio was for variable load, and therefore that the results at steady and rated load could not be as good as if designed for operation under such conditions. The principal value of the results of the tests is in showing the difference in efficiencies at rated load and at a small and variable load, and the test, taken in connection with the curve of daily performance, is of value in showing the result of increased average although greatly varying load, on the steam and fuel consumption.

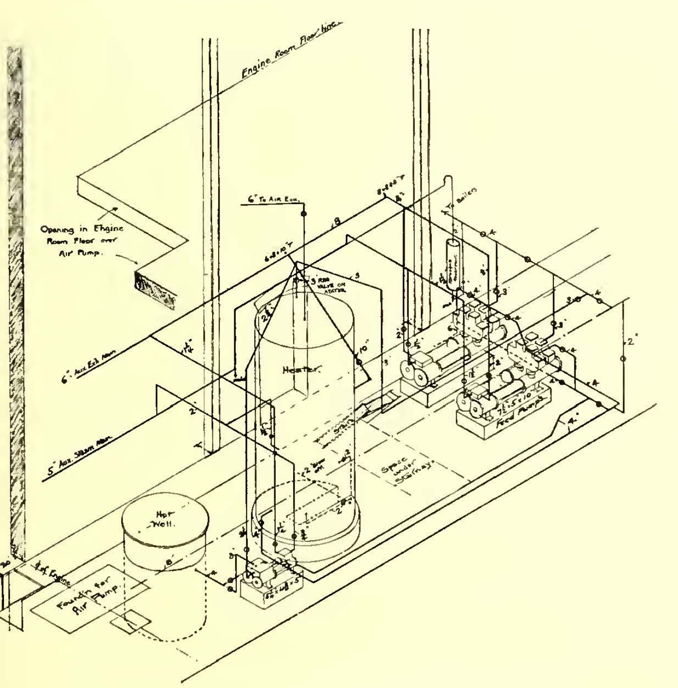
In the data following the tabulation, the numbers refer to the corresponding numbers in the tabulation.

INSTRUMENTS USED

All the gages, indicator springs, and electrical instruments were carefully calibrated by reference to standards.

The coal was weighed in the steel chutes, regularly in use, which are hung on Fairbanks scale beams. These scales were all tested by weighing a known weight on the test scales, and then hanging it on to the chute belonging to the scales to be tested. These scales are tested very closely, and proper correction was made in the coal weights for all differences.

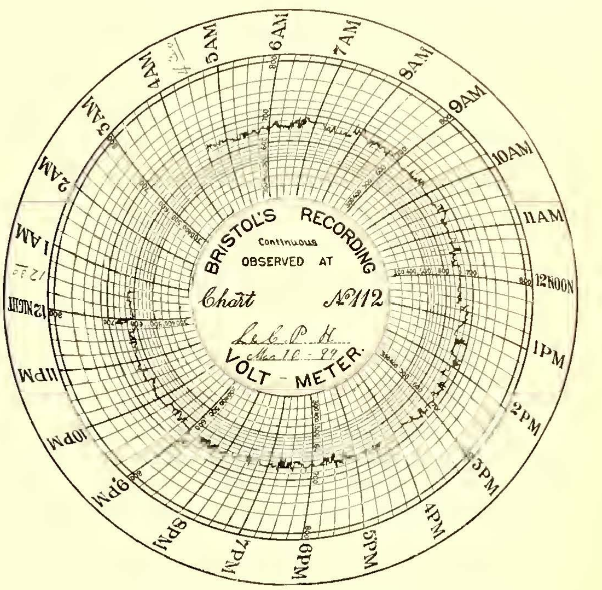
A large tank with an inverted funnel top, and a neck about 10 ins. in diameter, had been especially prepared for weighing water. This tank was filled from the service line by a 3-in. pipe closed by a quick acting lever valve, and



ISOMETRIC DIAGRAM OF PUMP CONNECTIONS

was emptied into a somewhat larger storage tank by means of a 4-in. pipe closed by a quick acting valve. In the 10-in. neck of the weighing tank an overflow pipe led to drain. As the tank was filled to this overflow, and allowed to drain from that point, the amount of water contained in the tank was identical for each filling. The tank was filled and then the water drawn off into a barrel placed on the test scales and thus weighed. This was repeated several times, and the readings gave only from .5 lb. to 1 lb. difference in 3676 lbs. for a full tank. The boiler feed pumps drew direct from the storage tank above mentioned.

It will be noted that the temperature of the feed was



VOLTMETER RECORD, MAR. 10, 1899

much lower than in practice because of the drawing from the tank, and not from the heater. The tables give the value of the difference.

BOILER TEST

1.	Date of trial	Feb. 12,'98.	Feb. 14,'98.
2.	Duration of trial	20.63 hrs.	20 hrs.
	DIMENSIONS AND PROPORTIONS		
	First day, two grates. Second day, three grates.		
3.*	Grate surface—length, 6 ft. 1 in.; width, 7 ft. 8 ins. Area ... sq. ft.	143	214.5
4.*	Maker's rating ... projected area.	92	138
5.*	Water heating surface ... sq. ft.	6,076	9,114
6.	Super-heating surface ... sq. ft.	0	0
7.	Ratio of water heating to actual grate surface	42.48	42.48
8.	Ratio of water heating to projected grate surface	66.03	66.03
	AVERAGE PRESSURES		
9.	Steam pressure by gage ... lbs per sq. in.	131.6	132.1
10.	Absolute pressure ... lbs.	145.93	146.44
11.	Atmospheric pressure by barometer, ins. mercury.	29.25	29.26
12.*	Force of draft between damper and boiler, ins. of water ... ins.	.2	.2
	AVERAGE OF TEMPERATURES		
13.	Of external air ... degs. F.	42	33
14.*	Of feed water entering boiler ... degs. F.	39	37.47
15.	Of boiler flue gases ... degs. F.	425	522.2
	FUEL.		
16.	Size and condition, Wheeling Creek bituminous; quite dry.		
17.	Weight of coal as fired ... lbs.	17,471	39,679
18.	Percentage of moisture in coal ... per cent.	.36	.36
19.	Total weight of dry coal consumed ... lbs.	17,408	39,536
20.*	Total ash, refuse and fine coal ... lbs.	3,360	5,530
21.	Total combustible ... lbs.	14,048	34,006
22.	Percentage of ash and refuse in coal ... per cent.	19.3	14
	ANALYSIS		
23.	Carbon ... 70.62 Nitrogen ... .93		
24.	Hydrogen ... 6.15 Sulphur ... 3.61		
25.	Moisture ... .36 Oxygen ... 7.76		
26.*	Ash ... 10.57 H. U. per lb., by analysis.	13,522	13,522
	Formula—H. U. $= 14,600\ C + 62,000 \left(H - \frac{O}{8}\right)$		
	FUEL PER HOUR		
27.	Dry coal consumed per hour ... lbs.	843.8	1976.8
28.	Combustible consumed per hour ... lbs.	680.9	1700.3
29.*	Dry coal per sq. ft. of grate per hour ... actual.	5.9	9.21
	Projected	9.17	14.31
	QUALITY OF STEAM		
30.	Percentage of moisture in steam ... per cent.	.49	.49
31.	Factor of correction for quality of steam	.9963	.9963
	WATER		
32.	Total weight of water fed to boiler ... lbs.	120,528	306,183
33.	Water actually evaporated, corrected for quality of steam and leak ... lbs.	119,683	304,352
34.	Equiv. water evaporated into dry steam from and at 212 degs. F. ... lbs.	146,675	373,531
	Factors, 1.2256 and 1.2273.		
	WATER PER HOUR		
35.	Water evaporated per hour, corrected for quality of steam ... lbs.	5,801.4	15,217.6
36.	Equiv. evaporated per hour from and at 212 degs. F. ... lbs.	7,109.7	18,676.5
37.	Equiv. evaporated per hour from and at 212 degs. F., per sq. ft. H. S. ... lbs.	1.17	2.04

HORSE POWER		
38. Horse power developed (34.5 lbs. water per hour into dry steam from and at 212 degs. F.	206	541
39. Builders' rated horse power	600	900
40. Percentage of builders' rated horse power developed	34.33	60.14
ECONOMIC RESULTS		
41. Water apparently evaporated per pound coal—actual condition—32 ÷ 17	6.89	7.71
42. Equiv. evaporated from and at 212 degs. F. per pound coal (including moisture)	8.39	9.41
43. Equiv. evaporated from and at 212 degs. F. per pound dry coal	8.42	9.44
44. Equiv. evaporated from and at 212 degs. F. per pound, combustible	10.43	10.98
EFFICIENCY		
45. Efficiency of boiler—heat absorbed by the boiler per pound combustible, divided by the heat value of 1 lb. combustible	74.05	78.89
46. Efficiency of boiler and grate; heat absorbed by boiler per pound dry coal fired, divided by the heat value of 1 lb. dry coal	59.78	67.02

NOTES RELATIVE TO TABLES.

Boiler Notes

Nos. 3 and 4.—In item No. 3 the actual area of the grate is used, but the makers of the furnace rated the grate surface in projected, or horizontal area, and the item No. 4 is given accordingly.

No. 5.—Three thousand and thirty-eight sq. ft. per boiler, or at a rating of 10 sq. ft., gives 303.8 h.p.

No. 11.—Although the force of draft is given as only .2 ins. of water as the average used, a draft of from 1.2 ins. to 1.3 ins. was at all times available by the opening of the damper, and is shown on the charts of the Bristol recording draft gage as a straight, or nearly straight line, reaching out to those values at intervals. This was done by changing the valves for the draft connection to the gage from between the boilers and damper to the outside of the damper. Several times during the second test the values for the boiler draft were as high as from .6 ins. to .7 ins. (See Recording Gage Charts.) Later Note.—Results in practice often show a utilization of 1 in. for short times.

No. 14.—Temperature of every tank of water was taken, and temperature in feed pipe to boilers.

No. 21.—A considerable quantity of fine coal passed through the grates, and as it was inconvenient to return same to the furnace, it was put aside. This fine coal is ordinarily returned to the furnace, and thus is not lost in the ash. For these tests this waste amounted to 8.73 per cent the first day, and 3.43 per cent the second day. When the boilers are working up to their capacity, very little coal passes through.

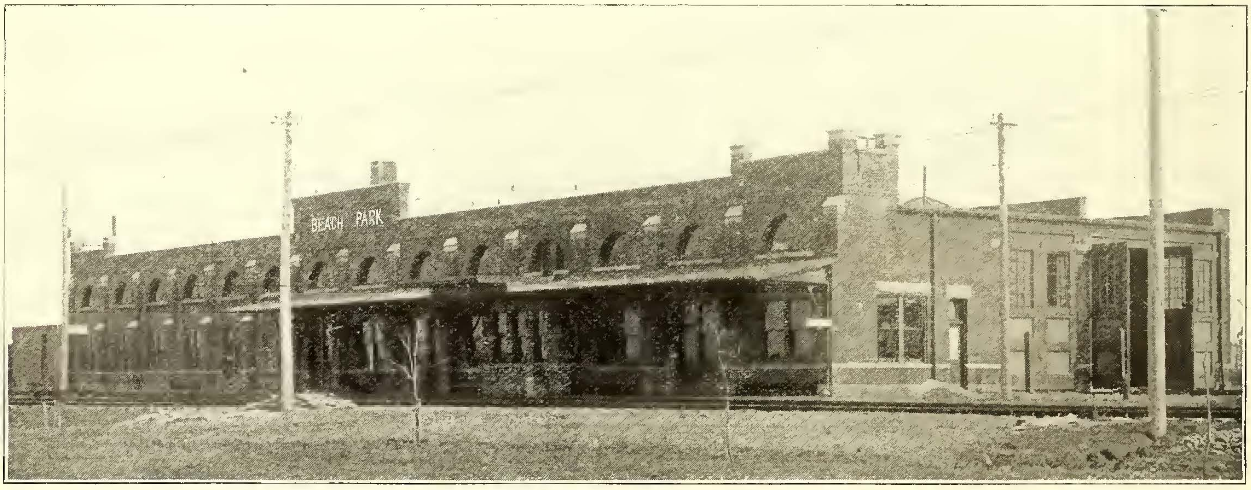
No. 26.—The heat units per pound is given as the same for both days. The coal used had been in the bunkers for some time, and as the amount used for two days made very little difference in the size of the pile, it was assumed that the average of the samples for both days would give a fairer average than keeping the readings separate.

Formula used for heat value—$14{,}600\ C. + 62{,}000\left(H - \frac{O}{8}\right)$

No. 29.—Three calorimeters were used, but two of these were found to be unreliable, and so only the third, which was used on the engine in the second day's test, was used for data. This gave the amount of moisture in the steam after passing the separator, and the drip from the Holly system accounted for the rest of the entrained and condensed water in the steam system. From this total an allowance was deducted for condensation in the pipes, and the rest charged to entrained moisture in the steam from the boilers. This agreed quite well with the determinations by the above-mentioned calorimeter of the amount of moisture at the boilers on the first day's test.

ENGINE TEST

	One Engine.	Both Engines.	Engine on Rated load. Results
1. Date of trial	Feb. 12, '98.	Feb. 14, '98.	
2. Duration of trial	20 hrs. 38 min.	20 hrs.	Feb. 14, '98
SIZES OF ENGINES			
3. Diam. high-pressure cylinder...ins.	20	20	
Diam. low-pressure cylinder....ins.	36	36	
Length of stroke...ins.	48	48	
4. Diam. of fly wheel...ft.	20	20	
5. Weight of fly wheel...lbs.	60,000	60,000	
6. Rated strokes per minute	80	80	
7. Rated horse power per engine	600	600	
8. Kw. output	2,544	9,024	6,644
9. Rated capacity in kw.	400	800	400
10. Actual average output	123.3	451.2	332
WATER CONSUMPTION			
11. Total water fed to boilers...lbs.	120,528	306,183	
12. Total water lost through blow-off...lbs.	554	900	
13.* Lost through Holly system, 675 per hour first day...lbs	13,925	1,145	
14. Total water delivered to engine and auxiliaries...lbs.	106,049	304,138	
15. Water used by auxiliaries...lbs.	33,161	59,435	
16.* Water used by service pump second day...lbs.	......	2,835	
17.* Water used by auxiliaries second day, deducting amount used by service pump...lbs.	......	56,600	
18.* Total water delivered to engines and auxiliaries, after deducting service pump...lbs.	......	301,303	
19. Percentage of total water delivered to system which is used by auxiliaries, excluding the service pump:			
First day = items 15 ÷ 14	31.3	......	
Second day = items 17 ÷ 18	......	18.8	
20. Total steam and entrained water delivered to engines	72,888	244,703	
21. Percentage of moisture in steam at engine, by calorimeter	.57	.77	
22. Total dry steam at engines	72,472	242,819	
23.* Proportionate amount of water used by engine No. 1 second day	......	70,280	
24.* Water used by engine No. 2 second day, steady load	......	......	172.539
25. Average speed of engines	79.6	......	76.4
26. Average vacuum inches of hg	26.01	......	26.2
27. Average gage pressure at main header	131.3	......	130.2
28.* Average initial pressure in cylinders	......	......	125.5
FUEL			
29.* Total coal fired...lbs.	17,471	39,679	
30.* Total dry coal fired...lbs.	17,408	39,536	
31.* Total combustible...lbs.	14,048	34,006	
HORSE POWER			
32.* Average i.h.p.	......	......	534.32
33.* Maximum i.h.p.	......	......	568.8
34.* Minimum i.h.p.	......	......	239.4
35.* Friction i.h.p.	......	......	47.74
36. Average electrical h.p.	......	......	445.33
CONSUMPTION AND OUTPUT PER HOUR			
37.* Lbs. dry steam per i.h.p. per hr.	......	......	16.14
38. Lbs. coal per i.h.p. per hr.	......	......	12.03
39. Lbs. dry coal per i.h.p. per hr.	......	......	12.08
40. Lbs. combustible per i.h.p. per hr.	......	......	1.79
41. Lbs. dry coal per i.h.p. per hr., with feed at 210 degs. F.	......	......	1.68
42. Lbs. combustible per i.h.p. per hr., with feed at 210 degs. F.	......	......	1.44
43.* Lbs. of coal per kw. hr.	6.86	4.39	3.37
44. Lbs. dry coal per kw. hr.	6.84	4.38	3.35
45. Lbs. Combustible per kw. hr.	5.52	3.77	2.89
46. Lbs. dry coal per kw. hr., with feed at 210 degs. F.	5.98	3.74	2.72
47. Ditto, combustible	4.82	3.15	2.32



TYPICAL WAY STATION AND CAR HOUSE

EFFICIENCIES

48. Efficiency of engine, including shafting and brush friction, per ct.	......	......	91.05
49. Efficiency of generator (see note) per cent	......	......	91.48
50.* Efficiency of combination, per cent.	......	......	83.3

AVERAGE LOAD PERCENTAGE OF FULL LOAD

51. Engine ....per cent.	......	......	89.05
52. Generator ....per cent.	30.8	29.75	83.05

LATER NOTE

Results from operating conditions:

	Power Factor	Lbs. water per kw.-hr.	Lbs water per e.h.p. hr.
Test of Feb. 12, 1898....................	30.8	41.34	31.01
Maximum output for one day up to July 24, 1898, gives 5 lbs. coal per kw.-hr; this, with evaporation of 7.71, gives	47.2	38.55	28.91

This test of Feb. 12, 1898, gives the same results as the average for the same output during operation from Jan. 1 to July 24, 1898. See point No. 6 on curve, which shows the test of Feb. 12 reduced to feed at 210 deg., which is the ordinary temperature of the feed water.

Engine Test Notes

During the run on Feb. 12, Engine No. 1 furnished current for the road until 10.05 A. M., when the load was changed onto Engine No. 2, which finished the run. On Feb. 14 No. 1 ran the road, and No. 2 was used on the water rheostat.

No. 13.—The large amount of leak from Holly system the first day was caused by a defective valve allowing steam to blow through. This was fixed for the second day's run, and shows only the natural leakage due to condensed water from the piping system and separators.

Nos. 15, 16 and 17.—It was inconvenient to change the piping so as to get the actual steam consumption of the pumps, and it was decided to estimate this. The number of strokes of each pump were taken, and also the average steam pressure in the cylinders, and the head against which they were working, and the steam consumption estimated.

No. 18.—This is deducted because the service pump is not a station auxiliary, but furnishes water for use outside of the station.

No. 23.—The engine set running the road (No. 1) on the second day had slightly less kw. output than on the first. If the steam be taken at the same rate per kw. it would be incorrect, as at the lighter load the set is less efficient. The amount deducted was the *difference* in kw. for the two days multiplied by 50 per cent of the *rate* for the first day.

No. 24.—Obtained by subtracting (23) from the second item in (22).

No. 28.—Obtained from average of indicator cards.

Nos. 29, 30 and 31.—Copied from boiler test.

No. 32.—Average of twenty-nine indicator cards.

Nos. 33 and 34.—Obtained from indicator cards taken at time of maximum and minimum loads.

No. 35.—Average of five sets of cards.

No. 36.—Computed from switchboard readings.

No. 37.—From items 24 and 32.

Nos. 38 to 42.—Are figured from the engine consumption alone, and do not include pumps, etc., and are, therefore, lower than the amount which would be required to run the station under this load.

Nos. 43 to 47.—Columns Nos. 1 and 2 are figured from the total coal, and total kw. output for the two days, and include that due to the auxiliaries, while Column No. 3 is figured for the engine alone.

No. 48.—From items Nos. 32 and 35

Nos. 49 and 50.—From items Nos. 32 and 36 the item No. 50 is found, and dividing No. 50 by No. 48 gives No. 49, or, dividing the combined efficiency by the efficiency of the engine, gives efficiency of generator. These efficiencies would have been increased if the load had been more nearly full rated load.

DISCUSSION OF RESULTS OF TESTS

Owing to the exceedingly variable load, the kw. per pound of coal for the run on the road was very different from what it was for the test on approximately full load, and this was to be expected.

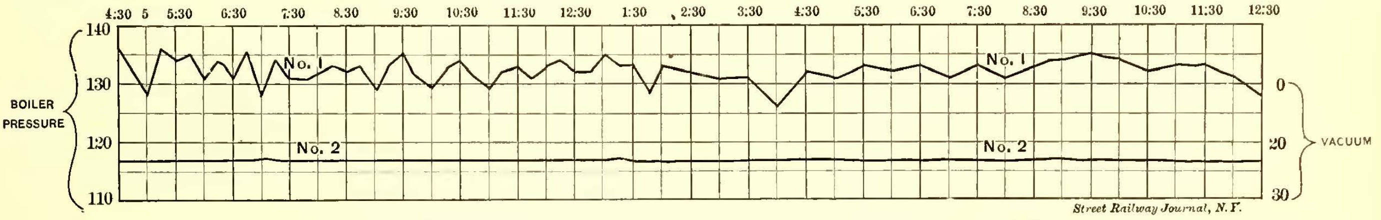
1. The boiler efficiency was not as high.
2. The percentage of steam used by the pump was much greater.
3. The engine efficiency was very much less.
4. The generator efficiency was very much less.

The record shows what the engine only would do if fully loaded, but this can never be obtained, as the pumps and the condenser must always be used.

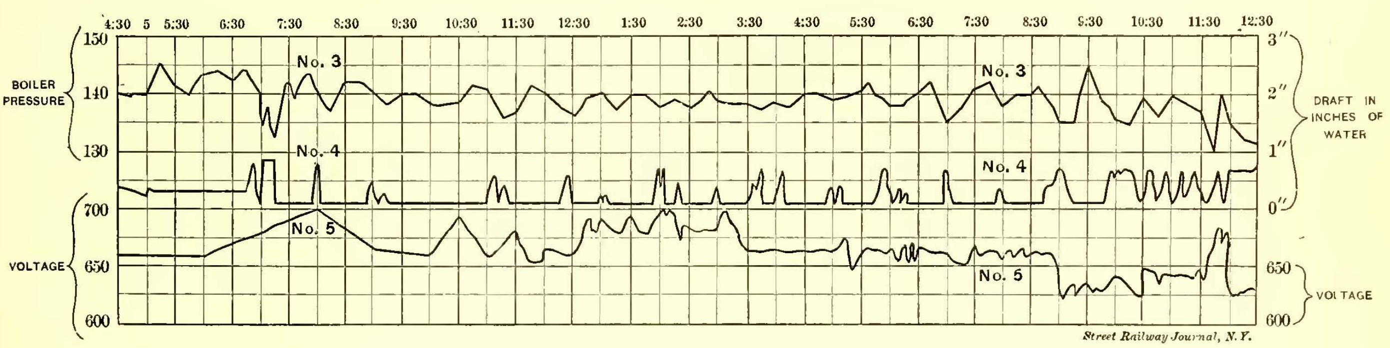
An approximate, but fairly close, estimate indicates that the plant at full load, and the same efficiency of boiler as at the time of approximately full load test, and the same fuel, would consume about 3.32 lbs. coal per kw.-hour; the combined efficiency of engine and generator being increased about 4 per cent. The boiler efficiency would be slightly higher, but probably 3.3 lbs. per kw.-hour is about the limit, a point unattainable, but valuable to know, for the sake of comparison of results obtained with what may possibly be considered, for this case, the theoretical limit.

Comparisons of daily output and coal consumption show the benefit of increased load on the station efficiency, and later, when more records have been obtained it was possible to plot a curve to obtain the average results, and to show how they compare with the theoretical point above mentioned.

It should be noted that the figure 3.3 lbs. per kw.-hour includes the auxiliaries which were taken for the estimate as using 14.5 per cent of the total steam. This would leave for the engine only 2.82 lbs. per kw.-hour, which, with a combined efficiency of 87.3 per cent, would give 1.83 lbs.



STEAM PRESSURE AND VACUUM CHARTS, TEST OF FEB. 12, 1898



STEAM PRESSURE, DRAFT AND VOLTAGE CHARTS, TEST OF MAR. 10, 1899 per i.h.p., and almost 2 per cent less for every 10 per cent error against the auxiliaries in the estimate of the steam used by the latter.

The success attending the operation of the road has been exceptional, and the officers whose capable management has secured this result are as follows:

B. Mahler, president, who gives the road his constant supervision; J. B. Hanna, vice-president; E. W. Moore, treasurer; J. C. Hoge, secretary; F. W. Coen, assistant secretary; W. E. Davis, superintendent.

The chief engineer of the power house is W. B. Stewart, who takes great pride in the appearance of the power house and gives it the most careful and intelligent attention. When the writer complimented the superintendent he was answered by the quotation that "it was the man behind the gun." Mr. Davis also stated that on the day previous to this statement, and also during the week of exceptionally cold weather, that the generator circuit breaker frequently operated at 1100 amps., and that 1000 amps. was carried for several minutes at a time.

It should be noted that 1100 amps. is 100 per cent overload.

THE RELATION OF THE LOAD FACTOR TO ECONOMY

The tests given above were made to determine the exact economy of the station under conditions as they existed upon two particular days, but the company has also maintained a continuous system of keeping records showing the relation between the coal consumption and kw.-hour output on different days. The coal is weighed, as stated, as it is fed into the hoppers, and the kw. hours taken from the wattmeter on the switchboard. The form in which these records are kept is given below, showing, as will be seen, the coal per kw. hour and per h.p. hour. The records for every twenty-four hours from Jan. 1, 1898, to July 24, 1898, were then plotted on a diagram, as shown on this page by O's. Later records are shown by X's. From the O records a mean line was drawn as giving the average consumption of coal per kw. hour with different load factors. This line is also a fair mean of the X points, as will be seen from its inspection, unless possibly that the line should dip a little more for large loads. To secure uniformity in records, all points are reduced to feed water at 210 deg. F. Point No. 1 was that determined by the test on Feb. 12, 1898, with a variable load, as given above. Point No. 6 is the same record, but with feed water reduced to 210 deg., and as will be seen, it lies directly on the average line. The following points, determined by a test on Feb. 15, 1898, were not put on the diagram owing to lack of room.

No. of Tests.	Character of Load.	Kw. H.	Feed Water 39 degs. F., lbs. per kw. h.	Feed Water reduced to 210 degs. F., lbs per kw. h.
1.	Combined variable and steady..	451.2	4.39	3.74
2.	Steady (engine load only).......	451.2	3.37	2.72
3.	Limit for full load (engines and pumps) calculated as stated under discussion of results..	......	......	3.32

It will be noted from the chart that the best result yet obtained is 50 per cent in excess of that which would be obtained at full load. The poorest (from the curve) is 120 per cent, and the average about 81 per cent. The variation in records for the same output is due, first, to the different amounts of coal in the hoppers and furnaces at the start and finish on different days; second, to the difference caused by the starting up of new boilers; third, to the difference in the character and combustion value of the coal; fourth, to the difference in the character of the load, and fifth, to the fact as to whether the service pump was used or not.

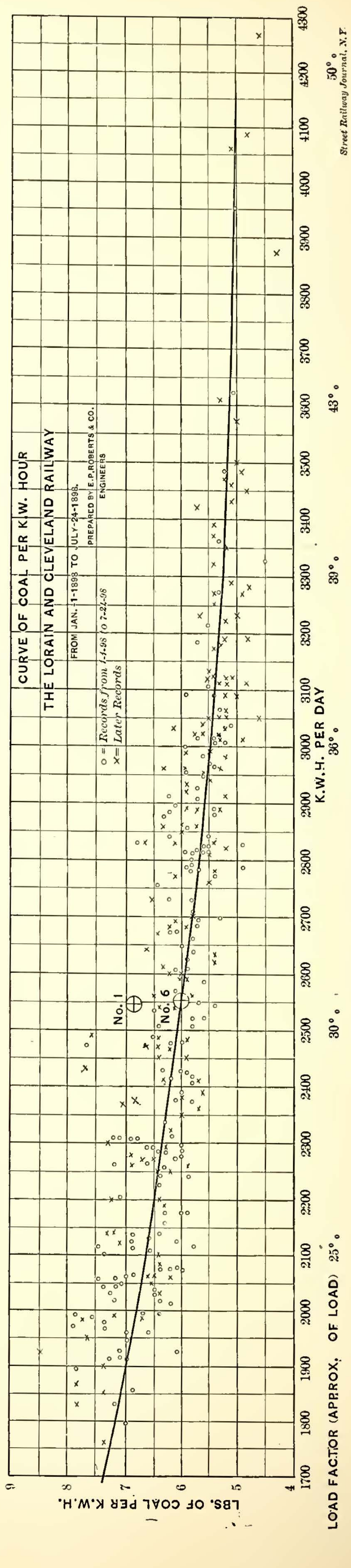


DIAGRAM SHOWING RELATION BETWEEN LOAD FACTOR AND ECONOMY

ECONOMY POSSIBLE FROM STORAGE BATTERIES

The results shown by the above curve will be found of interest to those considering the application of storage batteries to interurban roads. As is well known, the usual practice is to install a battery of sufficient size to take care of the overloads, the battery being charged at the time of underloads, and consequently the engine and generator running at all times at approximately rated load, with the result that the fuel consumption per i.h.p. and per kw. hour is greatly lessened.

One of the advantages derived from a chart and tests of this kind is the ability to determine the possible economy from the use of storage batteries as station regulators. When a plant is originally designed for the use of storage batteries, the steam end should be proportioned differently from when it is designed for exceedingly variable loads without the use of a battery. If the plant in either case were to be compound condensing, the ratio of the cylinders would be much greater for a storage battery plant than for one with variable load, and if batteries were not to be used and the decision were against compounding and condensing, the use of a battery might so modify the conditions as to make compounding and condensing advisable. In a similar way it might make advisable the use of economizers and induced draft in cases where otherwise it would not be advisable, or, at least, would be very questionable. A careful designer will also change the ratio of heating surface to grate surface and possibly the amount of each provided. If, however, the plant is one which is already in operation, as in the case of the Lorain & Cleveland Railway, the question of advisability of installing a battery auxiliary to take care of fluctuations under the present operating conditions, or to allow additional output without

THE LORAIN & CLEVELAND RAILWAY CO

POWER HOUSE REPORT.

Week ending *Jan. 1st,* 1899

DAY.	KW-HOURS 24 HOURS	COAL 24 HOURS	COAL PER K.W.H	COAL PER H.P.H.	
Monday,	*3871*	*16760*	*4 . 3*	*3 . 2*	
Tuesday,	*2866*	*17355*	*6 . 0*	*4 . 4*	
Wednesday,	*3055*	*16960*	*5 . 5*	*4 . 1*	
Thursday,	*2376*	*16230*	*6 . 8*	*5 . 0*	
Friday,	*2450*	*15900*	*6 . 4*	*4 . 7*	
Saturday,	*4263*	*19950*	*4 . 6*	*3 . 4*	
Sunday,	*3570*	*18310*	*5 . 0*	*3 . 7*	
Total,	*22451*	*121465*			

Average K. W. H. per Week, *3207*
" " " " Hour, *185+*
" Coal " K. W. H., *5 . 5*
" Coal " H. P. H., *4 . 0*

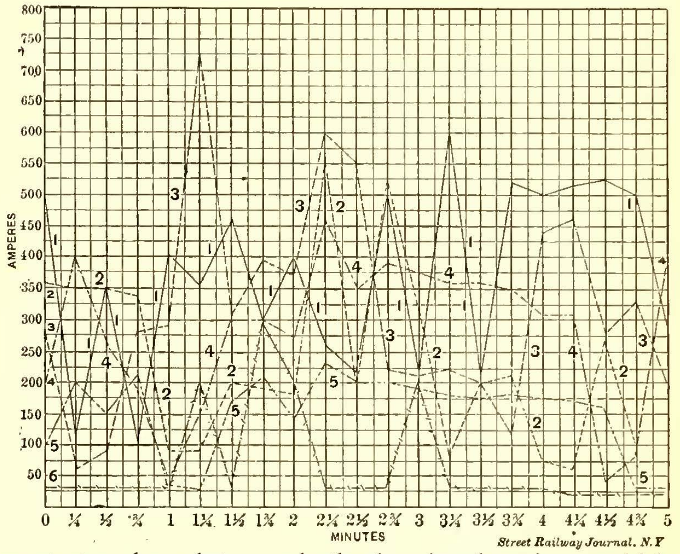
Remarks:

W. E. Davis, Sup't.

SAMPLE WEEKLY STATION ORDER

adding engines, boilers and generator, it would be considered along the following lines:

For the output now required for both the summer and winter traffic the curve shows the average coal per kw. hour, and the test indicates what result would be obtained if the load were constant. The percentage of saving of fuel would be as indicated by the figures given under "Discussion of Results of Tests," above. Whether such a saving would make it advisable to install a battery depends upon the price of coal, the amount used, the cost of the necessary battery, and the interest and depreciation charges which it is considered proper to allow, also whether any financial value shall be given to providing power which could be used for a short time in case of total break down. As a matter of fact, the importance of the latter consideration in a first-class modern station is small, but a practical economy is often secured by the use of a battery in allowing the station to shut down an hour earlier



or start an hour later, or both, than it otherwise would by taking care of the first car out over the line, and the last car in.

It is by obtaining such data as above that exact designing can be accomplished, and both the Lorain & Cleveland Company, as represented by its officers, and engineers have shown a commendable spirit in allowing its publication.

Quickly Baked Coils

BY J. F. HOBART

In cases where small coils are required for immediate use and there is no time in which to bake the shellac sufficient to hold them in place, they are made ready for instant duty by a method called "burning out" in the very few shops where I have ever seen the method used. Supposing the coil is a four-wire concern to form a part of the winding of an armature. It is wound into shape and held by several small metal clips so that it can be removed from the form on which it is wound and then immediately saturated with thick shellac varnish.

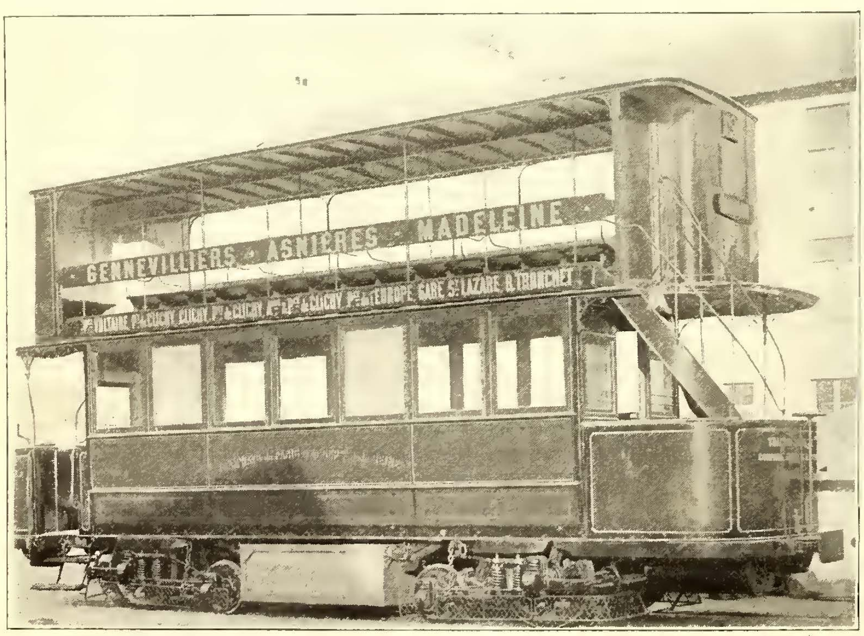
When possible, and that is in most cases, the shellac is applied before the coil is removed from the form, but in either case, after being shellacked, the coil is placed in the heat of a gasoline torch or Bunsen burner, and the shellac heated to the igniting point. It will blaze fiercely, and at just the right time—decided by experience—the blazing coil is removed from the flame and the blaze extinguished. The shellac must not be burned—that would spoil it for the purpose, but just enough of the alcohol is removed to make the shellac hard, but not brittle. A very little practice will determine just when to stop the firing operation, and a good coil can be quickly made ready for use by this process.

Under the average conditions a 22-ft. closed car or an eight reversible seat open car should be the limit for a single truck. Although there are single trucks which will carry a longer body fairly well, yet the increase in maintenance will, in most cases, warrant the use of double trucks. From paper at the Boston Convention, 1898.

Electric Railways in Paris, France

There are three companies which operate electric railways in the city of Paris—the Compagnie des Tramways de Paris et du Départment de la Seine, the Compagnie Générale Parisienne de Tramways and the Compagnie du Tramway de Paris à Romainville. The principal line leaves from in front of the Madeleine, in the center of Paris. The power station is situated on the line of the road at Asniéres, and contains three engines, each connected to a Walker 200-kw. generator. Two types of cars are used, a single and double truck, both of which are illustrated herewith. The double-truck car, which is mounted on Brill maximum traction trucks, carries fifty-eight passengers, and weighs, complete, 17,000 kg., made up as follows: weight of car body, 4200 kg.; trucks and motors, 4700 kg.; battery, 3700 kg.; fifty-eight passengers and two employees, 440 kg. A full description of the car, which operates on the mixed trolley and accumulator system, was published in the Street Railway Journal (international edition) for July, 1898.

ELECTRIC TRAIN, RAINCY-MONTFERMIEL RAILWAY



DOUBLE DECK STORAGE BATTERY CAR, PARIS

ELECTRIC TRAIN, RAINCY

The Compagnie du Tramway de Paris à Romainville operates cars from the Place de la Republique, at the center of Paris, to the Port de Romainville, and thence to Coté de Noisy-le-Sec. The line was installed in 1896, is equipped with Claret-Vuilleumier surface contact system. The length in Paris is 4 km. of double track, and outside of Paris 3 km. of single track. The minimum curve radius is 25 meters, and the steepest grade is 5½ per cent. The power station is situated at Lilas, about two-thirds of the distance from the Paris terminal. It contains three boilers, four Corliss engines, four generators, and adjoining it is a car house for thirty cars. The cars are capable of carrying fifty-two passengers. They weigh 13,000 kg. loaded, and are operated by two 30-h.p. Walker motors.

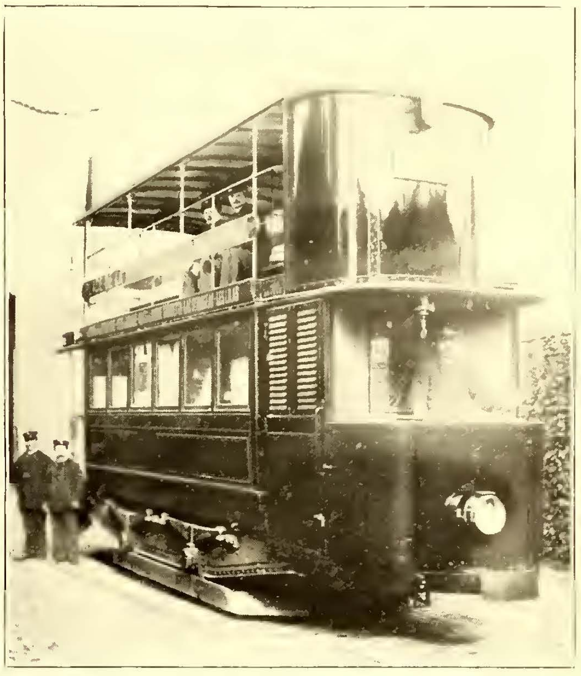
The Compagnie Générale Parisienne de Tramways has a line 6.2 km. in length, part of which is operated by the trolley system and part by the underground conduit. There are seventeen motor cars, each equipped with two General Electric motors. The power station contains three Thomson-Houston 200-kw. generators.

The Compagnie du Tramway Raincy à Montfermiel, while not in Paris, is not far from it, and it is proposed to extend the road into the city, by way of Romainville. It extends from Romainville to Montfermiel, has a length of 7 km., and is equipped with the trolley system. There are ten motor cars, weighing 12,500 kg. each, equipped with two 25-h.p. Walker motors.

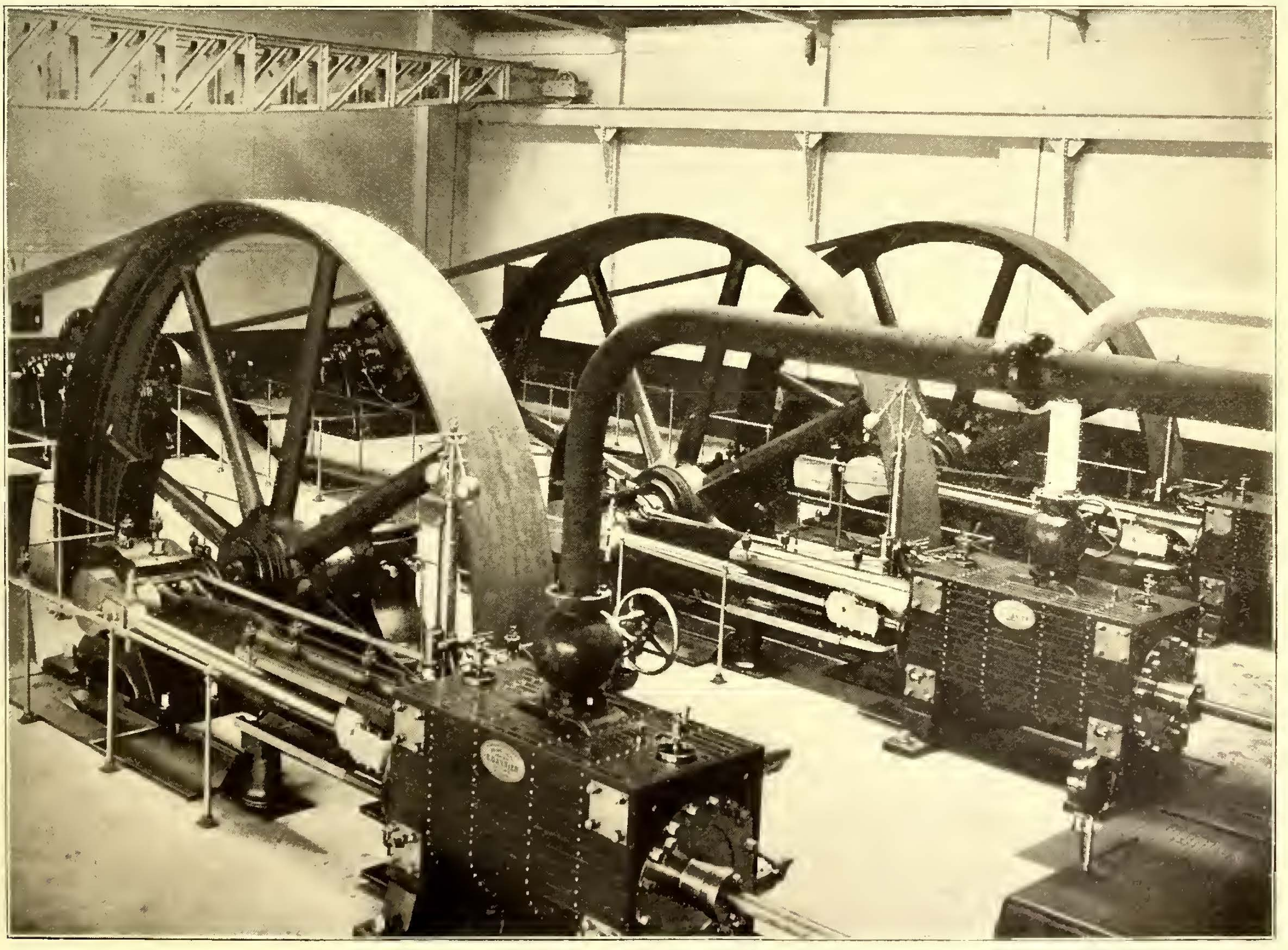
The following summary of the tramway companies in Paris is taken from "Revue des Transports Parisiens." There are nine companies, operating as follows:

1. Compagnie Générale des Omnibus. On Jan. 1 this company had 184.7 km. of track laid with Marsillon rail, 9.3 km. laid with Broca rail, 15 km. laid with Vignole or T rail, and 23.3 km. laid with "American" or strap rail. The company has fourteen Rowan (steam) cars, fifty-four Mekarski (compressed air) cars, fifty-nine Serpollet (steam) cars. The company had 4800 horses on July 1, 1898.

2. Compagnie des Tramways de Paris et du Département de la Seine. This company has 79.9 km. of track laid with Broca rail and 29.7 km. of track laid with Vignole rail, all operated by mechanical power, viz.: Lamm Francq (fireless) locomotives, Serpollet (steam) locomotives, accumulator cars, and, for a short distance in the outskirts of the city, a trolley line. The company has twenty Lamm Francq locomotives, twenty-two Serpollet motor cars, which are being replaced with accumulator cars, fifty-five accumulator motor cars, twenty-eight motor cars for a mixed trolley and accumulator service, and five trolley cars.



CAR ON SURFACE CONTACT SYSTEM, PARIS—ROMAINVILLE



ELECTRIC POWER STATION AT ASNIERES

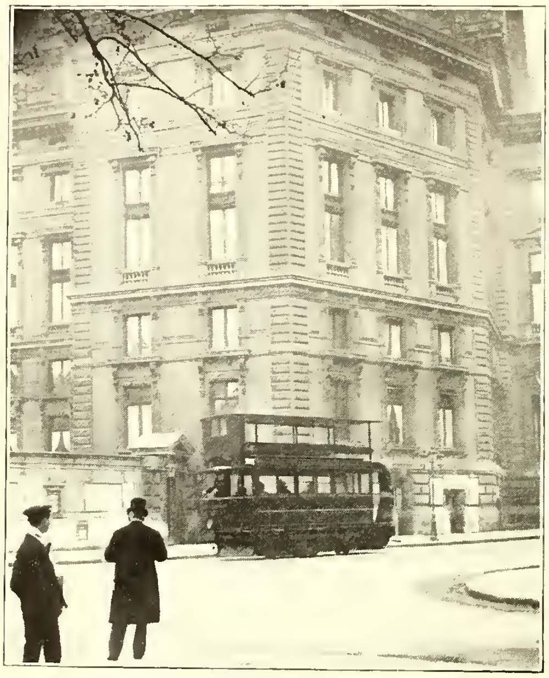
3. Tramway à Vapeur de Paris à Saint-Germain. This company has seventeen 17-ton steam dummies.

4. Funiculaire de Belleville, the Belleville Cable Railway. This road is 2 km. in length, laid with Broca rails, and has twenty-one cars.

5. Compagnie Générale Parisienne de Tramways. This company has 111.9 km. of track, of which 60.9 km. is laid with Broca rails, 32.4 km. with strap rails, 9.8 km. with Marsillon rails, and 8.8 km. with Vignole rails. This company has 154 cars, all horse cars with the exception of a

short electric line, most of which is trolley, but a short portion is underground conduit.

6. Compagnie du Chemin de Fer de Paris-Arpajon. This company has five compressed air locomotives and twenty-one steam locomotives, but is proposing to install an electric system on part of its line. The track is laid with Broca, Marsillon and Vignole rails.



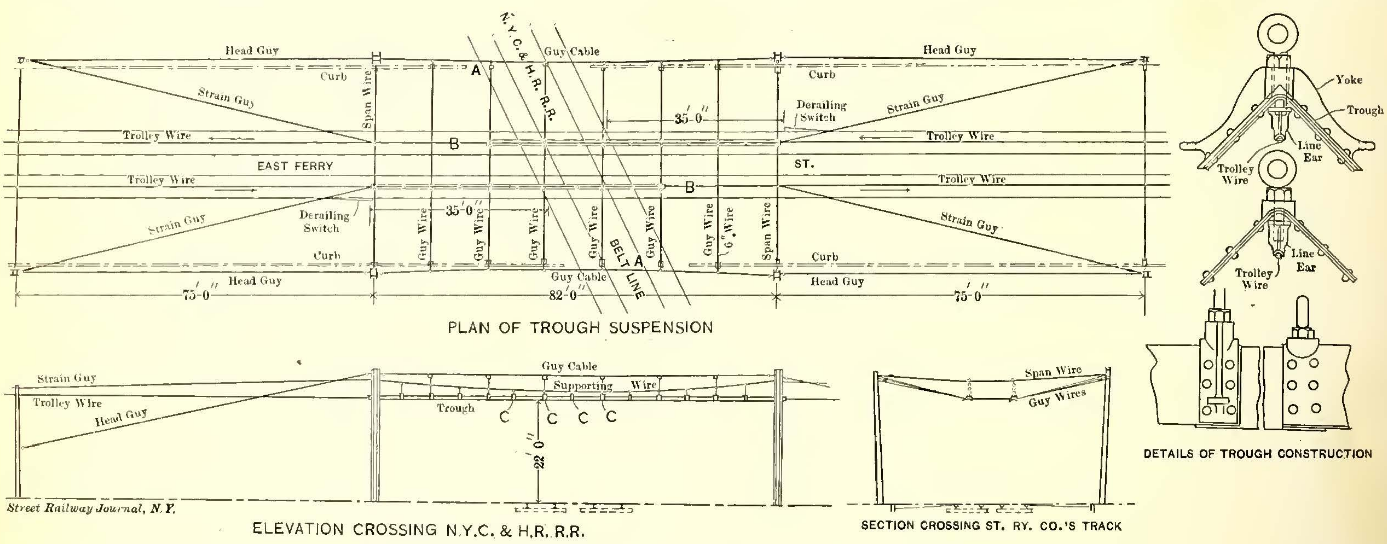
STORAGE BATTERY CAR, PARIS

Trolley Trough for Steam Railroad Crossing

The accompanying engraving shows a protective device for the trolley wire of electric railways at steam railroad crossings to avoid the possible danger of the electric car becoming stalled on the steam railroad track by either a break in the trolley wire or the trolley jumping off the wire at a critical time. The device was suggested by the engineer of the New York State Railway Commissioners and has been adopted by the Buffalo Railway Company at fourteen points where its tracks cross steam railroad tracks on grade. The accompanying drawing, for which the STREET RAILWAY JOURNAL is indebted to Robert Dunning, master mechanic of the Buffalo Railway Company, shows the construction of the device, as well as the method of supporting it.

The trough is constructed of two sheets of hard drawn brass in sections 8 ft. long, riveted together with copper rivets, and attached to heavy yokes, shown in the detail drawings at the right. The trough is not insulated from the trolley wire, but in metallic contact with it. One end of the span wire is attached to the ends of the yokes, and the other end to heavy box-plate poles, which are 33 ft. long, and set 7 ft. in the ground so as to maintain a height of 22 ft. A two-track crossing, such as that shown in the engraving, requires eight poles of this character, four used in supporting the trough, and the other four for the head guys.

The guy cables, shown by *AA* in the plan, are made up of two ⅜-in. steel cables twisted together, and from these, smaller cables are run to the trough to prevent its swaying. These smaller cables are shown by *CC*, and are insulated from the supporting guys and from the trough. This method of suspension permits the adjustment of the level of the trough to any desired height.



PROTECTIVE TROUGH FOR TROLLEY WIRES AT CROSSINGS

7. Compagnie des Chemins de Fer Nogentais. This company has 17.3 km. of track and owns nineteen compressed air motor cars and ten trail cars.

8. Compagnie des Tramways de Saint-Maur. This company has 12 km., and owns ten compressed air motor cars and eight trail cars. The line will be equipped with the trolley system soon.

9. Compagnie du Tramway de Paris à Romainville. This company has about 7 km. of track, and operates twenty electric motor cars on the Claret-Vuilleumier surface contact system.

In addition an electric line will be started during the year by the North and South Tramway companies. The trolley system will be used outside of Paris, and the conduit system within the city limits.

The angle of some of the tracks of the Buffalo Railway protected in this way is such that a curve on each side of the crossing is necessary, but the engineers have been able to protect the crossings without much trouble. They consider the device a good one, as it is practically impossible for the trolley wire to break, there being no strain upon it, but if it should part, the inverted trough will catch the trolley wheel and afford a metallic circuit to carry the car over the crossing.

The Boston Elevated Railway Company is planning to install a large power station at Lincoln Wharf. It will contain six 3000-kw. units.

Overhead Line Construction I.

BY ALBERT B. HERRICK

The overhead line is one of the most important parts of the equipment of an electric railway, and one in which good construction counts for as much in percentage of first cost as in any other part of the installation. I feel, therefore, that a practical exposition of some of the main principles relating to the erection and selection of apparatus and methods of construction will be of interest to co-workers in the railway field. Taking up the line, the question of poles and of which is the most economical pole line to erect immediately rises. This is largely a matter of local figuring, for in the case of suburban towns wooden poles may often be obtained at such a low price that the line can be renewed once, or perhaps twice, during the life of an iron pole at approximately the same cost.

In a trolley line, where continuity of service depends on the stability of the structure carrying the conductors, the whole overhead construction and trolley wire alignment is dependent upon the rigidity and stability of the poles. Care should be taken, therefore, when deciding between wooden and iron pole construction, to consider not only first cost, but also local climatic conditions, which sometimes seriously affect the life of wooden poles, but which usually have no effect on well-painted steel poles. For instance, the soil in the streets of a large city is usually charged with gas and ammonia, a condition which induces premature rot in wood.

The life of iron poles can be assumed as thirty-three years, provided the poles be painted with a good anti-rust paint every six years, and on this assumption there is an annual depreciation of 3 per cent in an iron pole line. Considering now the life of wooden poles, it should be remembered that there are a number of places in wood where rot starts besides in that part which is buried. Every bolt and nail entering or piercing the wood opens up a place where moisture can enter and rot begin. An average of eleven years' life for *city* and suburban constructior is a fair assumption, which gives a depreciation of 9 per cent per year. The investment, based on these figures, presents the following comparison between iron and wooden poles where used for trolley line construction, and shows the profit in using the best material:

With an iron trolley pole, set so as to bear a strain of 600 lbs. at 22 ft. above the ground, and buried 6 ft. 2 ins. in concrete setting, the cost per mile will be as follows: Poles, set 100 ft. apart, 104 poles, at $17.50, will equal $1,820; digging and setting in concrete, at $4.30, will equal $447.20; painting poles, at 30 cents, will give $31.20. The poles should be painted once each six years, which will cost $31.20, making five paintings at $31.20, or a total of $156. The total construction and maintenance per mile will cost $2,454.40, which when divided by the life of thirty-three years, will give a depreciation of $74.37 per annum.

Wooden poles of hard pine, planed and chamfered, will show the following necessary expenditures: One hundred and four poles per mile, to fill the same specifications regarding height as the steel poles—104 poles, at $6.30, will equal $655.20; labor erecting and digging, at $2.65, will equal $275.60; painting poles, at 40 cents, will give $41.60; making a total of $972.40. At the end of six years the painting must be done again at a cost of $41.60, and at the end of eleven years there will be an expenditure for a new pole line, or $972.40. Adding the expense of re-aligning span wires, $240 per mile, will give a total expenditure at the end of thirty-three years of $3,522, and with a depreciation per year of $106.73.

The comparison now stands: Total cost of steel poles for thirty-three years, $2,454.40, and for wooden poles, $3,522. This gives a difference in favor of the steel poles of $1,067.60 per mile. The depreciation rate of $74.37 for steel poles and $106.73 for the wooden poles gives a difference of $32.36 per annum per mile. If interest was charged against the invested amounts for the term of life of property, it would reduce somewhat the showing in favor of the steel pole, but in any method of figuring the relative values from an investment standpoint the showing is greatly in favor of the iron pole line. From an engineer's standpoint the superiority of the iron pole presents many advantages besides the lasting qualities, which directly affect the operation of the road. The item of re-

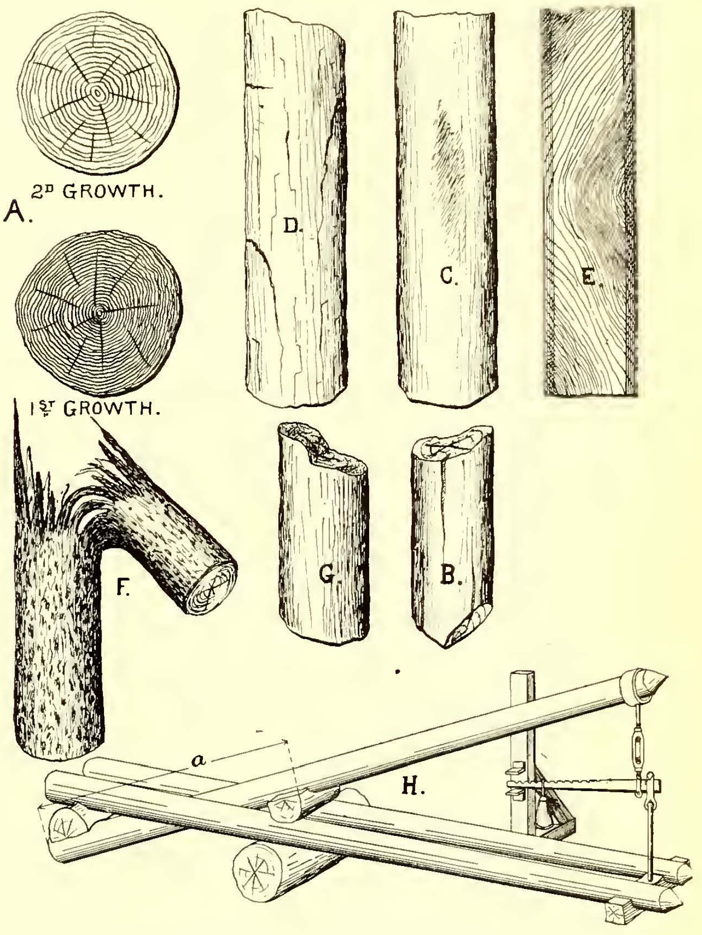


FIG. 1.—WOODEN POLES AND METHODS OF TESTING

equipping and renewing, which involves the adjustment of span wires and trolley wires, is directly contingent on the removal of poles, and should properly be charged against the wooden pole line, since it is obviated by the use of iron poles. The expense of keeping a trolley line taut and in good alignment, which insures the trolley keeping contact with the trolley wire, is largely dependent upon the rigidity of the pole line, and it is well known that eight years ago iron poles were manufactured in order to gain these results.

As previously stated, however, certain local conditions may be favorable to the use of wooden poles, and the essential features of a good wooden pole line will now be considered.

WHAT CONSTITUTES A GOOD WOODEN POLE LINE

Wooden poles are divided into classes dependent on their form, growth and symmetry. The woods usually chosen are chestnut, hard pine and cedar. As a rule, the dimensions of round wooden poles should bear the relations in the table on page 279. Cedar poles over 47 ft. long should not be used, as the wind and conductor strains are liable to break them down. All first-class chestnut poles should be second growth—that is, a pole grown from an offshoot of a chestnut tree that has been cut down. This can be determined by the annual rings being larger and of a lighter color, as shown at *A* in Fig. 1, or by the knot holes being nearer the top of the pole. If the bark is on the pole the serrations should not be deep in second growth chestnut.

A pole should be fairly round, and not vary more than 10 per cent from true diameter in all around dimensions.

In order that the pole line have a neat appearance, the poles must be straight; no deflection greater than 4 per cent should be allowed from the center line. A pole

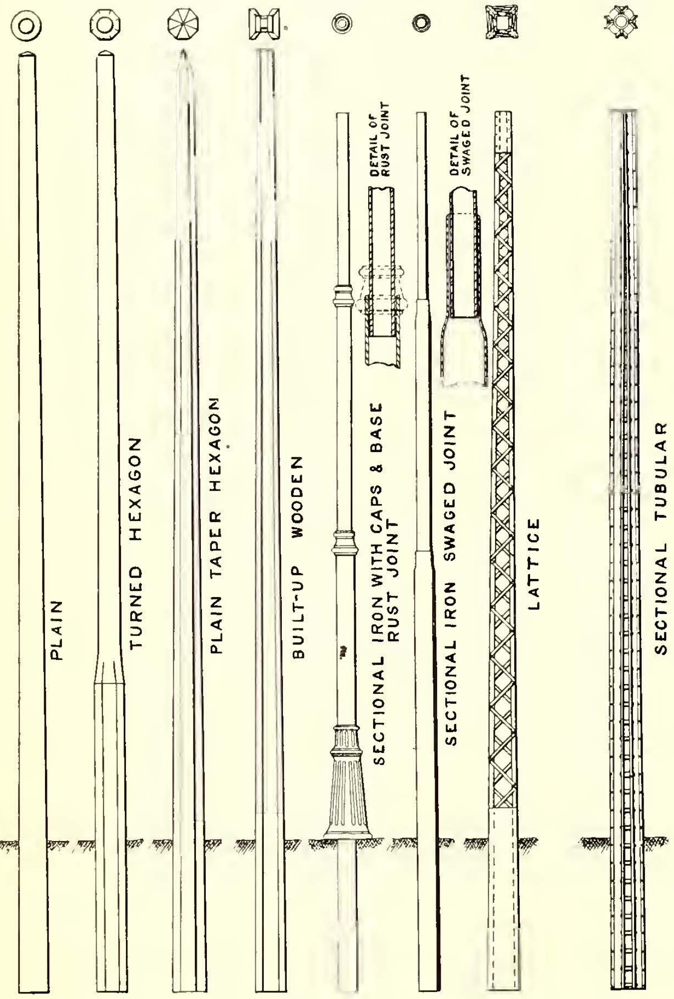


FIG. 2.—SHAPES OF STANDARD AND SPECIAL POLES

should be cut down when the sap is not running, either in midwinter or summer, in order to give the best life, as the sap contains the elements that decompose and start dry and wet rot.

After the pole is cut it should be allowed to stand with the bark on it, if exposed to the sun and weather, to season; otherwise it will be sun-checked—that is, cracks running parallel to the trunk shown at *B*, and exposing the interior of the pole to rot. A wind-shaken pole, shown at *D*, is one which has been subjected to severe wind storms during growth, and which has fractured the fibres and permanently weakened the pole.

Heart rot in second growth chestnut is generally near or at the butt. If a pole is affected by rot where it is exposed after peeling, internal rot will show on the surface of the pole by dark spots over the affected parts; when exposed for any length of time fungi will grow on the outside of the pole over the rotten portions. Knot holes larger than $\frac{3}{4}$ in. within 10 ft. of the butt greatly decrease the strength of the pole, for at this point the greatest strain comes. Knot holes where the core has dropped out or is loose indicate premature decay in poles. These points are given to indicate what to look for in the selection of first-class poles.

Chestnut deteriorates rapidly when the surface sap wood is cut, and for this reason hard pine is usually used where special shapes, such as hexagon, octagon, beveled or turned poles, are required. These are not, as a rule, made longer than 40 ft. In the selection of sawed poles the heart should be central to the axis of the pole. Wavy grain lines, as at *E*, on a sawed pole indicate it was gotten out of a crooked log, and heavy side strains are very liable to fracture such timber.

Cedar has neither the elasticity nor tensile strength of chestnut or hard pine of the same size, the fracture being a sharp one across the fibre, as shown at *G*, while chestnut still maintains its fibrous fracture when broken, as shown at *F*. Cedar, however, can be secured of very uniform sizes, and in some sections the increased size necessary to equal chestnut and hard pine in tensile strength still makes them a cheaper pole.

IRON TUBULAR POLES

Iron tubular poles are made up to 50 ft. high; both the standard pole and the extra strong poles are made to meet the variations in line strains. Taking one length most commonly used, which is 31 ft., they are usually divided into five classes:

	Lateral strain in lbs. to show 6 in. deflection. Pounds.	Pounds which will give permanent set of ½ in. Pounds.
No. 1	350	700
No. 2	500	1,000
No. 3	700	1,200
No. 4	1,000	1,700
No. 5	2,000	2,600

The test should be made when the pole is set in a proper concrete bed 6 ft. deep, and the strain applied to the top of the pole.

The poles should be as nearly round as possible; should not deviate more than $\frac{1}{8}$ in. between maximum and minimum diameter, and thickness of tube should not vary more than 1-32 in.; $\frac{1}{4}$ in. is the greatest deviation that will be allowed from true diameter at the top of the pole. As these poles are made up of sections, some provision should be made to test them where these sections are mechanically connected together. One provision inserted is that the pole should be dropped a distance of 6 ft., butt foremost, on a solid foundation, three times without the joints loosening.

There are two ways of connecting the different lengths—one is by heating the larger pipe, and, while hot, swaging the larger pipe down to the smaller cold pipe, over a length of about four times its diameter; when this joint cools the shrinkage of the outer pipe grips the inner pipe; tests of these joints usually show that they are stronger than either of the single pipes to both compression and lateral strains.

A guard ring slipped over the pole to rest on the earth at its base has been used, but water is retained here, rusting the pole at the point where it has to bear the greatest strain; and these have been removed in a number of cases and the life of the pole prolonged.

The other method is to introduce between the inner and outer pipe a rusting mixture, usually of sal ammoniac and iron filings; in oxidizing this mixture increases its volume, thus expanding and making a union between these sections. In testing this class of pipe for deflection the joints sometimes yield and show more permanent deflection than is caused by the pipe alone. These pipes are usually constructed by uniting three sections of round pipe.

The following weights and lengths are usually carried in stock:

27 ft. long, 240 to 350 lbs., standard; 335 to 560 lbs., extra strong.
28 ft. long, 250 to 610 lbs., standard; 345 to 1,175 lbs., extra strong.
30 ft. long, 270 to 780 lbs., standard; 375 to 1,380 lbs., extra strong.
35 ft. long, 800 to 1,050 lbs., standard; 890 to 1,670 lbs., extra strong.
40 ft. long, 850 to 1,530 lbs., standard; 1,335 to 2,355 lbs., extra strong.
45 ft. long, 1,174 to 1,665 lbs., standard; 1,835 to 2,600 lbs., extra strong.
50 ft. long, 1,345 to 1,800 lbs., standard; 1,995 to 2,835 lbs., extra strong.

STANDARD IRON TROLLEY POLES.

Nominal Inside Diameter	Thickness.	Length of Section.		Length of Pole.	Weight.	Deflection at Top of Pole when set in 5 feet of Ground.				
						500 lbs.	750 lbs.	1000 lbs.	1500 lbs.	2000 lbs.
Ins.	Ins.	Ft.	Ins.	Ft.	Lbs.	Ins.	Ins.	Ins.	Ins.	Ins.
4	No. 4	7	6	......	....	......	....	......	.....	.....
5	No. 3	9	6	28	450	5	8	10¼	20	......
6	9-32	14	0	......	....	.... ..	...	....	... ..	......
4	No. 4	8	0	.. ..	....	....	.....	....	.....	.... .
5	No. 3	9	0	30	515	5	10	17	26	......
6	9-32	16	0	.....	....	....	...	....	.....	......

EXTRA IRON HEAVY POLES.

4	11-32	7	6	......	... .	....	..	....	.....	.....
5	3-8	9	6	28	708	9-16	5	7⅛	......	......
6	7-16	14	0	...	....	....	.....	....	.....	......
5	3-8	8	0	......	.. .	....	.....	....	......	......
6	7-16	9	0	30	1025	....	7¼	8½	......	18
7	7-16	16	0	....	....	....	....	....	..	......
6	7-16	8	0	......	....	....	... ..	....	.....	.....
7	7-16	9	0	30	1380	....	.....	5⅛	7¼	9½
8	1-2	16	0	... ..	....	....	.....	....	......	......

DIMENSIONS OF ROUND WOODEN POLES.

Length in Feet of Pole.	At Butt. Cir. in Inches.	At Butt. Diameter in Inches.	At Top. Cir. in Inches.	At Top. Diameter in Inches.
30	33	10⅝	18	5¾
35	36	11½	20	6⅜
41	39	12½	23	7⅜
47	44	14	23	7⅜
52	47	15	23	7⅜
57	50	16	23	7⅜
68	53	16⅞	23	7⅜
73	56	17⅞	23	7⅜
84	64	20⅜	25	8

In the specifications for poles the above points, which are desirable, can be incorporated.

SPECIFICATIONS FOR WOODEN POLES

A selected lot of poles costs more than the run of the stock, yet in ordinary trolley line construction money can be saved by designating exactly how many of each class of pole will be required, the best and most uniform poles being for streets and highways, and the poorer qualities used along the country roads. Corner poles, and where extra span weights are to be supported, should be specially listed in the specifications; also stubs and anchors or foundation timbers. By careful attention in listing what is required for the complete pole line a saving of pole cost and time can be effected.

Specifications are varied for every class of line construction, but the usual clauses which relate to the class of pole to be delivered are as follows:

Round poles, first class.

There are to be (——) poles, (——) ft. long, with an average butt diameter of (——) ins. and an average top diameter of (——) ins., to be a gradual taper from the bottom to the top, to have no deflection bend or twist which will give the pole a greater deflection than (——) per cent from the true axis, that the pole shall be peeled clean of bark and fibre, that sun cracks shall not show on the surface of the pole, neither shall it be wind shaken or checked; no knots over (——) ins. will be passed in this class. The butt shall be sawed square and the top chamfered at an angle of 45 degs., the knots shall all be trimmed close, gains for cross arms to be cut (——) ins. from the bottom of the chamfer, and to be cut (——) ins. deep and (——) ins. wide. These poles will all be of (——) wood and show no signs of dry or wet rot.

For square sawed poles the specifications vary in this way: The pole shall be (——) ins. by (——) ins. at butt and (——) ins. by (——) ins. at the top; shall be planed and chamfered, the heart of the tree shall be central to the long side of the timber; where this pole is to be beveled on the edge the width of the bevel should be given, also where it is to begin, how far from the butt of the pole. In hexagon poles the length of the sides of the hexagon, as well as the diameter of the pole, should be given, as also the taper of the poles. In fancy turned poles the height of hexagon and beginning of turned part of poles should also be given. Built-up poles are special, and need drawings to clearly define the design. The length of a wooden pole may vary within such wide limits that sizes will have to be selected to give ample factor of safety for the line strains thrown on them, and depends on the soundness and preservation of the wood to maintain the line in service. A pole that has been thoroughly weather cured standing is stronger than a new pole which is partially green. A green pole shows greater deflection and less tensile strength than one that has been standing some time, so lumbermen do not like to be bound in a specification to the deflection and breaking strains which are applicable to iron poles, and they are not usually inserted.

SPECIFICATIONS FOR IRON POLES.

The weight and dimensions of each section and total length of pole are usually specified. The composition of the metal required may be specified, seamless steel tube now being generally used. The method of putting the sections together may be restricted in the specifications; the tensile strength, as well as the deflection and permanent deflection for different strains, are usually incorporated. To be delivered painted with (——) coats of anti-rusting paint is required both inside and out; also a turned plug of wood driven in at the butt end, and sometimes at the top, are necessary where they are to be handled much in transportation. Collars, flanges and tops are accessories in most cases on the pole. Manufacturers can drill any holes in the pole without any appreciable advance on the first cost. These holes, with their sizes, should be located and specified.

Lattice poles vary so much in the angles and spacing of the lattice, the slope and character of base, that the contractor or manufacturer should indicate what is desired or what will be furnished by a drawing. The pole can be specified regarding its mechanical strength and deflection the same as the round pole.

Fancy and special poles are not standard, and cannot be subject to general specifications, unless the product of a single manufacturer is to be adopted.

For shapes and special poles see Fig. 2.

STRENGTH OF AND METHODS OF TESTING WOODEN AND IRON POLES

The method usually given to test a pole is to set it the proper depth in the ground and apply a tackle to the top and draw it up with a given tension and note the deflection. The way it is usually applied is that the tension is usually put at an angle from the ground; the tension is partly borne by the pole and partly given to springing the pole over; the ratio of the two depends on the angle of application. Any yielding in foundation is liable to be charged to elasticity. If the pole is planted in cement, several days should be allowed for it to set before the test, which makes the test a lengthy affair. I have found that the following will give all the practical results necessary, and can be readily constructed and calibrated on the spot. (See *H* in Fig. 1.) For this testing rig two of the largest and most symmetrical poles are selected; they are then laid by the side of each other and separated far enough apart to allow any of the poles to be tested to lie between them. They are braced together at two points, the distance *A*, from the bottom of the foot brace to the top of the head brace, to be the depth of setting to be employed in this pole. Sufficient area to these braces should be given so the strain applied will not crush the fibre of the pole under test. A 12-in. turnbuckle, a 1 to 20 steelyard, with a 100-lb. weight, completes the

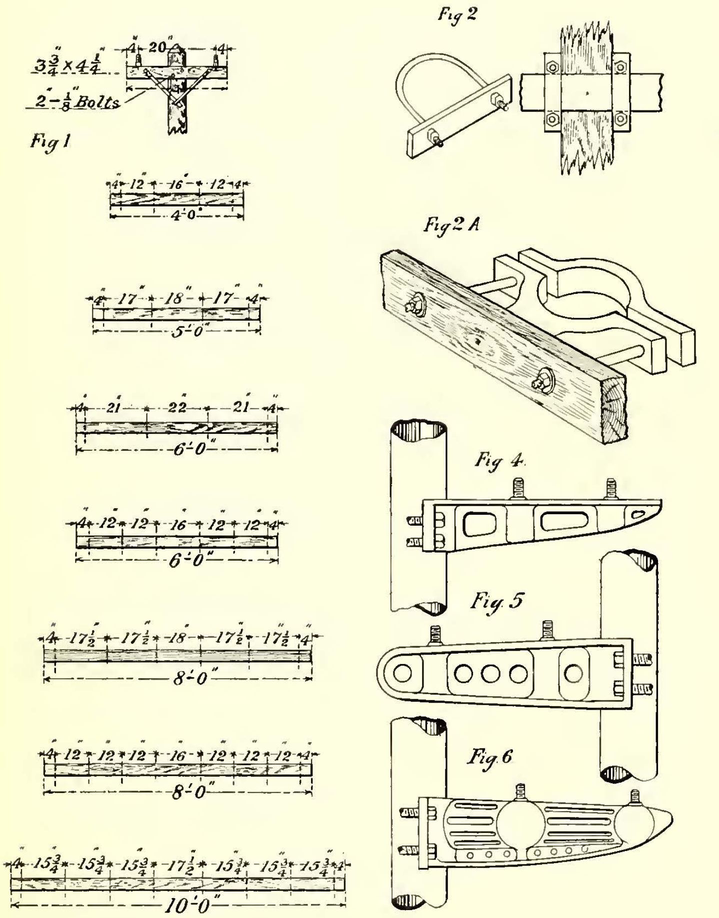


FIG. 3.—CROSS ARMS

outfit. One arrangement can be made as above. The weight on the steelyard is fixed, and, after the bridle is put over the pole, the turnbuckle is tightened until the steelyard is balanced. When the specified tension is applied the deflection of the pole is measured by a mark on a board opposite the pole under test.

This deflection is composed of the yield of the braces and the flexibility of the crib, but the pole on returning will show the permanent deflection, which will be the difference before and after the strain. Iron poles can be tested by the same method by substituting an iron pole for the wood, and the steelyard should be provided with a ratio of weights, so as to reach a 2000-lb. strain where extra heavy poles are to be tested.

The elasticity of wooden poles is approximately as follows where the pole is 30 ft. long and placed 6 ft. in the ground:

Round bottom.	Top.	Deflection.	Chestnut.	Cedar.
10⅝ in.	5¾ in.	7 in.	340 lbs. to 510 lbs.	360 lbs. to 406 lbs.
11½ in.	6⅜ in.	7 in.	405 lbs. to 680 lbs.	432 lbs. to 540 lbs.
12½ in.	7⅜ in.	7 in.	490 lbs. to 935 lbs.	495 lbs. to 675 lbs.

The above was the average of a number of experiments.

CROSS ARMS, SIDE ARMS AND BRACKETS

The standard cross arms usually kept in stock are given in Fig. 3, with the dimensions and spacing for pins. Cross arms are usually kept in white or Norway pine or long leaf yellow pine. The tensile strength of Norway pine is approximately 10,700 lbs. to the sq. in., and the breaking cross load for long leaf yellow pine is 21,300 lbs. per sq. in. The breaking cross load for the standard size of cross arm is 5060 lbs. for white pine and 3820 lbs. for yellow pine. Records show that the long leaf pine is 40 per cent stronger, but the yellow is more durable, as it does not rot so readily where the iron bolts pierce the

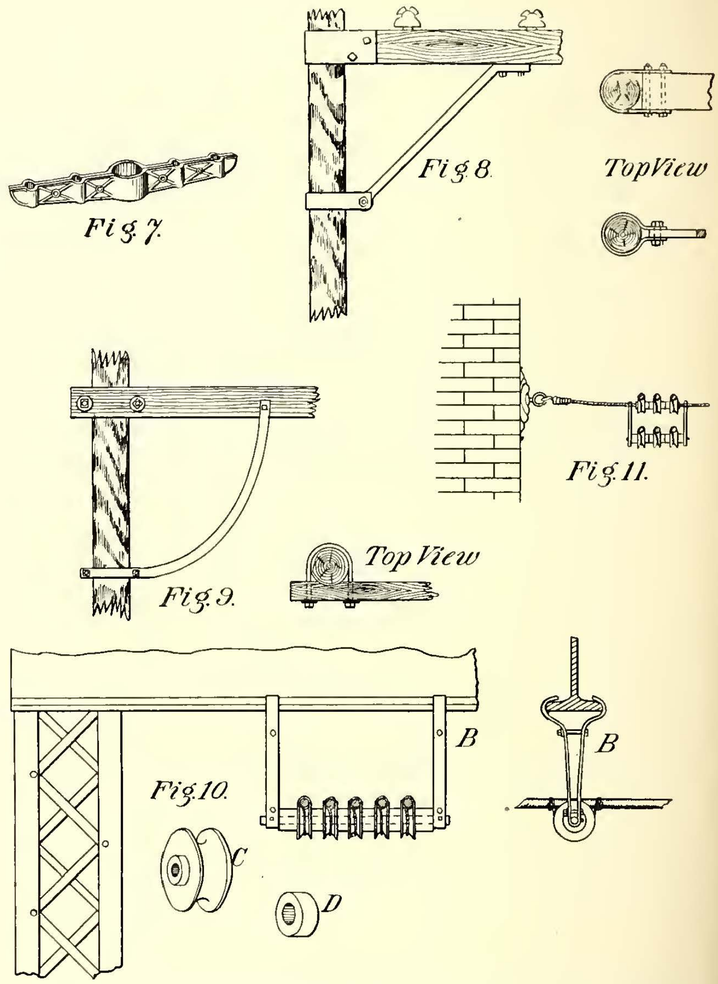


FIG. 4.—CROSS ARMS, SIDE ARMS AND SPECIAL METHODS

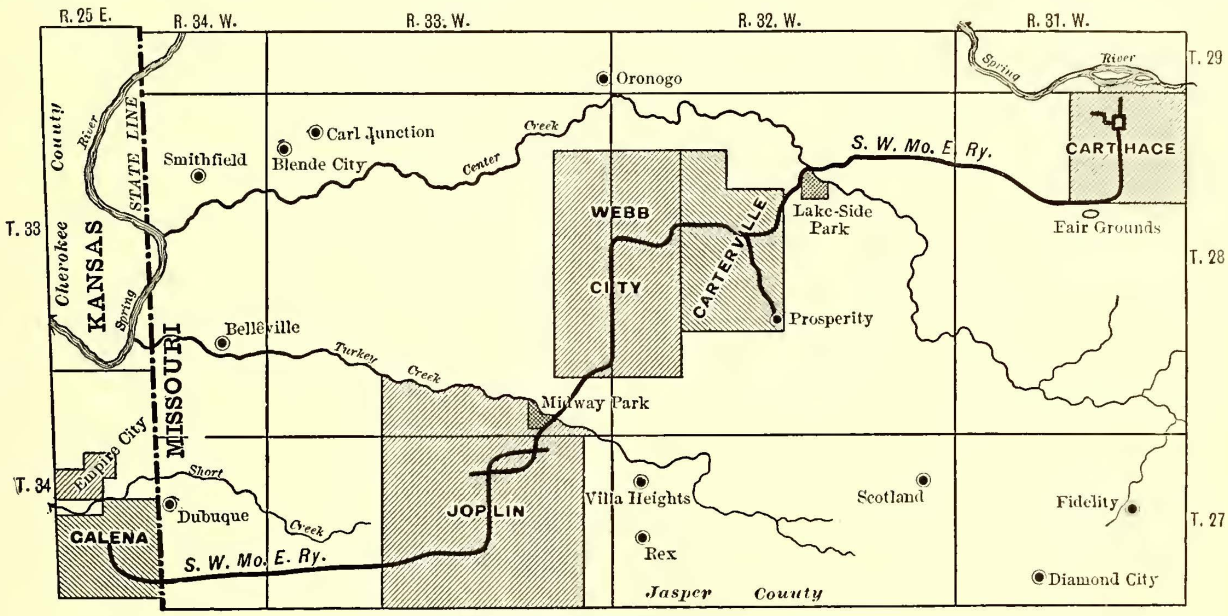
cross arm, which is the point at which the cross arm has to bear the greatest strain. In order to avoid piercing the wood at this point with wood poles and also where wooden cross arms are used on iron poles, straps and plates are employed, as shown in 2, Fig. 3. The pole is gained in the regular way when wooden, but where the pole is iron a saddle is cut into the cross arm to make it fit the pole and thus increase the bearing area of the cross arm. No. 2 A, Fig. 3, shows a cast-iron fitting to attach a wooden cross arm to an iron pole. For securing cross arms to poles in railroad feeder work use ⅝-in. bolts or ½-in. lag screws. The cross arms should be planed straight grained and painted with two coats of Prince's metallic paint, made up in the proportions of 7 lbs. to 1 gal. of pure linseed oil.

Three designs of split cast iron brackets are shown in 4, 5 and 6, Fig. 3. The two halves clamp the pole by two bolts which pull them together; the threads of the top bolt catch the whole strain in this method of fastening. The diameter of the pole at point of connection with cross arms can only vary 1 in. for this style of fastening. Instead of a cast-iron cross arm a sheet-steel punched cross arm, made in two duplicate halves, is shown in 7 in Fig. 4. The elasticity of the two halves allows for considerable variation in the size of poles. Four bolts hold the halves together and either iron or wooden insulator pins can be used. Side arms are very useful in dodging trees; where the poles have to be set at a fixed distance from the curb the arm may be swung either side of the pole, and the feeders in this way cleared of tree contacts. Nos. 8 and 9 show the two, three and one pin arm method of fastening.

In some instances the feeders have to be supported on structures. No. 10 shows them carried under an elevated railroad. At *A* is shown the general arrangement, at *B* the suspension irons, at *C* the porcelain insulator, at *D* the spacing washer between insulators. A $\frac{3}{8}$-in. iron pipe threads these insulators; these supports are placed every 12 ft. to 25 ft. and no tie wires are used. No. 11 shows how a wire support is made where house connection can be made, but no pole can be set. The feeders are tied in the insulators in this case, and the span wire is also insulated by strain insulators.

Large Interurban Electric Railway in Southwestern Missouri

The Southwest Missouri Electric Railway is an evolution from a mule road, the only remaining vestiges of which are a wooden car barn, still used for a car house, and a few of the little cars, now in use as suburban passenger stations and as business quarters for a shoemaker and a newsdealer. The progenitive mule road to which reference is made was built in 1890 by A. H. Rogers, now president of the surviving company. It extended from the west end of Webb City to the east end of Carterville, a distance of $2\frac{1}{2}$ miles, and was operated with mules from Sept. 1, 1890, until March 1, 1893, when it was sold to the present company, reconstructed and extended from its former Webb City terminus south and west to Joplin, a distance of 6 miles, and from its former Carterville terminus east and south a distance of 2 miles to Prosperity, a rich mining camp.



MAP OF SOUTHWEST MISSOURI ELECTRIC RAILWAY

In 1890-'91 an electric railway was built in Joplin, extending from East Joplin to and through Joplin proper and to the suburb of Blendville—just south of Joplin—a distance of 5 miles. This railway was absorbed by the Southwest Missouri Electric Railway Company in 1895, and in 1896 was extended from the Blendville terminus west to Galena, Kan., a distance of 7 miles. In 1895 an electric railway was constructed from Carterville to Carthage, a distance of 12 miles; this property was also purchased in 1896 by the Southwest Missouri Company. Thus, at the present time the Southwest Missouri Electric Railway Company owns and operates an interurban electric railway system, the main line of which connects Carthage, Carterville, Webb City and Joplin, Mo., and Galena, Kan., with branch lines; Carterville to Prosperity, Joplin proper to East Joplin, and Carthage square to the two railway depots. In addition to the interurban service given, a city service is maintained in Joplin and in Carthage. The total mileage is 35.

Carthage, the eastern terminal of the system, is the county seat of Jasper county, and was a town of considerable size long before any of the neighboring mining towns came into existence. It contains many handsome residences, fine churches, good schools, and is enjoying a healthy growth. Carterville and Webb City are twin cities, whose existence is due to the discovery in 1873 of

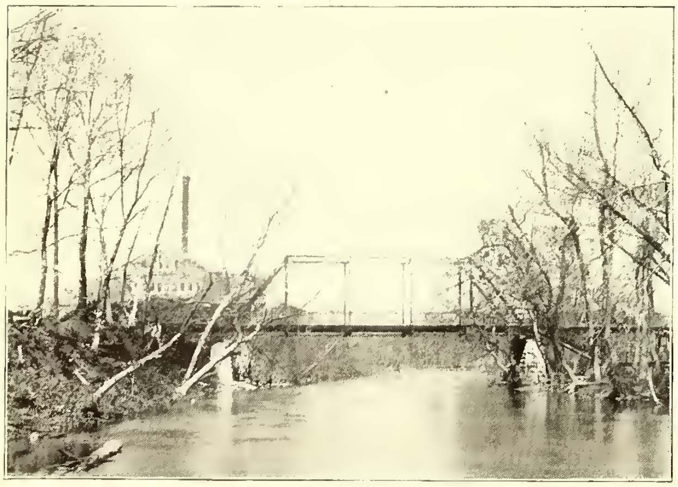
Electric Railway at Amiens, France

The tramway system at Amiens consists of four lines, radiating from a central point and comprising about 18.7 km. of track. The entire system has recently been equipped electrically by the French Thomson-Houston Company, and is now in operation. The track is laid with 36-kg. Broca rails, and there are twenty-eight motor cars, each equipped with two 35-h.p. motors. The cars are divided into two sections, first and second class, each capable of seating ten passengers, while the two platforms together will hold eighteen passengers. The car weighs 8500 kg., and is capable of making speed at 25 km. per hour on a level.

The power station contains three 150-kw. units, with Corliss horizontal simple engines, with cylinder dimensions 560 mm. x 1220 mm., and running at 72 r.p.m. Each engine is belted to a generator of the six-pole type, and running at 400 r.p.m. The Standard overhead trolley system is used, and special attention was given to securing a light-appearing line by the use of ornamental poles.

rich deposits of lead and zinc in Center Creek bottoms, between the two town sites. Both of these places are prosperous, well-built towns. The main office, main power house and car house of the electric railway are in Webb City, as geographically it is in the center of the system. Joplin came into existence in the year 1869 as a mining camp pure and simple, and has grown to be a considerable railroad center, as well as a mining metropolis. Here are located large foundries, machine shops and smelting works, and the city is the headquarters of the zinc interests of the United States. Galena, Kan., is a typical mining town, and a good portion of the town site, as well as its contiguous area, is devoted to mining. The weekly output from the Galena mines alone will average $50,000.

The value of the output of zinc and lead ore from what



POWER STATION AT CENTER CREEK

is known as the Joplin district, for 1898, was $7,500,000; for 1899 it will reach $10,000,000. In 1895 the average price for zinc ore (Jack) was $20 per ton, now it is bringing $43 per ton. The population of Carthage is 12,000; of Carterville, 4500; of Webb City, 7500; of Joplin, 20,000; of Galena, 10,000.

POWER STATIONS

The power houses of the Southwest Missouri Electric Railway Company are two in number; one is in Webb City, the other at Lakeside Park. The Webb City station is of brick, 71 ft. x 140 ft., and the engine room is 71 ft. x 80 ft.

The equipment consists of one G. E. 225-kw. M. P. generator, belted to a single expansion Cooper-Corliss engine, and two Westinghouse M. P. 150-h.p. generators, each belted to a single expansion Cooper-Corliss engine. In addition, this station contains two D-62 generators used as boosters for furnishing power to the Galena section of the road, the extreme end of which is 15 miles from this power house. The boiler room measures 71 ft. x 45 ft., and contains five tubular boilers. Back of the boiler room are the coal bins, into which coal is dumped directly from the car standing on a private switch. Water for this plant is obtained from a well 250 ft. deep, and passes through a Cookson 1000-h.p. heater.

The power plant at Lakeside Park, on the bank of Center Creek, is a combination station and car house. This building is 90 ft. x 115 ft., and is equipped with two condensing Bates-Corliss engines, each driving by rope transmission a Walker M. P. 200 kw. generator. The boiler room measures 45 ft. x 45 ft., and contains two tubular boilers.

The voltage carried at the power house is 600 on the generators and 800 on the boosters. The greatest drop at any place on the line is down to 450 volts, under heavy loads.

The company has three car houses, one at Lakeside Park, as stated, one in Webb City, and one in East Joplin. During the present season an additional car house will be erected at Galena.

TRACK AND ROLLING STOCK.

Cedar poles and No. 0 trolley wire are used in overhead construction, and the track bonding is made up principally of No. 0000 copper bonds, though a number of plastic bonds are also in use. The feed wire comprises nearly 300,000 lbs. of copper. Double poles and span wire overhead construction prevails throughout. The overhead material is General Electric make, and the copper bonds were supplied by the American Electrical Works.

The track is laid with 50-lb. T rails throughout, except on Main Street, Joplin, and Main Street, Galena, where 56-lb. girder rails are employed. These rails are spiked to white oak ties of standard railroad size, and the entire roadbed is ballasted with tailings from the mining plants. These tailings provide a ballast that tamps nicely, and afford an easy-riding and solid track.

The two main streams crossed—Turkey Creek, near Joplin, and Center Creek, between Carterville and Carthage—are spanned by steel truss bridges resting on cut-stone abutments.

The rolling stock consists of ten single-truck cars, twelve double-truck closed cars, eleven double-truck open cars and three trail cars. The cars are heated by electric heaters and Baker hot-water heaters, and all interurban cars carry Wagenhals electric headlights. The motor equipments are made up of S. R. F. 30, G. E. 1200, Walker

STANDARD DOUBLE TRUCK CAR IN JOPLIN

5-A, Westinghouse No. 3, No. 12-A's, No. 49 and No. 38-B motors. The electric heaters are of the American and Consolidated types.

The managers of the company state that they have not yet found any trolley wheel that can always be depended upon to stay on the wire. The main remedy for the trouble of trolleys jumping the wire is found in good line work and attention to the trolley rope by conductors while passing around curves, etc.

Two parks are owned by the company—Midway Park, near Joplin, and Lakeside Park, between Carterville and Carthage. The latter represents an investment of $20,000. At Lakeside the company owns a small hotel, surrounded by a beautiful lawn, for the convenience of its employees at the Lakeside station and car men whose run is out of the Lakeside car house.

Very little trouble is experienced in the country sections with snow, as the snow does not get deep enough to interfere with the operation of the cars. In the cities, however, it does become an obstruction. The company owns a snow plow of its own manufacture, which is used in cases of deep snows, but for the average storm, where only the city streets are to be contended with, the main reliance is placed upon salt. One salting of the track will not only remove an existing snow, but will also cause the next one that falls to melt rapidly.

CAR SERVICE

The interurban car service is divided into two divisions—the eastern and western. The former is between Joplin and Carthage, and is approximately 20 miles in length. On this division regular cars leave each terminal every thirty minutes from 6 A. M. until 11 P. M., and reach the opposite terminal one and one-half hours later. To this regular service the company added on March 1 a special service of fast electric cars known as the Empire County Express. These cars are operated every ninety minutes from 8 A. M. to 11 P. M., and reduce the running

VIEW OF TRACK BETWEEN JOPLIN AND WEBB CITY

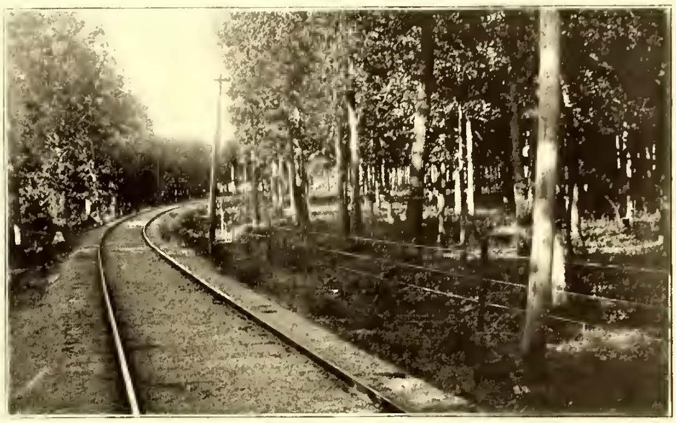
time between Joplin and Carthage from one and one-half hours to one hour flat. Trips have been made by these cars in forty-eight minutes, including the four regular stops and four stops for railroad crossings, making an average running time of 25 miles per hour.

This fast car service, though operated over a single-track road, does not conflict in any way with the schedules of the slower cars, and has worked out to entire satisfaction from the outset. The cars used are new from the shops of Jackson & Sharp Company, and are mounted on Jackson & Sharp trucks. The bodies are 38 ft. over all, are fitted with smoking compartments, and (with motors) weigh about 31,000 lbs. each. They are equipped with hand brakes and heated with electric heaters. The motor equipments are G. E. 1200's and Westinghouse 38-B, one to each truck. The express service has proven a success, and seems to have increased the receipts of every car in service.

The western division is between Joplin and Galena, and is approximately 10 miles in length. On this division regular cars leave each terminal every thirty minutes from 6 A. M. till 11 P. M., and the running time is forty-five minutes from terminal to terminal.

The movement of the cars is regulated by a car dispatcher located at a telephone switchboard in the Webb City office. At each switch and terminal there is a telephone, through which the conductors communicate with the dispatcher and receive orders from him. The rules governing the telephone dispatching system are as follows:

"Cars must run as closely to schedule time as possible, and each conductor must communicate by telephone with the car dispatcher at time of leaving car house and at each passing point and terminal, wherever there is a telephone, and must govern the movement of his car strictly by orders received from dispatcher,



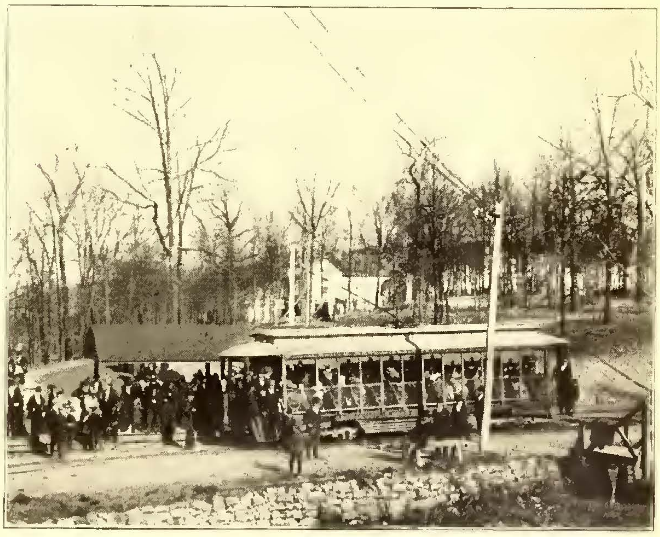
1000 FT. CURVE

proceeding from station to station only on orders. He must not allow his car to go beyond any meeting point without orders, whether he meets another car or not.

"When two cars meet, the conductor of the car first to arrive will report, and repeat orders received, to both his own motorman and to the conductor of connecting car, and the motorman of latter must not proceed till ordered or signalled so to do by his conductor.

"No extra car nor work car must leave the car house without reporting to and receiving orders from the dispatcher, and all such cars must move only in accordance with orders received from dispatcher."

When the express car service was started a great deal of dissatisfaction was manifested by patrons of the line who were accustomed to take the cars at points where the fast



OPEN CAR AT LAKESIDE PARK

cars would not stop, and considerable trouble was experienced in overcoming their objections, but nearly every one has now adapted himself to the new order of things, and peace prevails. This, and similar instances, show that a large amount of diplomacy is required on the part of the manager of an interurban railway in dealing with different communities and adverse personal interests; but it has been shown to be a fact that adherence to principles of equity and fairness by the management of such an enterprise will silence factious opposition.

FARES

The fare from Joplin to Carthage is 20 cents. Express cars do not stop at any 5-cent collection point, and on these cars fares are collected in two instalments of 10 cents, and are rung up as collected. On other cars between Joplin and Carthage, which stop everywhere, fares are collected from passengers' starting point to destination at one collection, and identification slips are given him, a yellow slip indicating 10 cents, a green slip 15 cents, and a red slip 20 cents. At each regular collection point the conductor starts at the front of the car and rings up one fare for each passenger, gathering up yellow slips on second collection, green ones on third and red ones on fourth.

The fare between Joplin and Galena is 10 cents, and is collected and rung up one fare at each collection point.

The company's rule respecting half fares is given below in full:

"Children over five years of age and under twelve are to be carried for half-fare, but the half-fare privilege is to be strictly confined to children between ages above stated. Conductors will keep a supply of half-fare tickets on hand, and all transactions with half-fare passengers must be with half-fare tickets. Conductors will sell one half-fare ticket for five cents, punching same in presence of passenger from whom the five cents is received; this is not to be rung up, but on next collection the ticket is to be taken up and rung up. A half-fare ticket in possession of a half-fare passenger, if punched with the regulation punch mark, is to be accepted for one half-fare and rung up. Half-fare tickets are to be punched only in presence of passenger, and half-fare tickets when taken up, must not be reissued."

This system has in several years of practice proven that it overcomes all objections to ordinary methods of handling half fares. The conductor buys these tickets at the office for 5 cents each, and issues them as provided in the rule given.

Free transportation is given to those so favored in the form of coupon ticket books—each book containing 100 coupons. These coupons are accepted by the conductor as of the value of 5 cents each, and are rung up as other fares. Virtually no transfer system exists; the number of transfer tickets issued per day by all the conductors will not average more than twenty-five.

No freight is carried except such as can be taken on the front platform of the passenger cars. Each conductor carries a schedule of rates to be charged, and conductors are allowed to retain 20 per cent of all money received from this source, dividing it with his motorman. The charge for a trunk or baby carriage is 25 cents, regardless of distance, and for a bicycle 10 cents. The conductor issues to the passenger a receipt for amount received for carrying his freight, and turns in stubs to office.

Between July 11, 1897, and Jan. 8, 1899, the company maintained a rate war with a parallel steam road, as described elsewhere. The total receipts for the year ending Aug. 31, 1897, were $117,127.53, during this year being free from steam competition up to July 11, 1897—ten and one-half months. The total receipts for the year ending Aug. 31, 1898, were $115,050.11, in spite of fierce steam competition during the entire year, and with rates cut to one-third of the regular amounts after June 5.

The partial restoration of rates on Jan. 8, 1899, had an immediate effect in increasing receipts, and the addition of the rapid service between Carthage and Joplin, inaugurated Mar. 1, had a still further effect—the receipts for March, 1899, exceeding those of March, 1898, by more than $4,000, and were greater than for any previous month in the history of the road, in spite of weather very unfavorable for street railway operation.

Extensive additions and improvements will be made during the present year, particularly along the lines of increased motive power, greater car speed and additional rolling stock and equipments.

The officers and heads of departments of the company are: A. H. Rogers, president and treasurer; E. Z. Wallower, vice-president; A. G. Knisely, secretary; E. J. Pratt, superintendent of motive power; C. E. Baker, superintendent of transportation; J. M. Maret, superintendent of tracks, lines and bridges; H. T. Morrison, superintendent of repair shop.

Electric Railways in Europe

The accompanying table, taken from a recent issue of "L'Industrie Electrique," shows a summary of the length, station capacity and number of motor cars in the different countries in Europe, brought up to Jan. 1, 1899, with the totals at Jan. 1, 1898, for comparison:

Country.	Total Length of Lines in Km.	Total Power Capacity of Stations in Km.	Total Number of Motor Cars.	Character of Equipment.						
				Number of Trolley Lines.	Number of Conduit Lines.	Number of Surface Contact Systems.	Number of Accumulator Lines.	Number of Mixed Lines.		Total Number of Lines.
								Trolley and Accumulators.	Trolley and Conduit.	
Austria-Hungary	113.2	3,604	291	12	2	..	..	..	..	14
Belgium	69.0	2,415	107	6	1	..	1	..	..	8
Bosnia	5.6	75	6	1	..	..	..	..	..	1
England	211.1	10,507	398	19	1	8	1	..	..	29
France	487.5	18,718	759	42	2	1	6	4	1	56
Germany	1402.8	30,378	3,140	63	..	..	4	4	2	73
Holland	3.2	320	14	..	..	..	1	..	..	1
Ireland	22.8	646	32	1	..	1	..	..	..	2
Italy	146.9	6,620	318	12	..	..	1	..	..	13
Portugal	2.8	110	3	1	..	..	..	..	..	1
Roumania	31.4	590	48	2	..	..	..	..	..	2
Russia	40.7	1,950	95	4	1	..	..	..	..	5
Servia	10.0	200	11	1	..	..	..	..	..	1
Spain	104.7	2,450	144	7	..	..	..	..	..	7
Sweden and Norway	24.0	875	43	3	..	..	..	..	..	3
Switzerland	200.7	6,665	325	32	..	..	..	..	..	32
Total	2876.4	86,123	5,734	206	7	10	14	8	3	248
Total January 1, 1898	2[illegible]59.3	68,106	4,514	172	8	8	13	3	..	204

LETTERS AND HINTS FROM PRACTICAL MEN

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

SCHENECTADY RAILWAY COMPANY,
SCHENECTADY, N. Y., April 19, 1899.

EDITORS STREET RAILWAY JOURNAL:

Continuing the comparison and analysis of the "Standard Rules and Regulations" of the A. S. R. A. committee, we wish to know:

10. Are they couched in plain, terse language, so as to be easily understood and remembered and—if necessary—memorized? This point has been partly answered previously (under head No. 5), but something more needs to be said on the subject, as the construction and language of the rules is an important point. The committee appears to have had a dread of "elegant phraseology"—whatever that may mean to them—and to have been led by that dread into phraseology that was inelegant, incorrect and misleading. To go over all the instances of this in the rules would be vexatious and tiring. We will be content with one of the worst specimens—Rule 33 for Conductors, which says:

"Lights: It is your duty to test lights and see that they are in good order before leaving depot, and you also must be very careful and particular that the headlight (in the direction the car is moving) is lighted, and must see that your car is provided with switch light plug before leaving depot."

The actual purpose of this rule of fifty-seven words can be much more clearly, correctly and thoroughly expressed in one of thirty-five words, as follows:

"Car lights: Before his car leaves the depot he will, by actual test, make certain that *all* lights are in good order, and that the necessary chimneys, the incandescent lamps and fuse links (or fusible plugs) are in their place on car."

The rule as given by the committee states that "it is your duty to, etc." This is entirely unnecessary, for if a certain instruction or command is placed in the rules, it goes without saying that it *is* the employee's "duty" to obey it, and—if it is addressed to one employee or class of employees—it is the "duty" of that employee or class of employees only. The same remarks apply also to the phrase "you also must be very careful and particular," and, in addition, this phrase is easily capable of a double meaning, either of which may be correct. As written, "you *also* must be very careful, etc.," it means that some one besides the conductor "must be very careful, etc.," whereas the true meaning of the phrase is "you must *also* be very careful, etc." In either case the language is unhappy, and if it means what it says, that the conductor is to be responsible for the burning of the headlight, that duty has already been placed on the motorman, under "Rule 17 for Motormen." It would certainly be poor discipline to give the motorman a specific duty, and under another head to give the same duty to the conductor. No specific duty capable of *always* being done by *one* employee should ever be divided among two or more. It divides the responsibility into fractions, lessens the interest of each one in that duty, and increases the chances of neglect. If a duty is so important that it must be done at all hazards, and if there is a fear that no one employee can be trusted to do it, it should be made the duty of some *official* to check its performance, but it should not be made the duty of a fellow employee of the same or inferior grade. In this instance the duty referred to is plainly the duty of the motorman—and no one else; for the headlight, whether it be oil or electric, is peculiarly the light of the man who runs the car, and on him should devolve the responsibility of seeing that it is in perfect order before he starts from the depot with it. He should be the one that should make certain that all necessary renewal parts liable to be needed while it is in use are in their place on the car, and on him alone should be the responsibility of its being lit at the proper time, and kept lit when and as long as it is necessary.

If we read the phrase the other way, as calling the attention of the conductor to the headlight as being the especial light to be looked after, it is still unnecessary, the italicised word "all" in the amended rule covering the ground thoroughly. The last part of this rule is unnecessarily verbose, and is also rendered obscure by the use of the local word "switchlight-plug." As this word is used in connection with the lights it is supposed to mean a "fuse-plug," "fusible-plug," or "fuse-link," either of which are better understood names for the article in question.

While a great many of the rules are unnecessarily loaded with words which frequently befog their meaning, others are so curt as to not fully express or explain themselves, or cover the subject of the rule. As has been stated in a previous article, "brevity must be sacrificed to perspicuity." A rule must, above all, be clear as to its meaning, but that clearness must be shown in the fewest and best chosen words; every word and sentence should be scrutinized and its meaning well weighed before it is allowed to go. All unnecessary words and phrases should be cut out—but no more. There is a happy medium between going naked and smothering one's self in unnecessary and clogging garments; and this applies to rules. Few people have the gift of extemporaneously saying the right things in the right words, and almost as few have the gift of writing them. It therefore behooves any one making a rule or order to see that it is first written so as to clearly express its full meaning and intent—that it is both clear and comprehensive—and after that is done to prune out the unnecessary words and phrases—to "boil it down to clear syrup!"

11. Are they arranged in some definite, connected and consecutive manner, and divided into groups having specific relation to certain persons, duties, responsibilities, acts or things? They certainly are not! To speak plainly, they are jumbled together in a very careless manner, and the employee who was compelled to pick out and remember the rules appertaining to him or his department would be entitled to hearty sympathy. While this point is not a vital one, while a set of good rules might be shaken up in a hat, printed as they come out, and possibly no great harm be done, still it would be easier for all concerned to have them in logical shape for better, safer and easier reference and remembrance. It costs very little in labor to put them in such shape if the principles that underlie such an arrangement are defined, understood and followed.

As a beginning, the rules in any one rule book should be consecutively numbered with a single series of numbers. There is no reason for niumbering the "Rules for Conductors" with a series of numbers and the "Rules for Motormen" with a similar series, so that there is a "Rule 1" and "2" and "3," etc., for each. If it is desired to have the employee so conversant with the separate rules that they can be called to his attention and memory by number only, it will be just as easy for him to remember the first rule of his department as No. 19 as it will be if it is No. 1. Besides this, it is much easier for the superior officers or officials who have supervision over *all* the rules to remember them and place them if there is only one series of numbers. Finally, it is much less productive of confusion and mistakes in notices or orders relating to the rules to have only one rule of each number instead of half a dozen "No. 1's" or "No. 9's," which depend for their identification on the name of some department or class being tacked onto them. The only reason for numbering as given by the committee is that it permits the addition of new rules at the end of those applying to each department without breaking the continuity of the numbers or using fractions or letters. In a well-considered and up-to-date set of rules the need of an absolutely new rule that cannot be temporarily added to an existing rule is—or should be—a rare occurrence, and where it does occur frequently it is a pretty sure sign that the rules, as a whole, need readjusting and rearranging. If, however, it is thought probable that there will be a need for additional rules before such a rearrangement is necessary, it is an easy matter and one productive of no evil or confusion to leave a few unoccupied numbers at the end of each section or department, these numbers to be given to the new rules as they are made.

Even worse than the system of numbering as adopted by the committee on some of the rules is the system of no numbers at all, as under "General Rules" and "Depot Masters," the designation of which could only be by "line No. so and so" or "paragraph such and such," a most cumbersome, confusing and impossible arrangement.

The first principle, therefore, in the arrangement of the rules is that all the rules in any one rule book should be consecutively numbered, without regard to departments or any other division.

The next point is to prefix each rule with a short heading, giving the object of the rule or the subject or subjects treated by it. In practice it is wise to have these headings printed in a display type, so as to quickly catch the eye of a person not familiar with the rules.

The next thing is to group the rules under proper heads or sections, relating to the departments, or classes or divisions of employees. As we are now considering only two classes, conductors and motormen, these groups will only number three—one for both and one for each.

The next is to subdivide these groups according to the relations of these two classes of employees. The relations that any traffic employee works under are as follows:

I. To his employer.

II. To his superior officers and officials.

III. To his subordinates.

IV. To fellow employees having the same duties as himself.

V. To fellow employees having different duties from himself, but with whom he will be thrown in working contact.

VI. To the materials, tools, apparatus, appliances or machinery under his charge, or used or operated by him.

VII. To the general public.

VIII. To persons not belonging to, or not having authority from his employer, but who may have relations with or authority over him under laws, ordinances, or general or local customs.

Keeping in mind these separate relations, the grouping of the rules for conductors and motormen naturally divides itself into:

A. An "Introduction" or "General Notice," in which the employer states the general duties, responsibilities, requirements, etc., common to all employees, and the principles underlying the duties of the employees for whom the rules following are made.

B. "General Rules for both Conductors and Motormen," stating fully their relations with their superior officers and officials, and with one another, with the general public and with outside parties in authority, where such relations are *general*, and identical for both conductor and motorman.

C. "Special Rules for both Conductors and Motormen," stating requirements, defining responsibilities and instructing in duties common to both.

D. "Special Rules for Conductor in relation to car."

E. "Special Rules for Conductor in relation to passengers."

F. "Special Rules for Motormen in relation to car."

G. "Special Rules for Motormen in relation to passengers and general public."

H. The bell and gong signals, and the rules specially and solely applicable to them.

I. Specific instruction in regard to special apparatus and localities, or to local customs, laws, ordinances, etc., relating to the employer—as represented by the conductor and motormen—or *directly* applicable to them.

Under these groups the rules should be arranged as much as possible in a natural sequence, taking up the different duties and responsibilities as nearly as possible in the same order as the employee will meet with them in actual practice. The following are given as suggestions for this arrangement:

Rule 1.—General requirements.
Rule 2.—Rules and orders.
Rule 3.—General conduct while on duty.
Rule 4.—"Time" and "Pay."
Rule 5.—Absence from duty.
Rule 6.—Resignation and discharge.

Under "Special Rules for Conductors and Motormen:"

Rule 10.—Uniforms.
Rule 11.—Badges.
Rule 12.—Other company property.
Rule 13.—Taking out and bringing in cars.
Rule 14.—Defects in track, line, etc.
Rule 15.—Articles sent by car.
Rule 16.—Disablement of car.
Rule 17.—Leaving car while on run.
Rule 18.—Disturbances, ejections, etc.
Rule 19.—Accidents.

Under "Special Rules for Conductor in relation to car:"

Rule 25.—Responsibility and authority.
Rule 26.—Care and condition of car.
Rule 27.—Trolley.
Rule 28.—Safety-gates, bars, nets, etc.
Rule 29.—Direction or route signs.
Rule 30.—Grade crossings.
Rule 31.—Place and actions on car.
Rule 32.—Articles left on car.
Rule 33.—Running and schedule.

Under "Special Rules for Conductor in relation to passengers:"

Rule 40.—Non-riders.
Rule 41.—Collection of fares.
Rule 42.—Keeping order on car.
Rule 43.—Conversation with passengers.
Rule 44.—Stopping for passengers.
Rule 45.—Assisting passengers.
Rule 46.—Looking out for passengers.
Rule 47.—Calling streets, etc.
Rule 48.—Platforms and steps.
Rule 49.—Smoking and spitting.
Rule 50.—Intoxicated persons.
Rule 51.—Disorderly persons.

Under "Special Rules for Motormen in relation to car:"

Rule 55.—Responsibility and authority.
Rule 56.—Who may run car.

Rule 57.—Care and condition of machinery and apparatus.

Rule 58.—Special points to be observed in relation to machinery and apparatus.

Rule 59.—Special points to be observed in regard to running.

Rule 60.—Speed.

Rule 61.—Headway.

Rule 62.—Schedule.

Rule 63.—Grade crossings.

Rule 64.—Right of way.

Rule 65.—Block of road.

Rule 66.—Sand boxes.

Rule 67.—Headlight.

Rule 68.—Track signals.

Rule 69.—Use of foot-gong.

Under "Special Rules for Motormen in relation to passengers and the general public:"

Rule 75.—Looking for passengers.

Rule 76.—Blocking of track.

Rule 77.—Ambulances, fire wagons, processions, etc.

Rule 78.—Alarms and warnings.

Rule 79.—Danger and risks.

After these may be placed the bell signals and all rules relating *exclusively* to them. Also, copies of, extracts from, or directions in regard to laws, ordinances, etc., to be observed, or peace or other officers to be obeyed or reported to.

Under each one of the above—or similar—headings should be grouped everything appertaining to the subject contained in that heading that applies to that particular employee or class of employees. The different divisions of this subject had best—for easy reference—be paragraphed. For instance, under "Rule No. 41.—Collection of Fares," should be stated in separate paragraphs the following points:

The different kinds and amounts of fares to be collected.

When and how they are to be collected.

When and how they are *not* to be collected.

When and how they are to be registered, or otherwise publicly recorded.

When and how they are to be privately recorded.

When and to whom they are to be "turned in."

Regarding errors in regard to collection of fares or of making change.

Regarding disputes concerning same.

Regarding errors in registering or recording fares.

Counting and checking passengers.

Instructions in regard to setting, changing, handling, etc., of registers or other recording or checking devices.

Change.

Tickets.

Full instructions in regard to transfers.

Free riders other than employees.

Riding of employees.

And any other specific instructions as to local or special procedure or customs regarding fares.

The above classification, grouping and paragraphing may seem like an appalling and unnecessary mass of detail, but nothing has been suggested but what is necessary to make the rules quick and easy of reference and easily remembered—surely two very important points. As to the number and title of heads, or rules, given, there are few but what are general and can be used in full by the smallest of roads, while a road much larger or more complex would very probably have to add considerably to their number.

H. S. COOPER.

(To be Concluded.)

Heavy Snows in Montreal

MONTREAL ISLAND BELT LINE RAILWAY,
MONTREAL, April 11, 1899.

EDITORS STREET RAILWAY JOURNAL:

On the introduction of electric railways into Canada it was prophesied that snow would be an insurmountable difficulty. I inclose a couple of photographs of "difficulties" on our line. This drift was so hard that it would hold a shovel so firmly that the latter could be broken off, and it would quite easily bear a man's weight.

DEEP SNOW NEAR MONTREAL

This storm was fought with shovels and a Ruggles rotary plow, equipped with four G. E. 1200 motors. The plow alone would handle a considerable amount of soft snow, but banks of this description are not to be overcome by such mild persuasion. Some of our cars are furnished with noses, but are not of much use when the snow is too deep.

A TYPICAL DRIFT

I may say that we have some 12 miles of track, on which the snow fell on March 28 to a varying depth of from 2 ft. to 10 ft., and all hard packed.

While the difficulty was not insurmountable, I think all will admit that it was a difficulty.

OUR LADY OF THE SNOWS.

The Breakage of Car Axles

ST. LOUIS CAR WHEEL COMPANY,
ST. LOUIS, MO., April 14, 1899.

EDITORS STREET RAILWAY JOURNAL:

I have read with interest the discussion in your columns on the breakage of car wheel axles, and think a large factor in accidents of this kind is the condition of the track. Where the railway has light T rails and bad joints, some disasters of this kind must be expected with light or low grade axles. It is also necessary to have the wheels properly adjusted to the track gage, for if too narrow between flanges they impinge on guard rails, in frogs and at crossings, and if too wide are grinding continually against the inside of the rail heads, all of which produces undue strains upon the axle. With 18-ft. closed cars bodies or ten-bench open cars, 33-in. wheels, good track and a speed not exceeding 12 miles an hour, an axle of $3\frac{3}{8}$ ins. diameter, if of good material, should stand all the proper strains that are likely to come upon it in service. We have fitted many hundred of wheels, a large proportion of which have been 36-in. wheels, upon axles of that size made of hammered steel, and I do not remember of a single breakage except in collision or derailment. It is supposed that the axles are properly trammed when under the cars; if not, that will cause another strain on the axle.

Our experience with rolled steel for axles has been most unsatisfactory, so much so that we have abandoned its use for axles entirely and use hammered steel instead, as mentioned above, and have found it most satisfactory. Again, a good many car builders and street railway superintendents (or their truck men) when pressing street car wheels on the axles leave them wide in the gage, making the flange run close to the rail in order to prevent lateral play on the car as much as possible. This is very good practice when the tracks are kept in first-class condition, straight and level, and when the rail joints are well kept up, but if otherwise, a close working flange is pretty severe on the axle, as the crowding of the flange, when added to the strain of the load bearing on journals outside of the wheels, tends to bend it continually.

Our practice in pressing on is to leave a little lateral play between flange and rails, and having received no "kicks" from our customers we consider the practice a good one.

ALEXANDER MAGEE, Foreman.

A Method of Increasing the Life of Gears and Trolley Wheels

DENVER, COL., April 10, 1899.

EDITORS STREET RAILWAY JOURNAL:

During the early and dark days of the electric railway we used a trolley wheel of about one-half the diameter of those required by modern practice, and pressed harder against the wire. When made of brass they would not last over three days, but the metal was gradually made harder, until finally we used steel, tempered file hard. These wheels proved to be desirable, electrically, and quite durable.

In later experiments with motors and boxed gearing, of my own design, to deaden the noise and lubricate the gears we supplied them liberally with common bar soap and oil. This proved to be quite desirable for the purpose intended, and besides it showed another remarkable feature. The face of the teeth of the gearing were soon covered with a thin scale of foreign material, which prevented the metal from wearing. This material became flint hard, and required a cold chisel to remove it.

The writer is of the opinion that trolleys which will last ten times as long as those in common use, and car gearing that will not become noisy and wear, are within reach. I do not supply the exact specifications, but leave room for a little study and experimenting on the part of the railway master mechanic.

JOHN C. HENRY.

Babbitt Melting Forge

BROOKLYN, N. Y., April 4, 1899.

EDITORS STREET RAILWAY JOURNAL:

In many shops it is customary to melt babbitt metal in the smith's forge—a very wasteful and vicious method, when it is considered that the forge fire gives too intense a heat for properly melting babbitt, and that babbitt metal injures the working of the forge whenever any of the metal finds its way into and remains in the tuyre. Lead there will effectually prevent the welding of iron as long as it is exposed to the action of the vapor of the lead.

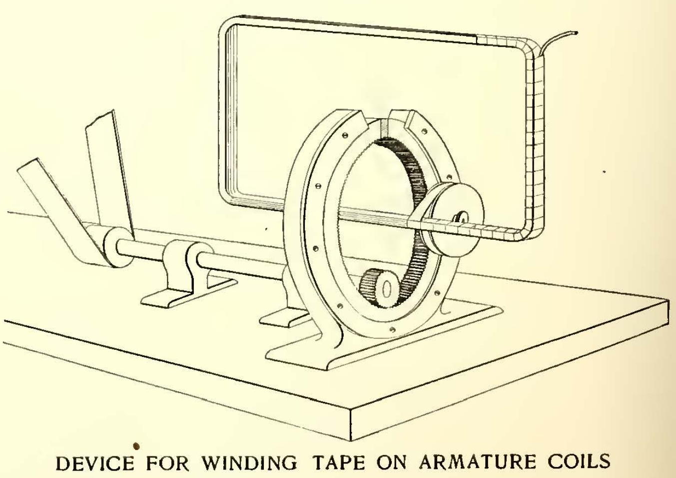
A much better way, and a cheaper one, too, is to rig up a little gas bench for the melting of small lots of babbitt. When a quantity of it is to be handled a furnace similar to that used for melting out—and melting in, too—the lining of axle and motor boxes will do. But, the gas bench, that is made of one or two heavy gas burners similar to those used in kitchens for cooking. They are placed in an iron bench, and proper iron bearers rigged for holding the ladles in place. With this rig the heat can be regulated at will, and there is no danger of melting out the bottom of the ladle before the workman is aware that it is even red hot and before the babbitt is fairly warmed through.

JAMES FRANCIS.

Quick Method of Winding Tape on Armature Coils

The winding of armature coils is a tedious and rather expensive job, on account of the labor required to wind the tape on the coil. Mr. Sheldon, of the Indianapolis Railway Company, has made a very ingenious and simple winding device by which the coil of tape is reeled around the armature coil. The accompanying engraving shows the general construction of this tool. The large external gear was cast from a lawn-mower casting, and gave very excellent results.

The spool on which the tape is wound is secured to a

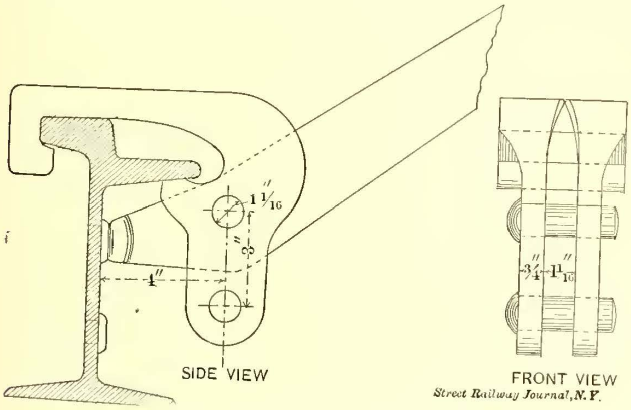


DEVICE FOR WINDING TAPE ON ARMATURE COILS

stud projecting from the rotating internal gear wheel. In order to introduce this coil into the center of the rotating ring, a diagonal slot is cut across the gear, and when the slot is opposite the opening in the containing bearing for this ring the coil can be introduced into the center of the ring. The device is then started up, and the tape is wound on the coil as it is fed along through the center of this rotating ring. More or less tension can be given to the spool containing the tape by increasing or decreasing the pressure on the friction surfaces. The ring makes about 60 to 100 r.p.m., depending upon the character of the coil. It gives excellent results, and labor can be cut down about two-thirds by the use of this machinery instead of hand work. The perspective drawing of this arrangement is shown in the engraving, and details can be changed to suit any conditions which the repair man may consider desirable.

Device for Riveting Rail Bonds

On the Cleveland Electric Railway an ingenious method of holding the rail bonds in place while they are being riveted is employed. This consists of a hook lever, which is



DEVICE FOR RIVETING RAIL BONDS

placed over the head of the rail, and to which is connected a long bar which can be brought with heavy pressure against the head of the lug. This holds the rivet firmly while the riveting takes place. The arrangement is shown in the accompanying diagram.

Accident Instructions

The New Orleans Traction Company has recently issuch a set of instructions for government of its employees in case of accident, which gives in concise form the rules to be followed in case of accident. These instructions are printed on a large sheet, and have been posted in all the stations of the company.

The company has adopted the custom of teaching the employees topically by large cards of this kind, each referring to some special field of their work, rather than to embody the rules governing their duties in a book. This practice has been adopted because it has been noticed that by posting in the conductors' and motormens' rooms separate cards for the several sub-divisions of their duties discussion is more likely to be provoked, and this seems to breed greater familiarity with the subjects presented.

The company has been giving some special attention to the matter of accidents, with the result that its record during the past year has shown about 33 1-3 per cent improvement as compared with the previous year, with a 26,000 car-mile daily run.

ACCIDENTS

The term ACCIDENT includes injury to PERSONS OR PROPERTY, COLLISIONS, BREAKAGES of all kinds to the CARS, EJECTIONS, PERSONAL TROUBLE in car between EMPLOYEES and PASSENGERS, or between PASSENGERS, and any event of any name or nature occurring upon a trip, wherein damages occur to PERSONS OR THEIR PROPERTY, to CAR, to VEHICLES, or wherein the possibility of damages may arise from any action of EMPLOYEES OR PASSENGERS themselves, whether complained of or not.

CONDUCTORS are not permitted to use discretion as to reporting or not any occurrence included in above statement, but must report promptly all matters coming within above list.

Reports must be TRUTHFUL and state EXACT facts, without FEAR, FAVOR OR PREJUDICE, and no attempt must be made in a report to SHIELD any employee, or to CONCEAL any of the circumstances surrounding the occurrence reported. Reports must state FACTS which can be SWORN TO IN COURT by the employee reporting or by the party or parties named as witnesses. INFERENCES, OPINIONS and SUGGESTIONS must be stated as such, and not as facts. Report must give:

1st. DATE OF ACCIDENT AND EXACT TIME OF DAY WHEN IT OCCURRED.

2d. EXACT PLACE OF OCCURRENCE; full name and address of party injured, or likely to have been injured, either in person, property or feelings; the owner of property damaged or doing damage to company's property; if vehicle, name of driver, license number and year of issue.

3d. NATURE OF ACCIDENT, and cause of its occurrence. THIS CAUSE MUST BE CAREFULLY ASCERTAINED.

4th. FULL NAME AND ADDRESSES of all passengers, bystanders, and employees, as far as possible, whether they saw how the accident happened or not.

5th. DISTANCE WHERE CAR STOPPED, after the accident happened, from place on the street where accident occurred; measurement to be made by stepping the distance from the front end of car to point of accident. This measurement should be witnessed by a bystander, or some one not connected with the company.

6th. Statement of injuries or damages as well as any expressions of opinion from bystanders regarding the accident.

Above report must be filled out upon blank for that purpose, signed by the conductor and motorman, and left at the station, after turning in the car.

In the event of personal injury, care must be taken to render all the necessary assistance and attention to person injured.

The most TRIVIAL and apparently UNIMPORTANT ACCIDENT OR OCCURRENCE in or about the car, even where a person declines to give name, claims no injury, or seems to regard the whole matter as trifling, must be REPORTED with as much care as though the damage or affair was of the utmost importance.

All accidents must be telephoned to general office of company as soon as possible, and especially in the event of a serious accident, the general office must be notified IMMEDIATELY so that prompt aid may be furnished and investigation begun pending the full report.

It is expected that a report will be made of all accidents or injuries that may occur on the track, or within 10 ft. of same, whether the car was concerned in the accident or not.

Attention is specially called to question arising between CONDUCTORS and PASSENGERS, as to the PAYMENT of fare, CHARACTER OF MONEY OFFERED, CHANGE FURNISHED, TRANSFERS or other COMPLAINTS leading to DISORDERLY, or BOISTEROUS conduct, in each of which events conductor must secure POSITIVE PROOF and EYE WITNESSES, so as to be able to clearly substantiate the truthfulness of his report in court, particularly before any EJECTION OR ARREST is attempted, and full report of same must be promptly made in accordance with above rules. NO EJECTION must be made without FIRST REFUNDING FARE.

Conductors or other employees MUST NOT TALK about, or GIVE ANY INFORMATION WHATEVER concerning an accident to any person, other than the proper officer or person delegated with the authority of the company to investigate the occurrence, and all questions asked of any employee of company, except by person or persons above named, must be answered by directing the questioner to general office for information.

Employees must not VISIT an INJURED PARTY, or FAMILY, to make inquiries or discuss accident without authority of company.

The above rules must be STRICTLY OBSERVED, and too much stress cannot be laid upon their importance. If any doubt as to their meaning in any respect exists in the minds of employees, they should consult, for their own protection and the company's, their station foreman.

C. D. WYMAN, General Manager.

New Orleans, La., April, 1899.

Cars should be sponged off daily with clear water, and any accumulation of dirt removed as far as possible with a chamois skin and sponge—care being taken to rinse off the grit before rubbing with sponge or chamois. Once every thirty days the car should be thoroughly washed down, using a good grade of soap. From paper at the Boston Convention, 1898.

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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.

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The theorists and social reformers who claim to represent the enlightened and progressive element of the people of New York, but who certainly do not speak for the millions of "strap hangers" who suffer daily discomforts in the travel to and from their business, have succeeded in influencing Governor Roosevelt to take a somewhat decided stand against the granting to the Rapid Transit Commission of the City of New York the power to confer a perpetual franchise upon the group of capitalists which was prepared to spend $60,000,000 in bringing about genuine rapid transit in the boroughs of Manhattan and The Bronx. The offer to expend this money has therefore been withdrawn, the Metropolitan syndicate stating in a characteristically direct and candid manner their unwillingness to appear before the public as a "grabber of franchises," and their equal unwillingness to expend so large a sum of money upon a short tenure of privilege. It is hardly to be believed that so favorable an opportunity to secure a great public benefit at private expense and risk should be allowed to pass away, but it is impossible not to see that the growing tendency in municipal administration is to drive the hardest, sharpest bargain possible with public service companies, obtaining for the city treasury the last penny of profit, and leaving to the companies little margin for the larger improvements and extensions which are often unprofitable at first, but which the future would justify were the conditions more secure and the bargain more equitable. The people will inevitably suffer in the long run from a narrow money-making policy of this kind, but the latter is popular, and enables astute politicians to court and win public favor and office.

* * * * * *

The really incredible thing is that a man so broad-minded and sensible as Governor Roosevelt should be impressed with so superficial a view of the true interests of the city of New York as is taken by the "reformers," and should be so deceived by the sophistry of their arguments. Again and again have the opponents of a perpetual franchise urged the impossibility of making a bargain to-day which would properly protect the city's interests one hundred years hence. Again and again have they calmly ignored the workings of the Metropolitan syndicate's proposition to pay 5 per cent of the gross receipts to the city, and have wilfully or carelessly asserted that the city would get no more in future than at present. What are the real facts of the case? They are, obviously, that, as the travel increases with increase of population, the city's revenue increases in the same ratio. Moreover, this 5 per cent of the *gross receipts* really means a far larger percentage of the *net profits*—a percentage so large as to amount to a very profitable "special partnership" obtained by the city in the rapid transit enterprise. As we do not remember to have ever seen the real character of this "special partnership" clearly brought out and explained in the many discussions in different cities about the proper basis of franchise remuneration, it is worth while here to show in some detail exactly what "5 per cent of the gross receipts" really means in this particular case.

Clauses 7 and 8 of the Metropolitan syndicate's proposition read as follows:

7. The city to receive as compensation, in addition to the services rendered and in lieu of all other charges upon the franchise granted hereunder, an annual rental equal to 5 per cent on the gross receipts from the operation of the new road, provided that whenever any such payment shall leave the receipts insufficient to pay the rental of 5 per cent on cost of construction and the operating expenses, including taxes, the percentage to be paid shall be abated accordingly.

8. The real and personal property forming part of said railway to be exempt from taxes until it pays 5 per cent, as provided in section 15 of the rapid transit act, with the amendments proposed by the commission in the bill now pending before the Legislature.

If the new tunnel railway earns, in competition with the present surface and elevated lines, $7,500,000 gross per annum, or nearly as much as the present Manhattan elevated system is earning, and expends 50 per cent of this sum in operating expenses proper, it will turn over to the public treasury, in the form of taxes on real and personal property and agreed rental to the city not less than 10 per cent of the gross receipts, or $750,000, and will have left for its stockholders their 5 per cent guaranteed rental upon their $60,000,000 investment, or $3,000,000. In other words, $7,500,000 is the minimum gross earning power of the tunnel railway by which its projectors will be able to make 5 per cent interest upon their investment and pay all the city's rental and taxation charges as agreed. Under these circumstances, and assuming this $3,000,000 to be merely "interest," and not in any sense "profits," the public would obtain all the "profits," leaving nothing for the controlling syndicate; or, put in another way, the public would obtain 20 per cent of the entire earnings from operation applicable to return on investment without itself making any investment whatsoever. Now, what may be expected of the future? Suppose that with the increase of population there comes a proportionate increase in traffic, such that fifty or one hundred years hence the tunnel railway will earn $25,000,000 gross. It cannot, of course, do this without making constant additions to its capital account in the way of extensions, increase of equipment, etc., and we will be well within limits in taking the aggregate investment account for a $25,000,000 gross earning power at $80,000,000. Let us see, then, what proportion of the earnings from operation and of the true profits the public would obtain at various stages of development between these maximum and minimum limits:

Investment.	Gross Earnings.	Operating Expenses.	Interest on Investment.	Rental and Taxes 10 per cent.*	Profit to Private Capital Above. Interest on Investment and Taxes.
$60,000,000	$7,500,000	$3,750,000	$3,000,000	$750,000	———
65,000,000	10,000,000	5,000,000	3,250,000	1,000,000	750,000
70,000,000	15,000,000	7,500,000	3,500,000	1,500,000	2,500,000
75,000,000	20,000,000	10,000,000	3,750,000	2,000,000	4,250,000
80,000,000	25,000,000	12,500,000	4,000,000	2,500,000	6,000,000

* The average city and State taxes paid by the Manhattan (Elevated) Railway Company of New York during the last five years amount to 7.2 per cent of the gross receipts.

It appears from this table that, as before stated, on a basis of $7,500,000 gross earnings the public will get all the profit above the interest, and private capital nothing; with $10,000,000 earnings the public will get 57 per cent of the profits and private capital 43 per cent; with $15,000,000 earnings the public will get 37½ per cent of the profits and private capital 62½ per cent; with $20,000,000 earnings the public will have 32 per cent of the profits and private capital 68 per cent; and with $25,000,000 earnings the public will have over 29 per cent of the profits and private capital less than 71 per cent. Even at $50,000,000 gross earnings, assuming $100,000,000 accumulated investment, the public would obtain 25 per cent of the profits above interest. In all cases the public will get 20 per cent of the entire net earnings. Does this partnership seem inequitable or against good public policy? Can the social reformers really hope that a municipal administration can so manage an enterprise of this highly technical character as to surely bring a larger sum into the public treasury, and at the same time to serve the whole public as well as can be done through private enterprise? Can Governor Roosevelt himself, with his intimate knowledge of the way in which public affairs are conducted by politicians, really believe that better results to the public can, in the long run, be obtained by municipal ownership or management?

* * * * * *

There are other phases of the Metropolitan syndicate's proposition which do not seem to be clearly appreciated by the public. The State does not hesitate to grant to a steam railroad company a perpetual franchise and the right of eminent domain, by which it can lay out a route across fields and roads and through cities and towns, as it pleases, and own such route forever. Why, therefore, should private capital be debarred from undertaking the work of constructing a tunnel beneath the surface of a city at an expense per mile enormously greater than any railroad is called upon to bear? Again, one of the chief advantages of the present proposition for rapid transit in New York lies in the surface connections and transfer arrangements, by which the surface system acts as a collecting and distributing agent for the subway. The Metropolitan Street Railway Company's surface franchises are perpetual, and even if a short-time franchise only were granted for the tunnel, with a provision for revaluation at the end of each of successive periods, the city would practically be forced to come to the terms of the surface railways in order to maintain the advantage of the distributing and collecting media. In spite of the withdrawal of the Metropolitan propositions, we sincerely hope that some means may be found to bring about rapid transit in New York at the earliest moment. The tunnel is an inevitable necessity, however long its building be postponed, for it will be wholly impossible five or ten years hence to carry on the surface or elevated lines of the city the people who will demand transportation facilities. The city is growing at so rapid a rate and the lines are, even at present, so congested with traffic, that nothing is more sure than that in some way new facilities must be provided.

It looks as if we were to have a municipal ownership experiment in Detroit, and perhaps another in Toledo. On the whole, we are inclined to welcome the carrying through of such a proposition in a single American city, feeling confident, as we do, of what will be the result. Perhaps it is as well, too, that Detroit is the first city selected to enjoy the benefits of municipal ownership so freely promised by "Pingreeism," for three-cent fares are already established in that city on many of the street railway lines, and we presume that the first decision made by the new owners will be to reduce fares to this figure on all. If a municipality can operate a street railway system on a three-cent fare basis, and make money in doing it, we all want to know it; while the cost of the experiment, if unsuccessful, can be distributed upon the large mass of taxpayers with less individual suffering than upon a smaller group of street railway stockholders. A month hence we hope to know on what basis the purchase is to be made and the possibilities of profit or loss to the city.

It is becoming more and more a recognized fact that electric railway operation is more akin to steam railroad operation than to the former horse car service, so far as the duties and abilities required of the employees are concerned. The modern electric car is a machine, not an omnibus, and all machinery such as that carried on a car should be in charge of persons having a knowledge of its proper maintenance. An example of the increasing similarity of electric cars with steam locomotives, and the necessity of the establishment of a proper system of inspection and supervision is illustrated by the increasing use of air brakes. We believe that where this type of brake is employed good results would be obtained by an extension of the system of training to this part of the equipment.

This is not founded upon the ground that the air brake is a more delicate part of a car equipment than the motors or controller, but as any piece of machinery can be abused by unintelligent handling, there is no more reason why street railway companies should not instruct their employees as to the proper method of handling street car brakes than steam railroad companies. The history of the latter has shown that the best results follow the establishment of schools for instruction of employees as to the operation and inspection of air brakes, and that the outcome warrants the expenditure of the effort has been proved beyond the possibility of doubt.

An exceedingly interesting and able argument in rebuttal of the excessive claims for taxation of street railway companies by municipalities was recently presented by John W. Boyle, president of the Utica Belt Line Street Railroad Company, in an attempt in that city to compel a railway to pay for the cost of pavement between its tracks and for two feet outside. The question is discussed from both a legal and a moral standpoint, and while Mr. Boyle takes occasion to point out a number of the popular fallacies and prejudices under which the railway company has to labor, he shows that while more beneficial to a city than a manufacturing establishment employing the same number of persons, it differs from the latter in that when overtaxed and persecuted it cannot shut down or remove its plant to another city, and for this reason is made the target of all kinds of oppressive measures. The pavement tax is particularly onerous in that the railway company is probably the only taxpayer which does not use one foot of the pavement, but furnishes and keeps in repair, at its own expense, that portion of the street on which its wheels revolve; in fact, a good pavement is a detriment to the railway company, if it exercises any effect upon its business. The usual argument, Mr. Boyle contends, for assessing railway companies is that they occupy the streets, and have thus a valuable franchise. While it is true that the cars are on the streets, this also applies to other vehicles, the only difference being that a car occupies, in proportion to the number of persons carried, a very much smaller proportion of the street than do the other vehicles, and that, while on the street, they have no exclusive right of way, but are bound under the most strict penalties, in the way of damages from accidents, to avoid collisions with other occupants. No one ever rides in an electric car under compulsion, or for the benefit of the railroad, but solely for his own convenience, and if a person decides the convenience is not worth the nickel, he keeps the nickel and walks. It is no answer to this to say that many ride from necessity, because the exigencies of their business demand it, and pay the fare under protest. There are people who pay under protest for the food they eat and the clothes they wear; but when the food has been furnished them at the lowest market price, and the clothing for less than any other merchant of the city sells it, the protest carries little weight. If people ride from necessity, then the railroad becomes a necessity to the city, which is what the railway companies claim. Altogether, the argument, which is printed in pamphlet form, will be found most readable and valuable.

It is not often that the engineering public has the privilege of reading and digesting such a clear, intelligent and convincing report on the electrical equipment of a large city tramway system as has just been presented to the Glasgow Corporation by H. F. Parshall, its consulting engineer, a full transcript of which appeared in our columns last month. Not only are such reports in this country presented to the directors of private companies and jealously withheld from the public, but electric traction in this country has been more a matter of development in each city than of the intelligent laying out of complete plans beforehand. Great Britain is fortunate in having an opportunity of drawing upon the world's experience in the construction of municipal and private plants, and we have no doubt that the opportunity will be taken advantage of in a majority of cases. Mr. Parshall's experience has been so wide and his practice so uniformly successful that his recommendations to the Glasgow Council have peculiar weight, and may well be studied by street railway managers in America, as well as in Europe. His most important recommendation is that a high tension three-phase main generating station, with several rotary transformer sub-stations, forms a system of generating and distributing power more economical than is that of several separate 500-volt direct-current generating stations. This is undoubtedly the best engineering practice of to-day, as shown by the decisions in its favor made by the Metropolitan and Third Avenue companies in New York, by the Edison Electric Lighting Company of Brooklyn, and by the Central London Underground Railway. The advantages are a less capital expenditure in buildings, generating plant and real estate; greater latitude allowed in the selection of a power station site, where coal and water can be obtained at minimum cost; less working cost for labor and repairs, due to the minimizing of the skilled force necessary for operating the plant, and to the economy always found in the operation of large instead of small units; the greater flexibility of the system with respect to future extensions, and the placing of new sub-stations wherever desired; and the relatively shorter time taken in constructing the plant, by which the superior economy of electric traction over horses can be more quickly realized. Mr. Parshall's estimates of the relative investment costs and operating expenses of the two forms of generating and distributing plants is interesting. For the three-phase rotary converter plan, the investment cost is placed by him at $1,580,000, while for the five separate generating stations it will be $1,950,000, these figures not taking into account cost of ground and railway connections, which, if included, will bring about a result much more favorable to the single generating station. The total power operating expenses for the three-phase system, exclusive of maintenance, depreciation, interest, insurance and taxes, are estimated by Mr. Parshall at $.0046 per kw. hour, and including maintenance and fixed charges, at $.0106; while the power operating expenses proper for the direct current generating stations would be $.0075, and including depreciation and fixed charges, $.0147. These figures do not include interest on the cost of sites and railway connections. The annual estimated saving in Glasgow in using the tri-phase distribution, based on a 600-car plant, is estimated by Mr. Parshall at over $100,000.

A Formula for Train Resistance

BY HENRY GRAFTIO

The question of train resistance is one that has attracted the attention of many prominent engineers. Besides the high scientific interest which the subject posseses, it has also a practical value of the highest importance, for a more accurate knowledge of all the factors of train resistance can only contribute to the finding of means to diminish them. As the Street Railway Journal has been paying particular attention to this subject during the past few months, it may be of interest to its readers to have given briefly some of the results secured abroad in investigating this problem.

During the last few years some very interesting and complete tests on the resistance of trains and locomotives have been made in France. Some of these tests indirectly, and some directly, are likely to confirm the opinion expressed by Mr. Angus Sinclair, of "Locomotive Engineering," and of Mr. Lundie, that at high speeds the resistance of trains seems to increase as the first power of the speed. For a long time the general opinion prevailed that the resistance of trains must follow a parabolic law. This was due in a large measure to the general adoption of the well-known formula of Newton.

$$R = k\,S\,v^2$$

for the resistance of a moving plane surface in free air. But all evidence now seems to prove that this theory is wrong. As it is quite impossible to find an expression for air resistance on moving bodies by pure mathematical deductions in the present state of our knowledge of aerodynamics, it is manifestly wrong to admit *a priori* for air resistance, a theoretical expression similar to that of Newton's, or by finding by experiment within restricted limits—coefficients more or less accurate to extend their application to limits outside of the experiments.* Only experiments made on very large scale can be considered as reliable.

Among the experiments on air resistance those of Mr. Crosby occupy in the mind of the writer one of the first places, being conducted on a very large scale and with bodies that were really moving in the air. Mr. Crosby's curves† are represented in Fig. 1. Some experiences on air resistance made in France seem to contradict these results; but this is due almost entirely to the fact that in investigating the laws of air resistance Newton's formula was adopted *a priori*, and all efforts were directed to find the most probable value for k. Thus M. Poncelet expressed the opinion that up to 50 km. the resistance of air on a parallelopiped body is practically expressed by Newton's formula by putting k. = 0.08. Messrs. Cailletet and Colardeau, from experiments made on the Eiffel Tower, consider this value to be too large and within the limits 0 km. to 90 km. per hour, consider k. = 0.07. But here was another cause for error, viz.: the fact that the velocity of the wind was measured by anemometers, and therefore not in so accurate a manner as by the speed of moving bodies as in Mr. Crosby's tests.

The noteworthy and most reliable experiments made on train resistance in the United States by a great specialist on this subject, Mr. Angus Sinclair, invariably showed at high speeds the relation

$$R = a + bv$$

between the limits of 60 km. and 120 km. per hour, and the no less remarkable experiments made in France seem fully to confirm the theory that the resistance of trains is rather a hyperbolic function of the speed, and at high speeds can be expressed by the equation of a straight line. In confirmation of this may be cited the tests of the well-known and eminent engineer of the state railways of France, M. Desdouit, the inventor of the pendulum apparatus for measuring acceleration. From exceedingly careful experiments made on the lines of the French state railways this engineer found that the resistance of the locomotive,

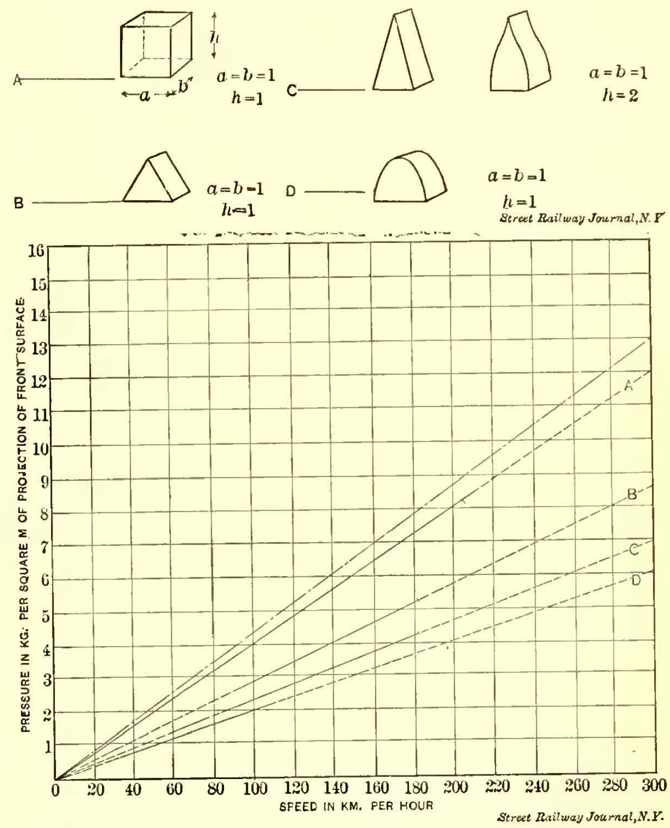


FIG. 1.—O. T. CROSBY'S CURVES ON AIR RESISTANCE.

with the tender, within the limits from starting up to 80 km., increased very nearly as a hyperbolic function of the speed of the form

$$R = a + \sqrt{b + cv^2}$$

The curve represented by this formula for a passenger locomotive weighing, with its tender, 55 tons (36 tons + 19 tons), and running with the steam shut off, is plotted as No. 1‡ in Fig. 2. As can be easily seen, at speeds higher than 40 km. the resistance increases very sensibly as a linear function of the speed.

On the same sheet is plotted another curve, No. 2, connecting three points, and also based on M. Desdouit's data. This curve seems to indicate that at high speeds the resistance of the locomotive increases with, but not so rapidly as, the speed. I do not consider this curve as improbable.

On the same sheet are plotted two curves, No. 3 S and No. 3 β, that are deduced from experiments made on the Paris-Lyons-Mediterranean line with new compound cylinder express locomotives by M. Privat, the engineer of that railway. These experiments were carried out by M. Privat in a very reliable manner, and were published partially in the "Revue Generale des Chemins de Fer" in 1896. In his very interesting article M. Privat discusses principally

* Given a certain number of points representing in an approximate manner (as is the case here) values of a function, as found by experiment, it is possible to plot many curves that will be more or less accurate within the small limits, but when extended will prove absolutely wrong.

† See transactions of "American Institute of Electrical Engineers," February, 1891, and Street Railway Journal, April, 1891.

‡ This curve represents the resistance on level track and in a perfectly calm atmosphere. M. Desdouit especially insists on the latter condition. The resistances expressed by the above curve include all elementary resistances due to vertical and horizontal shocks on the rails, friction of journals, friction of wheels on rails produced by the manner in which the wheels are fixed to the axle, side friction of flanges of wheels, resistance of the different parts of the mechanism, and finally, air resistance. Pneumatic effects of pistons in cylinders were practically eliminated by using such admission valves that the effect of vacuum due to the cut-off was practically nil; but all these resistances are considered by M. Desdouit to be small, as compared to air resistance.

the working of the compound system at different speeds, admissions in high and low pressure cylinders and the work performed. He plotted a series of curves showing the total amount of indicated power developed by the locomotive in hauling trains at various speeds and ratios of admission in the two cylinders. All these curves were reduced to the case of moving on a level and with no acceleration. Deducing the power required for hauling the train, he found curves showing the power required for moving the locomotive and tender alone, for the case of a level track and no acceleration.

I have plotted these curves in Fig. 3. The heavy lines here correspond to the case of an admission of 0.7, and the light lines to admissions of 0.4-0.5,in the *low* pressure cylinders. Numbers 0.2, 0.3, 0.4, 0.5 on both series of curves show ratios of admission, viz.: 0.2, 0.3, 0.4 and 0.5 in the *high* pressure cylinders. It is easy to see that the ratio of

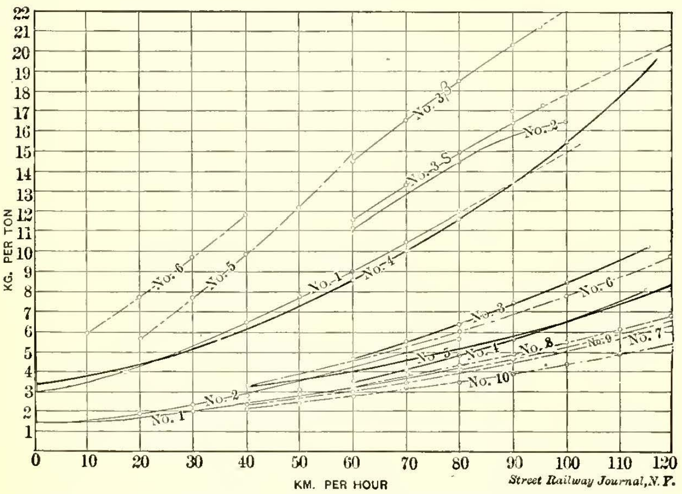


FIG. 2.—GROUP OF CURVES FOR RESISTANCE OF LOCOMOTIVES (WITH TENDER) AND FOR CARS ONLY.

Upper curves for locomotive and tender only.
Nos. 1 and 2.—Desdouit [French State Railways]. L = 55.
No. 3 β.—Maximum resistance deduced from M. Privat's experiments [French P. L. M. Ry]. L = 84 2.
No. 3 S.—Minimum resistance deduced from M. Privat's experiments [French P. L. M. Ry]. L = 84.2.
No. 4 —Barbier [French Northern Ry.] L = 93.5.
Nos 5 and 6.—Gen. Petroff.

Lower curves for cars only.
No. 1.—Desdouit [French State Railways] Q = 75, n = 8.
No. 2.— " " " " Q = 75, n = 3.
No. 3.—Barbier [French Northern Ry.] Q = 206, n = 15.
No. 4.— " " " " Q = 206, n = 7.
No. 5.—French Western Ry.
No. 6.—French Northern Ry., from Gen. Petroff's formula, Q = 206, n = 15.
No. 7.— " " " " " " " Q = 206, n = 7.
No. 8.—Canadian Pacific " " " " " Q = 152, n = 5.
No. 9.—Pennsylvania Ry , " " " " Q = 162, n = 5.
No. 10.—Russian Railway, " " " " Q = 390, n = 13,

admission in the low pressure cylinders has a visible influence on the resistance of the locomotive.

Taking the mean of each group of light and heavy curves we obtain the probable average power required for moving the locomotive and tender under most favorable and most unfavorable conditions of resistance in functions of the speed. These mean curves are plotted in Fig. 4, and are slightly curved.

Without making a great mistake we can *a priori* assume them to be of the form

$$W = a + b\,v + c\,v^2$$

and find most probable values for a, b and c. Doing this we have very nearly

$$W_{min} = -40.2 + 1.64\,v + 0.0437\,v^2$$
$$W_{max} = -135 + 4.5\,v + 0.0375\,v^2$$

but only within the limits from 60 km. to 95 km.

Now if we put R as the resistance of the locomotive and tender (weighing 84.2 tons*) in kg. per ton of weight we shall have

$$W = \frac{R \times 84.2 \times v}{75 \times 3.6}\text{; whence}$$
$$R = \frac{3.2}{v} W$$

or, substituting values for W_{max} and W_{min}, we have

$$R_{min} = 5.24 + 0.14\,v - \frac{129}{v}$$
$$R_{max} = 14.38 + 0.12\,v - \frac{432}{v}$$

again only in limits from 60 km. to 95 km.

These two curves are shown by No. 3β and No. 3S in Fig. 2. While perhaps not being absolutely accurate, they

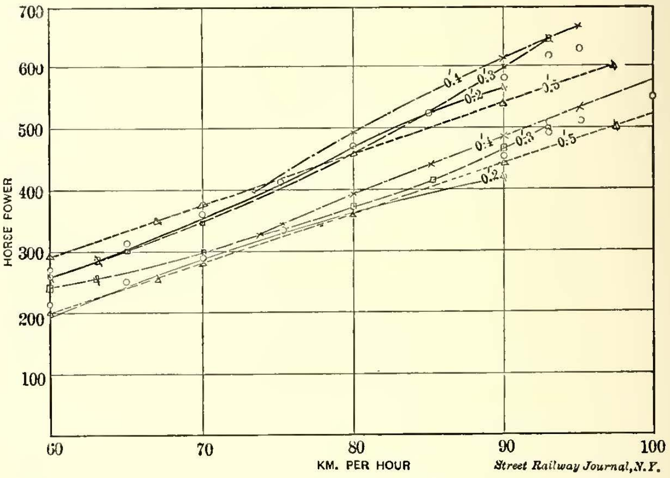


FIG. 3.—CURVES SHOWING POWER (NUMBER OF I.H.P.) REQUIRED FOR HAULING THE LOCOMOTIVE AND TENDER AT DIFFERENT RATES OF ADMISSION.

The lower curves show power required at most favorable ratio of admission, *i. e.* 0.7 in low pressure cylinders and the following ratios in high pressure cylinder.
———————— = 0.2.
——— ——— ——— = 0.3.
—— . —— . —— . —— = 0.4.
— — — — — — — — = 0.5.

The upper curves show power required at unfavorable ratio of admission *i. e.* 0.4 to 0.5 in low pressure cylinder and the following ratios in high pressure cylinder.
———————— = 0.2.
——— ——— ——— = 0.3.
—— . —— . —— . —— = 0.4.
— — — — — — — — = 0.5.

can be considered characteristic and in a certain accord with M. Desdouit's opinion. Of course, between these two limiting curves we could plot a multitude of others, more or less inclined, depending on the ratios of admission in the high and low pressure cylinders. But in the case of the continuous use of an admission of 0.7 in the low pressure cylinders we have the limiting curve No. 3S, that seems to indicate that the resistance of the trial locomotive, when well governed, increases rather more slowly than the speed, or, at least, very nearly as a linear function of the speed, again within limits from 60 km. to 95-100 km.

In the same diagram is plotted the curve, No. 4, found by M. Barbier during a very extended set of experiments made recently on the French Northern Railway with two new, fine four-cylinder compound express locomotives, designed by M. Du Bousquet. A very complete report of these tests, made by M. Barbier, appeared in a series of articles published by the "Revue Generale des Chemins de Fer" in 1897-1898. The curve No. 4, which is taken from this paper, has a slightly parabolic form.

$$R = a + b\,v + c\,v^2$$

The very low resistances given by this curve are due largely to the fact that the weight of the tender was considerable (43 tons) as compared to that of the locomotive (50 tons).**

Also in Fig. 2 are plotted two curves, Nos. 5 and 6,

* By "tons" in this article, the metric ton = 2200 lbs., is intended.

** The writer is not disposed to criticise in any way M. Barbier's very complete and reliable experiments and deductions, but may not a curve of a hyperbolic form, if taken a *priori*, instead of a parabolic one, prove no less accurate and concordant with the series of points found by experiment?

given by General Petroff, now Assistant Minister of Ways of Communication. Both are represented by the parabolic equation

$$R = a + b\,v + c\,v^2$$

Curve No. 6 represents the resistance of a freight locomotive, and No. 5 that of a passenger locomotive. The points for these curves were established at comparatively small speeds. For high speeds they give too large results, and General Petroff himself admits that in the case of the curve No. 5 at speeds from 80 km. to 100 km. the resistances given by this curve must be reduced by about 20 per cent.

All these considerations seem to strengthen the opinion that at high speeds the resistance of the locomotive increases very nearly with the speed. The latest experiments on air resistance seem to prove that this factor increases as the first degree of speed, and air resistance is the largest part of the total resistance of the locomotive. On the other hand, the friction in journals diminishes at high speed, because of a better oiling, but as the coefficient of friction is very small,* it need not be taken into account when considering the resistance of locomotives.

Before passing to the resistance of trains of cars and of complete trains the writer thinks it may be interesting to point out a well-known way, if adopted in the right manner, of lessening the resistance of air to the motion of the locomotive.

Some years ago shields for reducing the air resistance were tried on the Paris-Lyons-Mediterranean Railway. These shields were of about the same size and shape as an ordinary nose snow plow, but were carried higher on the locomotive, partly hiding the stack. It was found, however, that the useful effect of these shields in reducing air resistance was not considerable, and they were abandoned. Such an arrangement lessened the front pressure, but as it was open at the back, it had as an effect the forming of a vacuum at the rear of the shield with consequent eddy currents, increasing the resistance. If completed to the back part of the locomotive the shield would have proved far more efficient. Experiments made on the French Western Railway with the first Heilmann electrical locomotive in 1894 seem to confirm this opinion.

RESISTANCE OF THE CARS FOLLOWING THE LOCOMOTIVE

The resistance of the cars only of a train, that is, the total resistance of the train minus that of the locomotive, is plotted in the lower series of curves in Fig. 2. It will be remembered that the resistance curve of a locomotive is generally of a hyperbolic form, and in some cases the curve is concave on the axis of X (such as shown from M. Privat's test). On the other hand, almost all curves for resistance of the cars are of a well-marked parabolic form. These latter curves seem to be reliable, as the resistance of the cars can be measured accurately by means of a dynamometric car, and consequently the values can be found more accurately than that of the resistance of the locomotive alone or of the complete train.

It is easy to see from a glance at Fig. 2 that these curves for car resistance do not coincide in shape. This is caused by the fact that the respective importance of each of the different factors which make up the resistance varies with the number of cars in the train, the distances between the cars, the load on each axle, and the number of axles per car, as well as within certain limits with the conditions of track, weight of rails, size and number of ties. The influence of the latter factor can be appreciated by considering that the effect of the forward wheels upon an elastic track is to produce a continuous wave immediately in front of the wheels. This factor, of course, affects the resistance of the locomotive more than that of the cars, on account of its greater weight. Most of the existing formulæ do not include all of these various factors.

In the lower series of curves plotted in Fig. 2, Nos. 1 and 2 are those of M. Desdouit. Both of these are for a train weighing 75 tons, the first for a train of eight four-wheel cars, and the second for a train of three eight-wheel cars. It is easy to see that the second curve shows a lower resistance. This is due mainly to the fact that the number of spaces between the cars is less, and, therefore, that the resistance of the air in the shape of eddy currents and partial pressures on the fronts of the cars is less, there being fewer car fronts. It is also due, however, to the fact that the running was smoother with bogie trucks, horizontal shocks on the rails being fewer and

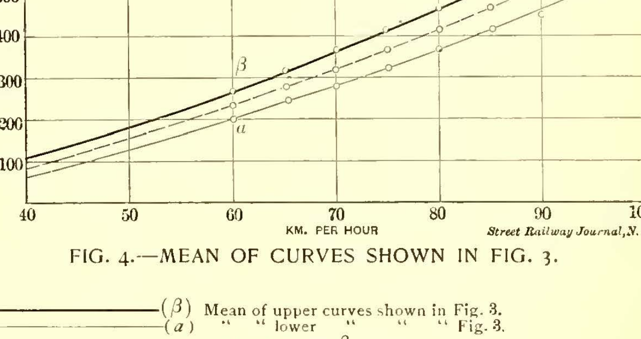


FIG. 4.—MEAN OF CURVES SHOWN IN FIG. 3.

(β) Mean of upper curves shown in Fig. 3.
(a) " " lower " " " Fig. 3.
" " a and β

smaller. So far as the first factor is concerned, a vestibuled arrangement between the cars would have reduced the resistance; and so far as the second factor is concerned, it is needless to say that every side shock involves a loss of energy in the form of *vis viva*.

So far as the friction of the journals is concerned, there is practically no difference, whether the cars are mounted on bogies or on two axles, like a single-truck electric car, or some of the freight cars in Europe, since, as has been already stated, the coefficient of journal friction is very small (only about 0.005). This disposes, by the way, of the question of roller bearings on cars, showing that they have no value from a practical standpoint.

Curves Nos. 3 and 4 are due to M. Barbier, and are the result of very extensive tests made by him several years ago on the French Northern Railway.* Here, again, the influence of the trucks and number of cars is very marked; curve 3 corresponding to a train of fifteen four-wheel cars, and curve 4 to a train formed by seven eight-wheel cars mounted on bogie trucks. The weight was the same in both cases, *i. e.*, 206 tons. Curve No. 5 was found in 1897 by a test of trains made up of four-wheel cars running on the French Western Railway. All of these five curves do not differ materially from each other. Finally, curves Nos. 6, 7, 8, 9 and 10 were plotted from a formula suggested by General Petroff.

While most of the other formulæ are of the shape

$$R = a + bv + cv^2$$

and therefore can be applied only in cases similar to those for which the constants a, b and c were established, General Petroff's formula for *resistance of cars only* is

$$R = 1.2 + \frac{0.6n}{Q}v + \frac{0.037}{Q}(1 + 0.004n)\,v^2$$

where

* The coefficient of friction is generally taken = 0.05, but General Petroff considers 0.005 a closer valuation.

* See "Revue Générale des Chemins de Fer," 1897.

R = resistance in kg. per ton (metric) of train (cars only)
Q = weight of the train (cars only) in tons (metric)
n = number of cars
v = speed in km. per hour.

This formula was found by means of a very careful and scientific study of *all* the causes for resistance, and as the air resistance is not so large a factor in the total resistance of the cars of a train as it is in the resistance of a locomotive running independently, this formula gives much closer results for all cases than the Petroff formula for the resistance of a locomotive. This latter, as has been previously stated, is not quite correct, because of the narrow limits of speed between which the tests were made, and because of the false assumption that Newton's formula for air resistance, *i. e.*, $R = k S v^2$, is correct.

Having once established the general form of his equation for the resistance of cars, General Petroff found the most probable values of coefficients from a very large number of experimental data. Curves Nos. 6 and 7 in Fig. 2 correspond to the case of a train on the French Northern Railway, such as used by M. Barbier's experiments. The weight of the train (cars only) in both cases was 206 tons, number of cars, fifteen for curve No. 6, and seven for curve No. 7. It is easy to see General Petroff's formula gives results somewhat lower than those found by M. Barbier. Curve No. 8 corresponds to a train on the Canadian Pacific Railway, weighing 152 tons, and composed of five cars. Curve No. 9 shows the resistance of a train on the Pennsylvania Railroad, weighing 162 tons, and composed of five cars. Curve No. 10 is that of a train on the Russian Nicolaievski Railway, running from St. Petersburg to Moscow. This train weighs (cars only) about 390 tons, and the number of cars was thirteen.

RESISTANCE OF COMPLETE TRAIN, INCLUDING LOCOMOTIVE, TENDER AND CARS

Finally, in Fig. 5, I have plotted some curves showing resistances of complete train, including locomotive, tender and cars. In plotting these curves the maximum and minimum resistances of the locomotive and tender are taken from the maximum and minimum values as given in curves No. 3β and 3S in Fig. 2, as found from M. Privat's experiments. For the resistance of cars General Petroff's formula is used. The two values are then combined by the following formula:

$$R_m = \frac{R_{100} \times L + R_t \times Q}{L + Q}$$

in which

R_m = resistance of total train in kg. per ton
R_{100} = resistance of locomotive and tender in kg. per ton
R_t = resistance of train (cars only) in kg. per ton
L = weight of locomotive and tender in tons
Q = weight of train (cars only) in tons.

Thus, in Fig. 5 curves Nos. 1 and 2 correspond to the case of the train used in the experiments made by M. Barbier, in which L = 93 tons, Q = 206 tons, n = 7; in the upper curve the formula for the maximum resistance of the locomotive is used, and in the lower one the minimum. The two curves No. 1′ and No. 2′, lying quite close to curves Nos. 1 and 2, correspond to the case of a train on which experiments were made on the Austrian Ferdinand Northern Railway. Here L = 96 tons, Q = 203 tons, n = 5. Curves Nos. 3 and 4 correspond with a train on the Pennsylvania Railroad; L = 82 tons, Q = 162 tons, n = 5. Curves Nos. 5 and 6 correspond with a train on Russian Nicolaievski Railway. L = 91 tons, Q = 390 tons, n = 13.

As will be seen, within the limit of speed from 60 km. up to 120 km., all these curves are practically straight lines. Finally, curves S and V represent, respectively, the resistances of trains as found by Mr. Sinclair, and quite recently by Mr. Vauclain, of the Baldwin Locomotive Works. Mr. Sinclair's formula, expressed in kg., tons metric and km., is R = 1 + 0.075 v. That of Mr. Vauclain, expressed in kg., tons metric, and km., is R = 1.5 + 0.052 v. These last two formulæ give for resistance of trains (locomotive and tender included) straight lines too, with limits from 50—60 km. up to 120 km. (*)

Having all these curves before us, it seems interesting to see how they agree with data found directly from experiments.

(1) On the Russian Nicolaievski Railway it was found

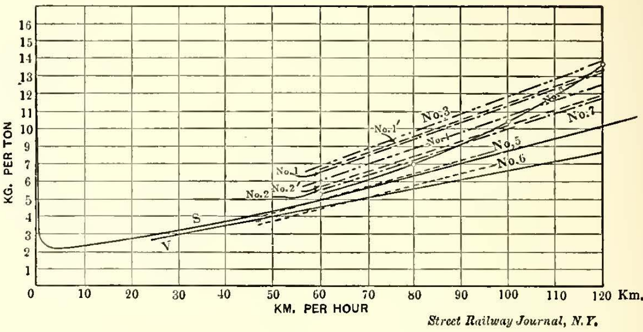


FIG. 5.—GROUP OF CURVES FOR RESISTANCE OF COMPLETE TRAINS.

Nos. 1 and 2.—Max. and min. curves from tests on French Northern Ry., L = 93, Q = 206, n = 7.
Nos. 1 and 2.—Max. and min. curves from tests on Austrian Ferdinand Northern Ry., L = 96, Q = 203, n = 5
Nos 3 and 4.—Max. and min. curves from tests on Pennsylvania R. R., L = 82, Q = 162 n = 5.
Nos. 5 and 6.—Max. and min. curves from tests on Russian Railway.
No. S.—Curves plotted from Mr. Sinclair's formula.
No. V.— " " " Mr. Vauclain's "
No. O.— " " " Mr. Barbier's "

that new high-speed locomotives, weighing, with tender, 91 tons, were capable of hauling continuously trains of 390 tons at a uniform speed of 80 km. on the level, and of 48 km. on a 0.8 per cent grade. From curve No. 5 we learn that the locomotive was obliged to develop about 915 i.h.p. in the first case, and 860 i.h.p. in the second These data do not differ materially. As the locomotive was designed for high speeds it was naturally able to develop more power when running at 80 km. than at 48 km.

(2) On the Austrian Ferdinand Northern Railway a locomotive weighing, with tender, 96 tons, when running with a train of 203 tons on a grade of 0.26 per cent at a uniform speed of 80 km. developed about 1027 i.h.p. From curves Nos. 1′ and 2′ we obtain, respectively, maximum power, 1000 i.h.p., and minimum power, 890 i.h.p.

(3) On the Pennsylvania Railroad a locomotive weighing, with tender, 82.5 tons, when running with a train of 162 tons on a level at a uniform speed of 104 km., developed about 1120 i.h.p. From curves Nos. 3 and 4 we obtain respectively, maximum power, 1080 i.h.p., and minimum power, 945 i.h.p.

The writer has at his disposal too small a quantity of similar data to carry this investigation further, but it would be of interest if persons who have made tests of this kind should try and combine, in the manner shown above, the

* A final reason for a lower coefficient of resistance at high speeds can be found in a reduced coefficient of track resistance due to a better alignment of the cars on the track. This can be deduced analagously from some experiments conducted by M. Barbier on the French Northern Railway on the resistance of trains on grades. If the track resistance were the same on level tracks and grades, it would be natural to assume an increase of 1 kg. per ton for every 0.1 per cent of ascending grade and a decrease of 1 kg. per ton for the same per cent of descending grade. The tests made showed, however, that the increase when ascending was only 0.9 kg., instead of 1.0 kg., and the reduction on the descending grade was 0.9 kg., instead of 1.0 kg. This difference in the case of the ascending grade is attributed to the greater tension of the train, by which the axles are kept more closely at right angles with the rails. As a result, there is less flange wear, and the track friction is reduced to a minimum. Conversely, the increase in resistance on down grade is due to a relaxation of the tension, permitting the cars to get out of alignment, increasing the wheel and track resistance.

curves for resistance of locomotive and tender, as found from M. Privat's experiments, and those of General Petroff for the resistance of trains (cars only), finding thus a curve for the resistance of a complete train, including locomotive, tender and cars in different cases, and obtaining the i.h.p. of the locomotive as developed from the formula

$$W = \frac{R_m \times (L+Q) \times v}{75}$$

R_m = resistance in kg. per ton of complete train
L = weight of locomotive and tender in tons
Q = weight of cars in tons
v = speed in meters per second
W = work in i.h.p.

It would be interesting to learn how these values accord with the values of the i.h.p. as obtained directly by indicator diagrams.

While a little outside of the subject of discussion, the writer suggests that the portion of the air resistance which is made up through the creation of a partial vacuum and consequent eddy currents at the rear of the train, a factor which constitutes a certain amount of the total air resistance, could be lessened in a measure, which might be considerable, by placing at the end of the train a car formed somewhat like the inverted stern of a boat, as shown in Fig. 6. It is a well-known fact that the resistance of a

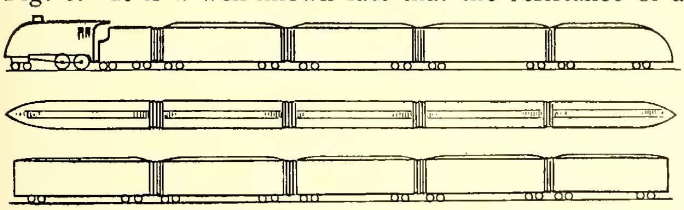


FIG. 6.—PROPOSED FORMS OF ELECTRIC AND STEAM TRAIN FOR REDUCING AIR RESISTANCE.

ship moving at high speeds depends very much upon the form of the stern, even more than upon the form of the bow. If the stern of the vessel is not sufficiently acute, there is a tendency to create a vacuum, and considerable power is lost in eddy currents, and when the train is moving rapidly it is natural to suppose that there is a corresponding depression behind the last car. The writer has no data as to the amount of power that is lost in this way, but it is possible that experiments in that direction will prove interesting and valuable. For high speeds, then, he would suggest trains of vestibuled cars with, in case of an electric train, a pointed motor car and rear car, and with a steam train, a complete protective shield on the locomotive to form a cutting surface.

The Expenses of Mechanical Traction in Paris

The annual report of the Compagnie Générale des Omnibus, the largest street railway company in Paris, has just been published, and from advance proofs the STREET RAILWAY JOURNAL is able to show some of the results secured in operating costs by the different systems of mechanical power employed. The company has four types of mechanical motors, viz.: Serpollet locomotives, Rowan locomotives, compressed air locomotives and compressed air motor cars. The locomotives draw two or three trail cars and the motor cars one trail car. The car mileage made by the different systems last year was as follows: Serpollet motors, 902,968; compressed air motor cars, 640,375; compressed air locomotives, 546,198; Rowan locomotives, 117,685. To these should be added the mileage made on one line (Louvre-St. Cloud) of 354,297, made up of a mixed service of Rowan and compressed air locomotives.

The cost of operation of all the mechanical systems is given below in francs per car km., cents per car mile and gross expenses in francs. The cost of the operation of compressed air motor cars drawing one trail car amounted in 1898 to 0.4815 francs per car km. (15.07 cents per car mile), and for compressed air locomotives capable of drawing several trail cars, 0.5358 per car km. (16.76 cents per car mile). The company is probably the largest tramway company in Europe, and is one of the largest in the world. It operates both tramcars and omnibuses, and in its tramway department alone the operating expenses (including taxes) amounted in 1898 to about $3,400,000, and, including the omnibus service, the operating expenses of the company were over $8,000,000.

Following the table of expenses for mechanical power are given those for horses, so that a comparison of the operating conditions in Paris may be drawn. In this table a franc is considered equal to 19.45 cents, and a kilometer equal to 0.621 miles. The fractional differences account for the difference of one figure in the last decimal place in some cases.

EXPENSES OF MECHANICAL POWER CARS—COMPAGNIE GENERALE DES OMNIBUS, 1898.

	Fr.	Fr. Per Car Km.	Cents Per Car Mile.
General Expenses.			
Taxes	328,477	.0794	2 59
Interest on funded debt	357,893	.0865	2.82
Other general expenses	459,618	.1113	2.64
Total general expenses	1,145,988	.2772	9.05
Passenger Expenses.			
Wages of superintendents and inspectors	15,381	.0037	0.12
Wages of starters	147,801	.0358	1.17
Wages of conductors	299,820	.0725	2.37
Wages of detectives	9,787	.0024	0 08
Rent, heating, lighting, etc., of stations	48,920	.0118	0.38
Total passenger expenses	521,719	1.262	4 13
Rolling Stock and Track.			
Maintenance of cars	195,346	.0472	1.54
Maintenance of registers	3,398	.0008	0.02
Heating of cars	9,370	.0023	0.08
Lighting of cars	50,610	0122	0.40
Cleaning and lubrication of cars	46,654	.0113	0.37
Maintenance of track	423,067	.1023	3.34
Total rolling stock and track	728,447	.1761	5.76
Mechanical Power.			
Labor at stations and repair shops	148,949	.0360	1.17
Wages of motormen	355,619	.0860	2.80
Maintenance of locomotives and motor cars	816,412	.1975	6.39
Maintenance of stationary engines and lubrication.	175,395	.0424	1.29
Fuel	645,950	.0562	5.11
Water	27,655	.0067	0.22
Establishment of Orleans-Odeon line	32,724	.0079	0.26
Total for mechanical power	2,202,706	.5327	17.39
Total, all expenses	4,598,862	1.1122	36.32
Sinking fund	683,322	.1652	5 40
Grand total	5,282,185	1.2771	41.73

During the same period the expenses for horse cars were:

	Fr.	Fr Per Car Km.	Cents Per Car Mile.
General expenses	3,037,462	.2355	7.37
Passenger expenses	1,684,136	.1305	4.08
Rolling stock and track	2,382,182	.1846	5.88
Animal power	6,376,545	.4943	15.47
Total	13,480,325	1.0449	32 70
Sinking fund	1,515,688	0.1174	3.67
Grand total	14,996,013	1.1623	35.35

During the same period the expenses for omnibuses were:

	Fr.	Fr. Per Car Km.	Cents Per Car Mile.
General expenses	5,380,891	0.2302	7.20
Passenger expenses	3,122,859	0.1336	4.18
Rolling stock	1,516,433	0.0649	2.03
Animal power	13,266,404	0.5676	17.77
Total	23,286,588	0.9963	31.18
Sinking fund	2,252,489	0.0964	3.02
Grand total	25,539,077	1.0926	34.20

Mr. Sprague on Rapid Transit in New York

The following letter has recently been written by Mr. Frank J. Sprague, to Chairman Orr, of the New York Rapid Transit Commission:

SPRAGUE ELECTRIC COMPANY,
NEW YORK, April 26, 1899.

Dear Sir—I have read with interest the letter of March 29, 1899, addressed to you by President Stuyvesant Fish, of the Illinois Central Railroad.

Coming from the chief officer of a railroad which has accomplished so much in the way of steam rapid suburban service, its conclusions should, and naturally will, receive serious consideration.

With many of the facts stated and with some of the views promulgated, especially those suggesting guaranteed high schedules, I am in hearty accord, but there are two statements which I will quote *in extenso*, which are in error, or are capable of two readings. These are:

Paragraph I. "The motive power used by the Illinois Central consists of steam locomotive engines, most of which were built many years ago. If the tunnel company is to be tied down to electricity as a power it cannot, in the present state of the science, be required to make the speed of our trains. We believe, however, that before long it may become possible to move trains by electricity on our schedules, and we have been carefully watching developments in that direction for many years."

Paragraph IV. "As yet electricity has not been applied in such a way as to give a service equal in speed to that furnished by the Illinois Central in Chicago by using steam. After the most careful, painstaking and patient investigation, we have been forced to adhere to the use of steam, although anxious on many accounts to substitute electricity. . . . While I believe that electricity can be hereafter so used as to develop schedules about equal to those which we now have in use in Chicago, there is as yet nothing to show that better can ever be done through the use of electricity. Our investigations teach us that with each added unit of speed the cost increases more rapidly where electricity is used than where steam is used."

It is impossible to understand the reason for the conclusions given by Mr. Fish, and I must take exception to them, not only from engineering reasons, but from the record of accomplished facts.

Under any given conditions schedule speed is solely a question of the amount of available power per ton and the proportion of it which can be effectually used. The higher the schedule, the shorter the station intervals and the longer the station stops, the greater will be the amount of power required for moving any given tonnage, and the greater the power thus required, the higher the ratio of weight moved which must be on the driving wheels.

On the local suburban service of the Illinois Central Railroad a five-car train weighing, with its passengers, 105 tons, is driven by a locomotive of 80 tons weight, which can develop from 900 to 1000 effective brake h.p., making the total weight moved 185 tons, 46 of which, that is, 25 per cent, are on the drivers. Or, to epitomize, there is provided a maximum of about 5 h.p. per ton, with 25 per cent of weight moved on the drivers.

Leaving, for the moment, out of all consideration *how* it is to be done, if greater power is applied to a train and a higher percentage portion of the weight on the drivers is utilized during the period of acceleration, higher schedules immediately become possible.

Taking the street railway systems of the country as a precedent, from 80 per cent to 100 per cent, not 25 per cent, of the weight is on the drivers. Adhering to the single car as a unit, and putting all the available power in the motors connected to each of its axles which space permits, it is readily possible to put on motor equipments which will develop not less than 20 h.p. to 22 h.p. per ton moved, and to use 100 per cent of the weight on the drivers. The possibilities of this unit, that is, using the entire weight of a car for traction, and all the power which can be put within the space provided, *is the limit, and absolutely the only limit*, of the possibilities of speed to be attained by an electric car, and it must necessarily exceed that possible to a steam locomotive alone.

Lengthen now this unit, put joints in; that is, aggregate cars into a train, preserve the same ratio of weight on the drivers and the same h.p. per ton, then it matters not what the length of the unit; in other words, no matter what the size of the train, identically the same schedules can be made with a train as with a single car.

In the table of Illinois suburban trains, the local schedules are stated as 18.51 and 18.76 miles an hour, with stations averaging 2900 ft. apart.

On Dec. 23, 1897, a proposition was made to the Illinois Central Railroad by the Sprague Company, which required the use of the entire weight of cars and a very high power equipment, and guaranteed a schedule of 24½ miles an hour on the same runs, but it was not accepted at the time, and I think wisely, in view of the developments which were being undertaken on another road, namely, the South Side Elevated of Chicago, and the opportunity which these would afford for study and natural improvement. This latter road has been in operation for nearly a year. It started with an original equipment of 120 cars, each of which was equipped with two 50-h.p. (hour rating) motors on one truck, or a maximum of about 6 h.p. to 6½ h.p. per ton with average loads, and utilizing from 60 to 62 per cent of the total weight on the drivers, the general equipment being what is known as the Sprague "multiple unit" system, in which each equipped car is a self-contained transportation unit, but so controlled that aggregations in any number or sequence can be made, and the whole controlled from a single point. For weeks, every day, morning and night, with the exception of Sundays, 119 out of 120 equipped cars, pulling 28 or 29 trail cars, thus overloading the general equipment one-third, has run on as hard service as has ever been undertaken on any elevated railroad, and the success of the system from every standpoint has been unparalleled in so novel a departure. This equipment has been followed by thirty more completely equipped cars.

It may be that Mr. Fish referred to this system in speaking of the possibilities of the future, and the limitations spoken of were as to schedule speeds actually accomplished, rather than to methods demonstrated. On the South Side road no attempt was made to equal the schedule of the Illinois Central Railroad. The contract requirement was 15 miles an hour, with existing station intervals, and 16½ miles have been frequently made, but if a higher schedule had been desired all that was necessary to be provided was more power. The general method of application and control is settled for a finality.

It is true that as the schedule increases, the power increases in a more rapid ratio, and equally true whether the power is steam or electricity, but cars equipped and controlled on the system referred to here are already in operation, and taken singly or aggregated into train units, will outrun any possible steam combination which now exists on the local suburban service of the Illinois Central, or any other road, and this fact can be easily demonstrated in this city with existing equipments, so far as permitted by local conditions.

As I have stated, much in the letter meets my hearty assent, but the inferential conclusion that a four-track elevated railroad, however good an engineering proposition in itself, is advisable, because steam can be used on it, whereas electricity only can be used on an underground, is untenable.

A number of years have passed since I publicly offered, at my own expense, to run express trains at 40 miles an hour on an elevated structure in this city with electricity as a motive power, and I am ready to guarantee, in competition with any other known method of train operation, whether for local or express service, practical schedules higher than have ever yet been attempted, and higher than is possible by any combination, steam, air, or electric, which localizes the power in one or two units, and pulls dead cars between or behind them.

It may be pointed out that the actual limit of schedule speed possible on a level railroad, with stations averaged at 2900 ft., as on the Illinois suburban, and with a maximum of 300 lbs. to the ton adhesion, is very nearly 30 miles per hour, as against 18.51 and 18.76 given in Mr. Fish's reference, and these increased schedules are absolutely only possible with electric motor application, and where the motors are distributed throughout the train, every pair of wheels being used as drivers. Of course, this is in fact the aggregation of the car units, such as fill our city streets, except somewhat larger in size, with the addition of a suitable secondary control, which simutaneously governs all cars.

In this connection permit me to call attention to a letter, under date of April 1, 1898, to Mr. John H. Starin, the then chairman of your contract committee, copy of which I inclose herewith. Very respectfully,

FRANK J. SPRAGUE,
Second Vice-president and Technical Director.

LETTER TO MR. STARIN

John H. Starin, Esq.,
Chairman Contract Committee, Rapid Transit Commission,
22 William Street, New York.

APRIL 1, 1898.

Dear Sir—In all the published accounts on the subject of the negotiations between the commission and the Manhattan Elevated Company, as well as with any one else, one of the most important essentials seems to be entirely ignored. Routes, structures, rights of way and penalties are all considered, but the one thing which would do more to relieve congestion does not seem to be insisted upon, and that is the question of motive power.

The time has past when there could be any question as to the advisability of abandoning steam and adopting electricity, and by this agent, and this alone, can the essentials of cleanliness, reduction of noise, smoothness of operation, and, what is most important of all, increase of schedule speed, be obtained.

The elevated railroads now make on way trains a schedule speed of not exceeding 12 miles an hour, including stops, when running with loaded trains. It is possible to increase this to 18 or about 18½ miles, although that is the absolute maximum with station stops as they now exist; but 16½ miles is within the range of practical, reasonable demand.

It would seem, therefore, perfectly proper that the following conditions should be introduced in the granting of any franchise, of any kind whatsoever, and to whatsoever company:

1. That there shall be a change from steam to electricity.
2. That there shall be a schedule speed, including stops at each station, of not less than 16½ miles, whatever the length of train.
3. That there shall be a schedule speed, including stops at limited stations, of express trains of not less than 30 miles an hour.

The above conditions can be met, and it is only reasonable to expect that these increased speeds should be supplied by the railway company if they receive additional privileges.

Very truly yours,
(Signed) FRANK J. SPRAGUE.

The City Council of Bergen (Norway) has refused the proposition to buy and operate the local street railway system.

The Destruction of Old Transfers and Tickets

After transfers and tickets have been used the chief object of the railway company is to so destroy them that they can never be employed again. The usual practice is to have the tickets burned under the oversight of some responsible officer of the company, but this is not the only method employed. The STREET RAILWAY JOURNAL recently made an investigation of the methods in use by a number of companies in this country, and obtained the following particulars as to the practice of a number of companies in destroying tickets.

On the Brooklyn Heights Railroad Company the tickets are chopped in a machine designed for that purpose, and when thus mutilated are sold as waste paper. The company tried burning the tickets under the boilers of one of its power stations, but was obliged to transport the tickets to the power station, which was a considerable distance from the office, and after a short experience found that this was not the safest way of disposing of them.

The Boston Elevated Railway Company has for several years used a ticket cutting machine, located in the office of the auditor of the company and operated by a 1-h.p. motor. The machine was originally built to run by hand, but was altered in such a way that electric power could be used. With this machine the company is able to destroy about three barrels of tickets in two hours. The refuse is sold for a small amount.

The Twin City Rapid Transit Company, of Minneapolis, Minn., has for some time burned all of its canceled tickets under one of the large boilers connected with the general office of the company. This method, however, is not regarded with very great satisfaction, and the company may install a machine similar to that used in Boston and mentioned above.

The North Jersey Street Railway Company, of Jersey City, N. J., disposes of its tickets and transfers by burning them at one of its power stations. The tickets and transfers are in the custody of the cashier, who personally supervises the disposal of them from the time they leave the office until they are consumed in the furnace. Owing to the large number of lines operated, the company has a great many tickets and transfers, and finds that this is the best way to dispose of them.

The Milwaukee Electric Railway & Light Company writes that the practice of that company is to tie the tickets up daily in large paper sacks and then to burn them, a clerk from the accounting department supervising the operation.

The Metropolitan Street Railway Company, of New York, adopts a similar method, except that the tickets are first chopped into very small pieces before being burned.

The New Orleans Traction Company also employs the method of burning its old tickets. The plan has been found very satisfactory.

The Third Avenue Railroad Company, of New York, adopts a similar method, the tickets being deposited in wooden boxes before being taken to the boiler room.

The Union Traction Company, of Philadelphia, Pa., also destroys its tickets by throwing them into the furnace of a boiler room adjacent to the receiver's office. The tickets, however, are first placed in a manila paper bag 33½ ins. long and 11 ins. wide. The operation is conducted in the presence of the receiver, who witnesses their complete destruction.

The United Traction Company, of Pittsburgh, Pa., employs the same method, but keeps the tickets for a short time, usually a few weeks, before burning them in the power-house furnace.

On the Market Street Railway, in San Francisco, the tickets are returned to the accounting office, where they are inspected and checked, and are then deposited in a chute, which conveys them to a locked receptacle in the basement. This receptacle is opened daily after office hours and the tickets, transfers, etc., are emptied into a box truck, wheeled to the engine room and shoveled into the furnace. This is done under official supervision, although there is little opportunity of reusing the tickets, as the transfers are not only stamped with the date, month and year, but are also canceled at the time of being received for fare.

A Steam vs. Electric Rate War in Missouri

Fred H. Fitch, formerly of the Chicago City Railway Company, but more recently interested in the Southwest Missouri Electric Railway, and who is now again located in Chicago, was in New York last month, and gave some interesting particulars of a rate war which occurred when he was connected with the Southwest Missouri Electric Railway. This railway, which is described elsewhere in this issue, connects the important towns of Carthage, Carterville, Webb City and Joplin, Mo., and Galena, Kan.

Previous to 1893 all travel between these centers of population was taken care of by the steam railways, the charge being 3 cents per mile, and trains were run at very infrequent and irregular intervals. The district demanded more frequent and cheaper service, and in 1893 the electric road made its appearance, and by 1896 communication from Carthage through to Galena was had every half hour for eighteen hours during the day, at a cost of about 1 cent per mile. The district felt the healthful effect of it; the people and the press praised the men who had made it possible, and the road prospered.

The St. Louis & San Francisco Railroad Company, familiarly known as the "Frisco," in June, 1897, put on in competition with the electric road an interurban service, running trains consisting of an engine, combination baggage and smoker, and a coach, every hour over one portion of its road, and every two hours over another portion. The steam fares were reduced to meet those of the electric road, and the running time was about two-thirds that required by the electric cars. In order to discount the advantage which the electric road had in running through the streets, the steam railroad managers inaugurated a free hack service between the business portions of the towns and their depots.

In June, 1898, the electric railway company succeeded in obtaining a franchise into the city of Galena, and the "Frisco" managers immediately notified the electric railway company that unless it disavowed all intention of extending its road under the grant obtained that they would cut the rate to 5 cents between any two adjacent towns, and make 10 cents the maximum rate anywhere along the line. This threat was put into execution in June, and meant a cut from 40 and 25 cents to 10 cents, and from 10 cents to 5 cents.

But the "Frisco" did not stop here. For a while, on Sundays and holidays, this new rate was cut in two, and a rate of 10 cents only was charged for the round trip from Carthage to Galena and return, and correspondingly low rates along the line. This made a ride of 60 miles for 10 cents, or 1/6 of a cent per mile. Here is what the lucky populace could do on these occasions: enter a hack at a hotel in Carthage and be taken to the depot; be transported to Galena, 30 miles; enter another hack, and go to a hotel or to the business center; having spent the day in Galena, be driven to the depot, take a train for Carthage, and there take a hack to their homes, all for the great sum of 10 cents.

Mr. Fitch quoted from W. F. Merrill, second vice-president of the Erie Railroad, who said before the New York Railroad Club that it costs the Erie 27 cents per mile to run a train similar to those run by the "Frisco," "and," he added, "while Mr. Merrill didn't say as much, I don't believe the 27 cents included any expense for operating free hacks." Meanwhile, the receipts of the "Frisco" were from 12 cents to 15 cents per train-mile, and they operated 600 miles per day.

On Jan. 8 last an agreement was reached and the rates were restored, although not to the original amounts, for one lesson learned from the rate war was that cheap fares make business, and that an error can be made in making rates too high.

The "Frisco" still maintains its interurban train service, but the electric road is doing a splendid business, greater than ever before, and, having safely and victoriously passed through the bitterest fight that it can probably be the misfortune, or fortune, perhaps, of an interurban electric road to encounter, it no longer looks upon the "Frisco" as a bugaboo.

Southwestern Gas, Electric and Street Railway Association

In consequence of a smallpox epidemic at Laredo, the annual convention of the Southwestern Gas, Electric and Street Railway Association, which was to have occurred on April 19, 20 and 21 at Austin, has been postponed until May 17, 18 and 19. Advantage will be taken of the postponement to elaborate the plans for the meeting, and also for the electrical exhibition to be held in connection with the convention. The exhibition will be held in a well-arranged building, 80 ft. x 120 ft., which is situated near the railroad tracks, and is easily accessible from all parts of the city. The meeting and exhibition promises to be one of the most successful of its kind ever held. The following is a list of the papers which will be presented and discussed at the convention:

"The Item of Depreciation," by W. E. Hamilton, Shreveport, La.

"Meters," by W. E. Holmes, Austin, Tex.

"Transformers," by Harry L. Monroe, Dallas, Tex.

"The Amount and Extent of Legitimate Investment in Electric Lighting Plants of Certain Capacities," by F. Fries, San Antonio, Tex.

"Summer Amusements for Street Railway Companies," by W. H. Steuart, Waco, Tex.

"Art and Science of Selling Gas," by Thomas D. Miller, Dallas, Tex

"A Model Plant Under Model Management; What Both Would Be Like," by J. F. Strickland, Waxahachie, Tex.

"Alternators," by E. Dysterud, Monterey, Mexico.

"The Attitude of a Corporation to the Public," by W. R. Weiss, San Antonio, Tex.

"Means of Encouraging the Diversified Use of Electric Current," by C. L. Wakefield, Dallas, Tex.

Mexican Paper—"Electric Lighting and Application of Electricity to Various Purposes in Mexico," by a Mexican delegate.

"Arc Lamps," by Max Levy, Galveston, Tex.

"Fare Boxes vs. Conductors," by F. E. Scovill, Austin, Tex.

"Transfers," to be assigned.

"Gas for Fuel," to be assigned.

Some Recent Street Railway Parks

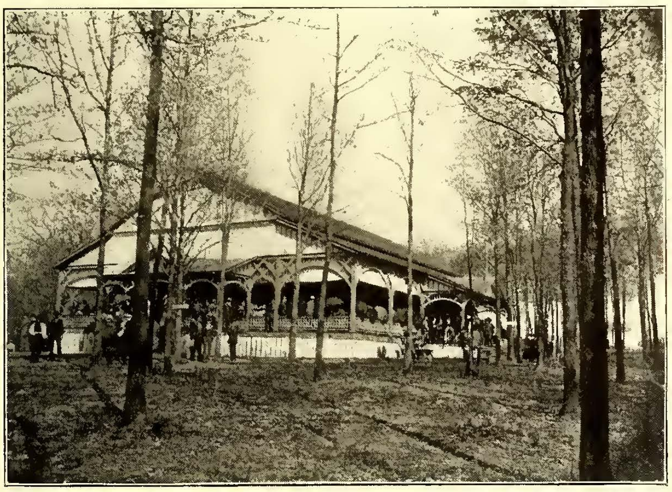
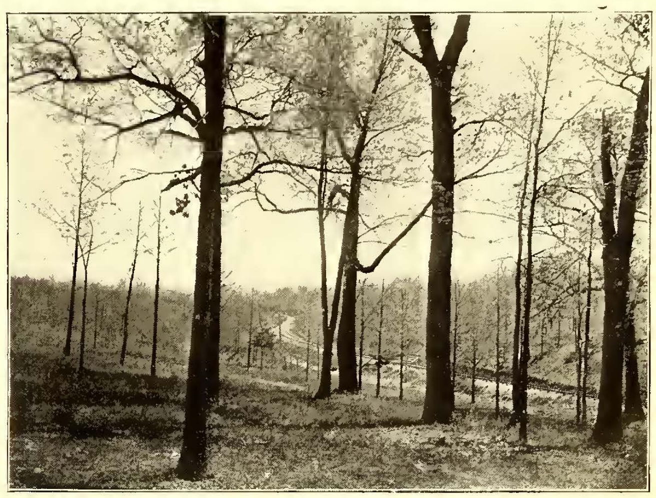
LAKESIDE PARK, MO.

The Southwest Missouri Electric Railway Company, with headquarters at Webb City, Mo., operates about 34 miles of track, extending from Carthage, Mo., to Galena, Kan., and passing through a number of towns and villages in its course. Along the line are situated two or three beautiful pleasure resorts, which are well patronized by the population of nearby towns, particularly of Joplin and Webb City. The most extensive of these parks is known as Lakeside, and is situated 7½ miles from Carthage, 3 miles from Webb City, 9 miles from Joplin, and 15 miles from Galena.

It is truly one of nature's parks, being located on the banks of a pretty stream of water, and containing a large and beautiful lake. The park has an abundance of forest trees, making a most delightful shade. As the lake is large and deep, one of the principal attractions is, of course, the boating, a large number of pretty boats of all descriptions being kept in readiness at all times for visitors. Bathing is another of the principal features of this resort. A floating bath house, especially for ladies and their escorts, equipped with all the modern accommodations, such as bathing suits and other necessities, is provided, in addition to a gentlemen's bath house, which is equipped with springboards, swinging ropes, etc. To amuse and entertain the children and young people a large number of swings have been distributed throughout the park.

One of the best appreciated features of Lakeside is the abundance of pure, cold water, there being two 160-ft. wells, that are never-failing, and the quality of the water is equal to the spring water at many of the popular watering resorts.

The grand pavilion, which is shown herewith, is a handsome and costly structure, with a stage and new scenery, and a seating capacity of 1000. It is built without sides, but is provided with curtains around its entire length, so that in case of rain it can be closed in a moment, making it a large and commodious hall. In this pavilion, and also throughout the park, are large tables and seats for picnic parties, etc. At one end of the pavilion are comfortable dressing rooms for ladies and gentlemen, and nothing is lacking in the way of accommodations to visitors. Not less pleasing than the charming scenery and delightful attractions at the park is the enjoyable trip from either direction. The country through which the road passes is one of the finest in the West, and the road itself is one of the best constructed and equipped properties in the United States.

VIEWS IN LAKESIDE PARK, MO.

HIAWATHA PARK, OHIO

The owners of Hiawatha Park are busily engaged getting the place into shape for the opening exercises, which will occur on Decoration Day. This resort is on the line of the Mt. Vernon Electric Railway Company, of Mt. Vernon, Ohio, and is conspicuous for its pleasing scenery and for the diversity and attractiveness of the amusements that are provided. Three years ago P. B. Chase, president and general manager of the Mt. Vernon Electric Railway Company, took charge of the old county fair grounds, which had not been used for years, and which consisted of a rough, unkept plot of ground with dilapidated buildings and fences. As a result of his planning and energy, this place has been transformed into a beautiful park, and when the changes now under way are fully carried out, this spot will be an ideal pleasure resort.

The fountain is being rebuilt and enlarged, the material used being moss-covered stone. The flower vases have been replaced with large rustic ones of the same material as the fountain, and these will contain growing plants. The floral work about the park will this year be finer and much more extensive than in other years, and will be on an altogether different plan. Formerly large floral plots have been one of the features of the park, but these will be discontinued, and in their place will appear large rustic vases, which will be filled with flowers, the effect being modeled somewhat after that produced at Lincoln Park, Chicago.

Probably the greatest change in any one of the many attractive features will be made in the grotto, which has always been a favorite place with visitors. In the interior flowing water will drip from crevices in the roof and sides upon plants, ferns and flowers. In front of the grotto stone columns, 3½ ft. square, will be erected, with an old-fashioned arch of moss-covered stone, rustic in appearance. Leading from the columns to the front of a semicircular design will be two stone walls, on the extreme ends of which will be located large vases of flowers. In the stone columns will be cut windows, giving all the appearance of the entrance to an old castle.

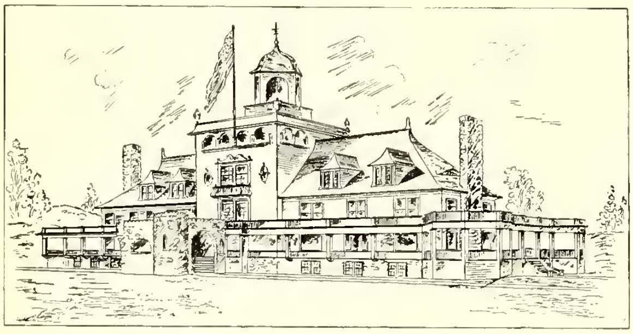
One of the principal drawing cards of Lake Hiawatha has been the zoo gardens, and these will be maintained during the coming season on a somewhat extended plan. Additions of rare and interesting birds and animals are to be made.

In addition to the large number of rustic seats on the grounds, about forty swinging seats have this season been placed in shady nooks, where they will be most appreciated. The boathouse will be enlarged, and a toboggan slide into the lake will be maintained. For the auditorium a large orchestra has been engaged. This orchestra will also furnish music to picnic parties for dances at the park or in the city at reasonable rates. The railway company is a member of the Interstate Vaudeville Association, and the best attractions will be given at this resort. Matinees will be given on excursion days, and performances every evening. The prices for seats are 5 and 10 cents, according to location. A large number of cottages have been built on the grounds, and these will be rented for the summer.

MERRYMEETING PARK, MAINE

Merrymeeting Park is situated near Brunswick, Maine, on the lines of the street railway company, and considerable time and money have been spent in developing it, and it is now one of the most attractive resorts in New England.

The most prominent feature of this park is the casino, which is shown herewith. This building is two and a half stories high, exclusive of the tower. The basement contains a kitchen and storerooms, and also accommodations for a large number of bicycles. The first story is divided into a general waiting room, office and a large ball room, with a moveable stage. Here plays and entertainments are given when stormy weather prevents the use of the open-air theater.



CASINO, MERRYMEETING PARK

The second story is devoted to dining rooms, ladies' parlors, smoking rooms, and a large public dining room. The tower will be used for observation purposes, and also as a roof garden. The building is heated by steam, and brilliantly lighted throughout with electricity. During the summer evenings a special feature will be made of the illumination of the building.

Merrymeeting Park has a frontage of one-quarter of a mile on the Bath road, and extends for nearly one-half a mile along the Androscoggin River. The park has been laid out and the casino built under the direction of Frank M. Blaisdell, of Boston.

One of the improvements made in the property that is particularly worthy of note is the substitution of a pretty pond for a piece of ground that was formerly an impenetrable alder swamp. This was accomplished by building a dam across a small stream that runs through the park.

In the center of the pond a large pavilion has been placed, which will be used for dancing during the warm summer nights, this arrangement being a particularly agreeable feature. Next winter it is intended to utilize this pond for skating, and arrangements will be made for clearing it of snow and flooding it when the surface of the ice becomes too rough. The grounds have been cleared of a large amount of undergrowth and fallen deadwood, and paths have been laid out in all directions, giving the visitor his choice of a dozen pleasant strolls. Rustic seats and chairs are placed at frequent intervals.

A rustic outdoor theater has been erected in a natural depression in the ground, the seats rising in tiers above the stage. Here the usual out-of-door vaudeville and dramatic amusements will be given. At each side of the stage is a spring of cool water, and attendants serve this water to the spectators during the progress of the plays. This feature is very much appreciated by the public.

The owners of the park have in contemplation numerous other improvements and attractions at this resort, and, during the spring and early summer, lawns, flower beds and shrubbery will be placed in the vicinity of the casino; little ponds will take the place of swampy ravines, summer houses, shelters and observatories will be erected at prominent spots, a large athletic field will be made in the meadow near the river, deer, caribou, moose and elk will be placed in the woods, and swans, ducks and other aquatic birds on the pond and river.

PARK AT ALLENTOWN, PA.

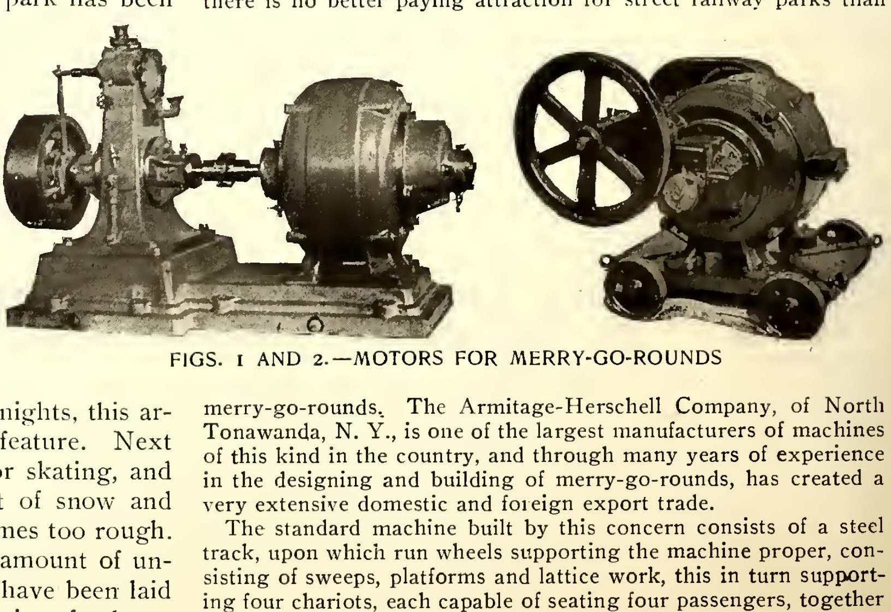
The park of the Allentown & Lehigh Valley Traction Company will open shortly with a large number of improvements and additions. The principal attractions at this place are an open-air theater, where performances are given daily, and a small "zoo." This company has found that a cage of lively monkeys provides one of the most pleasing and amusing attractions that can be found. Crowds will stand and watch the antics of a dozen monkeys for nearly a half-hour, when they would pass by the ordinary park attractions without notice. The company also owns an elephant, which has proven a center of attraction, especially to the children.

ROSS PARK, BINGHAMTON

Ross Park, located at Binghamton, N. Y., opens this year with greater promises than ever before for a successful season. This resort has been laid out on broader lines than the usual run of pleasure resorts, and it is known and patronized by people for miles around. Men have been busy for some time getting the grounds into shape, cleaning up the winter's rubbish and making a number of slight improvements. The company is considering the advisability of building a much larger open-air theater and amusement pavilion, as the present one is not large enough to accommodate the visitors on pleasant days.

Park Attractions

Practically all street railway managers unite in the opinion that there is no better paying attraction for street railway parks than merry-go-rounds. The Armitage-Herschell Company, of North Tonawanda, N. Y., is one of the largest manufacturers of machines of this kind in the country, and through many years of experience in the designing and building of merry-go-rounds, has created a very extensive domestic and foreign export trade.



FIGS. 1 AND 2.—MOTORS FOR MERRY-GO-ROUNDS

The standard machine built by this concern consists of a steel track, upon which run wheels supporting the machine proper, consisting of sweeps, platforms and lattice work, this in turn supporting four chariots, each capable of seating four passengers, together with the twelve pairs of horses, each of which has an animated and exhilarating galloping motion. Sixteen chairs are also provided, making the seating capacity of the machine fifty-six persons.

All of the parts of these machines are made in large quantities, by workmen skilled in their particular duties, and upon the interchangeable system. All of the parts are ingeniously fitted and interlocked, so that the whole machine may be assembled in a very short time, and when the various pieces are in place with their bolts turned up, the whole frame work becomes rigid as one piece, thus greatly lengthening the life of the machine by limiting all wear from racking strains.

The rotation of the gallery is obtained by means of a steel cable passing about a groove on the circumference of the machine. This cable is driven by a stationary engine, or where electric power is available by means of an electric motor, either of which is built by this company in the same plant as the gallery, thus assuring that each will be adapted for the other. This method of driving is covered broadly by patents which cover as well the use of the eccentric for giving the horses their galloping motion. The machines can be operated successfully by two men where a permanent stand can be obtained, although it is advisable to have three men when the machine is to be moved from place to place. When, however, the electric motor can be used, one man can operate the gallery successfully, as the electric controller is placed directly upon the machine, so that one man may act as both fare collector and operator, having perfect and absolute control of the motion of the gallery. The motor used for this purpose is shown in Figs. 1 and 2.

As a modification of the standard machine, and to meet a demand for a novelty, a somewhat similar machine is built in which there are three horses abreast instead of two, the number of chariots remaining the same. This increases the capacity of the machine by twelve riders, and increases the earning capacity to the same extent, and is very popular in locations where the capacity of the standard machine is inadequate to the demands for seating capacity.

In addition to the above machines and in order to supply a machine adapted for permanent locations where a large attendance is assured, the "Mountain-Valley" shown in Fig. 3 has been

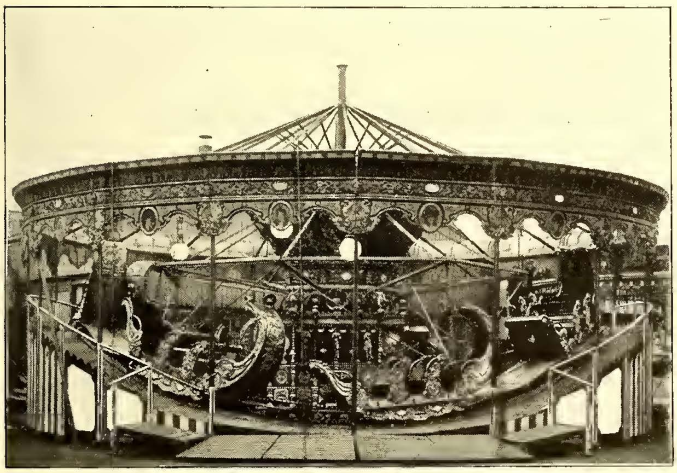


FIG. 3.—MOUNTAIN VALLEY MERRY-GO-ROUND

evolved and perfected. Upon an undulating track having a rise and fall of 6 ft., are propelled eight gorgeous chariots, each with a seating capacity of twelve passengers. Each chariot is resplendent with massive carving and gorgeous decorations, being studded with beveled mirrors and richly upholstered. The chariots are attached to the portable frame by brass rods and move about a center of magnificent pictures and superb decorations. Over the whole is a canvas top surrounded by a carved valance, resplendent medallion pictures, hand-carved scrolls and beveled mirrors, and supported by heavy brass columns.

With the standard and three-horse abreast machine is furnished an elegant organ about 60 ins. high, 40 ins. long and 25 ins. deep, with trumpets, piccolos and flageolets of very rich and powerful tones, having inside violin and basses, contra basses, and stopped diapason, with two barrels playing eight tunes each of the latest popular airs, also a novelty in the way of a negro image represented as turning the organ which automatically turns its head and bows to the audience as the gallery revolves. The organ furnished with the "Mountain-Valley" is considerably larger and finer than this.

VAUDEVILLE ATTRACTIONS

J. W. Gorman, of Boston, the well-known manager of amusement attractions for parks, states that an increased interest is being felt in the subject of street railway parks this season. Mr. Gorman formed a circuit last year among a large number of street railway parks in the East, and thus gave each one a change of bill every week or oftener, if desired, through the season, with satisfaction to the railway companies. Mr. Gorman has given the subject of entertainments attention for many years, and during this time has made a specialty of out-of-door attractions. After a study of local conditions the only information which he needs from a railway company is how much it is willing to spend on park attractions, and he will then supply the best entertainment for the conditions and prices named. Devoting, as Mr. Gorman does, his entire attention to this one specialty, he is well posted on everything that is needed, and will supply specifications for park theaters or other fittings necessary.

Official Tests of Brakes in New York

The Board of Railroad Commissioners of the State of New York has issued the following notice:

NOTICE TO OWNERS OF BRAKES FOR STREET SURFACE CARS

ALBANY, March 29, 1899.

The board of railroad commissioners of the State of New York will make a test of braking systems for street surface cars, on cars to be furnished for that purpose by the Metropolitan Street Railway Company of New York City. The tests will be made of such braking systems offered as appear to the commission to be practicable. Applications to have braking system tested, and for permits to equip cars for this purpose, must be made on the accompanying blanks. All applications must be accompanied by a drawing, tracing, blue print or photograph showing the system complete; also a full description of the same, setting forth the details of construction, application to car and method of operation.

The cars to be furnished will be eight-wheel cars, with "Brill" maximum traction trucks fitted with G. E. 1000 motors, with non-suspension; driving wheels 30 ins., tread wheels 20 ins. in diameter; length of car-body over all 28 ft; outside measurements of wheel base 17 ft. 6 ins. The railway company will furnish space in its car-house and pit-room for the purpose of fitting up cars, but will not furnish any supplies, labor or machine shop facilities. The general master mechanic of the Metropolitan Street Railway Company will designate the cars to be equipped and the car-house at which the work shall be done.

These tests will be made in any manner the board of railroad commissioners may determine. While the tests are being made only one representative of the applicant will be allowed on the platform on which the brake is operated.

All tests of braking systems for stopping a car will be from a signal on a basis of $\frac{WS^2}{D} = E$.

E = Efficiency of braking system.

W = Weight of car.

D = Distance between point at which signal is given to point of stop.

S = Rate of speed at time of giving signal.

The merits of braking system will be determined on the following points:

First—Emergency stop at —— miles per hour.
Second—Stop at —— miles per hour, without skidding wheels.
Third—Service at —— miles per hour.
Fourth—Ease of manipulation.
Fifth—Reliability of system.
Sixth—Operation of the system by the ordinary motorman.
Seventh—Simplicity of system.
Eighth—Liability of brakes operating when they should not
Ninth—Safety devices in case of failure of any part of braking system.

Distinctive emergency brakes will be tested on their merits and their non-interference with the ordinary brake.

Application for permits to compete and to equip cars should be addressed to C. R. Barnes, electrical expert, railroad commission of the State of New York, Albany, N. Y., and will be received until May 2, 1899.

JOHN S. KENYON.
Secretary State Railroad Commission.

There appear to be three main conditions involved in the "best material" for brake shoes, viz.: that it should be economical in wear itself, economical as regards wear on wheels, and should have a good coefficient of friction. Different men will vary in opinion as to the relative importance of these three conditions.—From paper read at the Atlanta, Ga., Convention, 1894.

LEGAL NOTES AND COMMENTS*

The Question of Practice in Negligence Cases

It is our purpose generally to treat questions in these columns aside from questions of practice, but a recent decision in our New York courts, under the Code of Civil Procedure (which has been substantially adopted now in many other States), is of so practical a character that we believe the loss departments, both in this jurisdiction and outside of it, will be interested.

Ordinarily, when the plaintiff's case is weak and the presiding justice believes that the complaint should be dismissed or the jury directed to bring a verdict for the defendant, he makes that ruling without submitting the case to the jury.

If, in the opinion of the appellate tribunal, he has made a mistake, then all the labor, expense and trouble of a new trial results, even though the jury upon the first trial was convinced, as the judge was, that there was no case for the plaintiff, and therefore would have rendered a verdict settling the controversy on the questions of fact forever.

Time was, when this was not the practice, and when a judge allowed a case to go to the jury, in many instances, with a settled intention in his own mind to set the verdict aside should it be in favor of the plaintiff, and grant a new trial on the ground that the evidence did not warrant the verdict. Thus, if the jury found a verdict in favor of the defendant, there was no new trial, even though the judge might have erred in his opinion that the case never should have been submitted to a jury and that the defendant was entitled to a direction of a verdict.

But when the appellate courts decided that it was the judge's *duty* to dismiss the complaint, or direct a verdict at the close of the evidence, and before submitting the case to the jury, *in every case* where he would be compelled to set aside a verdict in favor of the plaintiff, and to grant a new trial, this was necessarily abandoned by the judges, especially as it necessitated their going on record as having committed error in not dismissing the complaint or directing a verdict in the first instance.

The recent case which is the occasion of this article is that of Sullivan vs. the Metropolitan Street Railway Company, decided in the February term (37 App. Div., 491). There, at the close of the evidence, a motion was made for the direction of a verdict, and instead of deciding the motion *instanter*, the court, *pending the decision of the motion*, submitted to the jury four questions of fact, which were raised by the pleadings, in accordance with the provisions of section 1187 of the Code of Civil Procedure. The first three questions relate respectively to the absence of contributory negligence of the plaintiff, the presence of negligence of the defendant, and the amount of the plaintiff's damages. The fourth question was a special question as to whether the car was at a standstill when the plaintiff attempted to get upon it. The jury returned answers to the question which entitled the plaintiff to a judgment in a substantial amount; but the judge ignored their findings, and, granting the motion which he had taken under advisement, directed a general verdict for the defendant.

When this matter came before the Appellate Division, objection was made to the practice pursued by the court, but the court was upheld in that regard and the practice was approved, and the Appellate Division held that this practice would, ordinarily, allow them to direct judgment to be entered in accordance with the findings of the jury in favor of the plaintiff for the amount found, and so the necessity of a new trial would be avoided. In the particular case under consideration a new trial had to be ordered on another ground, because material evidence offered by the defendant company was rejected, to its prejudice. This evidence not having been before the jury, the defendant was entitled to a new trial.

It will be noted that this practice accomplishes at least three results, which cannot be obtained by the dismissal of the complaint or a direction of a verdict in favor of the defendant at the close of the evidence and before the case goes to the jury.

First, it gives both sides a chance to have the facts passed upon by a jury; and if in favor of the defendant the litigation is ended, unless there be valid exceptions.

Second, it gives the appellate tribunal a chance to direct a judgment in favor of the plaintiff, if it is found that the court erred in directing a general verdict for the defendant.

Third, in case the jury disagrees, the judge retains the power to direct a verdict or to dismiss the complaint upon the motion, which he has held in advisement, while the jury has been deliberating.

This last is a *desideratum*, since, in an ordinary case where a jury disagrees, both sides seem remediless under the present practice; for no motion will be entertained for a reconsideration of the ruling that may have been made upon the trial for the direction of a verdict or a dismissal of the complaint. A new trial, with all its expense and delay, must be accepted by both sides as the inevitable result of the mistrial.

The submission of special questions to the jury also simplifies the work of the Appellate Court, and may enable them to affirm a judgment when, under the usual practice, they would be compelled to order a new trial.

There are other advantages which, together with what we have already stated, ought to make the practice followed in the Sullivan case popular with the courts in lessening their labors, as well as with the bar. To the street railway company it would appear to be advantageous, in that it decreases the expense of litigation, and will oftentimes save them from a second trial and its accompanying inconvenience. H.

CHARTERS, ORDINANCES, FRANCHISES, ETC.

ILLINOIS.—Street Improvement—Assessments—Liability of Street Railroads—Ordinance.

An ordinance in consideration of the acceptance of which the rights of a street railroad company were extended, providing that it shall, "as respects the filling, grading, paving and otherwise improving and repairing the streets * * * on which it has constructed its railways, * * * fill, grade, pave and keep in good repair" a certain number of feet in width of the streets, in accordance with such ordinances as the city council may pass respecting the same, and the same shall be done by the company "with like material, in like manner and at the same time as required as to the rest of said street," is a valid contract, exempting the company from assessment for improvements of such streets.—(West Chicago St. Ry. Co. vs. City of Chicago, 53 N. E. Rep., 112.)

LOUISIANA.—Taxation—Street Railroad Franchises—The law requiring franchises to operate street railways to be taxed according to their value makes the earning capacity of the corporation a basis for ascertaining the value at which the franchise shall be assessed, but does not exclude reference to other elements that bear directly on the question of that value.—(Const. art. 203; Act 1890, No. 106, secs. 1, 28. St. Charles St. Ry. Co. vs. Board of Assessors et al., 25 So. Rep., 90.)

NEW YORK.—Ordinances—Street Car Fenders—A provision, in an ordinance requiring safety fenders to be attached to the front platform of electric street cars, that they shall not be more than 3 ins. from the tracks, is unreasonable, in view of the liability of the height of the car above the tracks to vary according to the loads, the grades, and the curves.—(City of Brooklyn vs. Nassau Elec. R. Co., 56 N. Y. Suppl., 609.)

NEW YORK.—Joint Use of Tracks—Leased Lines—A street railway company, having a right to operate its line in a certain avenue, agreed with another company that the two should con-

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

struct a double track on such avenue, to be used jointly by them; each to operate as many cars over the track as it might deem proper. Held, that the latter company could not restrain the former from operating the cars of a leased line over the double track.—(Coney Island & G. Ry. Co. vs. Coney Island and B. R. Co. et al., 56 N. Y. Suppl., 508.)

NEW YORK.—Lease—What Constitutes.

1. A contract for the passage of cars over a street railroad, of which the owner otherwise holds control, is not a lease, within Laws 1890, chap. 565, sec. 78, authorizing contracts for the use of railroads, but providing that, if such a contract is a lease for more than one year, it shall not be binding, unless stockholders consent.

2. Same—Use of Road—Right of Interference—Failure to pay compensation under a contract for the use of a street railroad does not authorize intereference with the use.

3. Same—That the terminus of the right of way has been slightly changed in the actual operation of a part of a street railroad, under a contract for its use, does not impair the right to enjoin interference with the use contracted for.

4. Same—Rights of Co-Tenants—One co-tenant of a street railroad, bound not to let, sublet, assign, or convey any interest therein without the other's consent, could not convey a perpetual right to operate the cars of a third road over the common tracks, on the consent inferable from their operation for several years without complaint from the other.

5. Same—Rights of Purchase—A company which has acquired the interests of co-tenants of a street railroad may object to the exercise of an easement to which only one interest is subject.

6. Same—Estoppel—Failure of a co-tenant of a street railroad to complain at once of the use thereof by a third road, which has acquired the right from the other co-tenant only, does not give rise to any estoppel in favor of the use.

7. Same—Corporate Stock—Foreclosure—Interest of Purchaser—One who acquires stock of a street railroad company by foreclosure of a mortgage takes it free from an agreement by the former owner, a street railroad company, for a right of way for the company whose stock it purchased over a line it occupied in common with another, and to procure from its co-tenant such right of way, though such agreement was the consideration of the purchase by such former owner.—(Chapman et al. vs. Syracuse Rapid Transit Ry. Co., 56 N. Y. Suppl., 250.)

OREGON.—Receivers—Liens—Priority.

1. Since a heater, furnished to an electric railroad company after a test showing that it would save a certain sum per month in fuel, was not necessary to keep the company in operation, the seller has no preferred claim for payment out of the receipts of the company after it goes into the hands of a receiver.

2. The fact that a heater furnished to an electric railway company before its insolvency has already earned a sum equal to the agreed consideration, by effecting a saving in fuel, does not give the seller a preferred claim for payment out of the receipts of the company.—(McCormack vs. Salem Consol. St. Ry. Co., 56 Pac. Rep., 518.)

RHODE ISLAND.—Franchise—Fare—Municipal Contracts—Right to Enforce—Test Cases.

1. Where a town granted a franchise to a street railroad company, the contract stipulating that the fare between any two points on its lines should not exceed five cents, the grantee waived its right to charge more as successor of another company whose charter allowed it to charge ten cents, under which charter the grantee had established a fare of five cents for a continuous ride.

2. Where a town grants a street railway franchise, the contract limiting the rate of fare between any two points, an individual who has been ejected from a car for refusing to pay more than that rate may avail himself of the contract, in trespass for assault and battery.

3. Under Pub. Laws 1891, chap. 975 (Act May 29, 1891), authorizing towns to make contracts granting franchises to corporations operating street railways, section 4 of which provides that the charge for service shall not exceed the price charged by the corporation at the time of granting the franchise, a contract which limits the rate of fare to less than that then charged by the corporation is not beyond the town's authority.

4. Where a party boards a street car, tenders a certain fare, and, on refusing to pay more, is ejected, an action by him is not a moot case, which the court will refuse to entertain, though the party's sole motive was to make a test case.—(Adams vs. Union R. Co., 42 Atl. Rep., 515.)

UTAH.—Self-Executing Statutes—Franchise Is Contract—Waiver of Breach—Status of Privileges Granted—Franchise—Breach of Condition—Waiver—Strangers to Contract Without Right—Forfeiture of Franchise—Procedure—Articles of Incorporation—When May Be Amended.

1. The various legislative acts under which the defendant street railroad company was incorporated, containing provisions that, unless certain acts were performed within a certain time, the "act of incorporation shall be void," and being later amended by adding the words "as to all parts of its chartered lines not then constructed," it is contended that such provisions are self-executing, and that, having failed to comply with the terms of the acts, defendant's rights have been forfeited. Held, that such contention is inconsistent with plaintiffs' allegation that defendant is a corporation, and of no avail.

2. A franchise is a contract between the State, or other body granting the franchise, and the party accepting and acting upon it. It is governed by the general rules applicable to contracts, and either party may waive any breach of the conditions of a franchise; and anything which would constitute a waiver of a breach of a contract constitutes a waiver of a breach of the conditions of a franchise.

3. The waiver of a breach, which, if insisted upon, would forfeit the franchise, or some special right under it, leaves the party in default free to enjoy the privileges granted until the State moves in the matter, and a forfeiture has been judicially declared.

4. The defendant company having been in operation for a period of about twenty-seven years, and no proceedings having been instituted by either State or city to forfeit any of the rights granted by the franchises to the defendant company, and additional franchises having been repeatedly granted, all defaults on the part of the defendant company up to the date of the last franchise (March 18, 1894) have been waived; and the plaintiffs, being strangers to the contract, have no rights in the premises.

5. The act authorizing the city to grant a franchise to defendant company imposed no restriction, except as to the time for which the franchise should be granted. No rights can be forfeited, therefore, except for the causes and in the mode prescribed in the franchise, and Rev. St., sec. 438, is not applicable.

6. There being no statutory time limit within which articles of incorporation may be amended, an amendment may be made more than ten years after filing the original articles; and, in the case at bar, the amendment having been made in 1889, seventeen years after filing the original articles, Rev. St., sec. 438, could have no application, except to the amended articles, and, as to such, there was no default when this action was commenced.—(Dern et al. vs. Salt Lake City R. Co., et al., 56 Pac. Rep.)

VIRGINIA.—Contract to Build Railroad—Liability to Sub-Contractor—Extras—A railroad company which has let a contract for the construction and equipment of its road is not liable to a sub-contractor for extra work done by him in constructing it under his contract with the principal contractor.—(Richmond Ry. & Elec. Co. vs. Harris, 32 S. E. Rep., 458.)

UNITED STATES COURTS.

WASHINGTON. — Jurisdiction — Citizenship — Circuit Court of Appeals—Decision—Conclusiveness—Supreme Court—Right of Appeal—Where jurisdiction of the Circuit Court originally depended on diversity of citizenship, Act Aug. 13, 1888, making the decree of the Circuit Court of Appeals final in such cases, applies, and prevents an appeal to the Supreme Court, though another ground of jurisdiction, under which such appeal might be taken, is developed in the course of the proceedings.—(Third Street & Suburban Ry. Co. vs. Lewis, 19 Supr. Ct. Rep., 451.)

LIABILITY FOR NEGLIGENCE.

DELAWARE.—Collision at Crossing—Negligence—Evidence—Opinions.

1. It is competent for a motorman of an electric car injured by collision with a wagon, claimed to have been negligently driven in front of the car, to show that the car which was run on schedule time, was on time when the accident occurred.

2. Question asked one suing for personal injuries whether he feels that he will ever again be able to do a good day's work, or recover from his injuries, is improper.

3. A motorman of an electric car, suing for injury from collision with a wagon who has given evidence that he was careful in handling the car at the time of the accident, and that the apparatus was then in good condition, cannot, before any attempt of defendant to show that he was an incompetent or careless man, give evidence that he was habitually careful to see that his car was in order.

4. A witness who has stated that when he saw the driver of a wagon whip up his horses, and the proximity of the car, there was bound to be a collision, cannot state why he says that.

5. A motorman suing for personal injuries received from collision of his car with a wagon cannot show the result of a hearing had by the motorman before a magistrate on a charge of reckless driving.

6. Plaintiff may ask his witness, who has testified that he saw a

car, and that, in his judgment, it was going about 5 miles an hour, whether he was safe in saying that he thought it did not exceed 5 miles an hour.

7. The owner of a team sued for injury to a motorman whose car collided with the team cannot state whether he has observed how long it will take a team to go from the side of the street to the car line, with the horses at a walk, any observations being immaterial, as the speed at which horses walk varies.

8. Where at foot of a hill, down which an electric car had come, there was a collision between it and a wagon, one not called as an expert cannot testify to a test made of a car going down a hill as steep as that in question, and of the space within which the experiment showed a car could be stopped.

9. The right of a person in charge of a street car and of a person driving a team to the use of the street at a crossing must be exercised with due regard to the right of the other, and in a reasonable and careful manner, so as not unreasonably to abridge or interfere with the right of the other.—(Price vs. Charles Warner Co., 42 Atl. Rep., 699.)

INDIANA.—Negligence—Driving Across Tracks—A plaintiff, driving at night in the direction of an approaching street car, which he can plainly see, is negligent in undertaking to cross the track when the car is so close that it strikes his horse before it is off the track.—(Citizens' St. Ry. Co. vs. Helvil, 53 N. E. Rep., 191.)

INDIANA.—Injuries to Passenger—Special Verdict—A complaint alleged that plaintiff notified the conductor to stop the car, and it could easily have been done; and, as the car approached the crossing, its speed was slackened; that plaintiff, being a passenger, was standing on the rear platform, and, as the car slowed down, the conductor, with his hands, "passed" plaintiff in front of him, to allow plaintiff to step off, which he did, taking hold of the railing and stepping down on the step, to be ready to step off when the car stopped; and, while he was so stepping down and off, the motorman suddenly turned on the electricity, so that plaintiff was thrown from the car. There was a general verdict for plaintiff. The special answers found that the car was running from 4 to 5 miles an hour, and there was no change in the amount of electricity used; that there was no evidence that the motorman turned the lever turning on and off the current; there was no finding that the speed was or was not increased; that plaintiff was getting ready to get off as soon as the car stopped; that he was not stepping from the platform to the step when he fell; and that he was trying to get off a moving car to avoid being carried past his destination. Held, that the special answers, being inconsistent with each other, could not control the general verdict.—(Citizens' St. R. Co. vs. Hoop, 53 N. E. Rep., 244.)

LOUISIANA.—Injury at Crossing—Contributory Negligence.

1. The authorities are numerous and uniform to the effect that a person whose business or pleasure occasions him to use the streets of a city which are traversed by electric cars, and particularly at street crossings, is guilty of negligence if he fails to employ proper precautions for his safety.

2. He is bound to look and listed for the approach of cars, and to exercise ordinary care and caution to avoid possible danger of a collision; and, should he see an approaching car in close proximity, it would be his plain duty to halt until same could pass by, rather than run the risk of an accident by attempting to cross the track in front of it.

3. Failing to take such necessary precautions for his safety, the injured party is guilty of that negligence which deprives him of the right to reimbursement for injury received.—(Dieck vs. New Orleans City & Lake R. Co., 25 So. Rep., 71.)

LOUISIANA.—Injury to Person on Track—Evidence.

1. One who heedlessly attempts to cross ahead of a car properly manned, if injured, has no one to blame but himself.

2. The motorman was not at fault, and none of the negligence charged by plaintiff was shown.

3. He exercised reasonable care to avoid the injury. He paid proper attention, saw the danger, and gave notice or warning, and did all he could to stop his car.

4. There was nothing out of repair about the car or the track, nor anything lacking to increase the danger in which plaintiff, the testimony shows, placed himself.—(Webster vs. New Orleans City & Lake R. Co., 25 So. Rep., 77.)

LOUISIANA.—Injury to Person on Track—Contributory Negligence.

1. A boy, eleven years of age, standing at night on the off side of the down-town track of defendant company's street railway, waiting for a car on the up-town track (which was furthest from him) to pass, and, that car having passed, without looking up the track nearest him, to see whether or not it was safe to cross, steps on the track, 12 or 15 ft. in front of an approaching down-town car, trips and falls, is run over, and his foot crushed. Held, a case of want of care on his part, barring recovery of damages; it being shown that, notwithstanding effort on part of motoneer to arrest car, it could not be done in that distance.

2. The motoneer had a right to suppose the boy was waiting for his car to pass, and to expect he would remain where he was out of danger until it had passed.—(O'Rourke et ux. vs. New Orleans City & L. R. Co., 25 So. Rep., 323.)

MASSACHUSETTS.—Personal Injury—Frightening Horse—Negligence—A horse drawing a buggy in which plaintiff was seated was driven in a public street near defendant's electric car, which made a loud noise and threw sparks from its wheels. When the motorman rang the gong, the horse took fright, and plaintiff was injured. It did not appear that the noise and sparks were due to any defect in construction, or negligence in operating the car, and the horse did not appear to be frightened until the gong sounded. Held, no evidence of defendant's negligence.—(Henderson vs. Greenfield & T. F. St. Ry. Co., 52 N. E. Rep., 1080.)

MASSACHUSETTS.—Place of Accident—Rebuttal—Where plaintiff's evidence is that she was run over at a particular place, defendant's evidence that the accident happened at a different place does not make a fresh case, which plaintiff is entitled to meet; so that admission or exclusion of evidence on rebuttal corroborative of plaintiff's statement is discretionary.—(Lansky vs. West End St. Ry. Co., 53 N. E. Rep., 129.)

MASSACHUSETTS.—Injury to Employee—Negligence of Superintendent—Defective Appliances—Evidence—Assumption of Risk—Contributory Negligence.

1. A car shifter, whose only duties were to get cars ready for conductors and motormen, starting the turntable at a car house, was not a foreman, nor engaged in an act of superintendency, in so turning the table, within St. 1887, chap. 270, authorizing recovery by one injured by negligence of a superintendent.

2. Where plaintiff was injured by alleged defective appliances, evidence of a change in such appliances after the accident is inadmissible.

3. Where a servant knew of the danger of the work in which he was engaged, he cannot recover having assumed the risk.

4. Where a conductor of a street car had an experience of three or four years with transfer car tables, he was guilty of contributory negligence, where he was injured by an obvious danger in the use of such table, though he had not observed it.—(Whelton vs. West End St. Ry. Co., 52 N. E. Rep., 1072.)

MASSACHUSETTS.—Negligence—Evidence—Witnesses—Instruction—Service on Corporation.

1. A request to rule, in an action against a street railway company for injury to a passenger, that on all the evidence defendant had proved there was no negligence on its part, and had thus overcome the effect of the evidence of the mere running off the track by the car, and to direct a verdict for defendant, is properly refused, there being evidence that the car had run off the track an hour before the accident, and that, immediately before it again ran off, causing plaintiff's injury, it was running at the rate of 15 miles an hour, down a grade, and around a curve.

2. In the absence of any other adequate explanation, negligence of a street car company may be inferred from the going off the track of a car, injuring a passenger, there being evidence that it had gone off the track an hour before, and that immediately before it again ran off, causing plaintiff's injury, it was running at the rate of 15 miles an hour, down a grade, and around a curve.

3. What inference shall be drawn from failure to call a witness equally within the reach of the parties is for the jury to say under all the circumstances.

4. Error cannot be predicated of an instruction, on a second trial, as to witnesses who testified at both trials, that the only purpose and effect of showing their testimony at the former trial is to affect the weight of their present testimony, the instruction evidently referring to witnesses as such, and defendant's exception thereto giving no intimation that it was understood to refer to plaintiff as a party whose previous testimony might be evidence against him in the nature of an admission.

5. Motion to dismiss for want of proper service on defendant corporation is properly denied, service on it by serving its assistant treasurer being returned, and no plea in abatement being filed, and it being impossible to know, as matter of law, that he was not an officer having charge of defendant's business, within Pub. St., chap. 161, sec. 36, authoring service on such an officer.—(Harriman vs. Reading & L. St. Ry. Co., 53 N. E. Rep., 156.)

MASSACHUSETTS.—Master and Servant—Negligence—Jury—The rear truck of a street car was derailed at a switch, and swung around so that there was just room for a car to pass on the other track. The motorman was trying to right the car with a piece of iron under the derailed wheels, and his superior ordered him to remove the iron, and use a crowbar. As he stooped to pull out the iron, the superior ordered a car on the other track to "come ahead," and, as the motorman raised himself, he was caught between the two cars. He heard the order given, but did not know to what car it referred, and the motorman on the other car did not know he was there. Held, that there was sufficient evidence of the superior's negligence on which to go to the jury.—(O'Brien vs. West End St. Ry. Co., 53 N. E. Rep., 149.)

MICHIGAN.—Damages for Personal Injuries—Pleading and Proof—Evidence—Instructions.

1. In an action for personal injuries, the fact that plaintiff's intended marriage had to be postponed on account of the injuries cannot be proved under a general allegation of mental suffering, since it was not a necessary consequence of the injury.

2. It is a violation of this rule to admit evidence of such fact, though the court charges that it "is not, independently, an element of damage, but an element" to be considered as bearing on plaintiff's mental suffering.

3. Manifestations and declarations of present pain may be proved, in an action for personal injuries, to show plaintiff's condition, though they were made long after the accident.

4. One who receives bodily injuries through the negligence of another may, under a general allegation of mental suffering, recover for the shame and mortification of being obliged to use a crutch and a cane.

5. Under a declaration alleging injury to the hip, hip joint, pelvis, and thigh, a resulting trouble to the sciatic nerve may be shown.—(Beath vs. Rapid Ry. Co., 78 N. W. Rep., 537.)

NEW YORK.—1. Evidence—Ejection from Cars—Res Gestæ.

In an action for damages for ejection from a street car because plaintiff's transfer check had expired, evidence of statements by a third person to defendant's conductor, that he had seen plaintiff get off one car an onto the next one, is inadmissible as part of the res gestæ.

2. Same—Hearsay.

It is also inadmissible because it is hearsay.

3. Trial—Objections to Evidence—Waiver.

A party does not waive objections to the admission of evidence by endeavoring to rebut it.—(Woods vs. Buffalo Ry. Co., 54 N. Y. Suppl., 735.)

NEW JERSEY.—Death by Wrongful Act—Right of Action—Pleading—Amendment.

1. A father, as such, cannot maintain an action to recover for the loss of services upon the death of his son, caused by the negligence of another. The action to recover pecuniary damages resulting to him by the death of his son is only maintainable, under the death act (1 Gen. St. p. 1188), by the personal representative of the deceased son.

2. After an action has been commenced by the father as such, and declaration has been filed, to which a demurrer has been presented, an amendment to the summons and declaration, substituting the personal representative of the deceased party as plaintiff in the action, under the death act, will not be allowed, because it would be the institution of a new action between different parties, and raising new questions, and would be vexatious, especially if it appear that the statutory period in which the new action could have been brought has expired. By such an amendment the defendant would be deprived of a plea which it could have if the action was commenced in the name of the personal representative of the deceased.—(Fitzhenry vs. Consolidated Traction Co., 42 Atl. Rep., 416.)

NEW YORK.—Injuries to Persons in Street—Negligence.

1. A street car on a populous street ran over a four-year-old boy, who started to cross the street when the car was 100 or 125 ft. away. The car was going down a steep grade at about twenty miles an hour. The usual rate of speed of a car was eight or ten miles an hour, and, traveling at such rate, it could be stopped within 20 ft. As the boy began to cross the street, a person in an adjoining house and passengers in the car screamed, and the motorman looked at the house, then at the passengers, and then began to stop the car, which was 40 ft. away from the boy, but its speed was such that he was unable to bring it to a standstill until the boy had been run over. Held, that the question of the motorman's negligence was for the jury.

2. Same.—It was the duty of a motorman to keep the car under such control as to be able to bring it to a standstill in time to avoid injury to persons on the street.—(Fullerton vs. Metropolitan Street Railway Co., 55 N. Y. Suppl., 1068.)

NEW YORK.—Directed Verdict—Judgment on Appeal—New Trial.

1. Code Civ. Proc., sec. 1187, authorizes the court to submit issues to the jury pending a motion to direct a verdict, and thereafter direct such verdict as either party is entitled to, and on appeal requires judgment to be entered in favor of the proper party. Held, that where there were erroneous rulings on the trial, duly excepted to, the Appellate Division would not render judgment on appeal, but would order a new trial, as authorized by section 1317.

2. Same.—Where the court properly submitted the question of negligence and contributory negligence to the jury, and directed it to assess plaintiff's damages, and such issues were found in plaintiff's favor, it was error to direct a verdict for defendant.

3. Witnesses—Impeachment—Evidence.—A policeman made a memorandum of an accident he had seen, which he gave to the desk sergeant, who entered its substance in a blotter. In an action based on the accident, the policeman testified that, after being subpœnaed, he asked the sergeant to read the entry to him, and that it was correct. Held, error to refuse to allow witness to read the entry, and state whether it had been correctly read to him, where it differed materially from his testimony; and this, though the original memorandum was not produced.

4. Same.—In an action based on an accident, a police desk sergeant testified that just before the trial the policeman who had reported it asked him to read his report to him. Held, error to refuse to allow witness to state whether he read the report to the officer correctly; the latter's testimony concerning the accident differing materially from his report, and he having also testified that the sergeant read the report correctly.—(Sullivan vs. Metropolitan St. Ry. Co., 56 N. Y. Suppl., 88.)

NEW YORK.—Infants—Loss of Wages—Right to Damages.

1. An infant cannot recover damages for the loss of wages unless he has been emancipated.

2.—Same—Allegation of Emancipation.—An allegation in a petition by an infant for the appointment of a guardian ad litem, that deponent "is unable to perform any work, and has been seriously injured and damaged," is not an allegation of emancipation, evidence of which entitles the infant to damages for loss of wages.

3.—Evidence—Pleadings.—The allegations in a pleading are not admissible as evidence in favor of the pleader.

4.—Judgments—Conclusiveness—Parties in Different Capacities.—A judgment in favor of an infant for damages for loss of wages in an action by his father as guardian ad litem is not conclusive against the individual right of the father to recover for the loss of the same services.

5.—Appeal—Remittitur.—Where a judgment in favor of an infant contains an improper element of damages, consisting of loss of wages, and the amount of such item clearly appears, he will be allowed to enter a remittitur.—(Lieberman vs. Third Ave. R. Co., 55 N. Y. Suppl., 677.)

NEW YORK.—Collision—Negligence—Presumptions.

1. A passenger in a street car, suing for injuries caused by a collision between it and the car of another railroad company, must prove that such other company was negligent, as its negligence will not be presumed merely from the happening of the collision.

2. Same—Appeal—Instructions—Error Cured.—Error in charging that the happening of a collision between defendant's street car and the car of another, in which plaintiff was a passenger, makes it incumbent on defendant to prove that it was not negligent, is not cured by the granting of a request to charge that the mere fact that defendant's car struck the blow does not prove negligence on its part.—(Falke vs. Second Ave. R. Co. et al., 55 N. Y. Suppl., 984.)

PENNSYLVANIA.—Boarding Car — Negligence.—While a street car which had reached the end of its run was being prepared for the return trip, a person mounted the running board before the barrier preventing him from entering on that side had been removed, and was struck by a car on the other track. Held, that the company was not negligent in failing to provide against such an act.—(Malpass vs. Hestonville M. & F. Pass. Ry. Co. et al., 42 Atl. Rep., 291.)

PENNSYLVANIA.—Collisions — Contributory Negligence.—One who drives at a trot upon an electric railway crossing, without slowing up and looking for a car after obstructions preventing a view from the house line are passed, cannot recover for injuries caused by a car, though it was negligently operated.—(Darwood vs. Union Traction Co., 42 Atl. Rep., 290.)

PENNSYLVANIA.—Negligence—Personal Injury—Instructions.—Where the accident on which an action for a severe injury is founded was apparently trivial, and did not indicate that serious results would follow, and no notice thereof was given to defendant until the action was brought, a year and a half later, it is a case calling for full instructions as to the duty of plaintiff to make out affirmatively every element essential to recovery.—(Cooley vs. Philadelphia Traction Co. et al., 42 Atl. Rep., 288.)

PENNSYLVANIA.—Accident to Conductor—Master's Duty to Instruct—A street car company is not bound to instruct a conductor of nine years' experience, when taking out for the first time an open summer car, with a running board on the side, whereby it was extended nearer cars on the other track, of the danger of being struck by such cars while on such board.—(Fletcher vs. Philadelphia Traction Co., 42 Atl. Rep., 527.)

PENNSYLVANIA.—Accident to Child—Question for the Jury—The question of negligence is for the jury where a child of six years old, who had been playing on a lot abutting the street, known to the motorman to be a usual playground for children, immediately before the accident ran from a point 40 ft. from the curb line to and upon the street, and came in contact with the car as soon as he reached the track, the distance from the curb to the track being 5 ft., and there being evidence that the car was running at an unusual and excessive rate of speed, by gravity down grade, without the gong being sounded, or other warning being given; that, if the electric current had been used, the car could have been stopped inside of 10 ft.; and that the boy was struck by the front of the car.—(Walbridge vs. Schuylkill Elec. Ry. Co., 42 Atl. Rep., 689.)

PENNSYLVANIA.—Collision—Car and Runaway Team—Negligence—There is no evidence of negligence of the motorman of the street car, with which plaintiff's runaway horse, which he was driving, collided, where it only appears that plaintiff, when 60 ft. or 80 ft. from the crossing, shouted to the motorman to stop his car, and that the latter, who had started to cross, without coming to a full stop at the crossing, proceeded to cross the street, either not hearing plaintiff, or electing to do otherwise than he said.—(Phillips vs. Peoples' Pass. Ry. Co., 42 Atl. Rep., 686.)

MISSOURI.—Ordinance—Creation of Civil Liability—Pleading—Verdict.

1. The violation of a municipal ordinance, regulating the running of street cars, resulting in an injury to a passenger, cannot be made the basis of a civil liability by a mere allegation that such ordinance was in force and binding on defendant, since it must be alleged and proven that defendant agreed to be bound by the ordinance.

2. Where a complainant combines a good cause of action with an invalid one, and the court instructs that he can recover on either, the verdict must be set aside, since it cannot be distinguished whether the verdict rests on that for which there was no legal foundation, or otherwise.—(Byington vs. St. Louis R. Co., 49 So. W. Rep., 876.)

MISSOURI.—Cable Cars—Negligence of Gripman—Jerks—Imputed Negligence—New Trials.

1. A complaint setting forth as the negligence the act of the gripman of a street car in negligently operating the grip iron so as to cause the car to jerk with such force that it broke plaintiff's hold, and threw him on the street with great force, limits plaintiff to proof of the specific negligence averred.

2. Evidence that plaintiff was thrown from a cable car by a jerk of the car caused by some action of the gripman, without showing what the gripman did, or how he caused the jerk, or that he caused it at all, is not prima facie sufficient to submit to the jury the question of the gripman's negligence.

3. The fact that a cable car gave a sudden jerk, throwing plaintiff from the running board, is, per se, insufficient to make the company liable.

4. It appearing that jerks in the running of cable cars are unavoidable, because of the slack in the rope, negligence will not be imputed to the company merely because of such a jerk.

5. A verdict rendered for the right party, though under erroneous instructions, should not be disturbed by the trial court.—(Bartley vs. Metropolitan St. Ry. Co., 49 S. W. Rep., 840.)

NEW JERSEY.—Damages for Personal Injuries—Where the plaintiff claims that a nervous condition has resulted from an accident for which the defendant is responsible, the defendant may show the existence of a fact, other than the accident, from which it may reasonably be inferred the nervous condition has sprung.—(Mullin et al. vs. Consolidated Traction Co., 42 Atl. Rep., 764.)

NEW JERSEY.—Electricity—Live Wire—Injury—Question for Jury—Evidence—Physicians—The plaintiff picked up a wire that was lying in a public highway, and was injured by an electric current. He brought suit against the telephone company, whose wire it was, and against the trolley company, whose current, it was contended, did the harm. Held:

1. That the question whether the lineman of the telephone company had been reasonably diligent in discovering the fallen wire, and in preventing probable injury, was properly left to the jury. Also, that:

2. Whether the failure of the trolley company to use guard wires was negligence by which the plaintiff was injured was for the jury.

3. Testimony that a witness had certain uses of his hand, after an accident somewhat similar to the plaintiff's was properly excluded.

4. If the plaintiff used reasonable care in the selection of a reputable physician to cure his injury, he cannot be kept out of damages because with a better physician he would have had better results.—(New York & N. J. Teleph. Co. et al. vs. Bennett, 42 Atl. Rep., 759.)

NEW JERSEY.—Injury to Passenger—Presumption of Negligence—In a suit brought against a street railroad company by a passenger for injuries caused by the derailment of the car, proof of the happening of the accident is sufficient to charge the company with negligence, and to place upon it the burden of showing that the injuries were not received through any fault on its part.—(Bergen County Traction Co. vs. Demarest et al., 42 Atl. Rep., 729.)

NEW YORK.—Injuries to Passengers—Exemplary Damages—Evidence—Before a passenger in a street car could take her seat she was thrown on the floor and injured by the sudden starting of the car, or the speed at which it was run around a curve. The officers of the company did not direct the starting of the car in such manner, nor did the conductor and motorman intend to injure the passenger. Held, insufficient to justify an award of exemplary damages.—(Wigton vs. Metropolitan St. Ry. Co., 56 N. Y. Suppl., 647.)

NEW YORK.—Instruction—A requested instruction, "If you believe that the occurrence did not happen as plaintiff described it, then your verdict must be for the defendant," is too broad, requiring a verdict for defendant if some essential detail was incorrectly stated by plaintiff.—(Bendit vs. Third Ave. R. Co., 56 N. Y. Suppl., 789.)

NEW YORK.—Bicyclists — Collisions — Contributory Negligence—An expert bicyclist, familiar with the streets and the dangerous situation into which he was riding, was following a downtown car, and when it stopped he turned out and passed it, crossing to the opposite track, and was struck by an uptown car, which, when he turned out, was only 25 ft. away. Held, that freedom from contributory negligence was not shown.—(Cardonner vs. Metropolitan St. Ry. Co., 56 N. Y. Suppl., 500.)

NEW YORK.—Injury to Person on Track—Where a woman, in full possession of her faculties, with an unobstructed view of a street railroad track for several blocks, glances up and down the street from the sidewalk, and then walks slowly upon the track, with an approaching car fully in view, and is run over, she is guilty of contributory negligence.—(Hickman vs. Nassau Elec. R. Co., 56 N. Y. Suppl., 751.)

PENNSYLVANIA.—Injury to Bicyclist—Negligence—A boy on a bicycle turned a corner, and in passing around a wagon, which stood between the curb and the defendant's tracks, struck a car which was approaching on a track so close to the wagon that there was no room for the bicycle to pass between. The motorman had his head turned, looking for people approaching from the opposite direction, but the bicyclist could not have been seen until he rode past the end of the wagon, when the car was so close that it would have been impossible to stop it in time. Held, that the motorman was not negligent.—(Gould vs. Union Traction Co., 42 Atl. Rep., 478.)

UNITED STATES COURTS—(WISCONSIN).

Collision with Bicycle—Negligence—Plaintiff, who was deaf, was riding a bicycle, and crossed one of the two parallel tracks of an electric street railroad, not more than 50 ft. in front of an approaching car, and, turning, continued in the same direction the car was moving, riding in the space between the two lines, which was 4 ft. wide. Not exceeding twenty seconds later his arm was struck by the passing car, and he was thrown from his bicycle and injured. The motorman on the car turned off the current when he saw plaintiff start across the track, but turned it on again when plaintiff had crossed, though he continued to sound his gong until the accident occurred. He had no knowledge of plaintiff's deafness. Held, that, giving plaintiff the benefit of the broadest construction of the qualification of the rule as to contributory negligence, which would permit him to recover notwithstanding his own gross negligence, if defendant might, by the exercise of reasonable care and prudence, have avoided the consequences of such negligence, there was nothing in the evidence to charge the defendant with liability, as the motorman was justified in supposing that, after having crossed in safety, plaintiff would keep at a safe distance from the track until the car passed.—(Nein vs. La Crosse City Ry. Co., 92 Fed. Rep., 85.)

NEWS OF THE MONTH

The original design for the tickets to be used by the Indianapolis Street Railway Company when the new four-cent fare arrangements go into effect, was not acceptable to the city authorities because it bore the words "Not good if detached." The company thereupon yielded the point and all tickets will be so worded as to be good when detached and tendered by any person to a conductor, and will entitle the possessor to transportation and a transfer to any line and to all other privileges the same as if a cash fare had been paid.

The April issue of the "Technology Review," the new magazine devoted to the interests of the Massachusetts Institute of Technology, contains articles on "Applied Science and the University," by James P. Munroe; "Institute Men in the Spanish War," several papers upon the institute facilities and athletic and other interests, and i any notes of much interest to graduates and undergraduates.

After a long discussion with the city officials, the Indianapolis Street Railway Company has finally been granted a new franchise, its old one having expired. The new franchise is for thirty-four years, and under it the company is to pay the city $1,160,000 in cash in instalments, and is to sell six tickets for a quarter, and twenty-five tickets for one dollar, all tickets to have transfer privileges. The company is also compelled to bear the cost of paving between the tracks and for 18 ins. on either side.

It is stated that about 318 cars, including regular bridge cars and trolley cars, pass over the Brooklyn Bridge every hour.

The New York, New Haven & Hartford Railroad Company has decided to extend immediately the third rail electric system on its Plymouth division from Nantasket Junction to Cohasset, a distance of about 3½ miles.

The power station of the Huntington Railroad, of Huntington, L. I., is one of the first street railway plants to be operated by gas engines. This road is 3 miles long, operating one car in winter and three cars in summer. As there is a steep grade on the line, the load is, of course, an extremely variable one. The power-house equipment consists of two Westinghouse, three-cylinder vertical gas engines, each of 50 nominal h.p., taking their gas supply from the adjacent works of the local gas company. Each engine is belted to a 27½-kw. Westinghouse four-pole, 550-volt generator. A storage battery of 265 cells is used to equalize the load. It is stated about 46 cu. ft. per car mile of gas is used. The car mileage is about 200 miles per day.

The International Traction Company, recently formed to purchase and consolidate the Buffalo and Niagara Falls street railway properties and others in Western New York, has organized, with W. Caryl Ely, of Niagara Falls, as president; Daniel S. Lamont, President Cleveland's former Secretary of War, as vice-president, and Bırt Van Horn as general manager. The new company has assumed control, and is now operating, the Buffalo and Niagara Falls street railway properties, the Buffalo & Niagara Falls Electric Railway, the Buffalo & Lockport Electric Railway Company, and others.

The Board of County Commissioners at Indianapolis has reduced the proposed charges set out in their schedules by the several interurban electric railways leading out of that city and across the county to one and two-fifths cents per mile.

By an order recently promulgated by the War Department, provision is made for the extension of the legal effect of any present or future United States patents to Cuba, Porto Rico, the Philippine Islands, and any other territory subject to military government by the forces of the United States. The order also applies to trade marks. By observing certain formalities the necessary record can be effected.

The convention of the Amalgamated Association of Street Railway employees will be held in Louisville some time in May, 1899.

The Sandusky, Milan & Norwalk Electric Railway Company, of Sandusky, Ohio, has restored the wages of conductors and motormen to 15 cents per hour from 12½ cents, the rate at which the men worked during the winter.

A bill authorizing the sale of property left in street surface railroad cars, and the disposition of the proceeds for the benefit of any of the employees and societies existing among the employees of the corporation has recently passed the New York State Assembly.

The Mahoning Valley Street Railway Company, of Youngstown, Ohio, has made an increase in wages in all departments. Motormen and conductors will now receive 14, 15, 16 and 17 cents per hour, according to class.

The Third Avenue Railroad Company has built a temporary track through 125th Street, and will operate this line with horses until the new electric conduit construction is completed. It has been found necessary to take out all the old cable construction on this line, including the yokes.

The Cincinnati Street Railway Company, of Cincinnati, Ohio, is planning to greatly enlarge its shops, so as to enable it to build all its own cars.

Several new cars, including a mail car, are being built in the shops of the Rochester Railway Company, of Rochester, N. Y.

It is stated that the experiment of giving vaudeville shows on special cars while en route will be tried in Brooklyn, N. Y. The car will be extra long, and at one end will have a small stage. At the other end will be a diminutive smoking apartment. The fare on this car will be 25 cents.

The Milwaukee Electric Railway & Light Company claims that it is losing thousands of dollars a year through the illegitimate use of transfers by the public, and a bill has been introduced in the Wisconsin Legislature providing that persons convicted of selling or giving away their transfers shall be fined from $5 to $10.

All of the city and suburban lines of Wheeling, W. Va., were tied up for several days recently owing to a strike of the conductors and motormen. The men demanded nine hours a day, at 20 cents an hour, and a recognition of the union. Much rioting and disorder attended the strike.

It is proposed to hold a World's Fair in the city of St. Louis in 1903, celebrating the centennial of the Louisiana purchase, and it is intended to make this exposition second to none in history. The project involves the organization of a stock company with a capital of $5,000,000, and with a par value of $10 per share. A popular subscription is invited, the first payment to be 5 per cent, and no subsequent calls for payment to be made exceeding *in toto* 20 per cent of the amount subscribed. All subscriptions are contingent on the securing of at least $5,000,000 in all, and except for the first payment of 5 per cent, no further calls on subscribers will be made until the aggregate subscriptions amount to $5,000,000. The city of St. Louis proposes to help the enterprise by increasing its bonded indebtedness $5,000,000, and the National Government will be asked for a loan of $5,000,000, and the State of Missouri for a loan of $2,500,000. It is believed that with the $17,500,000 thus secured an exposition will be obtained rivaling that of Chicago, where the total expenditure, before the opening of the gates, amounted to $18,600,000.

An interesting decision has recently been handed down by the Supreme Court against the Nassau Electric Railroad Company, of Brooklyn, affirming that street railway companies are liable for accidents caused by falling trolley wires, even though it has not been proven that the company was negligent.

Foreign Visitors in America

During the month of April several British engineers have visited the United States on tours of inspection of electric railway work. Among them was Prof. A. B. W. Kennedy, one of the most prominent of British electrical engineers, who is consulting engineer for the London County Council with special reference as to whether or not the underground electric conduit system is practicable for the conditions found in London. Prof. Kennedy in pursuance of this investigation visited New York, Hartford, Boston, Schenectady, Buffalo, Niagara Falls, Chicago, Pittsburgh, Washington, Baltimore and Philadelphia, on a flying trip extending over but two weeks, and at its conclusion expressed himself as very much interested in what he had seen. Accompanying Prof. Kennedy was E. W. Monkhouse, an electrical engineer of London, who desired to make a careful investigation of electric railway practice in this country in behalf of other clients. On April 13, Dr. Edward Hopkinson, managing director of Mather & Platt, Ltd., and Bertram Hopkinson, nephew of the late Dr. John Hopkinson, arrived in New York, and are now making similar investigations in various cities of the United States with a view to acquiring a general understanding of the best American practice in electric railroading. They expect to return in May.

New Manufacturers of Electric Railway Apparatus in England

Dick, Kerr & Company, the widely known railway contractors and manufacturers of England, are at the head of a syndicate which is about to form a company with a capital of £200,000 to carry on the manufacture of dynamos, motors and controllers (for electric railway purposes only) for the British home and foreign trade. The members of this syndicate are Dick, Kerr & Company, Ltd.; John Kerr, George Flett, Claude T. Cayley, Benjamin Sykes, T. S. Turnbull, Richard Prestwich, John Prestwich, George Readman, W. J. Kirk and Sidney H. Short. All except Mr. Short's are well known names in British business and financial circles, and Mr. Short has an international reputation as an electrical engineer and designer of electric railway apparatus through his connection with the Brush Electric Company, the Short Electric Railway Company, and the Walker Company, and through the many papers which he has contributed to scientific bodies on electrical engineering matters. The name of the new company is not yet determined upon, nor its officers selected, but Mr. Short will be in charge, as technical director, of the design of the machinery to be built by the new company.

It will be remembered that not long ago the Electric Tramway & Carriage Company, of Preston, Eng., was organized by another syndicate headed by Dick, Kerr & Company, and a large factory was constructed in Preston. Opposite this factory, a tract of 11 acres of ground has been secured as a site for the new railway motor and generator works, and the foundations are now under way for buildings which will cover about 4½ acres of this plot. The main machine shop will be 900 ft. x 120 ft., and in connection with this will be a foundry 400 ft. x 80 ft., together with pattern shops, offices, store rooms and other buildings usual with a plant of this kind. Electric power will be used throughout the works for running all machinery, and the capacity of the shops is expected to be 1200 equipments per annum of motors, and 30,000 kw. of generators. The buildings will have a steel framework with brick facings, and it is expected that the works will be in full operation by Jan. 1, 1900.

Mr. Short has engaged S. B. Fortenbaugh to go with him across the water as technical assistant, and it is the purpose of the syndicate to engage in America the principal superintendents needed for the new operations. On April 13, Messrs. Flett, Cayley, Turnbull and Short arrived in New York, via S. S. Teutonic, in order to make these engagements and to purchase the machinery and possibly the structural material for the new works. Contracts for at least $120,000 worth of machine tools will be placed in America, and orders have already been given to E. W. Bliss & Company for the presses, and to the Kemp-Smith Company for milling machines, and the remaining orders will be placed before May 6, when the entire party sails from New York for Liverpool. Orders for the engines were placed in England with the Musgraves, of Bolton.

The well known energy and indefatigable determination of Dick, Kerr & Company in pursuit of electric railway business in Europe have won them hosts of friends, and there is no question about their ability to fill their new electric railway works to overflowing with orders. One of the interesting features of the entire transaction, and one characteristic of British quickness to take advantage of opportunities for investment is found in the fact that the entire capital for the construction of the works, £200,000, was subscribed in about thirty minutes, and no subscription of less than £10,000 was accepted, while the desire to obtain larger amounts than could be alotted was urgent.

One of the unpleasant features about this new enterprise is that Mr. Short's friends in America will lose him for several years at least, as in pursuance of his contracts with the new company he will have to take up his residence in England. He returns with Mrs. Short to England on May 6, as stated above, and will shortly be followed by the remainder of his family. He has leased for several years a beautiful house and estate in Weybridge, one of the most charming of London's suburbs, and has been fortunate in securing one equipped with all the modern improvements, including a system of heating by hot water, a rare thing to find in England.

Municipal Ownership in Detroit

In March last, H. S. Pingree, Governor of Michigan, affixed his signature to the so-called "McLeod" bill, thus creating it a law. This bill gives the city of Detroit the power to acquire and operate all the street railway lines in that city and gives the conditions under which they are to be so acquired. As is quite generally known, municipal ownership is one of the pet theories of Governor Pingree, and he has been endeavoring for a number of years to put his opinions into actual practice. To this end about a year ago he opened negotiations with T. L. Johnson and R. T. Wilson, the holders of a majority of the stock of the Detroit street railway properties looking to the transference of the roads to the city at a price to be decided by a commission. The new bill is the result of these negotiations.

There are twelve sections in the bill and its provisions are briefly as follows: The Common Council of the city of Detroit is authorized to appoint three persons who shall constitute a board of commissioners to be known as the Detroit Street Railway Commission. One of these commissioners shall be appointed for a term of two years, one for a term of four years and one for a term of six years. At the expiration of each respective term, the Mayor shall appoint the succeeding commissioner for the term of six years. The bill expressly provides that no alderman shall be appointed on the commission. Before entering upon the duties of their office, the commissioners are severally required to execute a bond to the city of Detroit in the sum of $250,000 to secure the faithful performance of their duties. This commission, with the consent of the Common Council, is empowered to construct, operate and maintain, lines of street railway, to carry passengers and freight and to use the earnings of the road to that end. The commissioners are also empowered, if in their opinion it is deemed necessary, to issue bonds in the name of the city for such amount as may seem proper, the sum to bear interest not exceeding 4½ per cent per annum, and to be payable thirty years from date in gold. The bonds will not, however, be a charge against the city or the property of its taxpayers, but the commission will pledge for the payment of the bonds all assets and property connected with or relating to the line of the street railway constructed by said commission, and as additional security the commission is authorized to grant to a trustee a franchise to maintain and operate said line of railway for a term not to exceed fifty years and on such conditions as said commission shall deem proper. The rate of fare over a single line shall not exceed five cents for a single fare, and six tickets must be sold for twenty-five cents. In addition to this, the workingmen's tickets (at eight for twenty-five cents), already provided for by a street railway ordinance, will be maintained.

The franchise to be granted to the trustee shall be of no force except in the event of the default of the commission or said city in the payment of the bonds. In the event of such default the franchise is to be transferred to a corporation to be organized by the holders of the bonds and all rights, powers and benefits guaranteed by the franchise shall inure to the benefit of the holders of the bonds.

The bill expressly provides that the commissioners may purchase the present street railway lines in the city and may issue bonds to the necessary amount to pay for the same. These bonds are to bear interest at a rate not exceeding 4½ per cent per annum and to be made payable not more than thirty years from date. These bonds also will not be a direct charge upon the property of the taxpayers, but will be secured by the net earnings and tangible assets and property of the street railway lines purchased, and, in addition, by a franchise granted under similar conditions as mentioned above.

The three commissioners appointed are Governor Pingree, Carl E. Schmidt and E. G. Stevenson.

The price to be paid for the present street railway lines has not yet been fully settled. The companies are bonded for $11,000,000. It is estimated, however, that the system can be duplicated for about $5,000,000 at present prices. It is thought that the city will pay about $12,000,000 for the properties.

Late in April it was announced that a technical flaw had been discovered in the McLeod bill, and that the law would be declared null and void. It is claimed that the engrossed bill does not contain a clause which was in the original; namely, "Providing that nothing in the act shall affect the granting of franchises by the City Council." Governor Pingree thinks that this omission will not invalidate the law, but it is stated the street railway companies will make the alleged discrepancy a strong point in the proceedings they are about to bring in the courts to test the act.

Messrs. Issigonis and Piltacos, of Smyrna, have been granted a franchise for the construction of a railway in that city.

Some of the Larger Transportation Problems in Cities*

BY EDWARD E. HIGGINS

The managers of a large city railway system are constantly called upon to deal with problems of great difficulty and complexity. They have a double responsibility—a responsibility to the public and a responsibility to the investors of whose interests they are trustees. They are charged with the management of thousands of employees whose attitude toward the enterprise, whether of content or discontent, is of vital importance to its success. They must pass upon inventions and improvements in the science of municipal transportation, determining where costs and true economy join hands; they must adopt operating methods adequate to the development of the system and of the city which it serves; they must care for the comfort and pleasure of the public, and they must so unify all of these varied and sometimes conflicting duties as to develop an organization and management successful as a whole and not unduly weak in any part.

Grave misunderstandings often arise between street railway companies and the public. The people often believe the companies to be grasping, sordid, careless of their duties as public carriers, and desirous only of making the largest possible return to stockholders. The companies, on the other hand, daily harrassed by complaints about inconveniences suffered, small or large, often come to regard the public as unreasonable in its demands, forgetting that that public is not in a position to see all the difficulties and perplexities which beset the management at every turn, and which make it often impossible either to grant such demands or to explain why they cannot be granted. The street railway business as a whole is so complicated and so much a matter of detail that no one department of it can be well understood without some knowledge of the others, and fragmentary or partial explanations of the reasons for specific decisions, however sound in their relationship to the general plan of management, might not always or often appear so to non-technical critics.

I shall attempt in the following discussion to give such an explanation of the entire scheme of modern street railroading on its broad lines and of the principal problems which the manager has to solve as will lead to a clearer understanding by those who are not of "the faith" of what the public has a right to expect from the street railway companies, which are its servants and which are, as a rule, honestly trying to fulfill all the obligations which can reasonably be imposed upon them.

ESSENTIAL DIFFERENCES BETWEEN CITIES

In the first place, it cannot be too clearly made evident how different are the transportation conditions in each city from those of any or all other cities. Nothing can be more fallacious, or lead to greater injustice, than to say that because such and such concessions are granted by the companies to the people of a certain city, therefore, similar ones can and should be made in another city. The most common error of all, perhaps, is to assume that the conditions found in a small city obtain in a large one or vice versa. Population and population density have an enormous influence on street railway earnings, profits and possibilities of generosity. A second even more common error is to hold that as much ought to be expected from an old company which has passed through one or more experimental stages of street railroading and has had to throw away enormous investments for antiquated motive powers and to purchase their substitutes at high initial prices, as from a new company just entering the field, with all the accumulated experience of many years to draw upon, and with the benefit of the low prices for material and supplies of the present day. Behind these more obvious injustices come others less easy to understand without some technical exposition. How, for example, can a manager satisfactorily explain to the public the reason why the people of his city patronize their street railway system to the extent of only $3 per capita per annum, while in another city of the same population, the earnings are over $5 per capita? When the generosity of the richer system is cited as a precedent for the poorer to follow, it is a delicate matter to show that the latter's public is largely composed of the working classes to whom the daily five or ten-cent fare forms a material burden, or a difficult one to make clear that the plans on which the two cities are laid out are radically different, the one calling for greater patronage of street car lines than the other, without necessarily involving greater expense to the operating company. A knowledge of these differences in city plans and lines of development is so essential to the understanding of the theory of street railroading that a brief explanation of their effect upon earnings is desirable.

The world's great cities are, with scarcely an exception, built upon or around some form of water front—sea, lake or river. Upon some section of this water front is always found the "congested district" devoted to commercial and business purposes. The manufacturing districts of a city may or may not be on this water front, according to the location of the railroad termini and branches, the presence or absence of rivers tributory to the main water front, and other governing conditions. All, or nearly all cities are laid out and developed on one of four distinctive plans; first, the peninsula plan, such as that of New York city (Manhattan Borough) and San Francisco; second, the valley plan, with a river or rivers running through the center, such as Pittsburgh; third, the radiating plan, with territory on one side only of water front, such as Chicago, Boston, Brooklyn and many other cities, and fourth, the radiating plan with territory on both sides of the water front, of which examples are found in Metropolitan New York (including Eastern New Jersey), Paris, London and many other cities. large and small.

The peninsula and valley plans usually call for comparatively small street railway track mileage, and great traffic density is found on that mileage, together with large gross earnings per capita served, per mile of track and per car mile. For example, the complete transportation system of New York city proper (Boroughs of Manhattan and the Bronx) earns about $13 per capita gross, and that of San Francisco nearly $14. The radiating plans mean greater street railway mileage for the population served, and usually a much less density of traffic and less gross receipts per capita. The Chicago surface and elevated lines, for example, earn less than $10 per capita, and the surface lines of St. Louis hardly $8 per capita.

It can be easily seen how different, for example, is the transfer problem in a peninsula and valley city from that of a radiating city. In the former there may be a few through lines of heavy traffic with many cross-town feeder lines. Transfers in such a city might mean no additional expense to a company and little or no complications. In the radiating city, on the contrary, a transfer system might mean a ride of great length, while the plan of the system might be such that dishonesty in the use of transfers would be easily possible.

Again, a city plan very favorable to economical operation might make a four-cent fare possible in a given city, while in another city, even of the same population, such a fare would mean bankruptcy. A city system of large track mileage running many cars might have immense maintenance accounts to deduct from earnings, whereas a more fortunate one in another city would have a great traffic density on small mileage. All that a comparison of practice between the street railway systems of two cities can do, therefore, is to put the burden of proof upon the system which is apparently less generous with the public of showing why the more generous practice cannot be followed, and the company's argument should be received with attention and respect; for, after all, nothing is more certain than that the best reasonable service of the public will bring about the largest earning power to a street railway company, and none is more quick to recognize this fact than the average street railway manager.

THE FUNCTION OF ELEVATED AND UNDERGROUND RAILWAYS IN CITY TRANSPORTATION SYSTEMS

The question of adding to existing facilities or solving difficult congested district problems by the building of elevated or underground railways is facing the managers of several of the principal cities of the world, and it is a serious one indeed. The enormous cost of tunneling, and the hardly smaller combined investment required for building an elevated structure and paying damage claims to abutting property owners, leads, and will lead to a postponement of the issues as long as possible. The great tunnels of Paris are an immense burden upon French taxpayers, while private capital cannot hope to make a success of tunnel enterprises except in countries where rates of interest are extremely low, and even then the public must usually be called upon to help by special concessions or subsidies of one kind or another. The London Metropolitan underground system is a failure financially, partly because of its immense cost and partly because it was not properly laid out to obtain the greatest density of traffic. It is hoped that the new Central London Underground will be more successful, being comparatively short and built under one of the heaviest traffic routes of that great city. Private capital has so far shown very little enthusiasm for an underground railway in New York city, where, if anywhere in America, such a railroad should prove profitable.

The elevated railway system of Manhattan Island has been in the past exceedingly profitable, chiefly because it is built in a "peninsula city" *par excellence*, where an immense tide of travel sweeps south in the morning and north at night along few and narrow lines, but the fact that through all these years until the present time, the New York elevated lines have had as competitors only

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comparatively slow-moving horse cars, has been almost equally potent in affecting profits, since short distance as well as long distance travelers have been obliged to use the elevated when time is an object. Elevated railroading in the two "radiating cities" of Brooklyn and Chicago has been distinctly unprofitable. In cities of this class it is difficult or impossible to find the density of traffic necessary for the payment of operating expenses and interest upon the heavy capital outlay required. This is particularly true where the surface cars are run at frequent intervals and at high speeds, for the latter will inevitably obtain the short distance, or more profitable class of traffic, leaving the long distance, or unprofitable class only to the elevated lines. Moreover, in cities of the radiating class, the population is usually spread out over so large an area as to make it impossible for any one line to obtain a large proportion of the traffic. The adoption of electricity on the elevated lines of Chicago has favorably affected gross and net earnings, and with the scaling down of capitalization which has recently been accomplished, there is a possibility that a reasonable return on the new capitalization can be made if new competitive conditions do not arise; a similar result is hoped for in Brooklyn. It is by no means improbable, however, that the only permanent solution to the problem of running surface, elevated and underground railways in the same city is to have them under one control and management, so that the surface lines can serve as feeders to the elevated or underground lines, an express service only to be given on the latter, and a fare charged for the combined service somewhat greater than the single five-cent fare.

In the congested districts of our principal cities, elevated or underground lines, either, or both, will find a true and valuable field. The business sections of Chicago and Boston furnish problems of the most serious and complicated character, which are only partially solved at present, and are likely to grow graver in geometrical ratio as the years go on, and as the territory tributary to the business centers increases in area and population. It is probable that the only permanent solution to congested district problems in cities lies in subway or tunnel lines and loops in these districts. These will take from the surface of the streets the enormous crowds of people which at morning and evening hours of the day pour into and out of the tall buildings which have become so necessary an evil in the modern city business districts. Boston's new subway is a decided, though not as yet a complete, success in relieving congestion and saving time throughout a large portion of the twenty-four hours. The new Boston elevated lines at present under construction will be of great assistance in this congested district, passing as they do from its limits on the north and west (the latter projected) to those on the south, and the managers of the great city railway property in Boston have done wisely in confining these elevated lines to the congested district and not carrying them to a greater distance away from the business center. In Chicago, the loop terminal of all the elevated lines, recently put into operation, has been a great convenience to the people, and has added largely to the traffic, but it is a question if it has not even so soon nearly reached its train capacity, particularly on days of its heaviest traffic, for on a recent holiday, no less than 65 per cent of the trackage on one of the loop lines of the structure was covered by trains, i. e., they were less than a train length apart on an average.

THE PROBLEM OF MOTIVE POWER

No decisions which street railway managers have been called upon to make during the past ten years have caused them such anxious solicitude, and have meant so much to the public and to stockholders, as those connected with motive power Ten years ago horse traction was almost universal, with the cable in use or building on the heavy traffic routes of a few cities, and electricity just coming into sight. To-day electricity reigns triumphant, having displaced both horses and cable on nearly all the mileage of American cities. A synopsis of the reasons for this wonderful revolution in transportation methods which has completely changed the complexion of our cities and added new life and vigor to their daily routine, will be of present as well as retrospective interest, inasmuch as the primacy of electricity, and particularly of overhead wire electric traction, is still occasionally disputed.

All motive powers may be divided into two classes, those which make a car a more or less independent unit on the streets, and those which make it constantly dependent on some central source of power. To the first class belong the horse car, the storage battery electric car, the compressed air car, and various forms of gas, stored steam, petroleum and other motor cars. To the latter belong the cable system and the electric overhead wire and conduit systems.

Independence in the car unit is a highly desirable thing. With it comes minimum disturbance of the pavement or obstruction in the streets with minimum investment for installation; and with it comes also an avoidance of the danger that the central source of power may give out and stop the entire system or any large section of it for a considerable period. There is no question that a really successful independent unit system would be heartily welcomed by street railway managers, certainly as an auxiliary, and would find a large field immediately ready for occupancy.

But there are serious obstacles to success. It is probably impossible to devise a power generating and using system which will go within the narrow space limits available in a modern popular car, and which shall be capable of exerting as a maximum a power four or five times the average amount required for the propulsion of the car. Such a system can be placed in a dummy car and some room left for passengers as well, but when one or more trail cars are to be drawn, difficulties of traction come up immediately. At all times there is the impossibility of generating power in small amounts with anything like the economy with which it can be generated in large. If power be generated in quantities at some central station and stored in some one of several forms for transfer to and use on a car, that car is quite as surely dependent on the central station as it would be were the power transmitted by wires or cable, and is likely to give even more trouble through the exhaustion of the stored power and the consequent stoppage of the car on the line. Still another difficulty is found with so-called independent car operation (except where electric motors are used as in the storage battery system), and that is the impossibility of producing a rotary motion without the use of an initial reciprocating motion, with all the latter's well known disadvantages in the matter of wear of parts and reduction of tractive effort on grades, curves and in starting. Finally, such disagreeable concomitants as odor, noise, or danger of explosion must be excluded if the independent motor is to be an entire success.

Modern street railroading requires constantly increasing average speeds over city streets without increasing danger of accident. With the short runs between streets and the many stops necessary for taking on and letting off passengers, high average speeds can be obtained only by means of high rates of acceleration in starting, and correspondingly high braking effort in stopping. In other words, maximum speed must be reached as quickly as possible and kept up as long as possible before brakes are applied.

Now, the one propelling agency adapted for this peculiar class of work, so far developed in the entire transportation field, is the electric motor, with its constant rotary effort, or torque, and with its almost infinite capacity for automatically absorbing and transforming electric power into a rotary effort. A little 25-h.p. car motor can be overloaded 100 per cent or more if the occasion requires, and will take power until its wires actually melt in the process. There is no such reserve power in any form of reciprocating motion engine—no such constant torque and no such ease of control. Compressed air, stored steam, gas, petroleum and other motors all have their possibilities of development, mechanically and commercially, and when proven successful in practice on any considerable scale, there will be certain portions of the general transportation field open to them, but it is equally true that the electric motor has intrinsic advantages such that it will never be displaced in street railway service, while it is certain also that it will reach into larger transportation work now performed exclusively by steam locomotives.

Before proceeding further with electric motors, a word should be said about the cable system. It would appear at first sight that here also is found a system which would fulfill the requirement of maximum acceleration and braking possibilities, and consequent high schedule speeds. Maximum acceleration can certainly be obtained with the cable, as has frequently been demonstrated by a surly or incompetent gripman, to the great discomfort of passengers, but no cable line can compete with a parallel electric line in point of schedule speed for the reason that the maximum speed is limited to the speed of the cable, and the latter must be kept down to a point such that slippage through the grip is not continuous. In other words, there is little probability that cable cars, once behind their schedules, can catch up to them unless by rare good fortune in not being required to stop for passengers, while with the electric cars there is always the possibility of flying through the streets in the suburban or less congested streets so as to make up time lost elsewhere. As a matter of fact, the cable is disappearing from American street railroads, partly because it is not popular, as it is found that the people always prefer parallel electric lines because of the greater smoothness in running, and partly because of the greater economy in operation, demonstrated again and again in our leading cities where both motive powers have been used. The cable system is a complicated one with its immensely costly and cumbersome construction, which requires constant care and attention, and it is true, moreover, that a cable line cannot be sectionalized to the extent than an electric line can be done, to the end of minimizing the stoppage of traffic.

Granting, therefore, that the electric motor is the city transportation agency of the present and the future, there remain to be considered the relative advantages of the overhead system, the conduit system and the storage battery system. In spite of numerous attempts to put the latter system upon a commercial basis, it has not yet been demonstrated to the satisfaction of street railway managers that it can be used with economy on a large scale, or that good acceleration and grade climbing work can be done where storage batteries alone are dependent upon for reserve and contingency requirements. The equipment of the Chicago and Englewood Street Railway with storage batteries is about the only ambitious experiment on a scale that is now being tried in this country, but abroad batteries are used quite largely and successfully in what is called the "mixed system," in which the overhead trolley system is used for suburban and outlying lines, and storage batteries for the business centers. The great difficulties in the way of storage battery work for transportation purposes lie in the great weight of the batteries to be transported, the deterioration of the plates, particularly when called upon for the widely varying power requirements of a street car, and the somewhat sluggish action of the cars in acceleration. It is by no means unreasonable to hope, however, that improvements will come in this line such that commercially successful storage battery cars may be made possible.

The central station method of operating street railway systems, particularly by electricity, has many intrinsic advantages. In the first place, power can be generated at such stations in large quantity and at extremely small expense. It is probable that in the largest street railway power station in the world now building in New York, the cost of power will be reduced to three-quarters of a cent per car mile, or less than 8 per cent of the total operating expenses of the system, this cost including all losses of generation, conversion, transmission and reconversion. The inherent advantages and possibilities of electric transmission for power purposes are such that it is difficult to conceive of a more perfect adaptation of means to the desired end. When, however, the matter of transmission is taken up in detail, three methods present themselves for selection, the overhead wire system, the open slot conduit system and the surface contact, or "Button system."

The overhead wire system is the one in almost universal use, and the wisdom of its adoption has been completely justified in a large majority of cases. It is inexpensive to install as compared with the other two systems; it is, when well put up, probably more economical than either, and troubles can be easily located and quickly remedied. Its chief disadvantage from the public point of view is the so-called unsightliness of poles and wires. In the early days of electric traction, there was certainly grave cause for complaint about this feature, but since then the improvements have been so radical that it has no longer great force, while the danger of falling wires and of obstruction to firemen in the discharge of their duty has also been done away with to a very large extent, so that there are to-day as few accidents of any kind from the operation of trolley cars in our principal cities as could possibly be expected in view of the immense number of passengers carried, and the congested conditions of the streets.

The surface contact, or "button system," is not in use on any large scale in this country, but a large installation has just been made in Monaco, which is said to be working successfully. The chief trouble with this system lies in the employment of a great number of pieces of mechanism more or less complicated, and liable to failure, the number usually being 500, at least, per mile of single track. Theoretically, the system is an excellent one and has many points of advantage, but it has not come into common use as yet, and time only will tell whether or not the mechanism can be kept in good working order indefinitely without constant danger of "tie-ups" or delays.

The open slot conduit system is in use in America only in New York city and Washington. In New York it has cost probably ten times as much as an overhead system would have cost to accomplish the same results, and its operating expenses are probably about the same as, or perhaps slightly less than, those of the equivalent overhead trolley system.

The city of Glasgow, Scotland, in common with many other British and European cities, has before it to-day the problem of determining which of these three varieties of electric traction shall be adopted. Glasgow has had some experience with the overhead system, and knows that it is reliable, reasonable in first cost, and economical in operation. The favorable results obtained on the conduit lines of New York, Washington and a few European cities, have been studied in Great Britain and elsewhere with the greatest care and interest, and yet it has been determined in Glasgow and other places to use the overhead system in preference to the conduit. The fact is that it is only in cities where great traffic density obtains, and where the mileage to be equipped is comparatively small, that it is possible to pay interest upon the enormous investment requisite for the conduit system, and this is particularly true if this investment has to be piled up upon that for previous improvements, such as the equipment of horse lines with the overhead system. Moreover, the climatic conditions must be favorable in order that success with any form of conduit system may be assured, and the sewerage system must be perfect, for unless the conduit can be kept perfectly clean and free from snow or accumulations of water, serious electrical troubles will occur, which may tie up a railway in whole or in part. If the street railways in this country now operating on the overhead electric system were compelled to change to the conduit system over their entire lines or any large portion of them, financial ruin would undoubtedly be the consequence.

All these problems of motive power have had to be faced by managers in this country, and are now before the tramway managers of Europe. They are wise in their generation who have looked, and are looking forward to the future of their properties and of the cities in which they are located, and who recognize the importance of the part which local transportation plays in the onward march of a great and constantly growing city. The real interests of the people and of the private capital engaged in street railroading are, or should be, substantially the same. The ideal system for both is one which can be handled with the greatest certainty in operation, and which can be indefinitely extended into suburban territory in advance of population without too great cost and without the necessity of transfers, and which can be built at minimum expense for the advantages given. It cannot be for the public interest to load down street railway companies with constantly increasing burdens, such as the adoption of the most costly forms of motive power, if cheaper would answer the purpose, for by doing so they thus postpone still further the time when any reductions can be made in fares or a system of profit sharing with the city can be established.

THE PROBLEM OF CARS AND CAR SERVICE

Upon the character of the cars and the car service of a street railroad depends largely the gross revenue which will be derived from the public. One of the key notes to success in handling street railway property is to bring about to the greatest possible extent "short distance riding." The number of times that a car can load up and empty itself upon a trip governs the success of that car from a profit-earning standpoint. For this reason it is essential that cars be run frequently enough to make them a convenience to those who would walk were not the opportunity of riding offered on the instant. But on the other hand, the frequency is limited by the number of people who could by any possibility be induced to ride. In practice the manager has to experiment with car frequency until he strikes that which will bring about maximum earnings, and at this point it is not far from the truth to say that the public is well served.

The car service must also be rapid, for the short distance rider takes a car not only because it is right at hand, but also because he can save some minutes in getting to his destination.

The car must be comfortable and well lighted, by windows in the day and by lamps at night, for the further advantage and attraction of the traveling public. Never has there been such attention given to the comfort and convenience of the people as in these days of electric traction. When the investments are large, the business required to maintain that investment must also be large, and the margin between success and failure is so small that an inferior or unpopular service means a loss of business sufficient to turn the scale. In some of the Western cities, St. Louis in particular, where several companies are competing for business in the same territory, there have been developed many novel and attractive types of cars to the advantage of the public if not of the companies. The carrying of traffic is so delicately adjusted in cities like St. Louis that oftentimes the appearance of ten or fifteen new and beautiful cars on a given line has meant an increase in receipts on that line of hundreds of dollars a day, and a corresponding diminution on the lines parallelling it. These other lines, finding it necessary, of course, to get back their traffic, have been forced to order even better and more attractive cars. In the old horse railway days, 12-ft., 14-ft. and 16-ft. closed cars with longitudinal seats, and six or seven-bench open cars with cross seats were in almost universal use, though many railways denied themselves and the public the luxury of the open cars. To-day cars range in length from 20 ft. to 40 ft., and a 16-ft. car looks almost as small and as much out of place as the old 10-ft. and 12-ft. cars of the horse railway era. With these longer cars has come greater steadiness in riding, and trucks have been greatly improved to the end of bringing this about. The West, always in advance of the East in obtaining beauty and convenience in railroad passenger trains, is somewhat in advance of the East also in street railway cars, and in St. Louis, Milwaukee, Denver, San

Francisco and elsewhere, will be found some of the most beautiful travel attracting street cars in the world, with cross seats, center aisles, broad windows, window guards, electric signals and elegant fittings throughout.

Somewhat strangely, perhaps, the almost universal foreign custom of providing roof seats on tramway cars has not been popular in this country, the reason appearing to be that such cars are better adapted for slow speeds than for high, and for countries whose peoples do not place upon time the same value that Americans do, for there is no question that it would be impossible to keep up the present schedule speeds on American street railroads if the cars were obliged to take time to load and unload passengers to and from the roof seats, while the danger of accident to people not used to climbing up and down the stairs while cars are in rapid motion would be considerable.

The manager or employee who lays out the schedules of a street railway has in his hand when doing this work the operating profits of the enterprise. If he is too niggardly with car mileage, he saves a little in expenses, but may perhaps reduce gross income by a far greater sum than the savings. If, on the contrary, he is extravagant with car mileage, he may increase expenses far more than income. The mean is indeed a golden one, and worth a never-ending series of experiments to determine the maximum traffic and profit possible to be derived from any given line. In more than one instance, a languishing or unprofitable enterprise has been turned into a vigorous and profitable one by the mere application of common sense principles to the car service.

THE PROBLEM OF TRACK AND ROADBED

The introduction of longer and heavier cars, a much more frequent service and a self-propelling power which needs to obtain a grip on the rails, has enormously increased the difficulties of the track problem for street railway companies, and on all sides are being heard complaints that joints are wearing out, rails are showing excessive wear in spots, leading to unevenness of track, and that the repairs and depreciation of roadbed for electric traction have been underestimated. The most heavily worked track and special work of the larger cities will stand hardly three years of service, and the life of electric track varies from this period to ten or twelve years as a maximum, according to our present experience. When it is stated that it costs from $10,000 to $25,000 a mile to replace track, it can easily be seen how serious is this problem, and how great a burden upon the finances of a company is the track repair and depreciation account. In the few places where street railway profits seem excessive, therefore, such burdens as these, which are yet, in all their seriousness, of the immediate future rather than of the present, should be remembered.

THE PROBLEM OF FARES

In this country a uniform five-cent fare is almost universal; in other countries a variable fare, based on distance traveled, is equally universal. There is something more than a mere financial policy involved in the discussion of the fare problem. Broadly speaking, a uniform fare means depopulation of the tenement house districts and settlement of the suburbs—means a clean, happy life in purer air and better surroundings—means individual homes and plenty of room for the children. A graded fare means enormous density of population in the heart of the city, scanty suburban settlements, pale faces, sickly children and a miserable home life for the masses. These words are not too strong, nor is the influence of street railway fares upon these living conditions exaggerated. The difference between the street railway track mileage and investment in our principal cities and those of equal size abroad is something amazing. Compare, for example, Brooklyn, Glasgow and Boston, three cities of about the same size. Brooklyn, with a population of about 900,000, within five-cent fare limits, has over 500 miles of track; Boston, with 700,000 population, has 325 miles of track; while Glasgow, with 800,000 population, has but 77 miles of track. The total street railway investment in Brooklyn is nearly $100,000,000, in Boston is over $25,000,000, and in Glasgow less than $4,000,000. The 800,000 people of Glasgow are distributed over but 23 sq. miles of territory, and the population in the city is therefore about 35,000 per sq. mile; Brooklyn's 900,000 inhabitants live in a 45-mile area, and have a population density of but 25,000 per sq. mile, while Boston's 700,000 inhabitants are happy in 122 sq. miles of area, with a population density of but 5700 per sq. mile. Is not the uniform fare principle justified by these figures alone?

For five cents a citizen of Brooklyn may travel more than 10 miles. A citizen of any of our great cities can travel 10, 15, or even 20 miles. In doing so he inflicts a loss upon the company, and if there were a large proportion of the total number of passengers carried who traveled so far, or even 5 or 10-mile distances, our city railway properties would be continually unprofitable and probably insolvent. It is in the short-distance riding that the losses are made up, and it must, therefore, in frankness be admitted that the short distance rider pays part of the fare of him who rides the longer distance. This is an apparent injustice, which cannot, however, be remedied unless the whole principle and policy of American street railroading be radically changed, and the effect of the change would be undoubtedly disastrous from a sociological point of view, tending to check the expansion of cities into the suburbs and increase the congestion of life in the centers.

Is the present five-cent fare too high, and can it be reduced without consequent disasters to street railway companies? Both these questions can be most emphatically answered in the negative. The street railway companies of to-day are giving to their patrons a maximum ride two or three times greater than that given for the same price ten years ago, and an average ride at least 50 per cent greater; they are giving them a speed in transit from 50 to 100 per cent greater, and are providing them with cars cleaner, finer, better lighted, and in all respects superior to the old regime. Is a mere change of motive power from horses to electricity a magical thing that can multiply wealth as by a philosopher's stone and make all things possible? No. The street railway companies of the country are by no means unduly prosperous to-day. In fact, too many of them are struggling under far heavier burdens than ever ought to have been put upon them by the people. In Philadelphia, for example, the right to change the motive power from horses to electricity has been granted on condition that the street railway company shall lay down new pavement and permanently maintain this pavement on over 400 miles of street within the city limits—a condition more onerous perhaps than that ever before laid upon a quasi public industry, and one which will make the payment of excessive dividends or a reduction of fares impossible for many years to come, if not forever. Take twenty of the great street railway properties of the country, none earning less than $1,000,000 gross per annum. Their aggregate capitalization in bonds and stock outstanding is nearly $500,000,000; their aggregate gross receipts are about $67,000,000; their apparent operating expenses (including taxes) are about $42,000,000, or 63 per cent of the gross receipts, and the percentage of apparent earnings from operation amount to barely 5 per cent on the total capitalization.

"But these properties are overcapitalized," it will be said.

Admitted.

Suppose I assume, too, for the sake of the argument, that the overcapitalization is 100 per cent—that the real accumulated cash investment in all these particular properties is not $500,000,000, but $250,000,000. This certainly would seem to be an assumption sufficiently sweeping to suit any critics, and is far larger than the fact.

As a result we have apparent net earnings equivalent to a return upon investment of 10 instead of 5 per cent. Is this larger figure too great for risks so serious as those which have to be taken by investors in street railway properties?

But this is not all. These twenty properties are not now in reality earning 5 per cent on their $500,000,000 of their capital liabilities, or 10 per cent on half this amount. They are knowingly or unknowingly deceiving themselves in the matter of maintenance, and some day there will be a reckoning in consequence. In other words, their percentage of operating expenses to gross receipts is much more than 63 per cent, and perhaps hardly less than 75 per cent, and they are probably earning on an average but 4 per cent or less on their capitalization.

THE PROBLEM OF TRANSFERS

To most people, no doubt, the transfer problem appears a very simple one. Surely it would seem that no more just and reasonable demand could be made on a street railway management than that a passenger should be allowed to ride from any point within a city to any other for a single fare, particularly if the entire system is owned by one company, and if the city is a small one. It is on deeper investigation only that the real difficulties appear. Broadly speaking, it may be said quite certainly that hardly a street railway manager in the country would object to the simple proposition outlined above if that were all there were to the problem. It is not of serious importance to him whether a passenger complete his ride on the original car or on a connecting one. The trouble is found in limiting the use of transfers to their entirely legitimate purpose without running against sheer dishonesty on the part of the public, and on that of the company's own employees. The entire transfer problem is one of preventing this dishonesty and of nothing else. To prevent conductors from replacing cash fares with transfers is possible only by the most careful comparison of returns and records in connection with a more or less complete detective force, and the cost of this combined service is often very large. But a more serious trouble than this by far is found in the "swapping" of transfers by, for example, clerks in the same offices living in different parts of the city, or by their improper use in other ways for return or continuation trips, and in the actual giving away or selling of transfers taken for that purpose at the close of the honest trip. There are not a few cities in which the routes are so peculiarly laid out as to make it practically impossible to put into effect a transfer system which cannot be thus tampered with to a most serious extent, while in all cities there is a more or less large percentage loss from illegitimate use. The fact that in nearly all cities of America the street railroad companies have conceded some form of transfer accommodation and are standing the consequent loss in receipts and in operating expenses, should be credited to them as a partial offset for some of the things which they have been obliged to refuse the public.

THE AVOIDANCE OF ACCIDENTS

In the operation of many cars through crowded streets of cities, it is inevitable that there should be accidents, trivial and serious, from the running down of a peddler's cart to the killing and maiming of a carload of passengers. The fact that the trivial accidents are so few and the serious ones so extremely rare in proportion to the number of passengers carried and to the number of obstructions, human and otherwise, in the streets, points to the remarkable care which is uniformly exercised by the employees of our great companies working under carefully established rules. During the year ending Sept. 30, 1897, the street railway cars of the entire State of Massachusetts ran 61,577,917 miles, and carried 308,684,224 passengers. The number of accidents of all kinds was so extremely small that the cars traveled on an average over 48,000 miles before injuring a passenger, and about 83,000 miles before injuring any one in the streets or highways through which they passed. The number of fatal injuries was only one for each 200,000 miles traveled. The number of fatal injuries to passengers was but one for each 30,000,000 carried. This is a marvelous record considering the character of the "rights of way" which street railways possess, and indicates the most careful attention to safety in travel.

Accidents may be minimized in number, first, by reducing speeds of cars indefinitely; second, by increasing braking power; third, by the introduction of some form of fender or protective device; fourth, by the selection of employees who will exercise care in the handling of cars, and fifth, by the education of the public itself to treat the cars with respect at all times. Speeds will increase rather than decrease, for the constant effort is and will be, in America at least, to save time at the expense of concurrent disadvantages such as even that of injuries to passengers and wayfarers, and if the proportions do not rise to extraordinary figures, the public will not suffer the carlessness or misfortune of the very few to interfere with the advantage of the immensely greater number. The remedy must be sought, therefore, in the other directions named, and will, as a matter of fact, be found in the combination of all. The public, whether on foot or in vehicles, is daily learning to keep out of the way of street cars, and the lesson of the true economy of good employees has been well learned by street railway companies. No entirely satisfactory braking system of general application has yet been found, but the power of mechanical brakes has been enormously increased since the advent of electricity, while air and electric brakes for the higher speeds of interurban work have been developed, not perhaps to the highest point possible to reach in future, but to one of present commercial and effective value. Fenders are yet a necessity, though a troublesome one, and it is hard to see how their use can be avoided even with the best braking appliances.

THE MANAGEMENT OF EMPLOYEES

It is within the power of the street railway manager to exert an influence for good or for evil—towards better things or worse—in the lives of hundreds or thousands of employees. He can arrange their hours so as to keep them constantly on the move between home and work, or so as to give them long free periods of time within desirable hours. He can harass them with a multitude of rules, or deal with them as reasonable beings with comparatively few rules. He can make them loyal and enthusiastic in the service of the company, or disloyal and indifferent to its interests. Upon his treatment of employees depends the success of his administration more than upon any other of its features.

The new street railroading of to-day has brought into service a much more intelligent grade of employees than was found in old horse car days. Then it was only necessary that a driver should be able to handle horses with reasonable care and to maintain the schedules through the streets. The conductor was watched with the most jealous care to prevent dishonesty. Uniforms were rarely seen, and the morale of the men was undeniably poor.

To-day, the entire force of employees, particularly in the transportation department, is composed of trained men, neatly uniformed and with quick and intelligent minds. They are, and must be smart, "snappy" and businesslike in the conduct of their work. The conductors and motormen must know many things about their cars, which were never required from the horse car force, since blockades must be prevented and the road kept in operation at all hazards. As a consequence, the present employees can be made to feel proud of their work and their opportunities. The organization is more complicated, the chances for promotion are better, and the conditions are in all respects improved. The most successful managers of to-day have put their systems far beyond the danger of strikes by making friends with their men, and putting certain influences into play among them, which enormously increase their *esprit de corps.*

The most important of these influences perhaps is that of increase of pay with length of service. In the old days, the wages of a conductor or driver were no greater to the man of twenty years service than to the six months fledgling. All were treated alike, the theory being that the *work* was the essential thing, not the *man*. As a consequence, disaffection was easy to create in a body of employees. The long service employee felt, indistinctly perhaps, but none the less certainly, the injustice of putting him on a level with the new man, and felt, too, that there was nothing for him to look forward to in the future. All men were equal in the labor meetings, and a knot of the disaffected could sway the entire body of employees.

It is easy to understand the restraining influence brought about by the adoption of a graduated wage scale in a body of employees of this character. Suppose, for example, that this scale runs from $1.75 to $2.25 per day, the minimum being received for the first year's service, and a five-cent per day increase being granted for each subsequent year, so that only after ten years' service will the $2.25 rate be obtained. We have, therefore, in such a force, ten different bodies of men, each growing better and better satisfied, and more and more conservative as the years go by. Each takes a pride and pleasure in every increase of pay, looks forward to still better things, and considers the entire wage scheme reasonable and just. The chances for disaffection are confined to the newer men and the influence of all the others is a restraining one, not only because of their self-interest, but also because of their longer experience with the company's methods and the consequent value of their advice. In the remote contingency of a threatened strike, the employees cannot go before the public with as strong a case as they could were the average wage rate $1.75 or $2; for example, since the company can show that it is really paying the higer wages demanded for experience and ability, and it is the new and untried men who are making the trouble.

Another influence of much the same general character is the adoption of the "service stripe" plan of recognizing length of service. The man who carries on his sleeve one, two, three or four stripes, signifying an equal number of years of service, or one or more gold stripes, signifying five years each, feels the responsibility of his position, and feels a self respect which shows immediately in his care of the traveling public, and which in turn commands respect from that public. He is identified with that company, its interests are his and will be guarded. The officers of the company themselves should have, and do have, as a matter of fact, great respect for the older employees, and the entire force, from the president down, is welded together more and more closely as the proportion of the long service men increases.

Still another good influence among the men is that of promotion to positions of higher responsibility, and the sooner street railway companies realize this and put the principle into practice, the better will be the results they obtain, and the more nearly will they approach the stability and strength which the railroad industry has gained by the security in tenure of office and chance of promotion which has been for many years granted to railroad employees.

The principle of competition in the conduct of the street railway business has not as yet been introduced to nearly the extent that its value warrants. In the maintenance department, for example, piece work as against time work could probably be adopted with considerable advantage. A man will always work harder and more intelligently and adopt better labor-saving methods if the fruits of his work are to be given him in greater remuneration, and while careful inspection of such work is, of course necessary, the conditions under which street railway repairs are carried out are such as to make such inspection feasible and efficient. The experiment has been tried in one or two cases with excellent results.

Another place where the competitive idea can be introduced is in the management of the power used by cars. It is well known that motormen, as a rule, waste power enormously by the improper handling of controllers. In many cases this is done carelessly without much thought of results. In others it comes from a disposition to play with the immense force at the command of the motorman by the mere movement of his hand. The results of this misuse of the controller are seen not only in the power cost, but also in increased depreciation of motors through constant use of excessive currents. Now the very simple plan of placing in each car a wattmeter to measure the power which is used by that car, and of taking regular readings of this wattmeter at the end of each run, has accomplished in one or more instances, and would accomplish in practically all, remarkable results in the saving of power and of depreciation, for the moment that a motorman is called to account for using more power in going over a route than another motorman uses, that moment he begins to be more careful. In one case recently made public, a saving of 33 per cent in the cost of power was effected by this simple method.

The street railway employees' associations, with their corresponding club-rooms, gymnasiums, baths, libraries and monthly and annual entertainments, together with the provisions for death benefits, etc., tend to bring the management and the men into closer union, and are always to be encouraged as valuable adjuncts to the regular work. The library feature, which has been lately introduced on at least one large system, brings the home influence into play in behalf of a management, tending, however slightly, to cause the women of the family to exercise a restraining influence over the men in times of threatened strikes.

Broadly speaking, the modern street railway management, as distinguished from the older forms, brings men into closer communion with the official staff and creates in them a self respect and manliness of character which is the best possible security against trouble. Those managers who have adopted these broad gage methods and have been genuinely solicitous for the well being of their men, have been successful to a remarkable degree in securing the personal loyalty of the latter, and in strengthening their own position and that of their company in the community.

THE ADVANTAGE OF COMBINATION

The public gains, or ought to gain, with combination of municipal service enterprises. No principle in practical sociology is better established, perhaps, than that which grants to public service industries in municipalities the right to be regarded as "natural monopolies." It can never be to the permanent advantage of the people to have two lines of street railway serving the same territory on the same or parallel streets, while it is a distinct disadvantage to have separate companies serving different sections of the city. A transfer system between independent companies is an impossibility on any fair basis, while the almost universal result of a consolidation of several different companies in a single city is the immediate granting of transfer rights, and an immense saving to the people. This one advantage alone is a sufficient *raison d'etre* for consolidation, but in addition to this there are others. The entire transportation of a city can be operated by a single company on broader lines and to the far better service of the people than can be done by two companies. Economies can be introduced and more liberal expenditures in other directions made possible, through routes can be established along the lines of customary travel, and in many other ways the people will be benefited.

The economies effected in the street railway administration are numerous. Instead of several power stations, one or two of the best ones only may be kept in service and the cost of generating and distributing the current may be minimized. A better service may be given with a smaller number of cars than before, the official salary list may be reduced, the principle of division of labor may be introduced into shops, repair force, etc., and the day when fares may be made lower to the people will be brought distinctly nearer.

There is also much to be said in favor of the consolidation of street railway and electric light and power interests. The great difficulty with electric lighting stations to-day—a difficulty which is keeping up the price of light and power to materially higher figures than ought to be possible of attainment—is the fact that the stations can be loaded up to their capacity for but a few hours out of the twenty-four. This puts the working forces to a disadvantage, leaving them comparatively idle for many hours, and reduces the economy of the engine or leaves a part of the plant idle, which thereby earns no interest upon its cost. If the market for power can be increased and the loads distributed fairly evenly over the day, the cost per unit of power delivered will be far less than at present, and the price can be correspondingly reduced. The consolidation of all electric power using interests will tend to bring about this result, and is therefore to be favored on the grounds of public as well as of private gain.

THE PROBLEM OF MAKING A FAIR BARGAIN WITH THE CITY

I have purposely left this most important problem till the last because it is only through a more or less clear understanding of the nature of the other problems hereinbefore discussed that the true character and difficulties of this one can best be understood. There are, and will unfortunately continue to be, a great many false theories and ill-advised schemes put forward to solve the problem of how to best handle municipal service enterprises and to relieve the tension now existing between municipalities and private companies. The truth is that there is no one method of universal application. It is as foolish to assert that municipal ownership of everything in sight will bring the millennium immediately as it is to hold that municipal ownership has no place whatever in the management of public service enterprises. There is a sharp distinction between that class of services which a city has to itself use in whole or in part, such as, for example, sewerage, water supply, gas and electric light, etc., and that class which it does not use, such as transportation. An attempt to control the former class may be defended on the ground of wise economy in city expenditures. An attempt to control that latter has for its basic purpose an idea either of obtaining revenue by indirect taxation or of giving a service to the people at actual cost.

Under all circumstances and with all kinds of enterprises, it is true that municipal corporations, in which responsibility for results is so greatly subdivided, cannot, theoretically, and do not, historically, conduct business enterprises with economy or efficiency, while even more important than the question of mere money saving or waste comes the undeniable fact that the trustees of municipal funds cannot possibly manage these funds on broad lines, or with the calm confidence in the future justification of present expenditure that private capital would have. The taxpayers would not suffer the imposition of present burdens for the benefit of posterity, at least without a storm of criticism which would render the positions of the trustees difficult or untenable.

The transportation enterprise, particularly, is one where investment must be made without regard for present profit if the growth of the city on right lines is to be kept up. For this reason and entirely independent of the mere question of possible revenue to be derived by a city from the operation of its street railway system, I believe firmly that it would be utterly unwise to place the control of a city's transportation agency in other than private hands. I believe that in practically all cases the true solution of the problem of relations between a city and its street railway system is found in granting to the latter private ownership and operation, complete monopoly, perpetual franchises and a system of perpetual profit sharing with the municipality, joined to a remission of charges to the public if, and whenever profits come to be sufficient for that purpose.

By a policy of this kind it is possible:

1—To avoid pledging the city's credit for making the necessary original investment.

2—To place upon private capital the burden of all losses realized or contingent.

3—To obtain for the city an equitable share of all profits actually realized.

4—To avoid the creation by the city of a complex bureaucratic organization with its attendant political dangers.

5—To secure for the benefit of the municipality, its people and the private capital invested the undeniable benefits of private management as affecting profits, perfection of service and direct responsibility.

6—To secure for the municipality, the people and the private capital invested, the true pro rata shares of each in the additional profits coming with municipal development in the future.

When all the safeguards possible to devise shall be thrown around a municipal contract of this character, it will be found that the street railway problem in that particular city is solved for all time, and in a fair and equitable manner. Thenceforward the municipal government and the street railway corporations will work *together* to build up and develop on its broadest lines the municipality of whose interests they are, at once, guardians and servants.

Electric Traction and Its Application to Suburban and Metropolitan Railways *

BY PHILIP DAWSON

There are practically three methods of handling electrically the traffic on a railway, namely:

1. By locomotives or motor cars hauling a train of trailer cars.
2. By independent motor cars.
3. By a set of independent motor cars formed into a train and handled from the front car or from a so-called controller car. Each car, however, can be separated from the train, and it then becomes an independent motor car.

* Abstract of paper read before the Society of Arts, London, March 21, 1899.

As regards the supply of the necessary current for the motors, there are three distinct methods:

Firstly. By accumulators or storage batteries which may be carried either on the motor car or locomotive, or on a tender.

Secondly. By having a car containing a stationary engine, dynamo and boiler, which supplies the necessary current to the motors on the cars comprising the train of which it is part, and as proposed by W. Heilmann.

Thirdly. By continuous or multiphase current supplied directly from a generating station or from a sub-station which, in its turn, gets its supply of energy from the main station, the current being distributed either in the form of direct or polyphase to conductors running along the lines, and from which the power is supplied, through sliding contacts on the cars to the motors.

The two former methods, as far as this paper is concerned, will not be discussed, as sufficient data are not available to justify their being considered.

The system of transmission of energy to the motors by means of conductors laid along the track, will therefore alone be considered.

This method allows of several variations as far as the generation and distribution of power is concerned, amongst which the chief may be set down as follows:

(*a*) One continuous current generating station supplying current direct to contact rail. Where drop in pressure owing to distance becomes excessive, a negative "booster" may be used—it serves, so to speak, to pump back the current to the station, and is self-regulating, not taking at any period more power than is actually required to pump the current back. Should there be one or two lines too long to enable them to be worked this way, polyphase high tension generators should supply the power to one or more sub-stations along the line, as may be found necessary, in which rotary converters are located, which transform the current back into continuous. The polyphase generators to be driven by continuous current motors in the generating station. As an example of such a station, the new Dublin tramway power house may be taken.

(*b*) One central station generating continuous current with substations in which accumulators are located along the road, and which are charged by means of a booster and special cables. As an example of this system, the Leeds tramways may be taken.

(*c*) A series of stations, as described under (*a*) and (*b*), situated at various distances and connected together one with the other. As an example of this, the tramways and light railways in and round Boston, Mass., may be taken, owned by the Boston Elevated Railway Company, which has absorbed the well-known West End Company.

Data of Boston Elevated Railway.

Track miles operated	305
Number of cars	2,648
Car miles run during 1898	29,787,000
Passengers carried during 1898	172,764,300
Number of power stations	5
Total capacity of power stations in kilowatts	16,100
Total rated indicated horse power of engines	24,000

(*d*) A power station generating polyphase currents, which, by means of static step-up transformers, are transmitted at tensions which run from 2500 to 40,000 volts to sub-stations where static step-down transformers reduce them to pressures of 300 to 350 volts, the current at this pressure enters rotary transformers, which deliver direct current at 500 to 550 volts to the line. As an example of this latter system, the Central London Railway, which is now under construction, may be mentioned.

(*e*) A three-wire system with continuous current, the rails or return forming the neutral wire. This has been tried and found wanting, and the engineers of the Central London Railway most carefully investigated its possibility and decided in favor of polyphase transmission and rotary converters, and rightly so.

From careful calculations and the investigation of what has been done both in Europe and America, there is no getting behind the fact that for any power station which will exceed 4000 kw. in capacity, the polyphase system is nearly certain to prove commercially the only admissable one. This statement is upheld by such an authority as H. F. Parshall, M. I. C. E. It is evident that in the particular cases at present under consideration (suburban and metropolitan communication), more than 4000 kw. will be under consideration, and therefore nothing, as far as the power station and transmission is concerned, but polyphase currents will be considered.

There are two distinct varieties of service to be catered for. One that on a system like the Metropolitan and District, where the stops are frequent and the runs short. The other the case of long distance lines with few stops. In the present paper it is only proposed to consider the first variety. In this case the use of polyphase motors need not be considered, as for work entailing frequent stopping and starting they have not up to date proved satisfactory.

A short examination of the importance of rapid acceleration on lines having stopping places at short intervals is interesting. Practical experience with electrically-driven motor cars, or locomotives on the experimental track of the General Electric Company, at Schenectady, has proved that it is perfectly feasible to attain a speed of 30 miles an hour ten seconds after starting from a standstill. Assuming a level track, and that during sixty-five seconds the current is cut off, and the train allowed to coast, that the brakes are then put on, the train will be brought to a standstill fifteen seconds later, and the total time from start to stop will be ninety seconds. Under these conditions it will be found that the average speed will have been 23.16 miles an hour, and that the total distance run will be about .55 of a mile. Assuming that instead of attaining the 30 miles an hour in ten seconds, it took thirty seconds, and that this full speed of 30 miles an hour was kept up for forty seconds longer, and the brakes then put on, the train would be brought to a standstill in ninety seconds, and the average speed would work out as 21.66 miles an hour, or an average speed of about 10 per cent less than in the previous case, the consumption of power, however, being much greater.

It is evident that the most important point is to attain a high average speed, and to keep the maximum speed attained as low as possible, as by so doing less power is required in braking the train, and also less power is required to run the train. The time between the moment when the maximum speed is attained, and when the brakes are put on, should be at least from four to six times that required for stopping the train, so as to allow for errors in judgment on the part of the driver, and also to enable him to make up lost time. On the Manhattan Elevated Railway, in New York, the trains which are drawn by steam locomotives take twenty seconds to attain a speed of 14 miles an hour, or less than half the speed in double the time as compared with electric traction just mentioned.

A much larger current will be required to attain a rapid acceleration than to attain a slow one, but the current will be required during a much shorter time, and the total energy supplied will be less in the case of rapid than of slow acceleration. This fact must not be lost sight of when calculating the feeders for such a system, and the train service should be arranged in such a way that as few trains as possible start together. Furthermore, the more rapid the acceleration required the larger will the motors have to be, and therefore there will be a limit, above which it will not be advantageous to push the rapidity of acceleration. In new tunnel lines, such as are now being constructed all over London, it will be evident that it is an advantage to have the stations built with a down-grade for the trains to start, so as to help the motors and reduce the current required at starting, and that similarly it will be an advantage to have an up-grade when nearing a station, so as to reduce the amount of power required in braking. By properly choosing these gradients it is found that a total economy of from 40 to 50 per cent in the total power required by a train may be made. According to Mr. Potter's tests it was found that during acceleration an average power of 32 amps. per ton of weight of train was required.

From a comparison of the actual results obtained on the elevated electric railways of Chicago and on the Metropolitan & District line in London, we see that whereas the maximum speed of 25 miles an hour is obtained in ten seconds with electric traction, it takes thirty-three seconds to do it with steam locomotives—and that whilst the electrically propelled train could do the distance of 1880 ft. in sixty-six seconds, with steam it would take ninety-three seconds, or nearly half as much time again. If in the case of electric traction the power is cut off the moment the maximum speed of 25 miles an hour is obtained, and the train allowed to coast before the brakes are put on, the distance considered would be done in seventy-six seconds. The steam-driven train even then would take more than 25 per cent more time to do the same distance.

Having tried to show the advantages which electric traction possesses as regards the possibility of increasing the frequency of the trains without decreasing the factor of safety, namely, the distance between two trains, it may be advantageous to see how, from an economical standpoint of generating power, electricity is a cheaper method of operation than steam locomotion. An electrically-driven train only requires one man instead of two to drive it, and when the train is not running no power is consumed and no coal or water wasted. Steam locomotives, it is well known, use but very little less coal and water when they are standing still than when they are running, and are much less economical, consuming, as they do in America, from 5 lbs. to 6 lbs. of coal per i.h.p. On main line English roads it is stated that 3 lbs. to 4 lbs. are consumed, and taking an average power of 400 h.p. per locomotive, and a train plus engine weighing 250 tons, at a speed of 40 miles an hour, we get at the most economical rate about 0.65 lb. of coal per ton mile, or compared to the electric power required by electric traction 13 lbs. of coal per Board of Trade unit required, which is enormous—under favorable conditions it would not take much over 3 lbs. of coal to give one Board of Trade unit at the switchboard. A properly designed electric station with large units would probably never consume more than 2 lbs. of coal per i.h.p.-hour, or 2.65 lbs. per kw.-hour at the switchboard, and engines of the size of 4000 to 6000 h.p. would be guaranteed to consume not more than 12 lbs. of steam per i.h.p.-hour. A large station would fully justify a comparatively large initial expense in coal handling and stoking machinery, and the location of the station could be chosen so as to be most advantageously situated as regards both coal and water, the coal without being handled being taken from either the ship's hold or the railway truck, conveyed automatically to the coal stores, and from thence automatically to the fires, the ashes being conveyed away automatically as well. In such a station but very few men would be required, and the cost of power could be reduced below one halfpenny per Board of Trade unit, including expenses of every kind.

Comparing again the coal consumption per train mile on large English main line railways, which varies from 35 lbs. to 58 lbs. of coal per train mile, we get a coal consumption of from 0.146 lbs. to 2.32 lbs. per ton mile, corresponding to 28.12 lbs. to 46.4 lbs. per Board of Trade unit, required to be generated at the power house. The following results actually obtained with slow speed Corliss type engines and standard American railway generators, may be of interest:

Total coal consumed, Brooklyn City Railway Company, per Board of Trade unit, 3 lbs.

Total cost, everything included, of Board of Trade unit at switchboard, 00.5195 cents (about one farthing).

Cost of coal per unit, 0.2307 cents, about 0.166 of a penny; Union Traction Company, Philadelphia.

Poorest coal, 3½ lbs. consumed, per Board of Trade unit at switchboard.

In another case cost of coal, 0.272 cents per Board of Trade unit at switchboard, about 0.186 pence.

Total cost of unit, all included, 0.591 cents, about 0.296 pence.

Coal consumption in another case with Corliss engine, average for one year, per i.h.p.-hour, 1.65 lbs. to 1.76 lbs.

What good slow speed Corliss engines, properly designed for railway work, compared to other engines mean are shown by the fact that by such a change in a large American station the coal consumption was reduced from an average of 8.3 lbs. to 4.9 lbs. of coal per car mile.

From a series of figures obtained from the various Chicago electric overhead lines, from 0.16 to 0.135 Board of Trade units are required at the switchboard to drive the trains, the average speed of the trains being 13½ miles an hour, and the maximum speed obtained varying from 28 miles to 35 miles an hour.

The coal and water consumption, per Board of Trade unit, must necessarily be very low, the losses in the step-up and step-down transformers and in the transmission and rotary converters would not be very great, and it would be perfectly feasible to attain an efficiency of 60 per cent at the motor terminals and of 50 per cent on the power applied to the car axles. Large engines and large generators and converters are designed so as to take an overload of 25 per cent for any period of time, and be capable of overloading 50 per cent for a short time without injury, and by a selection of proper units a very large economy could be attained.

It may be interesting to mention a few details regarding the two large power stations which are now being equipped in New York, and which will operate the two large tramway systems of that city, namely, the Metropolitan and the Third Avenue. The Metropolitan station is now under construction, and will contain eleven direct connected sets each of 3500 kw., room for extension being allowed, and a capacity having been foreseen of nearly double that amount. The following gives the particulars of the General Electric Company's dynamos which will be used.

The machine will have a frequency of twenty-five cycles per second, at 6600 volts. It will have forty poles, and will run a speed of 75 r.p.m. It will be of the stationary armature type, the core being built up of laminations 0.14 in. thick. Each lamination has two dove-tail projections which fit in corresponding slots in a heavy cast-iron spider. Spaces are left between the laminations at intervals through which currents of air are driven by the rotating field and circulating by intimate contact with core and windings. The armature winding consists of form-wound coils placed in slots in the core and retained by wooden wedges, the edges of which fit into recesses in the teeth. The field frame consists of a cast-steel ring supported upon a cast-iron spider, to this are bolted laminated core of sheet iron, the pole pieces of which project over and support the copper field windings. The field winding consists of copper strip wound on edge with paper insulation between turns. The insulation is such as to stand a test of 4000 volts alternating between the winding and the core. The exciting e.m.f is 125 volts. The collecting rings are of copper, and carbon brushes are used. The armature winding is tested to 12,000 volts alternating. The temperature rise of the machine after ten hours' run at full load is well under 40 deg. C. The efficiencies are as follows:

	Per Cent.		Per Cent.
1¼ load	90	½ load	92.5
Full load	95.5	¼ load	88
¾ load	95	Inherent Regulation	9

The steam engines which drive these dynamos are cross compound Allis vertical engines 46 ins. high and 86 ins. low pressure cylinders, and 60 ins. stroke. They will develop 4500 i.h.p. at the rated economical load, and will be able to work continuously at 6000 h.p. if required, and for a short space of time they are to be able to work at 7000 h.p. The crank shaft is of solid steel, bored and forged, with a hole 16 ins. diameter the entire length, and it is 37 ins. in diameter where the wheel and armature are located. The diameter of the shaft in the bearings is 34 ins., and the length of the bearings 60 ins. The fly wheel will have cast-steel centers, and the rim will be built up of steel plates riveted together. The rim will weigh 225,000 lbs., and the engine itself, complete, about 600 tons, and it is believed that as good results as 12½ lbs. of steam per i.h.p. will be easily obtained. There will be several substations in which will be located step-down transformers of 300 kw. each, which will lower the voltage from 6600 volts to 350 volts. At this pressure the current will enter rotary converters of 900 kw. each, and will be delivered in the shape of a continuous current of 500 volts to the tramway system.

This company operates some 250 miles of tracks and carries approximately 250,000,000 passengers every year.

The Third Avenue Road is now engaged in equipping all existing horse and cable lines with electric traction, and for this purpose has just given out a contract for a power station which will eventually contain sixteen 3000-kw. generators. The generators will be very similar to those described above, and are being built by the Westinghouse Company, who are the sole contractors for the whole work. The engines will be marine type, vertical, and are being built by the Westinghouse Machine Company. Substations with rotary transformers will be used, as in the case of the Metropolitan system.

To give an idea of what may be done as regards power transmission the following few figures may be useful. The first attempts at this class of work were made during the Frankfort Exhibition of 1891, 300 h.p. being satisfactorily transmitted a distance of 106 miles with a pressure of 30,000 volts. Since that time electrical power transmission has largely increased, and the results obtained have been very satisfactory, 4000 h.p. at the present moment are regularly transmitted a distance of 85 miles to the city of Sacramento, Cal., at a pressure of 30,000 volts, where they are transformed into low pressure three-phase and continuous current for lighting, power, and traction purposes. At Telluride, Utah, 1000 h.p. are transmitted 55 miles at a pressure of 40,000 volts; 4500 h.p. are transmitted a distance of 40 miles to Salt Lake City at a pressure of 15,000 volts; 1400 h.p. are being transmitted 35 miles to Fresno, Cal., at a pressure of 11,000 volts; 2000 h.p. are being transmitted 30 miles to West Kootenay, British Columbia, at a pressure of 20,000 volts; 10,000 h.p. are being transmitted from Niagara to Buffalo, a distance of 22 miles, at a pressure of 10,000 volts. All the plants are working and giving satisfaction, and have nothing experimental about them, and there are hundreds more such.

In the designing and carrying out of a large system, there are three points which are frequently overlooked and which may cause a disastrous failure. These are good and adequate bonding; thoroughly good insulation, both mechanically and electrically, and trucks suited for the work for which they are intended.

As regards the bonding, the bonds used should be flexible, but, at the same time, should contain no solder or brazed joint, and they should be expanded against the side of holes drilled in the web or foot of the rail, and held in place by pins. Bonds of this description, when properly applied, can be absolutely relied upon, the contact resistance of the bond with the rail not being greater than the resistance of the solid bond.

With regard to the third-rail insulators, very good results are obtained by using insulating bolts screwed into base plates which are fixed to the sleepers, cast-iron chairs being fixed to the head of the bolts to hold the rails.

Parallel in the Development of the Locomotive and Electric Truck

BY JOHN A. BRILL

There is a remarkable and interesting parallel to be found in the successive steps by which locomotive and electric trucks have been developed. The striking resemblance is found in the treatment of the frame. The frame itself was the outgrowth of the requirements of constantly enlarging lines of service. The first illustration in this article (Fig. 1.) shows a locomotive designed by George Stephenson and built in the year 1836. An elaborate illustrated pamphlet was issued by the manufacturers showing the engine in detail. It was considered the finest machine of the kind which had been constructed up to that time. Our illustration is taken from "Cassier's Magazine," which recently published an article in which much of this remarkable pamphlet was reproduced. The engine was probably the most perfect machine of its type sixty-three years ago. It was put together, so far as its frame was concerned, in the simplest and by the most obvious mechanical method. Rivets were used everywhere to hold parts together and the frame was made up of materials ready at hand in the market. This frame, with its wood filling, was of flat bars and plate iron jaws to hold the boxes. These jaws were put on as independent pieces. A multiplicity of parts riveted together formed what seemed to be a solidly connected whole.

The fundamental principles of construction involved in the frame of an engine of this kind had not been discovered. The controlling idea in its construction was maximum power and convenience of manufacture. In fact, the old locomotive builders worked with the same limited conception of the problem that many of the modern builders of electric trucks entertain. They take, as in the olden times, what comes to hand in the market as most readily available for construction. The similarity of ideas which exists between this ancient frame and some of the electric truck frames of the present day is seen in Figs. 2 and 3. These show a modern built up frame as put in a truck and likewise the same frame by itself. The numerous rivets and the use of the bar iron are obvious. It is true that in the modern truck the wooden packing pieces are replaced with iron blocks, but in other respects there is little difference to be noted. The relationship of the modern truck to the ancient becomes very striking in Fig. 3, where the truck mechanism is absent and only the frame remains.

The very first American locomotive engines were quite similar in design. The model of the first locomotive turned out by Baldwin, now in the office of the Baldwin Locomotive Works, shows a frame of wood. Wooden frames plated with iron were common, if not the rule in the early days of locomotive building. As long as speeds were slow and the work light, these composite structures answered the purpose. How small the internal stresses were may be judged from the fact that the boilers of the Stephenson engine carried only a pressure of 50 lbs. per sq. in. The cylinders were 8 ins. in diameter, and the greatest strain exerted on the piston rod could not have reached 6000 lbs. even in starting. During operation the effective pressure fell off to a surprising degree, and the greatest pull exerted by the piston rod when running rarely reached 3000 lbs. This probably measures the greatest strain experienced in any part of the structure.

Higher speeds and heavier weights made the inherent defects of composite riveted frames very apparent. In less than six years experience American locomotive builders found that such frames were not the proper foundations upon which to mount an engine. In the year 1840, the Baldwin Works were using solid iron frames and it was at that time that M. W. Baldwin was granted a patent for making the jaws or pedestals in one piece with the frame itself which was of wrought iron. This practice has been followed by all American locomotive builders to the present day. The ad-

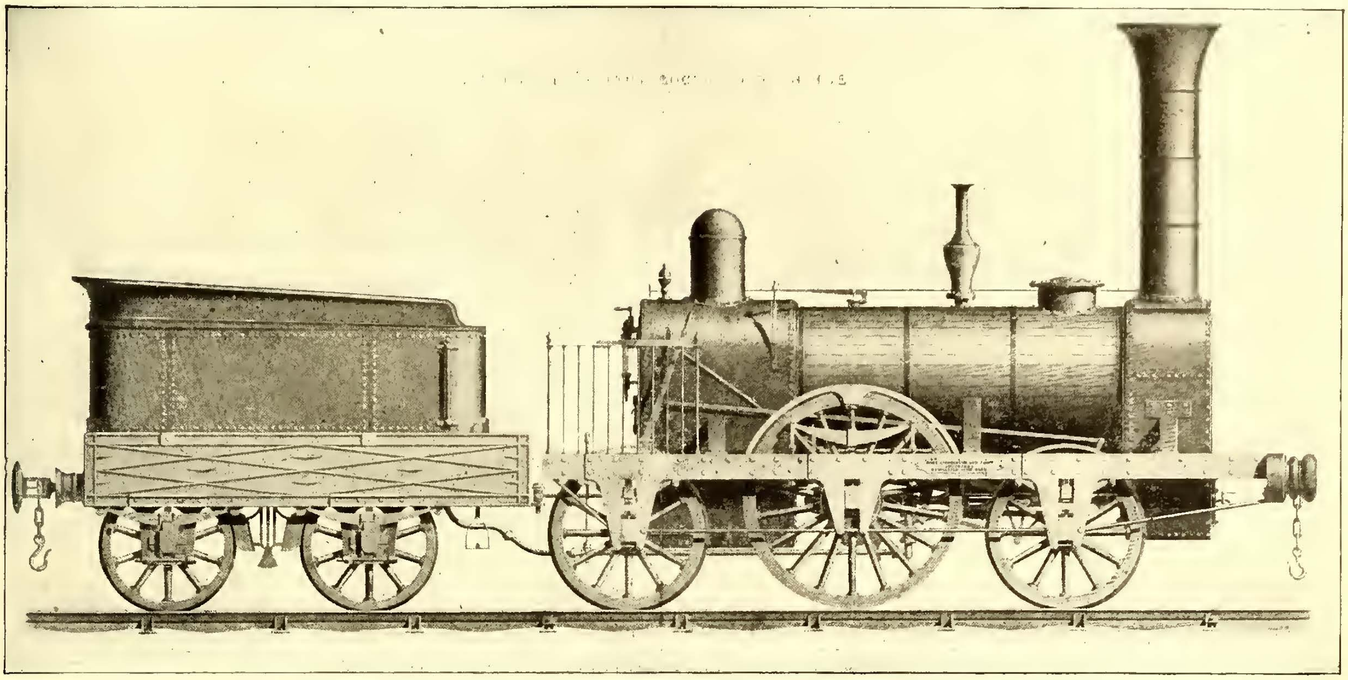


FIG. 1.—STEPHENSON LOCOMOTIVE BUILT IN 1836

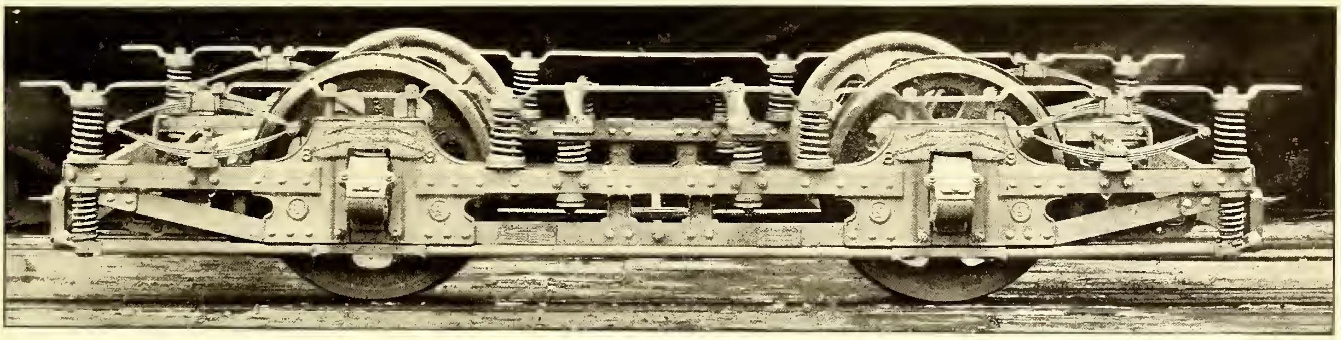


FIG. 2.—A MODERN ELECTRIC TRUCK WITH RIVETED FRAME

vantages of this form of frame were soon recognized and it was universally adopted in this country, only one locomotive builder adhering to the old plate frame for any length of time. His reason for so doing depended entirely upon manufacturing advantages having nothing to do with what was best and most mechanical for the purpose. As mechanical principles became better understood, it was seen that the solid frame was theoretically as well as practically right. The functions of the locomotive frame are simple and easily understood. It has to resist all the strains resulting from the operation of the machinery as well as those involved in the hauling of the train. It must sustain the load which strains it in a vertical direction, and, lastly, it must resist those forces which come into action when moving along the track. This includes the strains which are brought upon it when moving around curves and over irregular surfaces at the same time. In a word, it must be able to resist great strains which may be exerted upon it from all possible directions. Lastly, it must afford easy end for the attachment of the parts. The straight hollow cylinder for the least weight of material is the strongest of all geometrical forms for resisting strains from all directions. Difficulties of construction make them a form impracticable. The solid rectangular bar is the next choice since it has ample rigidity and its flat sides give facility for the easy and rigid attachment of the parts. A square hollow bar would, of course, be stronger for a given weight, but the difficulties of manufacture preclude its use. The American locomotive of the present day is essentially a rectangular bar of iron with the jaws forged into it. The points of the jaw are connected by tie bars, and the outer jaws usually have a diagonal bar connecting them with a prolongation of the main frame. The front section of the frame is usually a single bar of sufficient size and strength to resist all strain which may come upon it.

Fig. 4 is an outline sketch of the main portion of a frame made by the Brooks Locomotive Works for the latest type of six coupled, ten-wheeled passenger engines. Fig. 5 is an engraving of the engine itself. In the outline sketch the Brooks frame is shown from a point just behind the last or trailing axle jaw to a point just inside the cylinder seat. The great length and small scale necessary would make the details too minute to be seen had the whole frame been included in the engraving. It will be noticed that at the forward end a single bar is depended upon to do the work. These frames are neither of them a truss; their strength and stiffness are obtained from the substance and the quantity of metal which they contain. At the jaws where the strains are greatest, there is no attempt to truss or to maintain stiffness by means of braces. In Fig. 4 the inclination of the upper member between the first and second pair of driving wheels is merely an accommodation for the boiler. The bar at the forward end, which carries the cylinders, is a single piece of metal of immense size. This part of the frame could readily be formed into a truss if the truss form presented any advantages. As it does not, builders make it simply a massive bar.

The electric truck is a locomotive in its essential functions. It differs from the locomotive in having the additional duty of carrying a car body, and hence must be a carriage as well as a locomotive. The electric truck builders of to-day occupy a place relative to the art similar to the early locomotive builders. Like the early locomotive builders they are discarding the composite form after having, in their early efforts, given it an effective trial. Advanced

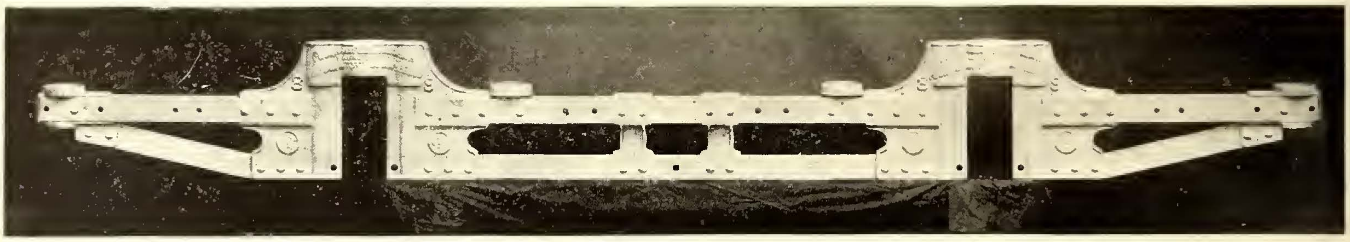


FIG. 3.—FRAME OF TRUCK SHOWN IN FIG. 2

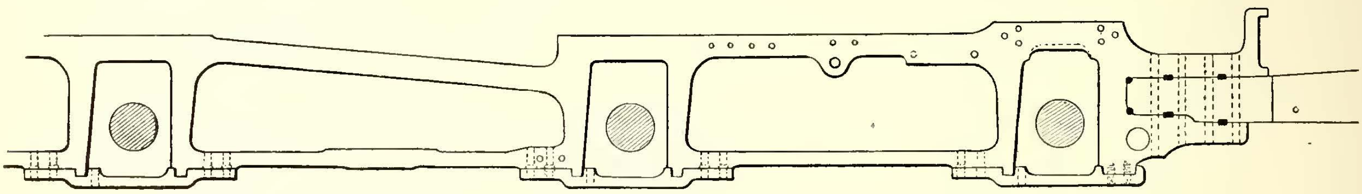


FIG. 4.—OUTLINE OF MODERN LOCOMOTIVE FRAME (BROOKS)

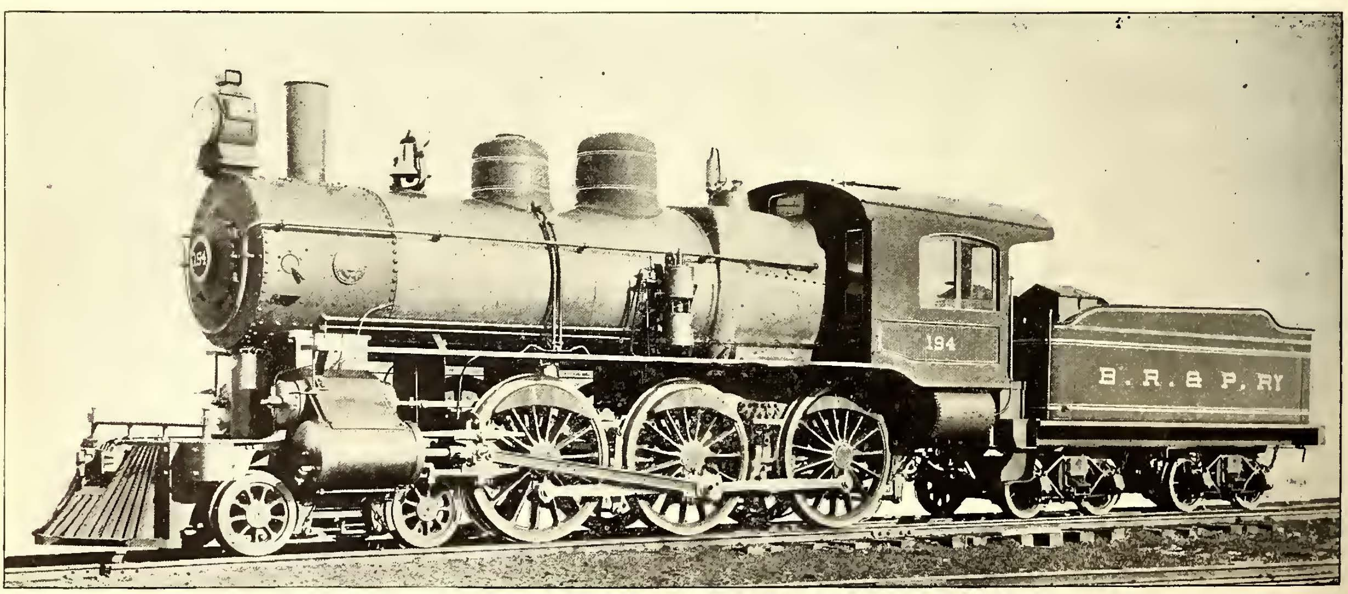


FIG. 5.—STANDARD BROOKS SIX-COUPLED TEN-WHEELED LOCOMOTIVE

electric truck builders have followed locomotive precedents in the introduction of a solid bar frame. A frame of this character by the Brill Company, of Philadelphia, is shown in Fig. 6, and the complete truck in Fig. 7. Like the locomotive frame, the metal is made sufficiently heavy to resist, without injury, all the strains that can come upon it. Comparing it with the locomotive frames, the similarity is at once apparent.

It is hardly surprising that the truss idea took such firm hold upon the builders who had thought of the subject in a superficial manner only. The truss is naturally the first thing that comes into the mind, because the load seems to be the most important factor in the problem.

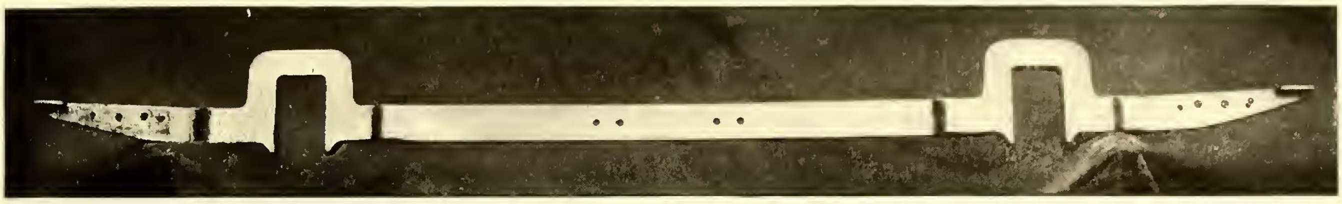


FIG. 6.—SOLID BAR FRAME

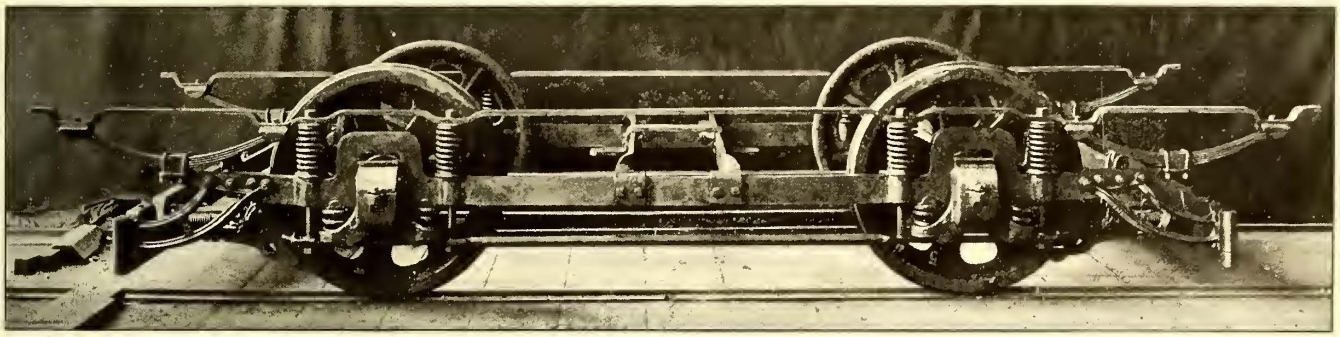


FIG. 7.—TRUCK WITH SOLID BAR FRAME

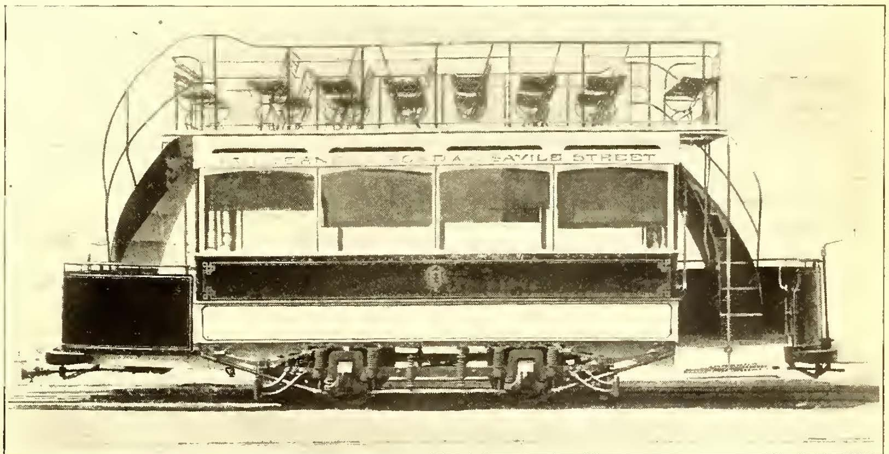
A little practical experience was required to show the fallacy of the idea, and it is surprising that it has retained its hold upon street railway men so long. It needs no study to prove a truss weak in all directions save one. It is a metal frame so disposed as to prevent the greatest resistance to a vertical load, with an entire disregard of strength in any other direction. In both locomotives and electric trucks the twisting and horizontal thrusts are often nearly, if not quite, as great as those exerted in a vertical plane by the load. There must be, therefore, horizontal as well as vertical strength. In addition to this, there is another element which is rarely given sufficient attention, the hammering and pounding of a locomotive or an electric truck upon the rails. This pounding destroys riveted connections with a speed which is quite surprising, and makes repairs frequent and expensive. This is undoubtedly one of the reasons for the early abandonment of riveted work in locomotive framing, and has also been an important factor in causing the composite frame to be regarded with disfavor in electric truck building.

Injunction in the Series Parallel Controller Case

The Thomson-Houston Electric Company and the General Electric Automobile Company on March 13, 1899, secured a preliminary injunction against the Detroit Citizens' Street Railway Company in the United States Circuit Court, Eastern District of Michigan, restraining the latter company from making, using or selling any combination of electric railway motors and motor circuits and resistance combined with controllers embodying the inventions or improvements recited in claims Nos. 20, 21, 22, 27, 28, 29 and 31, of Letters Patent No. 393,323. The principal claims of this patent were given in the Street Railway Journal (American edition) for March, 1899.

Double Decked Car

The J. G. Brill Company, of Philadelphia, has recently built a number of double deck cars for the Hull Electric Company, of England, which represented the very latest features of their type. The length of the body is 16 ft., the length over all about 28 ft., the width at sills is 6 ft. and the greatest permissible width but 7 ft. The platforms are rather longer than usual, being 5 ft. 6 ins. These cars differ from all those recently constructed in having fixed windows, and on this account the glass is of a large size and, of course, set without separate sash. The inside seats are longitudinal with spring backs and seats and are covered with carpet. Garden or "walkover" seats are used on the roof, with slat seats and backs. On the lower deck the car seats twenty-two persons. On the upper deck there are fourteen seats, accommodating twenty-nine persons, making a total seating capacity of fifty-one passengers. The cars are finished inside with three-ply maple ceilings and cherry over the windows. Spring blinds are used with the usual fittings.



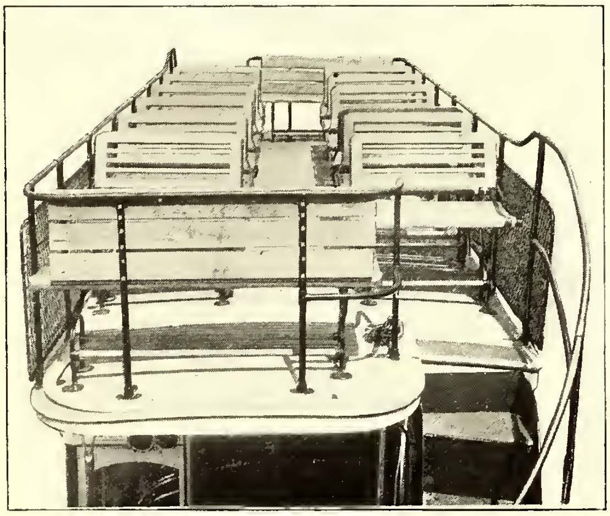
DOUBLE DECKED CAR–HULL

Returning to the exterior view of the car, it will be noticed that the railing at the sides of the stairs is made much higher than usual to give greater protection to persons ascending or descending the stairways. At the sides of the upper deck, instead of having covering boards fitted to the rail, wire netting is used, giving the car a much lighter appearance than is usually found in English cars of this type. Galvanized gutters are fitted on each of the hoods. Red, green and white lights are arranged at the corners diagonally opposite the stairways. The trimmings are of bronze with bronze hand rail for the stairway. No. 90 Westinghouse controllers are employed. By means of this the motors are turned into generators and form a brake by being short circuited through resistance. This brake is intended for emergency, but ultimately more resistance may be added and the use of the electric brake become more frequent.

The car is mounted on Brill No. 21 E truck. With the delivery

INTERIOR OF HULL CAR

of this order, there will be fifty-seven of this type of truck running in the city of Hull. There are two Westinghouse No. 46 motors for 500 volts and they are of the nose suspension style. The wheel



TOP SEATS OF HULL CAR

base is 6 ft., and the diameter of the wheels 30 ins. The Hull roads are of standard gage. One noticeable feature of this car is that of the unusual height which has been obtained in the center of the monitor deck, which is 6ft. 8 ins. from the floor. Angle iron bumpers are used with 6 ins. projection in front of the dasher. The cars are to be fitted with electric headlights. The platforms are dropped 6 ins. below the floor of the car, thus bringing the steps conveniently low.

A Handsome Catalogue

A handsome album of electric railway views has recently been issued by the Siemens & Halske Aktien Gesellschaft. It contains photo-engravings of many of the railway installations made by the company, as well as a complete list brought up to Jan. 1, 1899, giving detailed technical information of each road. These include both street railways in Budapesth, which are equipped partly by the trolley and partly by the underground conduit, and have employed the latter since 1889, the Franz-Joseph subway road in Budapesth, tramways in Switzerland, Italy, Russia, Holland, South America and China, mountain electric rock railways and mining roads. The cities in which the company has railway installations in operation or course of construction are in forty-six different States or countries.

Among the roads upon which construction is under way include the Berlin Elevated Railway, the complete tramway systems in Frankfort, A. M., and Vienna, the newly opened Stadtbahn in Vienna and the Wannseebahn in Berlin.

New Arc Electric Headlight

The accompanying engraving shows a new type of electric arc headlight, invented by H. Page Wellman, electrical engineer of the Ashland & Catlettsburg Street Railway Company, of Ashland, Ky., and in use on that line. The lamp is of the enclosed arc type, and is connected in series with about 500 ft. to 550 ft. of German silver resistance wire, No. 22, which reduces the voltage to that required by the lamp. The lamp is a hand-feed lamp, but has an automatic arc-starter, which automatically relights the lamp, after the current has been interrupted and again restored. The lamp will burn from two to three hours, when the carbons are easily fed together by the small knurled hand-wheel extending through the top. The carbons are so arranged that the arc is always in the exact focus of the parabolic reflector used.

It gives a very powerful light, which can be seen a half-mile

ARC ELECTRIC HEADLIGHT

away, and lights up the track so as to show clearly all objects in front of the car. The lamp consumes about 3 amps. of current, and is so arranged that it can be moved from one end of the car to the other. The connection is made by a plug located under the platform. The arc-enclosure is in the form of a transparent tube projected through the reflector, with the ends closed by caps, through which the carbon rods extend.

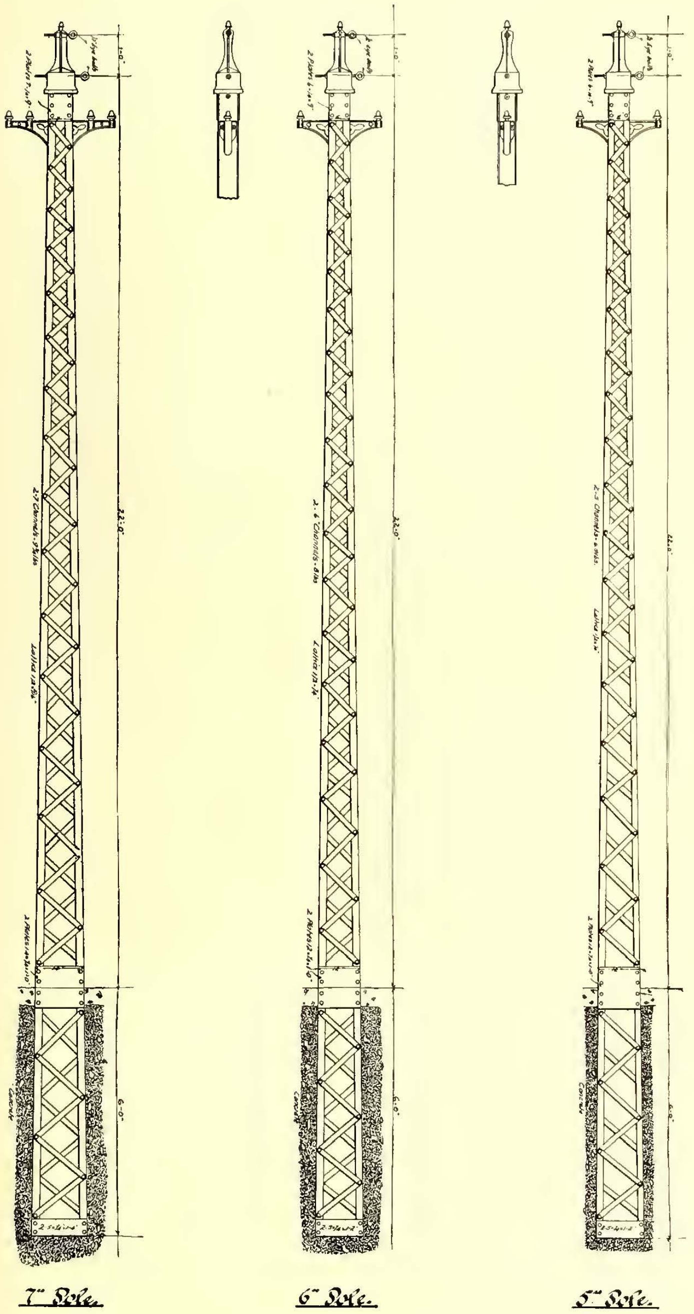
The arc-starting device has a cut-out, with a series coil, which controls the shunt magnets that operate to strike the arc, or, in other words, when the lamp is burning the armature of the cut-out is held suspended and open-circuits the shunt magnet coils, cutting the circuit out of them; but when the lamp is not burning this armature is down, and connects the shunt coils directly in the lamp circuit. Upon current being restored to the lamp it first circulates through the shunt magnet coils, and then through the series coil, cutting out the shunt coils and striking the arc.

Annual Oyster Roast

The sixth annual oyster roast given by the Berlin Iron Bridge Company, of East Berlin, Conn., to its employees was held on Wednesday evening, April 26, at East Berlin, and was a complete success in every way. These annual excursions are looked forward to with great eagerness by all the employees of the company and these dinners are considered largely responsible for the cordial good feeling existing between the managers of the company and the employees.

New Type of Lattice Pole

The accompanying engravings show a style of lattice pole which is manufactured by the Hilton Bridge Construction Company, of Albany, N. Y., and has met with considerable favor on some electric railways. The pole is designed primarily to give the greatest strength and stiffness possible, with an economical use of steel, and is made up with various sections of rolled steel channels, latticed with steel bars, in the manner familiar to every one in the present age of structural steel. By the use of larger sections, the pole may be made to stand the heaviest loads ever carried by line poles, and in all the various sizes of poles the strength is greater and the deflection less under the strains brought by the wires than in the case of much heavier poles made up of iron pipe. The experience of roads using the steel channel poles has been found to verify the calculations of engineers regarding the theoretical efficiency of latticed steel columns for such uses.



LATTICE POLES

The overhead construction, at best, is a source of discomfort to the portion of the public most interested in the æsthetic appearance of city streets, and anything which will improve its appearance is worthy of consideration. For this reason the form of pole illustrated is claimed to have a double bid for popularity—its actual lightness makes it cheap, and its apparent lightness makes it attractive to the eye. It requires no ornamentation except good paint.

The following table shows the principal characteristics of these poles:

TYPE OF POLE.	Weight.	Moment of Inertia.	Moment of Resistance, Unit Stress, C.	Safe Horizontal Pull.*
No. 1	550 lbs.	73.11	15.37 C.	698 lbs.
No. 2	650 lbs.	86.02	18.70 C.	850 lbs.
No. 3	800 lbs.	149.22	27.33 C.	1,242 lbs.

* Applied 22 ft. above ground, assuming maximum fibre stress of 12,000 lbs. per sq. in.

Hydro-Carbon Car

The gasoline or petroleum engine has been developed to a marked degree within the past ten years, and American ingenuity has produced engines which are reliable and economical. The advantages of this method of producing power are so numerous and well understood that they need not be mentioned here. Suffice it to say, that producing of power by the direct application of heat is the simplest way possible, as no transmitting medium, such as steam, is needed, the only thing necessary being combustible material and the oxygen of the air, which is free and found everywhere.

The practicability of gas engines for railroad use depends merely upon the proper arrangement of power-transmitting appliances, whereby the power from an engine can be applied to the axles so as to revolve them at any desired speed from zero to a predetermined maximum. This has been accomplished in the car illustrated herewith, which made its maiden run recently at Columbus, Ind., where it was inspected by a representative of the STREET RAILWAY JOURNAL.

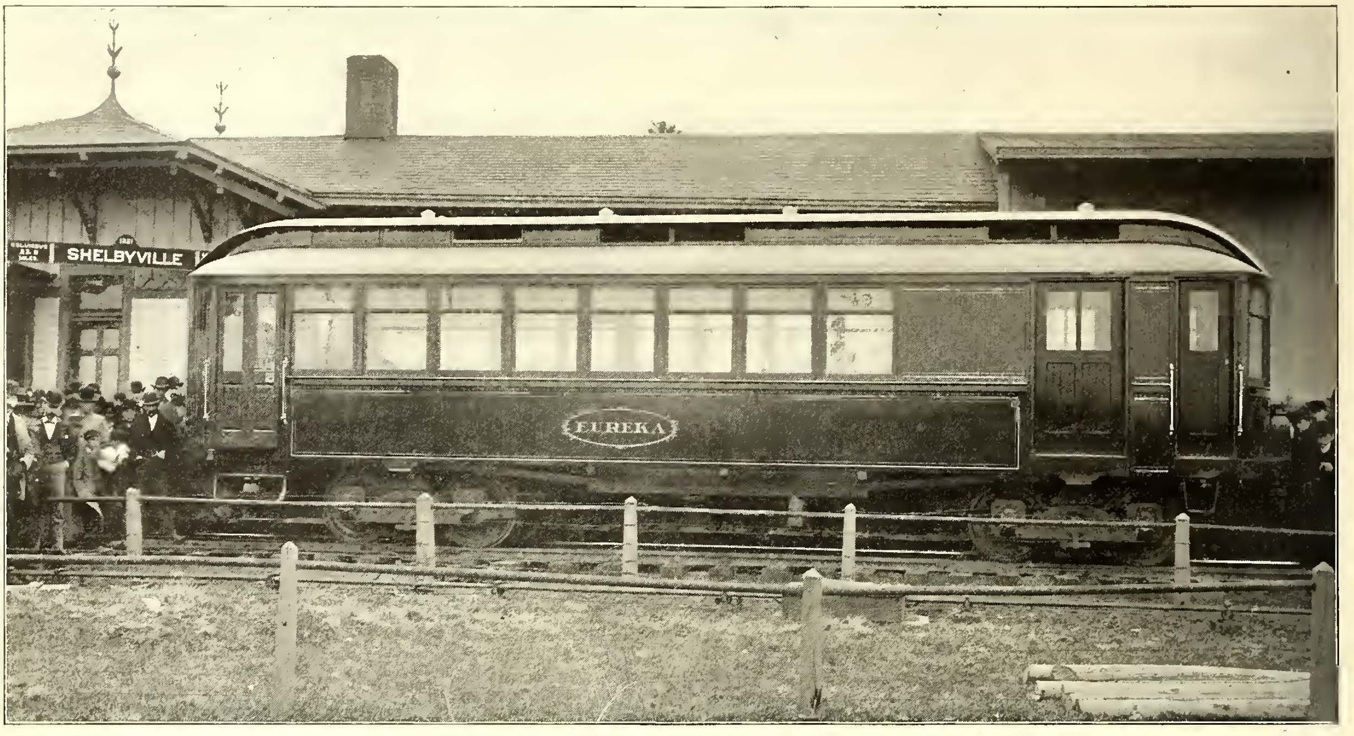
The car was built by the Vimotum Hydro-Carbon Company, of Chicago, weighs approximately 21 tons, is handled with a 45-h.p. three-cylinder, two-cycle gasoline engine, with the utmost ease and reliability, and starts, stops and reverses on short radius curves and grades without the slightest jar. It is mounted on a pair of standard M. C. B. trucks. The forward axles, besides carrying the regular truck, carry an inner frame, designed along the lines of a locomotive frame work. This frame has three points of suspension, and is provided with equalizing bars to provide for rock and tilt. Boxes are carried by the axles, which slide in ways, formed in this inner frame. Springs are interposed between the frame and axles, which give to the former a vertical resilience. This inner frame carries the engine, which is provided with a governor which regulates the speed to a predetermined number of r.p.m. A belt wheel, carried by the crank shaft, is belted to the initial shaft of the "Reeves" mechanism through a clutch carried thereby. This mechanism is supported on a supplemental frame yoked to the axle, and having the free end of the yoke suspended from the inner frame upon springs. This yoke keeps the axle gears, and mechanism gear, in mesh, but still allows a resilient movement of the mechanism relatively to the axle and to the inner frame. It will thus be seen that everything, from the engine to the axle gears, is resiliently mounted, but all maintain a given fixed relation to each other. All of this is independent of the car body, and the jar due to uneven roadbed, which is received by the inner frame, is absorbed thereby through its connections, and the same is not transmitted to the car body proper, the latter riding absolutely independent of the machinery.

In starting, it is merely necessary to throw a lever, which starts the engine, while the car remains stationary. When the signal is given to proceed, the clutch is thrown into the variable gear, the latter being in a position where its belt has its least lineal velocity. This starts the car easily and smoothly, and the speed is gradually increased to the maximum. To stop, the clutch is released, the mechanism returned to its slowest position, and the brakes set. These operations are accomplished simultaneously by the operator. The reverse is controlled by the engine lever.

Some particulars will now be given of the variable gear to which reference has already been made. This is the outcome of several years of experimenting, conducted by the Reeves Pulley Company, of Columbus, Ind., manufacturers of power transmitting appliances.

The mechanism primarily consists of two parallel shafts mounted in a suitable iron or steel frame. Each shaft carries a pair of driving pulleys, having the form of truncated cones, with their smaller bases facing each other, thus forming a V shaped groove between them. These pairs of pulleys are splined upon their shafts, and are capable of longitudinal movement thereon, but must rotate with their shafts. The corresponding members of each pair of pulleys bear, at their hubs, against ball thrust bearings, carried by levers, which are pivoted between the shafts and extended at one end to engage with nuts carried by a right and left hand screw shaft which is adapted to oscillate them simultaneously, but in opposite directions. This oscillation causes one pair of pulleys to slide toward each other, and the other pair to slide apart at the same time. An endless belt, of unique construction, is stretched between

The object accomplished in this machine has long been sought for, but a number of seemingly unsurmountable mechanical difficulties presented themselves, which were not met and overcome until the present time. One of these was the belt requirement. It is necessary to have a continuous belt of a predetermined length, and in a machine of this class it was found that if both pair



HYDRO-CARBON CAR AT SHELBYVILLE, IND.

these pairs of pulleys and in the V shaped groove which has its driving surface on the edges thereof, instead of upon the "flat" as in ordinary belting practice. The specially constructed belt is very rigid in cross-section, but is flexible longitudinally, and will pass around a circumference smoothly and easily. It will be readily understood that as one pair of pulleys move together, the belt is caused to move outwardly thereon and assume a large driving diameter, while the other pair move apart and the belt moves down

VIEW OF DRIVING MECHANISM

in the V groove and assumes a comparatively small diameter. If one shaft is driven at an initial speed, the other shaft can be varied to any required degree above and below this initial, as the lineal velocity of the belt regulates the speed of the driven shaft, and this velocity depends upon the diameter upon which the belt is working on the pulleys carried by the initial shaft.

of pulleys were moved in the same ratio, different lengths of belt were required to connect the pulleys when they were in the different positions. This belt length is accurately found by use of the well-known formula.

$$\text{Length} = R(\pi + .0349a) + r(\pi - .0349a) + 2D \cos a$$

$R = \frac{1}{2}$ diameter of large pulley.
$r = \frac{1}{2}$ diameter of small pulley.
$D =$ length between centers.

$$a = \text{angle whose sine is } \frac{R-r}{D}$$

$$\cos a = \frac{\sqrt{D^2 - (R-r)^2}}{D}$$

$\pi = 3.1416$

By this formula it will readily be seen that this variation in belt requirement is considerable, much more belt being required to connect the large diameter of one pair of pulleys with the small diameter of the other pair, than is required to connect the pulleys when the belt is upon the same diameter of each pair, the mean between the large and small diameters. The Reeves Company succeeded in overcoming this by a specially constructed lever which imparts to the pulleys a differential sliding movement along their shafts, so that the proper diameters are presented to the belt to keep it under a uniform tension. The device is complete in itself, and is rapidly going into use in many lines of manufacture where a variation of speed is required. This adaptation of the mechanism to the propulsion of a car is a departure of note.

The machine in this car, complete, weighs 1000 lbs., and is capable of starting and accelerating the car on excessive grades. The mechanism is placed in an upright position so as to economize space, and this position has practically no effect upon the working of the belt, as its driving does not depend entirely upon adhesion, as in ordinary belts, but upon adhesion and due to the initial tension of the belt and the centrifugal force. In this connection, it might be mentioned that this tension due to centrifugal force is taken advantage of in exactly the right place. When the belt is upon the largest diameter of the initial pulley it has its greatest lineal travel, therefore the greatest centrifugal tension. This centrifugal tension aids in keeping the belt from slipping on the smaller diameter of the driven pulleys. As the speed is cut down, the lineal velocity of the belt is decreased, and the centrifugal tension is thereby reduced in proportion to this reduction.

The very best quality of material is used in its construction, and the best workmanship possible is shown in its design. All parts are interchangeable and standard, and adjustments are provided. As the Reeves Company has had quite a number of these variable gears in hard practical use for four years, and as they are in as good condition to-day as when made, there seems to be no reason why they should not last as long as any other part of a car.

Parlor Car for New Brunswick, N. J.

The Brunswick Traction Company, of New Brunswick, N. J., has recently added to its rolling stock the handsome parlor car illustrated on this page. The main dimensions of this car, which

INTERIOR OF PARLOR CAR

is from the works of the Jackson & Sharp Company, of Wilmington, Del., are as follows: Length of body, 26 ft.; length over bumpers, 36 ft.; length of platforms, 4 ft. 6 ins.; width at sills, 7 ft. 3 ins.; height over belt rails, 7 ft. 9 ins.; height from sill to roof, 8 ft. 10 ins.; height from truck to sill, 2 ft. 6 ins.

The body is constructed from the very latest pattern, is very

PARLOR CAR FOR BRUNSWICK TRACTION COMPANY

wide over the frame, and has a shallow concave panel, thus giving plenty of floor space. The window openings are fitted with polished plate, fixed permanently. The roof is of the monitor type, with colonial deck sashes, fitted with fine Venetian glass with gold ornamentation.

The vestibules are of the usual type, except that one side is closed permanently, and the other side is fitted with double folding doors. The glass in all doors is beveled. The interior of the vestibules is finished in quartered oak, and on the side that is closed is placed a large refrigerator, one in each end. The floor is covered with rubber, and all the trimmings are nickel plated.

The interior of the car is finished in St. Jago mahogany, handsomely carved, and between the window sill and the floor it is paneled. In one end of the car are two buffets, with places for holding glasses, etc., and lockers beneath where supplies can be kept. The curtains are of silk tapestry, and fitted with Burrowes fixtures. The lambrequins are made in pairs and are of a handsome silk goods, draped in a neat manner. The carpet is Royal Wilton of a dark green color with a small figure. The ceilings are painted in two shades of green, are decorated in gold, and give a very handsome effect to the car.

All the chairs are mahogany, and are upholstered in silk plush and velour, all in dark green. Two small Chippendale tables are in the center of the car. All the trimmings inside are silver plated. The electroliers are placed so as to divide the light in the car to the best effect. Twenty lights are used in all, including electric headlight at each end. Push buttons are provided at each post. The end doors are of the usual double type, mounted on contra-twist fixtures made by the Adams & Westlake Company.

The trucks are of the Peckham 14 B short wheel base type, with 30-in. wheels, and by using these single steps are used, which is a great advantage. The car is equipped with Westinghouse No. 38 motors.

The Jackson & Sharp Company is also building a number of open cars for service on the lines of the Brunswick Traction Company, as well as a number for some of Mr. Radel's other railways.

Lubrication of Bearings

A lubricant adapted for use on locomotives, street cars, passenger coaches and machinery of all kinds, and for which is claimed extreme purity and economy, is manufactured by the Keystone Lubricating Company of Philadelphia. It is stated that the process of the manufacture of this grease is entirely different from that of making any other grease or oil on the market. The raw material is put through a chemical process known only to the manufacturers, and this process separates the foreign matter from the lubricant. The compound is then paddled by a process of direct natural heat until, it is claimed, it is perfectly pure. No gum, rosin, or other foreign constituent is put into the lubricant to give it body, as the process of manufacture leaves it with sufficient body without the addition of other substances.

The manufacturers of the Keystone lubricants have paid special attention to the requirements of electric railways, and they claim that one application of their grease on the bearings of an electric railway motor will go four times further than any other compound. In perfecting their process the following points have been kept in view: To constantly moisten the bearings, to avoid evaporation but to secure perfect adhesion of the bearings, to avoid all foreign elements that might in any way unevenly wear or clog the bearings, and to preserve the bearings bright and clean.

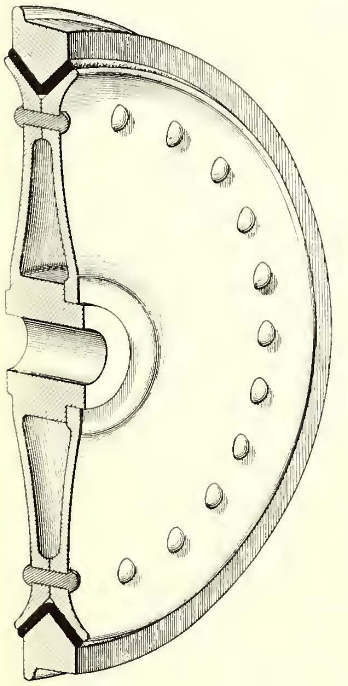
The lubricant remains inactive when the bearings are at rest and works only when the machinery is moving, thus avoiding unnecessary waste.

Cushioned Car Wheel

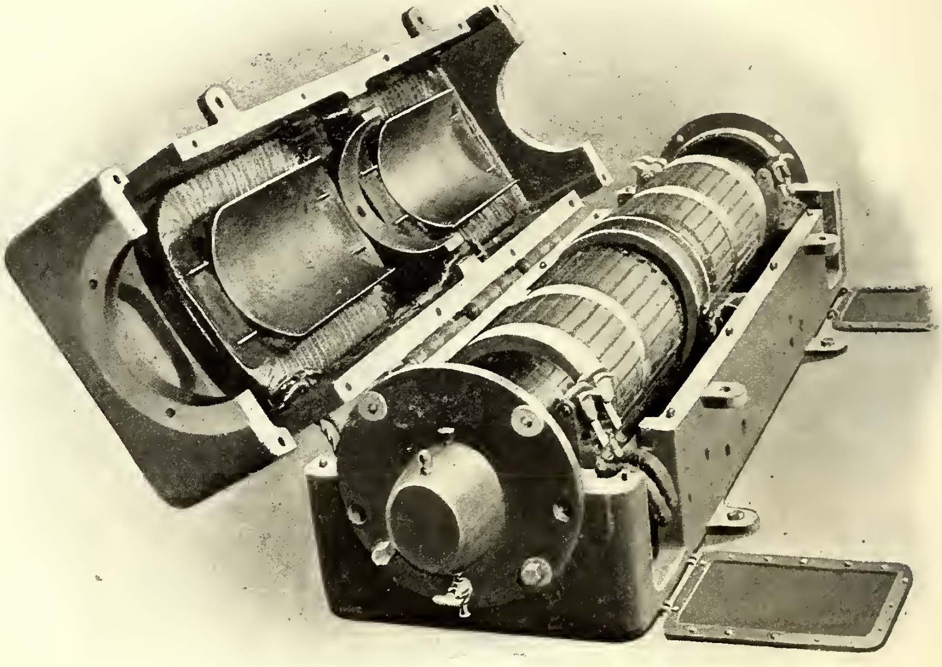
A wheel to reduce the rattle of electric cars in operation is shown herewith. This wheel has an elastic cushion between the rim and body of the wheel, by which the vertical and lateral jar and vibration are absorbed and the noise insulated, and its construction is such that the end thrust is cushioned. It is particularly adapted to electric cars on account of the great weight attached directly to the axle which receives little benefit whatever from any springs on such cars as at present constructed. Electrical connection is made by a simple U shaped metal band inserted through the cushion and held in contact with the rim and body of the wheel.

The cushion is securely confined and has a large bearing surface against the rim and body of the wheel. The wheel is easily and firmly assembled

The first cost is more than for wheels now in common use, but to offset this is the advantage derived by being able to renew a worn out wheel by simply supplying a new rim, which is done without drawing the wheel from the axle. In substituting this for the ordinary wheel, street car companies are not obliged to throw aside any property or to make any changes in construction. The wheel has been thoroughly tested in practice. It was invented by C. H. Cameron, of Chicago, Ill., and he is now endeavoring to make arrangements for placing it on the market.



CUSHIONED CAR WHEEL



MOTOR GENERATOR FOR THIRD RAIL CARS

Public Test of Safety Third-Rail System

On April 12, the Murphy safety third-rail system installed at Manhattan Beach and fully described in the STREET RAILWAY JOURNAL for April was subjected to severe tests in the presence of about 500 people. The automatic switches were, of course, the chief object of criticism of the electrical engineers. Their appearance is shown in the cut on page 327. They are of the solenoidal type and are provided with two bobbins. One is a fine wire, high voltage bobbin, and the other is of coarse wire and carries the main current which feeds the section. The operation is as follows: Suppose that the car is in motion and taking current from one of the sections, as described last month. The forward collecting shoe impinges on the section and current flows through the fine wire winding to ground. This raises the plunger, closing the coarse wire circuit and breaking the fine wire circuit. The series current keeps the switch closed as long as the car is taking current from that section. When current ceases in this circuit, and not till then, the switch releases its plunger, and as there is no current to break there is no arc at the switch jaws and thereby a serious disadvantage common to many systems of this class is eliminated. This was efficiently demonstrated at the test. A large box of switches were grouped together for observation, and as the car passed over the various sections of track which they controlled, the switches operated without arcs of any kind, though they were handling currents of from 20 amps. to 60 amps., as shown by the station ammeter.

The switches are subjected to a most severe test before being put into service, being required to make and break circuit with great rapidity for a period exceeding at least twenty-four hours, thereby making a number of breaks equivalent to many thousands of miles of service. The copper laminated jaws of the switches are supplemented with carbon jaws which are arranged to be the last to break circuit, thus providing for arcs in case of accident of any kind.

If the car is stopped all of the switches will fall, thereby cutting the current off from the power house, and means are provided to pick the switches up again. This consists, as mentioned last month, of a storage battery and a little motor dynamo. A storage battery of ten cells drives this motor dynamo which lights the car and provides 500-volt current to pick up the switches. The car lights are therefore never out, which is a great advantage. As the lamps are run directly from the storage battery they are on the multiple plan, which avoids the inconvenient arrangement of five lights or more. Moreover, the lamps being of low voltage with short, stumpy filaments, are of very long life, and being supplied by the storage battery are of uniform brilliancy whatever the line voltage may be.

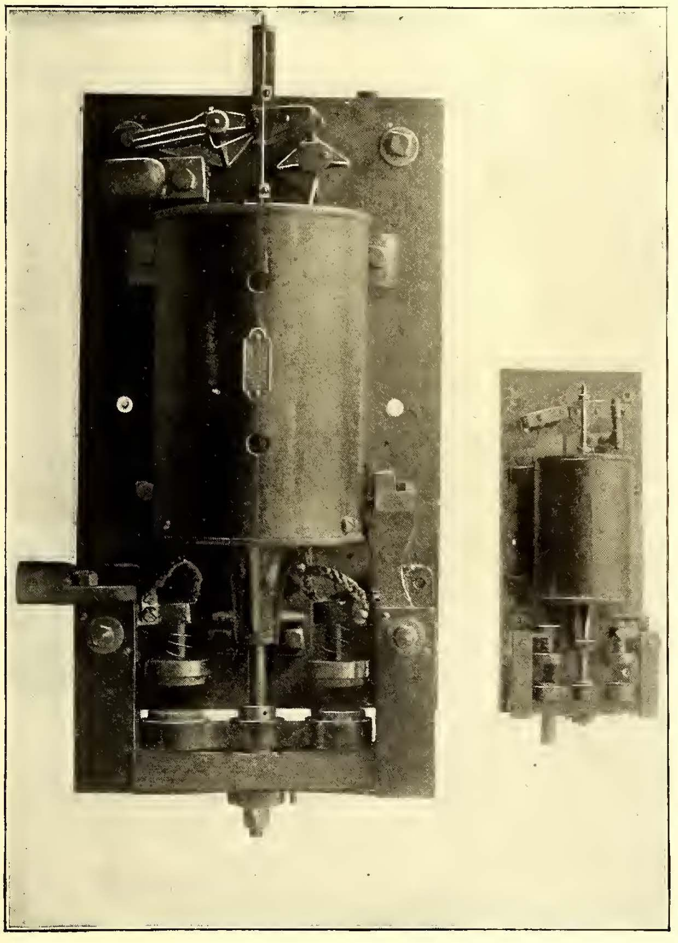
The car once started the sides of the rotary transformer exchange functions. It takes current from the line and charges the storage battery which, therefore, does not require to be removed and charged, and, in short, does away with all additional attention.

The motor dynamo is an interesting little machine and is shown on this page. It is entirely iron clad and is built on the rugged lines of a railway motor. It has two ratios of transformation This is necessitated by the fact that the storage battery requires to be charged at about 25 volts and discharges at full load at about 20 volts. Therefore the rotary transformer must charge at the rate of from 500 to 25 and discharge at the rate of 500 to 20. This performance is obtained by adding to the windings of the machine a 500-volt field coil which is connected, not to the terminals of the rotary converter, but to the trolley and ground. Hence, when the power house current is absent, the motor dynamo receives the excitation from the low potential side and gives the greater ratio of transformation. When the power house current is at hand, the high voltage coil produces the proper changes in magnetization to alter the ratio of transformation as required.

Another interesting exhibit at the Beach consisted of a large switch for handling heavy locomotive work. This switch is shown on the opposite page, photographed beside a switch for ordinary street railway work. The switch weighs nearly 400 lbs. and has very powerful and massive jaws, which carry the necessary currents for handling 80-ton and 90-ton locomotives. These jaws are reinforced by carbon contacts which will take any arcing which may occur there. These arcs, however, as a matter of fact, are slight because of the series coil device.

The cost of this system has given rise to a great deal of speculation, and as the Safety Third-Rail Electric Company has not yet gotten its equipments on a manufacturing basis, definite figures cannot be given, but it is believed that the cost of this system will not exceed that of an equivalent first-class overhead system.

The only serious item of depreciation in the system is the switches, and as these consist of about one-third of the total investment for outside electric construction, they can suffer a very large depreciation without bringing the total depreciation figures to any serious magnitude. In fact, the company proposes to guarantee the depreciation of this item for 10 per cent of the first cost of the switches or about 3 per cent of the total investment. When it is remembered that outside construction on the overhead system is frequently written at 15 per cent, this figure becomes very pertinent.



STANDARD SWITCH AND SWITCH FOR HEAVY SERVICE

During the exhibition at Manhattan Beach an elaborate luncheon was served and congratulatory speech-making followed. A large representative body of railway men was in attendance.

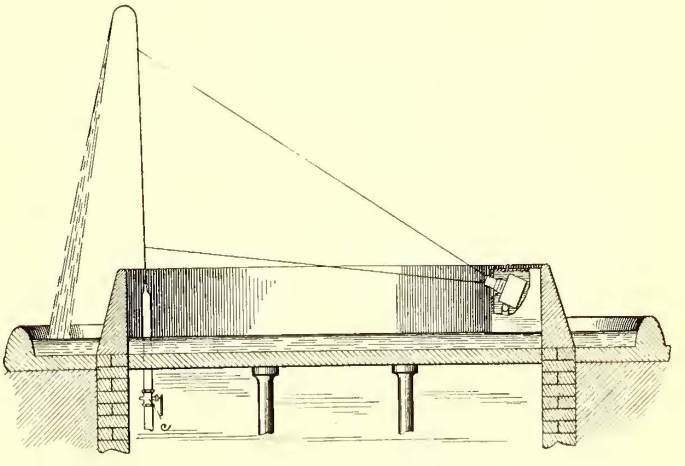
An Ornamental Fountain

After years of experimental work, Paul C. Just, who is in the employ of the North Chicago Street Railway Company, has succeeded in perfecting an improvement for electric fountains, and he has been granted United States patents covering the same.

The invention consists in the combination of a nozzle or other means for throwing a flat jet or sheet of water into the air, and a picture projecting apparatus, such as stereopticons or kinetoscopes so located with reference to said flat jet or sheet of water as to throw a picture or image upon said sheet.

The illustration published herewith shows the invention as it was exhibited at the electric fountain at Lincoln Park, Chicago, in 1898, where it proved a very great success, and one of the most striking and popular exhibitions ever given. It greatly increased the number of people visiting the park on the evenings when the fountain was in operation and the hearty applause of the crowds in nightly attendance evinced the appreciation of the beautiful display.

An electric fountain is not necessary for a display, a single supply pipe from a tank with from 50 lbs. to 65 lbs. pressure fully answering the purpose. A nozzle placed in a pond or lake with the projecting apparatus located conveniently, gives a beautiful effect. The image appears to be suspended or floating in the air. The upward movement of the water is not visible in itself. One remarkable feature about this invention is the extreme distinctness or definition of the image and the fact that the same may be seen as well from the side of the jet or sheet remote from the projecting apparatus as from the side adjacent thereto.



SECTIONAL SIDE VIEW OF FOUNTAIN

Large Supply House

The Electric Appliance Company, of Chicago, has recently removed into its new building at Nos. 32 to 34 West Van Buren Street, where it will carry a much larger stock of all kinds of electrical supplies than ever before. The interior construction of the new building was especially arranged for the company and is a model of convenience and adaptability. It contains five stories and a basement. On the ground floor are the general offices of the company, to the left that of W. W. Lowe, president of the company, and to the right and opposite that of T. I. Stacey, secretary and treasurer. To the right of the latter are the general offices. and to the left of the general offices is the storeroom. Occupying the rest of the first floor is a room devoted to outgoing and incoming freight.

On the second floor the manager of the shipping department has his office, his assistants' desks and benches for assembling use about half the space of this floor, the rest being devoted to bins for shades and shade holders, sockets, switches and miscellaneous stock. The third, fourth and fifth floors, with the exception of the list of goods stored in them, might well be described in the same paragraph; they are arranged with bins, racks and shelves to best suit the stock carried in them. The telephone department and shop are also located on the third floor as well as the offices of S. A. Dinsmore, the manager of this department.

The last, but by no means the least important part, is the basement, with its accommodations for heavy goods—Armorite and Armorduct tubing, "O.K." bare copper and iron wire, cross arms, brackets, polesteps, etc., etc.

On each floor is a stock clerk, who must be thoroughly posted on the stock under his immediate control. All bins and shelves are lettered or numbered, classified and indexed in such a manner that the assembler can at once place his hands on the item wanted. Every arrangement or device which would in any way help toward the desired end—a quick shipment—has been employed.

The history of the house which has grown in a few years to so prominent a position is briefly as follows:

The company started in business Dec. 1, 1891, using one floor of the building at 242 Madison Street, Chicago, with 2500 sq. ft. of space. One year later another floor was added. In the latter part of 1894 the entire building, or 8000 sq. ft., was required. The present location, at 92 and 94 West Van Buren Street, has 30,000 sq. ft. of floor space. So much in the way of history. With the increased facilities for quickly handling goods, which the new building affords, and with the additions to the strong list of agencies which the company represents, the management may confidently look forward to another prosperous period. The prompt and businesslike policy which has pleased and multiplied this concern's customers during the past eight years will hardly fail to bring like results in the future business.

Compound to Prevent Slipping of Belts

The Cling-Surface Manufacturing Company of New York city is introducing a compound for rendering power belts soft and pliable, and for increasing the efficiency of a power plant by reducing the slipping of the belts. A very thorough test of this compound was made recently by R. C. Carpenter, professor of experimental engineering at Sibley College, Cornell University, Ithaca, N. Y., and the following is his report upon the results:

The tests were made in every case on the belt testing machine owned by Sibley College; this is constructed so that the belt can be tested under ordinary running conditions and measurements can be made for determining the power supplied, the power delivered, the tension of the belt, the arc of contact on either pulley, and the slip. Three belts have been tested, each before and after treating with cling-surface, and each under various conditions of loading. In all over fifty tests have been made; a considerable number of observations have been repeated in order to check the accuracy of the results.

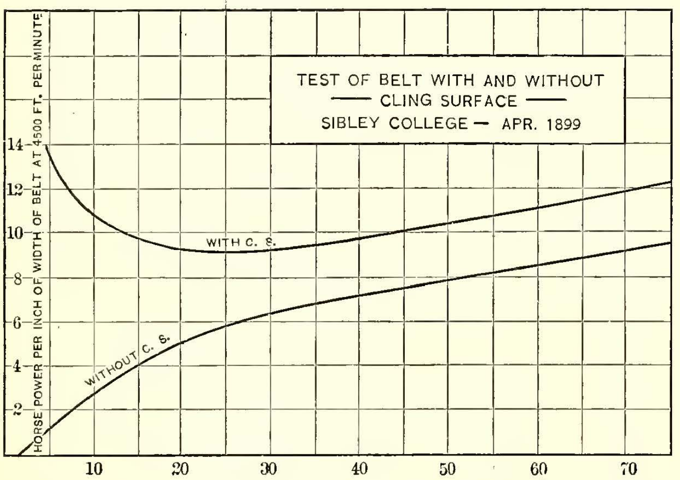
The belts before testing were in every case clean and in good condition, and running under rather better than average conditions.

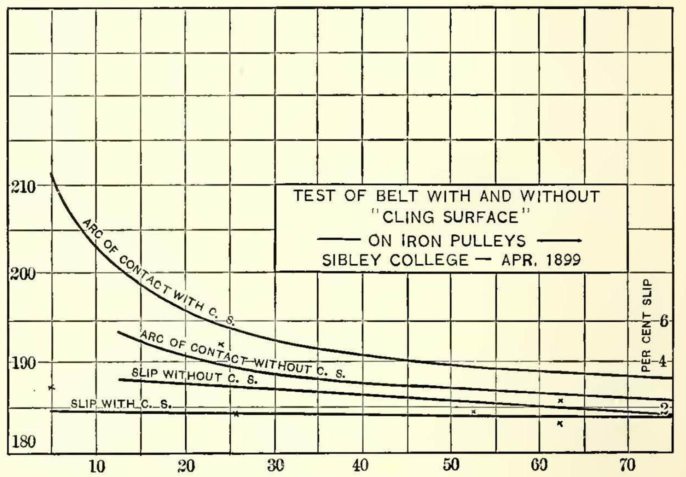
The cling-surface was applied on several successive days, and in small quantities, in accordance with the directions supplied by the manufacturers, before commencing the tests. The material was almost wholly absorbed at the time of starting the test, and none has since been applied. The material made the belt soft and pliable, and gave it an inner surface somewhat resembling patent leather. This surface was only in the least degree sticky to the touch.

The general results of the test with cling-surface show an increased transmitting power as compared with the same belt in an untreated condition; it also shows an increased arc of contact, and very much less slip. It shows a very high transmitting power when the belt is run extremely loose, or with very little tension on the pulleys, the reverse of which is true with the untreated belt. It will be seen by consulting the report that the greatest transmission capacity for the belt treated with cling-surface was found when there was the least possible tension on the belt, and when the belt was running so slack that the sides nearly touched. It will be noted also that as the tension of the belt was increased the transmitting capacity diminished until a tension of about 20 lbs. per in. of width of belt was reached, after which the transmitting capacity commenced to increase, and from that point continued to increase with increase of tension.

In the test of the same belt not treated with cling-surface the results were quite different, inasmuch as the capacity with very light tensions was practically nothing, and the capacity increased as the tension increased; at no point, however, did the untreated belt have even approximately the same capacity as the treated belt with the same tension; moreover, the treated belt transmitted much more power with a very light tension than the untreated belt with a heavy tension. The test with the belts treated and untreated, running on wooden pulleys, showed essentially the same characteristics. The general effect of the cling-surface appears to enable the belt to transmit a power equal to its entire capacity without producing heavy stresses on the driving boxes of the pulleys; or, in other words, it enables the full capacity of the belt to be obtained for transmitting power when the belt is so loose that the sides nearly touch.

The general results of the tests of the untreated and treated belts when running on iron pulleys is shown in the accompanying diagrams, Figs. 1 and 2. In Fig. 1 the horizontal distances show the tension on the belt in lbs. per in. of width, the vertical distances show the h.p. transmitted per in. of width of belt for a speed of 4500 ft. per minute. The lower line represents the results obtained with the untreated belt; the upper line the results obtained with the treated belt. It will be noted that the lower line continually rises, showing an increase in capacity with an increase of tension; the upper line descends at first, showing a decrease in capacity with increase of tension, and later rises. In no place does the transmitting capacity of the treated belt fall below that of the untreated belt. In comparing the respective results it will be noted that the treated belt has a carrying capacity of 13.8 h.p. when the tension per in. of width is 5 lbs, while for the same conditions the untreated belt has no carrying capacity; furthermore, it is noted that the carrying capacity of the treated belt, even at this low tension, is nearly 40 per cent higher than that of the untreated belt, even when the tension has been increased to 80 lbs. per inch of width of belt. The diagrams in Fig. 2 show the arc of contact and the maximum percentage of slip for belts run both in the treated and untreated condition with different tensions and on iron pulleys. From this it is seen that the slip of a treated belt is much less, and the arc of contact greater for a given total tension than with the untreated belt.





DIAGRAMS SHOWING RESULTS OF TESTS

The falling off in carrying capacity with increase of belt tension for the treated belt is doubtless due to the rapid change in the arc of contact, which diminishes with increase of tension. This causes a diminution in the transmitting power which is greater than that produced by the increase of pressure due to the increased tension on the belt. With the untreated belt such change is very slight, and consequently a falling off in carrying capacity for light tension takes place.

In regard to the questions raised as to the preservative qualities of cling-surface and to the permanency of the effect produced by its application, the writer would say that our tests have of necessity been of too short duration to give conclusive answers. The general effect of the cling-surface is to soften the belt and to put it apparently in the best condition for transmitting power and retaining its good qualities. The surface produced by the cling-surface remains apparently unchanged after several weeks of use, and the inference to be drawn is that the material has an effect which continues permanent for some time at least.

The Gothenburg (Sweden) County Council on April 4 decided by a vote of 32 to 14 to buy the local tramway's concession and properties for £70,000; this sale is subject to approval of the shareholders. The tramway company had its head office in London, and was started by English capital under a forty-year concession running from 1879. The following are the chief characteristics of the road: Capital stock, £50,000; 6 per cent debentures, £4300; reserve fund, £2800; dividend, 5½ per cent; number of horses, 132; rolling stock, thirty-six cars and four busses; mileage in operation, 6¾ miles.

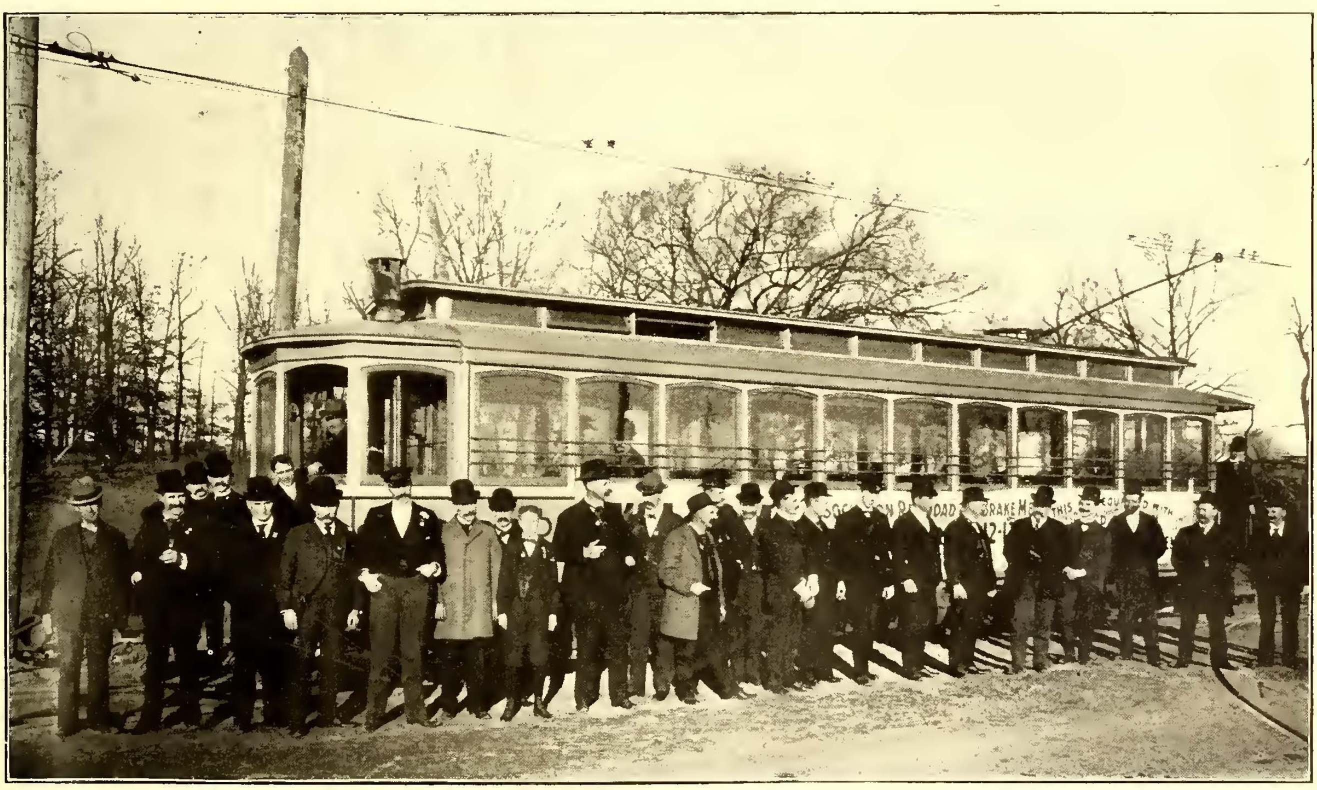
Railroad Air Brake Men's Association

The sixth annual meeting of the Railroad Air Brake Men's Association was held in Detroit, Mich., on April 11, 12, and 13, the headquarters being at Hotel Cadillac. This is an international organization of 400 members, composed of men in Mexico, Canada and the United States. who are occupied with the care, operation or maintenance of air brakes. The Grand Trunk, Michigan Central, Wabash, and the Lake Shore Railroads each placed an inspection car, completely fitted with air brake apparatus, in the Union Depot yard for exhibition.

At the opening session on April 11, addresses were made by Mayor Maybury and Robert Miller, the veteran Michigan superintendent of motive power, and the President's annual message was received.

One of the most pleasant incidents of the meeting was the trip over the lines of the Detroit & Pontiac Railway, arranged by William D. Ray, of the G. P. Magann Air Brake Company, of Detroit. The trip was made in a special car, equipped with the Magann storage air brake system, and a number of tests of the brakes were made on the trip.

The party, consisting of over fifty delegates, started in the afternoon of April 12, made the 17-mile trip to the Birmingham power house in remarkably short time, and the true Detroit hospitality was shown on this occasion in many ways, and the air brake men enjoyed themselves thoroughly. After leaving the city limits, the car was run at very high speed. While going at the rate of 47 miles an hour an emergency stop was made with the air brakes, and the car was brought to a standstill within a few feet. Numerous service stops were also made, and it was noticed that each stop only caused a reduction of .6 of a lb. of air, showing what efficiency the storage air brake system has reached. At Birmingham the car was run over a pit, where the apparatus was inspected and air applications made.



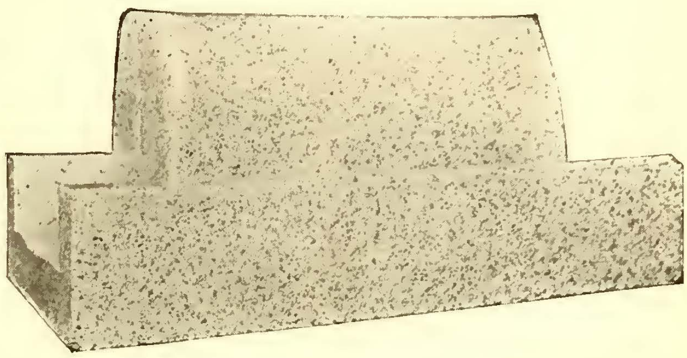
GROUP OF MEMBERS OF AIR BRAKE ASSOCIATION

A special test was conducted on March 15, when car No. 5 left the power house at Birmingham for Detroit with 230 lbs. of air. The car made two round trips, consuming 160 lbs. of air and making a total of 300 stops. The time consumed was six hours. The car made a total mileage of 104 miles. After completing the two round trips there was still 70 lbs. pressure. The car was equipped with double action cylinders.

It will be seen from these results that there was only about 8-15 of a lb. of air used for each stop. On March 16 a car made 165 stops, consuming 88 lbs. of air.

Reconstructed Granite

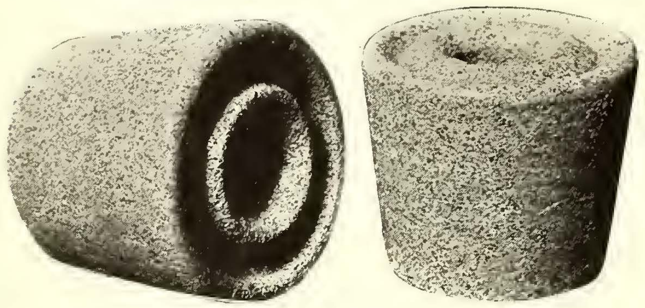
In the April issue of the STREET RAILWAY JOURNAL some particulars were given of the third-rail railway at Coney Island. One of the important features of this line is the insulating blocks made of reconstructed granite, used between the rail sections. This material is so novel, and possesses so many remarkable properties, that it is thought that a description of it would prove of interest.



THIRD-RAIL SECTION BLOCK

"Reconstructed Granite" is exactly what its name implies, and consists of choice Maine granite, pulverized, moulded into form and fused together at a temperature of 3000 deg. F. It differs from the natural stone, of which it is composed, in several very important respects, viz: (1.) In being absolutely fireproof, as it can be heated red-hot and thrown into cold water without being in the slightest degree injured or affected thereby. (2.) It resists the action of every known solvent, acids and alkalies of all kinds, except hydro-fluoric acid, and is only superficially affected by that. (3.) It is absolutely frost-proof, having been tested in liquefied air at an estimated temperature of 350 deg. below zero not only without injury, but was as strong while frozen as before, and not at all brittle, in this respect differing from all other materials tested in this way. As it is a well-known fact that all natural rocks are disintegrated by extreme cold, and as 80 deg. to 90 deg. below zero is the coldest temperature known upon earth, the test is a severe one. (4.) Natural granite not only contains a considerable percentage of moisture, but has a constant tendency to absorb more when exposed to dampness, whereas this material contains no moisture whatever, and being vitrified clear through (when prepared for electrical insulation), cannot absorb any. (5.) Its crushing strength, as shown by tests by the United States Government at the Watertown Arsenal, ranged as high as 14,560 lbs. per cubic inch, which is far above the average strength of the natural stone. Its tensile strength is from 480 to 500 lbs. per sq. inch.

Its great strength, its uniformity throughout, its non-absorbent properties, and its susceptibility to being rapidly and economically moulded into all ordinary shapes, at a comparatively low cost, would seem to make it a valuable insulating material, especially for railway work, when it would be constantly exposed to the



CUP INSULATORS OF RECONSTRUCTED GRANITE

weather, and frequently buried under ground, for these reasons it is rapidly growing in favor upon electric railways, especially for third-rail insulation. Herewith are shown two forms of these insulating blocks made of this material, the first being the section insulator of the "Murphy system" tested at Manhattan Beach, and the other the cup insulators of what is known as the "Martin system," now being introduced upon the Brooklyn and other elevated railroads. There are also many other forms.

A recent test at Niagara Falls showed that it required 56,600 volts to penetrate about ½-in. of this material with a merely nominal absorption after soaking the fragments for many hours. Many other tests equally satisfactory have been made by eminent electricians.

Reconstructed granite is manufactured at Norristown, Pa., by the Reconstructed Granite Company, of New York. These works are very extensive, covering nearly 7 acres of ground, and have direct connection to all parts of the country by both the Pennsylvania Railroad and the Philadelphia & Reading (B. & O.) Railroad, both of which have sidings into the works.

Storage Battery Auxiliary of the New York, New Haven, & Hartford Railroad

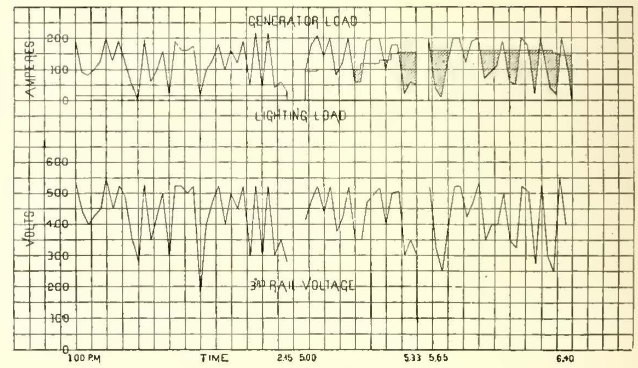
A little over a year ago the New York, New Haven & Hartford Railroad Company installed a plant with storage battery auxiliary at Hartford, Conn., for the purpose of lighting the Hartford station, that has been operating successfully ever since and which exemplifies in an unusual manner the advantage of a storage battery as a regulator, and its adaptability to unusual conditions. It will be remembered that the New York, New Haven & Hartford Railroad operates the Hartford-New Britain section of its line electrically by the third-rail system. Five hundred volts are used and the voltage is subject to all the fluctuations incident to such a system, on account of the current required for starting and accelerating the trains. The fluctuations on the circuit are more violent at Hartford as it is located at the end of the third-rail system, and were so great that lamps could not be operated from an ordinary motor-driven generator without battery. A combination of the motor-driven generator and regulating battery was, therefore, finally decided upon.

The generating unit consists of a 45 kw. shunt-wound generator direct connected on a common bed-plate to a specially compound wound 500-volt motor, the compounding being so designed as to run the motor as nearly as possible at a constant speed through large variations of voltage in the motor circuit, which is derived from the third-rail system of the railroad.

The scheme of operation and the results obtained are well exemplified in the curves shown in the diagram herewith. The lower curve gives an excellent idea of the extreme variations in the motor circuit. It will be noticed that this covers a range of 375 volts, or from a minimum of 175 volts to a maximum of 550 volts. The battery is directly across the system as a regulator, receiving its charge through the hours of light load as will be seen by reference to the left-hand set of curves in the cut, and only being required to furnish a small amount of current when the generator current drops off, due to fall in the voltage on motor, to a point below the lighting load shown by the straight line across the curve; but as the lighting load increases, it will be noticed from the right-hand set of curves in the same figure, there is a large portion of the time when the generator is unable to furnish the current required for the lighting load and which is in turn supplied by the battery, which thus keeps a practically constant pressure on the lamp circuits, discharging whenever the generator current falls below the load and charging when the reverse occurs.

In addition to this service, when the lighting load falls off to a minimum the generator is shut down and the battery furnishes all the current required at such time, constant potential being maintained by the ordinary method of cutting in reserve cells by switches on the lower panel of the switchboard.

The storage battery consists of sixty-two cells of Chloride Accu-



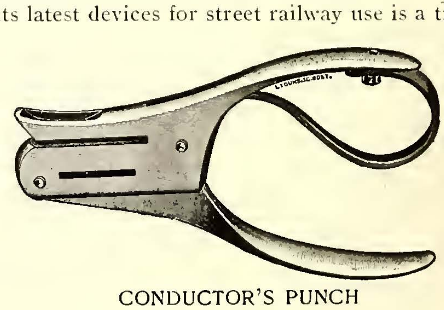
LOAD LINE—HARTFORD BATTERY

mulator, manufactured and installed by the Electric Storage Battery Company, of Philadelphia. Each cell contains eleven plates, but the tanks are large enought to provide space for additional plates to double the capacity of the present plant. The plates are of type "G," 15½ ins. x 15½ ins., while the containing tanks are 23⅜ ins. x 19¾ ins. x 22⅞ ins. high. The cells are installed in one tier on special porcelain insulators, the plates being burned up to solid lead busbars in accordance with the standard practice.

Conductors' Punches

The R. Woodman Manufacturing & Supply Company, of Boston, Mass., is one of the largest and oldest manufacturers of small steam and street railroad supplies, such as ticket punches, ribbon, office and perforating stamps, railroad baggage checks, coat and time checks, employees' hat and breast badges, uniform buttons of every description, etc., and is constantly bringing out new specialties.

One of its latest devices for street railway use is a transfer ticket



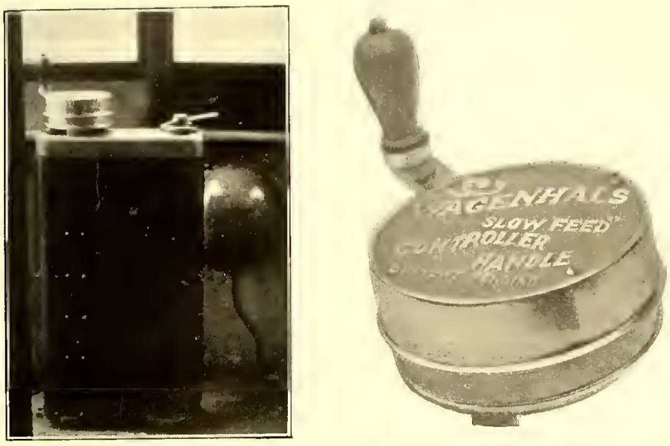
CONDUCTOR'S PUNCH

punch fitted with a new elliptical spring, which, it is thought, will be found a great improvement over the old types of springs. These punches are milled out over the top of the die so that conductors can very readily see all dates and figures which are to be punched in the tickets. The cutting dies for the punches are made from the very best Jessop's tool steel and this accounts for their lasting qualities and durability. Over four thousand of these punches are now in use on the street railways of Boston and vicinity, and the company has large orders on file from a number of roads in Canada.

The Corporation of Glasgow will shortly begin work looking to the conversion of their entire system, and they hope by the date of the Glasgow Exhibition in 1901, which will immediately follow the Paris Exposition, a considerable portion of the system may be converted to electricity.

A Slow Feed Controller Handle

In the accompanying illustrations is shown a new controller handle which has been devised by a practical electric railroad manager and which is believed to be one of the best checks ever devised for preventing the waste of energy by careless or indifferent motormen. There is, of course, no question as to the enormous amount of current that is absolutely wasted by green motormen by the improper handling of the controller. In addition to this direct loss, the increased cost of repairs to motor and parts damaged by excessive currents is by no means a small item. To



SLOW FEED CONTROLLER HANDLE

compel the motorman to use his power economically is the aim of the new invention.

The standard series parallel controller has nine points and the average motorman will cover these in six seconds with a consumption of 250 amps. with two 35-h.p. motors. With the new slow feed handle the time in which the motorman shall cover the nine points is under the control of the manager, who, by regulating an attachment on the controller can limit the time to eight, ten or twenty seconds, as he may desire. No alterations in the present type of controller are necessary to adopt the use of the handle, the old handle simply being lifted from the stud and the new handle put in its place. The device is manufactured by the Wagenhals Manufacturing Company, of Cincinnati, Ohio.

Lubrication of Gearing

The lubrication of the teeth of gearing is a subject of much greater importance and requires closer attention than is often given it, and too often waste lubricants from the bearings, engines, and machinery generally, are considered good enough to supply the gear teeth. The conditions under which gear teeth operate are so very much different from those of a revolving bearing that it is not proper to assume that the same lubricant will do for both; in fact, after careful experiments it has been found that by the application of a lubricant made especially for the purpose, the life of gear teeth can be very perceptibly prolonged.

Gear teeth should be constructed to have as little side clearance as possible and the perfect working gear would be one absolutely without side clearance. As a matter of fact, it is nearly impossible to so adjust gearing as to prevent all initial side clearance. This clearance soon gives rise to a hammer blow, commonly termed "back lash," thus tending to crystallization and breakage. As soon as this "back lash" has once started it very soon increases and the destruction of the metal is very much more rapid. It is evident that a lubricant to satisfactorily answer the varying requirements of gear teeth must possess tenacious qualities to adhere and be able to deposit on the working surface of the teeth, preventing metallic contact and consequent wear and noise and reducing side clearance, thus forming a cushion for "back lash." This is the exact opposite of the requirements of a lubricant for revolving journal bearings. A lubricant for accomplishing this result of a "gear shield" is made by the Ironsides Company, of Columbus, Ohio. This material has been used for some time and it is stated has greatly prolonged the life and decreased the noise of gearing on which it has been used. It is adapted to all conditions from the even running motor gearing on street cars to the most ponderous and heavily loaded gearing of rolling mills.

Annual Report of the General Electric Company

The following is an abstract of the seventh annual report of the General Electric Company:

PRESIDENT'S REPORT.

SCHENECTADY, N. Y., April 26, 1899.

To the Stockholders of the General Electric Company:

The prosperity which has attended other lines of business during the past year has been shared by your company. The important extensions made to its factory plants during the past eighteen months have proved to be most timely, and the company is now greatly benefited by the increased facilities they afford.

The matters of stock reduction and revaluation of the patent account of the company were brought to your attention in the last annual report. Since then a reduction has been made of 40 per cent in the share capital of the company, by vote of the stockholders at a meeting specially called for that purpose, the common stock being reduced from $30,460,000 to $18,276,000, and the preferred stock from $4,252,000 to $2,551,200. The patent account has been reduced from $8,000,000 to $4,000,000.

The profits for the year, after deducting all general patent and miscellaneous expenses, were	$3,896,884.10	
Deduct deficit as of Aug. 18, 1898, after reducing patent account and capital stock	1,840,761.03	
		$2,056,123.07
Less interest on debentures and current dividend on preferred stock		371,638.40
		$1,684,484.67
On Jan. 31, there had been paid or charged against surplus all the old accrued dividends on preferred stock		1,527,913.68
Surplus, Jan. 31, 1899		$156,570.99

By order of the Board of Directors,

C. A. COFFIN,
President.

FIRST VICE-PRESIDENT'S REPORT.

SCHENECTADY, N. Y., April 25, 1899.

C. A. Coffin, Esq., President General Electric Company:

Sir—I submit herewith a brief report of the operations of the Sales Department for the fiscal year ending Jan. 31, 1899.

Total sales (amount billed to customers)	$15,679,430.86
Cost of goods sold, general expenses and taxes, including sundry losses and allowances for losses	13,094,534.25
Profit on sales	$2,584,896.61

ORDERS RECEIVED.—The increase over last year in orders received is 21 per cent. Apparatus orders represent 52 per cent of this increase, supply orders 39 per cent, incandescent lamp orders 9 per cent. The increase in each class is:

Apparatus orders	19 per cent over last year.
Supply orders	24 " " " "
Incandescent lamp orders	23 " " " "

Over 124,000 separate supply orders were received and over 8,400,000 incandescent lamps were ordered, during the year.

About 89 per cent of the year's orders were on our standard terms—cash within sixty days.

Orders Received for the Past Five Years.

Fiscal year ending Jan. 31, 1895	$12,160,119
" " " " " 1896	13,235,016
" " " " " 1897	11,170,319
" " " " " 1898	14,382,342
" " " " " 1899	17,431,327

The local office stocks are maintained in good salable condition. The annual inventory shows these stocks classified as follows:

Active	92.5%	$442,380.43
Inactive	6.5%	30,666 60
Obsolete	1.0%	4,976.01
Totals	100.0%	$478,023.04

The improvement in this respect is shown by the following comparisons:

Local Office Stocks for Past Five Years.

	1895.	1896.	1897.	1898.	1899.
Active	68%	82%	86%	90%	92.5%
Inactive	27%	14%	12%	8%	6.5%
Obsolete	5%	4%	2%	2%	1.0%

GENERAL REMARKS.—The past year shows the largest volume of business for the company for any fiscal year since its organization. The increase is well distributed, as shown above.

During the past year large power houses have been constructed or projected in or near many of our large cities, which power plants are centers of distribution of the electric current for railway, lighting and many other and constantly increasing uses and applications. The establishment of such large stations will result in decreased cost and increased use of electric power.

The utilization of water powers by electrical transmission has also been a marked feature of the past year, and the successful transmission of electrical power over the 80-mile line of the Southern California Power Company, at Los Angeles, Cal., is the long-distance record to date of commercial transmission.

Some of the more important water power transmission plants which have been sold by this company are given in the following table:

Total H.P.	Power used at	Transmission Distance in Miles.	Voltage.
1670 H.P.	Redlands, Cal	21	10,000
3000 "	Portland, Ore	14.5	6,000
4000 "	Sacramento, Cal	22.5	11,000
2000 "	Pachuca, Mexico	19	10,000
1407 "	Fresno, Cal	55	19,000
2667 "	Salt Lake City	14	10,000
1206 "	Bakersfield, Cal	16	10,000
5000 "	Ogden & Salt Lake City	40	15,000
800 "	Hookset, N. H	10	10,000
1440 "	Cordova, Argentine Republic	16	10,000
1000 "	Varese, Italy	14	5,000
4000 "	Los Angeles, Cal	80	33,000
2000 "	Provo, Utah	40	40,000
5000 "	Schenectady, N. Y	19	12,000
4000 "	Butte, Montana	21	15,009
235 "	Tuscarora, Nev	10	11,000
300 "	Cripple Creek, Col	10	6,300
1000 "	Hiroshima, Japan	15	11,500
8000 "	Minneapolis, Minn	10	11,000
670 "	North Gorham, Me	14	10,000
800 "	Kingston, Jamaica	21	16,000
400 "	Trenton, Canada	12	11,000
2000 "	West Kootenay, B. C	20	20,000
765 "	Victoria Goldstream, B. C	12.6	10,000

Many of these lines have been in operation for several years, and we have yet to learn of a fatal accident resulting from the use of such high voltages. This record is in striking contrast with the popular expectation and fear expressed as to the results, when such lines were first proposed.

The Spanish War led to an increase in our business in the items of searchlights, cables, marine dynamo sets, etc., considerable as to each item, but small in proportion to our total business.

The increased business of the past year has considerably increased the burden upon our department and local office managers and selling agents whose faithful and efficient work is deserving of commendation.

Respectfully submitted,

EUGENE GRIFFIN,
First Vice-President.

THIRD VICE-PRESIDENT'S REPORT.

SCHENECTADY, N. Y., April 25, 1899.

C. A. Coffin, Esq., President, General Electric Company:

Sir—I submit herewith a report on manufacturing and engineering for the fiscal year ending Jan. 31, 1899.

MANUFACTURING.—The method of determining our factory costs which has proven satisfactory in previous years, has been continued during the present year, such factory costs including all material and labor plus a percentage to cover general expense items and an ample allowance for depreciation. The inventories have been most carefully taken. Financial statistics relating to factory investment are given in the report of the second vice-president. Large additions have been made to our manufacturing plant, and others are now in progress. At the Schenectady Works the large iron foundry mentioned in last year's report as in course of erection, was completed last summer and is now fully occupied. A brick and steel machine shop, covering three and one-fourth acres (142,000 sq. ft.) was begun last June and is now being equipped with the necessary machinery. This large shop will provide unsurpassed facilities for the economical production of the largest apparatus, the demand for which is increasing steadily. Extensions amounting to about 40,000 sq. ft. have been made to other existing buildings, including a suitable building for the safe storage of our valuable patterns. At the Lynn Works the capacity of the steel foundry has been increased 40 per cent, and we have in construction a new building for the manufacture of meters and instruments, the total addition amounting to 35,000 sq. ft.—all substantial, well-lighted, brick buildings. At the Harrison Works, we have, in order to meet the increased demand for incandescent lamps and to improve our facilities, started a new fireproof, four-story building containing about 60,000 sq. ft., which will be completed this summer.

The area of the factory buildings now in use aggregates 1,800,000 sq. ft. (41.3 acres enclosed), and the number of employees now at work is about 9000. In addition to the buildings mentioned, we have expended about four hundred thousand dollars ($400,000) for machinery and tools in the complete equipment of the new buildings and to maintain existing machinery at the point of maximum efficiency and economy.

ENGINEERING.—The demand for electrical machinery of large capacity and special design has continued to increase. A number of the great electrical generators (5000 h.p.) for the new station of the Metropolitan Traction Company at New York, have been completed, and we have under construction an additional order for similar machines, including the transformers and rotary converters to be used in transforming the alternating current into continuous current for the operation of the electric street cars in the borough of Manhattan. The equipment by us of the Buffalo & Lockport Railway with electric locomotives for handling freight, and motor cars for passenger service, is interesting as an instance in which the steam locomotive has been completely displaced by electricity both for freight and passenger service.

The number of installations using alternating generators, in a single generating station, and supplying through our rotary converters, located at convenient distributing points, continuous current for light and power, as described in my last report, has been added to during the year by installations at Philadelphia, Boston and other places. Plants involving the transmission of electricity to long distances have continued to increase in number, those already in operation having been found economical and reliable. We have now in operation about forty long distance transmission plants, employing potentials of from 10,000 volts to 40,000 volts and transmitting power from 10 miles to 80 miles.

About two-thirds of the power required for operating our Schenectady Works is now regularly supplied from a water power at Mechanicsville on the Hudson River, 19 miles away; the production of electricity at high pressure directly in the stationary armature winding of the generators used in this transmission, has, as anticipated, been successful, and has been followed in other similar installations because of its economy and simplicity.

A notable illustration of the flexibility of long distance electric transmission is to be found in the supply of Salt Lake City with electricity from two generating plants, located some 50 miles from each other, the energy being united so as to simultaneously supply electricity over the same set of mains.

The St. Anthony Water Power Company's plant, mentioned in my previous report, has operated so successfully since its installation that additional apparatus to bring the total up to about 10,000 h.p. has been ordered during the past year.

The apparatus for use in the 80-mile transmission to the city of Los Angeles, Cal., mentioned in my last report, has been in successful operation for some months.

Many important orders for electric locomotives, large generators, etc., have been secured in competition with various European manufacturers.

Confidence in the reliability of electrical apparatus is now well established and a general appreciation of its simplicity, flexibility and economy has resulted in a rapid increase in the use of electric motors in older fields and the opening of new. Electric motors are therefore being used in increasing numbers for the driving of machine tools in large and small factories, presses in printing establishments, for ventilating, pumping and mining operations. We have designed many motors specially adapted for such work during the past year.

Our engineers have been actively engaged during the past year in developing the apparatus and details required in new work and in improving and reducing the cost of existing standard lines of apparatus. Numerous improved forms of transformers, arc lamps, meters and instruments, have also been introduced.

We have continued to protect our new designs as far as possible by applications for letters patent.

The work of our factory managers and engineers is worthy of the highest commendation.

Respectfully submitted,

E. W. RICE, JR.,
Third Vice-President.

SECOND VICE-PRESIDENT'S REPORT.

From the report of Second Vice-President J. P. Ord the following figures are taken and comparison made with reports of previous years:

CONSOLIDATED BALANCE SHEET.

ASSETS.

Dated Jan. 31.	1896.	1897.	1898.	1899.
Patents and franchises	$8,000,000	$8,000,000	$8,000,000	$4,000,000
Factory plants	3,468,002	3,400,002	3,400,002	3,400,002
Real estate (other than factory plants)	453,585	643,016	586,529	615,035
Stocks and bonds	5,479,332	8,545,796	7,455,873	7,226,422
Notes and accounts receivable	6,584,123	4,578,601	4,537,301	5,086,680
Work in progress	961,386	517,866	283,832	507,336
Inventories	4,219,884	4,034,753	3,860,553	4,882,238
Cash	879,686	703,484	1,425,875	1,456,794
Profit and loss (deficit)	13,917,071	12,957,413	11,725,561	--------
Totals	$43,963,069	$43,380,931	$41,275,526	$27,174,507

LIABILITIES.

Capital stock, common	$30,460,000	$30,460,000	$30,460,000	$18,276,000
Capital stock, preferred	4,252,000	4,252,000	4,252,000	2,551,200
5 per cent. gold coupon debentures	8,750,000	8,000,000	6,000,000	5,700,000
Accrued interest on debentures	72,916	66,666	50,000	47,500
Accounts payable	428,153	402,265	263,526	431,496
Unclaimed dividends	--------	--------	--------	11,739
Mortgages	--------	200,000	--------	--------
Reserve for extension to factory plants	--------	--------	250,000	--------
Profit and loss (surplus)	--------	--------	--------	156,571
Totals	$43,963,069	$43,380,931	$41,275,526	$27,174,507

CONSOLIDATED PROFIT AND LOSS ACCOUNT.

EARNINGS.

Years ending Jan. 31.	1897.	1898.	1899.
Sales	$12,540,994	$12,396,093	$15,679,431
Royalties and sundry profits	279,402	128,845	792,591
Interest and discount	88,336	90,371	119,954
Dividends and interest on securities owned	282,144	299,418	342,000
Profit on sales of stocks and bonds	79,817	116,356	324,462
Discount on deben ures purchased and canceled	57,139	14,015	2,422
Balance brought forward	12,957,413	11,725,561	--------
Totals	$26,285,245	$24,770,660	$17,260,859
Balance from previous year	$13,917,071	$12,957,413	$1,840,761
Cost of goods sold	9,691,501	9,241,822	11,275,612
General expense and taxes, sundry losses and allowances	1,834,419	1,654,757	1,818,922
Patents and patent expenses	349,919	333,335	269,440
Interest on debentures	431,250	333,333	290,000
Depreciation of inventories	50,355	--------	--------
Depreciation of consignments	10,730	--------	--------
Reserve for factory extensions	--------	250,000	--------
Dividends on preferred stocks	--------	--------	1,609,552
Balance	--------	--------	156,571
Totals	$26,285,245	$24,770,660	$17,260,856

Large Register Order in St. Louis

The consolidation of the principal lines in St. Louis has been followed by a careful consideration of the field and the placing of a number of orders for the new equipment necessitated by increased traffic. One of the first of these orders to be placed was that for registers and was secured by Mr. Carson, president of the Sterling Supply & Manufacturing Company. The order was placed by Mr. Coleman, general manager of the St. Louis Traction Company, the corporation which will operate the lines controlled by Alexander Brown & Sons, and the type specified was the double recording register. This register was described in the last issue of the STREET RAILWAY JOURNAL, and is arranged so that it can record both cash fares and transfers.

The order was one of the first to be placed by the new company and Mr. Carson is to be congratulated upon the recognition secured for the new Sterling double register.

Cord for Arc Lamps and Trolley Cars

The Samson Cordage Works, of Boston, Mass., are devoted exclusively to the manufacture of cords and small ropes for suspending arc lamps, etc., and for use with trolley poles on electric cars. The Samson cord is made from the very best cotton yarns, and is guaranteed free from waste stock. It is braided and finished by the Samson patented and secret process, and is inspected with great care to insure freedom from flaws.

The Samson cord is the result of thirty years' experience in the manufacture of small braided cords, and it is easily distinguished by the colored spots which are woven at frequent intervals through the surface of the cord. When desired, the cords are treated to a coat of waterproofing, that greatly adds to their durability when the material is used where it is subjected to excessive moisture.

Electrical Exhibition at Madison Square Garden

Final arrangements for the electrical exhibition to be held at Madison Square Garden, New York, during May, are being completed. This exhibition promises to exceed in number of exhibits and public interest any previous electrical show that has been held. One of the most prominent features of the 1899 exhibition will be the display of automobiles, and it is thought the exhibit of electrical vehicles will be by far the largest and best ever seen in America, and second only to the great exhibits at Paris. Another interesting feature will be the wireless telegraphy experiments and instruments. The experiments in wireless telegraphy will be more extensive than the ones last year and arrangements have been made for sending messages between different points in the Garden and also from the Garden to points of interest in different parts of the city.

Several valuable Government exhibits have been secured and these will be grouped and attractively displayed. They include apparatus from the army and navy, the signal corps and the weather bureau, and will embrace also not a few interesting relics of the war with Spain.

Recent Consolidations

The air is still full of rumors of consolidations and combinations of street railway companies, many of them simply reports but a number of them well defined. Among the latter may be briefly mentioned the following cities where negotiations are either completed or are well under way.

In Chicago, the Chicago Consolidated Traction Company has made application for the listing of 150,000 shares of its capital stock on the Stock Exchange. This company was chartered Jan. 28, 1899. and in February, 1899, acquired by purchase the entire property of the following named companies: Chicago Electric Transit Company, North Chicago Electric Railway Company, Chicago & North Shore Street Railway Company, North Side Electric Street Railway Company, Evanston Street Railway Company, Cicero & Proviso Street Railway Company, Ogden Street Railway Company, and the Chicago & Jefferson Urban Transit Company. This company has a capital stock of $15,000,000 and the funded debt is $6,085,000, all bonds of the underlying companies.

It is also reported that negotiations which have been in progress for a long time for the consolidation of the larger street railway systems of Chicago have been practically completed. This plan does not contemplate the purchase of the three large companies operating south of Seventy-first Street, i. e., South Chicago Street Railway Company, Calumet Electric Street Railway Company, and the Chicago Electric Traction Company, but does include the Chicago City Railway Company, the North Chicago Street Railroad Company and the West Chicago Street Railroad Company.

In St. Louis, the St. Louis Traction Company has been organized for the purpose of purchasing several street railway properties in the city. In addition to this, the stock of the Lindell Street Railway Company has been increased from $2,500,000 to $10,000,000, which is said to be the preliminary step to the consolidation of all the lines in the city.

All the gas and electric lighting plants in the city of Washington, with the exception of the property of the Capital Traction Company, have been purchased by a syndicate composed chiefly of Baltimore capitalists. It is stated that the purchased roads will soon be consolidated under one system. It is understood that the companies effected are the following: Anacosta & Potomac River Railway Company, the City & Suburban Railway Company, the Georgetown & Tenallytown Railway Company, the Metropolitan Railroad Company and the Washington & Great Falls Electric Railway Company.

As stated in another column of this issue, the Brooklyn Rapid Transit Company has absorbed several additional companies, and now controls practically every street railway and elevated railway line in the borough of Brooklyn, with the exception of the Coney Island & Brooklyn Railway Company.

Société des Tramways Unis de Bucharest is the title of a new company organized at Brussels for operating the tramway system of Bucharest, Roumania. The capital is 8,000,000 fr., and the directors are Josse Allard, Brussels; Eugène Baelde, Saint-Josse-ten-Noode; Hector de Backer, Brussels; Emile Costinesen, Bucharest; Maurice Blanck, Bucharest; Alexandre-Grégoire Jenescu, Bucharest; Samuel Kocherthaler, Berlin; Lucien Van de Vin, Brussels, and Charles Charlier, Brussels.

Railroads in Cuba

The National Railway Publication Company, of New York city, publishers of the "Travelers' Official Railroad Guide," has issued a supplement, giving complete maps, timetables, and lists of officers of all railroads and steamship lines in Cuba. The supplement also contains a page of very interesting notes on the general characteristics of the island of Cuba, with special reference to the conditions of travel by railroad. In part it says:

"The railways are not far behind the times when the conditions by which they have been surrounded and the traffic they have to provide for are carefully considered. The right of way is fenced in, if that is a proper term to use for cactus hedges and stone walls. The roads are laid with steel rails, from 50 to 62 lbs. to the yard, joined with fishplates, with rock ballast, and generally well tied and surfaced. The passenger trains are equipped with air brakes. The freight cars are of smaller dimensions than cars recently built in the United States, and more like those of thirty years ago. The transportation of baggage is paid for, the baggage system resembling that in use on European railways. Three instances will serve to illustrate the rates charged: From Havana to Cardenas, 105 miles, the charge for a trunk of moderate size and weight is $1.30 in Spanish silver, including crossing the ferry from Havana to Regla; from Cardenas to Cienfuegos, 118 miles, the charge is $1.20 in Spanish silver; and from Cienfuegos to Matanzas, 135 miles, the charge is $1.90 in Spanish silver. These charges in American money are equal respectively to 78 cents, 72 cents and $1.08. The railroad fares are generally about five cents a mile in United States money, which means about eight cents a mile in Spanish silver.

"The passenger cars are well adapted to the climate, as well as to the service for which they are intended. Each train, as a rule, consists of three coaches, respectively first, second and third class, although the classes are occasionally divided by partitions in the same car. The conductors and employees on the railroads are usually intelligent, polite and well versed in their duties. On most of the roads buffet lunches are served en route at reasonable prices. Cab fares and porter fees are said to be very reasonable."

Exhibition at Philadelphia

Of the numerous national and international expositions projected for the next three or four years in different parts of the United States, the one to be held in Philadelphia in September, October and November of the present year is in many respects the most important to the trade and commercial interests of the country. The Philadelphia Exposition of 1899 will be an exposition for the development of American manufactures and the expansion of the American export trade and it will be the first national exposition of that character ever held in the United States. The exhibit will be conducted under the joint auspices of the Philadelphia Commercial Museum and the Franklin Institute. The Exposition grounds are situated on the west bank of the Schuylkill River, south of the South Street Bridge and embrace a valuable tract of land of 56 acres in extent, deeded to the Commercial Museum by the city of Philadelphia. The grounds are easily accessible and the buildings are so arranged as to give the greatest convenience to exhibitors and visitors. The Congress of the United States, the Legislature of Pennsylvania and the councils of Philadelphia have indorsed this enterprise and the applications for space already received indicate its complete success.

New Transfer Arrangement in New York

Announcement was made recently that the Third Avenue Railroad Company and the Manhattan Elevated Railway Company, of New York City, had signed an agreement whereby transfers were to be issued to each other's lines at an additional cost to the passenger of 3 cents. The agreement was reached after careful consideration of the probable results, and it is thought the new arrangement will be exceedingly far reaching in its effect upon the traffic of both systems.

The portion of the city most directly benefited by the new transfer arrangement will be the upper part of Greater New York lying in the borough of The Bronx, as it will be possible for a resident of that portion of the city living anywhere near the lines of the Union Railway Company to reach City Hall or the Battery for 8 cents for the trip, and in comparatively good time. This he can do by riding to the northern end of Third Avenue on the electric cars of the Union Railway, and there transferring to the Third Avenue Elevated for an additional fare of 3 cents.

The better traveling facilities secured by the new system will, of course, be shared by the residents of Manhattan Island, though perhaps to a lesser degree. By means of the 125th Street crosstown line and the Forty-second Street and Amsterdam Avenue lines, it will be possible to go from the lower east side to the upper west side, and from the lower west side to the upper east side, or vice versa, for 8 cents instead of 10. Transfer tickets will be issued from the elevated stations to passengers that have paid their fare on the elevated, and from the surface cars to passengers that have paid their fare to the Third Avenue Railroad Company. Over 3,000,000 transfer tickets were required to inaugurate the system.

Metropolitan Street Railway's Rapid Transit Offer Withdrawn

In the last issue of the STREET RAILWAY JOURNAL was printed the proposition of the Metropolitan Street Railway Company to the Board of Rapid Transit Commissioners to build an underground railroad in New York for the purpose of furnishing rapid transit to all parts of the city. On April 17, however, the attorneys of the Metropolitan Street Railway Company sent the following letter to the Board, withdrawing its offer for the reasons given:

"Since attending the meeting to which you invited us, with our clients, this afternoon, we have considered the situation as it was then presented, and determined upon the action then indicated to you orally.

"You will remember that at the time of making our proposition of March 27, to build an underground rapid transit railroad, we advised you that our clients considered the difficulties and risks of the undertaking so great that they were not willing to assume them unless assured of popular approval and support; and the correspondence was made public in advance of any action upon it with the understanding that, if it did not prove to be really acceptable to the people of this city, we were to be at liberty to withdraw the offer at any time.

"We made the proposal as advantageous for the city as we consistently could, with a reasonable prospect of profitable investment, and so favorable to the city that from the figures made by our experts as to cost and carrying capacity, the profits seemed to our clients doubtful, and their desire to make the investment, even under the most favorable circumstances, was but slight. While the proposition seemed at first to be received with general approval, and in many quarters was treated in the same spirit in which it was made, we are forced to recognize, and you agree, that criticisms often originating in adverse interests, and attacking the only details of the plan which gave any prospect of profit, have made a lodgment in the public mind, and created an impression that we are trying to drive a hard bargain, and get possession of privileges of great value without rendering an adequate return. Our clients are not willing to occupy this position, and they are satisfied that under such circumstances success in the enterprise would be impossible. They are not willing on these terms to undertake to provide a sum which they estimate at fully $60,000,000, with the certainty of changes in financial conditions long before the work is done and to invest in a novel enterprise of doubtful profit.

"They therefore feel constrained to withdraw their proposition to build the underground rapid transit railroad.

"As you are aware, that proposition had its origin not merely in our clients' wished-for profits, but in a natural inclination to continue and perfect the system of passenger transportation in this city to which they have devoted a great part of the last fourteen years, with results not only profitable to them, but beneficial to the public, and which they could not have accomplished except for the approval and support generously accorded to their efforts by the people of the city. They wish us to express their appreciation of the courtesy and consideration with which you have received and treated them throughout the negotiations."

Death of M. K. Bowen

Menard Kenner Bowen, president of the Chicago City Railway Company, died on Sunday evening, April 9, shortly after an operation for acute appendicitis. He left his office Friday afternoon in his usual health, intending, the following day, to start for Colorado Springs upon a holiday, but in the evening severe pains came on and at a consultation of physicians at midnight, the trouble was recognized as appendicitis and in an advanced stage, and it was determined to remove him to the Chicago Hospital for an operation. This was performed Saturday morning at an early hour, but the disease had progressed too far to be checked, and although the patient rallied after the operation and made a hard struggle for life, the end came at about nine o'clock Sunday evening.

The funeral on Wednesday was one of the most impressive ever seen in Chicago, by reason of the presence in the assembly at Mr. Bowen's residence of many hundred street railway employees, as well as some of the wealthiest and most prominent citizens of Chicago. An escort of 800 men in the train service department of the Chicago City Railway, with the band of the Cottage Grove Avenue Trainmen's Association playing a funeral march, accompanied the body to the train for Jackson, where it was to be interred. The entire procession was over half a mile long. Mr. Bowen leaves a widow and two children, twelve and four years old, respectively.

It is probable that few street railway managers have so fully won the confidence and affectionate regard of their employees as M. K. Bowen. When he became superintendent of the Chicago City Railway in 1891, it was determined by the employees, then a rough, heterogeneous mass of men of all nationalities, and practically all members of labor unions, to make the new superintendent's work as hard as possible, and, in fact, to "run him out of town." Instead of accomplishing this, the unruly element was weeded out, and a strong and coherent body of employees was formed, which quickly came to look upon Mr. Bowen as an absolutely fair-minded, straightforward man, on whose sense of justice they could rely and whose magnificent ability as an organizer and manager they could admire. Mr. Bowen has rarely failed in carrying out any plan which he had at heart, and his directors recognized his services by advancing him from the position of superintendent to that of general manager, and eventually of president of the company—a company, one of the strongest and most prosperous in the United States. It is characteristic of the man that when early on Saturday morning he knew that the operation must be performed, and realized as others did not that the result of his long struggle of years against disease was likely to be fatal, he put aside his own pain and trouble long enough to send for Superintendent Nagle, of the Chicago City Company, to whom he gave some final directions concerning its management, and bade farewell.

M. K. BOWEN

Mr. Bowen was a man in the prime of life, being but forty-one years of age. His father was Gen. John S. Bowen, a graduate of West Point, and his grandfather, Pierre Menard, first Lieutenant-Governor of Illinois. He was educated at St. Louis and Washington Universities, and at the age of nineteen, entered the Government service as assistant engineer in civil engineering work on the Mississippi River. In 1880 he was engineer in charge of the topographical survey of the St. Louis & San Francisco Railway from Fort Smith, Ark., to California. He first became identified with street railway work in Kansas City, becoming chief engineer and superintendent of construction for the Kansas City Railway Company, then building its cable line. A little later he became the New York representative of the Short Electric Railway Company, and in 1891 entered upon his eight years' service with the Chicago City Railway Company.

During his connection with this system Mr. Bowen was instrumental in bringing about important changes and extensions. The methods of conducting the business of the company were revised, new lines constructed, old ones rebuilt, and the motive power changed to electricity on all but the trunk lines, which are operated by cables. Mr. Bowen himself made no pretensions to inventive genius, nevertheless he demonstrated his ability to design and improve methods, and his opinion on all matters pertaining to street railway management had come to be highly regarded.

To his many friends in street railway circles, Mr. Bowen's death causes grief as at the loss of a close personal friend. He was singularly winning and generous in his friendships, granting to all credit for the best intentions and rarely taking offence. An unkindly word of another was almost unheard from his lips, for his principle in life seemed to be to "think no evil of any man." He was a rare character and a friend long to be remembered among those who enjoyed his friendship.

Personal

MR. W. R. BENSON has been appointed manager of the Easton Consolidated Electric Company, of Easton, Pa.

MR. C. D. MENEELY has been appointed assistant secretary and treasurer of the Brooklyn Rapid Transit Company.

MR. H. M. BRINCKERHOFF has been made assistant general manager of the Metropolitan Railway Company of Chicago.

MR. JAMES R. CRAVATH, a well-known electrical engineer, was married on April 19 to Miss Ruth M. Rew, at Grinnell, Ia.

MR. WILLIAM P. GANNON has been elected president of the Syracuse Rapid Transit Railway Company, in place of Charles R. Flint.

MR. U. H. McCARTER has entered upon his duties as secretary and treasurer of the New Jersey Electric Railway Company, of Hoboken.

MR. ARTHUR ORR, a prominent Board of Trade operator and capitalist, has been elected director of the Chicago City Railway Company in place of Mr. Bowen.

MR. GEORGE HURD, of Toledo, Ohio, has been appointed manager of the Janesville Street Railway Company, of Janesville, Wis., in place of Fred O. Greene, resigned.

MR. J. L. HINES, formerly president of the New Jersey Electric Street Railway Company, of Hoboken, N. J., has resigned, and has been succeeded by Mr. Chandler W. Riker.

MR. J. W. MEAKER, JR., will open an office in Chicago, where he will handle street railway specialties. Mr. Meaker has for some time been connected with the Meaker Manufacturing Company.

MR. ALBERT S. RICHEY, formerly electrician for the Citizens' Street Railway Company, at Muncie, Ind., has resigned to accept a position as electrical engineer of the Marion City Railway Company and its interurban branches, at Marion, Ind.

MR. G. HARRY GARRISON, secretary and treasurer of the Cortland & Homer Traction Company, of Cortland, N. Y., has resigned his position to accept another one in Troy. Mr. Garrison on the eve of his departure was tendered a farewell banquet by a number of his friends.

MR. FRANK W. CARR has accepted the position of Superintendent of The Falk Company, of Milwaukee. Mr. Carr for some time past has been the chief engineer and superintendent of electrical construction for the West Chicago Street Railway Company, and is a thoroughly well-informed electrical engineer.

MR. L. D. TANDY, one of the engineers of the railway department of the General Electric Company, has severed his connection with that company and sailed for Europe, April 15. Mr. Tandy will make his headquarters in London and will be associated with Messrs. John Hays Hammond and Henry A. Butters in their continental electric railway enterprises.

MR. F. L. HART, until recently general manager of the Baltimore City Passenger Railway Company, has been engaged by the Crosby-Lieb syndicate in Washington as manager of the street railway and electric lighting properties which are now in process of consolidation, and has at once commenced work on the construction of 20 miles of underground conduit track construction.

MR. MAURICE COSTER, for three years manager for the Westinghouse Electric & Manufacturing Company at Chicago, has sailed for Europe, where he will enter upon the duties of general manager of the Société Industrielle de Electricité Procédés Westinghouse, a French company newly formed to manufacture and sell Westinghouse electrical machinery and apparatus on the continent of Europe.

MR. W. F. HAM, formerly secretary of the Nassau Electric Railway Company, has been appointed auditor of the entire Brooklyn Rapid Transit system, and has entered upon his new duties. Mr. Ham is an expert accountant, and has given the subject of street railway accounts most careful study. He was one of the organizers of the Street Railway Accountants' Association, and has been one of its hardest workers since its beginning.

MR. ERVIN G. LONG, vice-president of the Peckham Truck Company, of Kingston, N. Y., was married to Miss Cora A. Reynolds on Wednesday afternoon, April 26, 1899, at Christ Church, Poughkeepsie, N. Y. Mr. Long is one of the best-known supply men in the street railway field, and his large circle of acquaintances will wish him the heartiest congratulations at this time. Mr. Long has recently returned from a very successful business trip in Europe.

MR. FRANK X. CICOTT, who was well known in electrical and tramway circles on both sides of the Atlantic, died recently at the home of his sister in Detroit. Mr. Cicott had just returned from a trip around the world, undertaken to investigate the possibilities for the investment of American and European capital in tramway enterprises abroad, and some articles from his pen on foreign practice have appeared in recent issues of this paper. Mr. Cicott was at one time director of the United States Government mint at San Francisco.

MR. BURT VAN HORN has received the appointment of general manager of the International Traction Company, of Buffalo. As announced in the last issue of the STREET RAILWAY JOURNAL, this company is completing the consolidation of a number of street railway companies in the city of Buffalo and vicinity, and the combined system will be one of the largest in the East. Mr. Van Horn is well known to the street railway fraternity, and he enjoys the reputation of being an exceptionally able and well-informed street railway manager. He has the best wishes of his many acquaintances in entering upon his new duties.

MR. R. M. DOUGLASS, until this month secretary, treasurer and general manager of the Schuylkill Valley Traction Company, of Norristown, Pa., has accepted the position of general superintendent of the Cleveland Electric Railway Company, having entire charge of the property, under President Everett. Mr. Douglass entered the street railway field about five years ago, his first work being the building of the Syracuse & East Side Street Railway, of which he had general charge until the sale of the property. He then went to the Brooklyn Heights Railway Company as superintendent, but on account of severe and protracted illness he gave up this position in order to take that at Norristown, where he has since been an active and efficient manager.

MR. E. H. CHAPIN, who was formerly connected with the STREET RAILWAY JOURNAL and later with the Standard Oil Company, of New York, has recently opened an office in Rochester, with headquarters in the Granite Building, where he will represent the Burnett Company, of New York, dealers in railroad, electrical, marine, mining and milling supplies, and also the Swan & Finch Company, of New York, refiners and dealers in lubricating oils and grease. This latter concern has been engaged in the manufacture of oil and grease since 1853, and is well known in the trade. Mr. Chapin's energy and popularity insure a successful business in anything which he undertakes and in his new business he has the best wishes of his former co-workers on this publication.

MR. DAVID G. HAMILTON, the new president of the Chicago City Railway Company, succeeding Mr. Bowen in that position, is one of the best-known street railway men in the United States, having been for many years a regular attendant at the conventions of the American Street Railway Association, where his advice and counsel have always been sought and have had great weight. As Mr. Hamilton has been the responsible financial head of a half-dozen or more street railway properties in St. Louis of which Mr. Robert McCulloch has been the chief executive, and his street railway experience, gained partly in this connection and partly as a large stockholder and director, and latterly second vice-president, of the Chicago City Railway Company, has been intimate and wide. Mr. Hamilton was born in Chicago in 1842, and nearly all his life was spent in that city. He studied law at the old Chicago University, and entered upon a practice later on, but after a number of years he became interested as investor and financier in many important financial undertakings in Chicago, and especially in real estate. He is Western director of the Union Life Mutual Insurance Company, of Maine, a member of the board of trustees of the University of Chicago and of De Pauw University, and is a member of several clubs of Chicago.

AMONG THE MANUFACTURERS

THE EDW. P. ALLIS COMPANY, of Milwaukee, Wis., has just booked a large order from Russia for mining and pumping machinery.

PEPPER & REGISTER, of Philadelphia, Pa., have removed their offices to rooms 712 and 715 Fidelity Mutual Life Building, North Broad Street, Philadelphia.

THE Q. & C. COMPANY, of New York city, is about to make extensive shipments of pneumatic tools to Russia, Paris and London. This company is doing an excellent foreign business.

E. F. DE WITT & COMPANY, of Lansingburg, N. Y., manufacturers of the "Common Sense" sand box, have appointed the W. R. Garton Company, of Chicago, Western agents for these sand boxes.

DICK BROS. & CO., bankers, of New York and Philadelphia, announce that William R. McLaughlin, formerly of the "Electrical World," will represent them in the placing of investment securities.

THE JACKSON & SHARP COMPANY, of Wilmington, Del., reports that it is exceptionally busy at this time, having more orders for both open and closed car bodies than it has had at any one time in years. This company has also just shipped some large double truck, double deck cars to the Argentine Republic.

THE B. F. STURTEVANT COMPANY, of Boston, Mass., is sending out Bulletin M, which is devoted to the Sturtevant electric propeller fans, for ventilating buildings of all classes, smoking and dining rooms, restaurants, kitchens, bakeries, boiler rooms, etc.

THE ELECTRICAL INSTALLATION COMPANY, Monadnock Block, Chicago, announces to the trade in a handsomely engraved notice that after May 1 it will be at home to its friends in new offices at 1516 and 1517 Monadnock Block, directly over and four floors above its old location.

THE HENRY R. WORTHINGTON PUMP WORKS, of New York, are well filled with foreign orders, and their weekly shipments to Europe average two carloads. This concern will furnish the pumping machinery which is to furnish the water supplied for the coming Paris Exposition.

THE JEWELL BELTING COMPANY, of Hartford, Conn., has completed and has ready for shipment two leather belts which were ordered by a firm in a leading city in France. The belts are ½-in. in thickness, 5 ft. in width, and together are 225½ ft. long. They weigh over 2400 lbs. and will undoubtedly be the widest belts in France.

THE ABENDROTH & ROOT MANUFACTURING COMPANY, of New York, manufacturer of the Root improved water tube boiler and Root's spiral riveted pipe, on May 1, removed from its former location at 28 Cliff Street, to the new building erected at 99 John Street, where it will occupy commodious offices on the sixth floor.

THE EDW. P. ALLIS COMPANY, of Milwaukee, Wis., will furnish two 750-h.p. direct connected vertical cross compound condensing engines to the North River Light, Heat & Power Company, of Hoboken, N. J., and two direct connected cross compound condensing engines of 300 h.p. and 450 h.p., respectively, for a new electric railway at Lebanon, Pa.

WILLIAMSON & COMPANY, of Allegheny, Pa., have published a descriptive catalogue of the Ramsey signal system. This system is now well known to electric railway managers, and is in operation on many single track roads. The catalogue contains a number of interesting testimonial letters, and also a complete diagram showing the working of the system.

THE TURNER ENGINEERING COMPANY, of Bucyrus, Ohio, is furnishing the "Turner" water tube boiler, 250 h.p., for the Findlay Ohio Street Railway; two 200 h.p. for the Central Traction Company, and three 225 h.p. for the Indianapolis Ice & Cold Storage Company. Large boilers of this type recently put into service are showing excellent results.

THE WESTERN ELECTRICAL INSTRUMENT COMPANY, of Newark, N. J., is making contracts for its new factory at Waverly, N. J., a suburb of Newark. A railway switch has been constructed to the spot, and ground was broken recently for the erection of what will be one of the most complete manufacturing establishments in the United States.

JOHN E. DE LEON, of Buffalo, N. Y., after numerous experiments, has perfected a unique electrical exhibition for street railway parks and pleasure resorts. His exhibition consists of several feats upon a bare wire cable charged with electricity. The cable and his body are outlined with numerous incandescent lights of various colors, and some very startling and attractive results are secured.

THE DUPLEX CAR COMPANY, of New York, has found it necessary to extend its factory capacity, on account of the number of orders received. Many of the cars this company is building for foreign delivery are arranged with a single seat on one side of the aisle and a double seat on the other. The officers of the company report excellent prospects for a large business during the next few months.

THE DORNER TRUCK & MANUFACTURING COMPANY, of Cleveland, Ohio, has received an order for trucks from the Cleveland & Eastern Railway Company. The truck used will be the company's latest type, No. 15 Criterion pivotal motor truck. The Dorner Truck & Manufacturing Company also has some good orders for its No. 11 Criterion single motor truck, and two orders of ten trucks each for its new Moore truck.

THE FRANK M. PIERCE ENGINEERING COMPANY, of New York city, has closed a contract with the Amsterdam Street Railway Company, of Amsterdam, N. Y., to install a 250-h.p. Erie Ball engine to be direct connected to two 80-kw. G. E. generators. The Frank M. Pierce Engineering Company has also shipped a 100-h.p. engine for electric work at a mining plant in North Japan; also two 125-h.p. engines to the same country.

WINTHROP G. NORRIS & COMPANY, of Boston, Mass., have completed plans and specifications for a power station and car barns for the Gardiner, Westminster & Fitchburg Railway Company. This will be a direct connected station, with Slater compound condensing engines. The road will be 9 miles in length with a branch of about 2 miles from South Fitchburg to Wauchusett Lake. The work will be pushed rapidly to completion.

CHANGE OF OWNERSHIP.—It is announced that all the capital stock of the Commercial Electric Supply Company, of St. Louis, Mo., has been purchased by William F. Nolker, his sons and associates. Mr. Nolker proposes to increase the capital stock of the company and to place the Commercial Electrical Supply Company in a very enviable position. The management and general personnel of the company will remain about as heretofore.

THE BERLIN IRON BRIDGE COMPANY, of East Berlin, Conn., has taken the contract for the new roof on the East Armory of the Colt's Fire Arms Manufacturing Company, at Hartford. This roof is 60 ft. wide and 500 ft. long, and is to be entirely re-covered. The new roofing is to be the Berlin Iron Bridge Company's anti-condensation fireproof roof lining, consisting of anti-condensation lining underneath the corrugated iron outside covering.

THE ERICSSON TELEPHONE COMPANY, of New York, has moved its offices from 20 Warren Street to 296 Broadway. This company's specialties have been sent to a large number of cities of this and foreign countries, and the Ericsson telephones need no introduction. The company's latest catalogue contains interesting descriptive matter on the different types of receivers and transmitters and telephone sets that are carried in stock.

THE AMERICAN RAIL JOINT & MANUFACTURING COMPANY, of Cleveland, Ohio, has closed contracts with the Erie & Cambridgeboro Electric Railway Company for joints on about 25 miles of track; with the Orleans & Jefferson Railway Company for 9 miles, and the Kansas City & Leavenworth Railway Company for 11 miles; a total of about 21,000 joints. This company so far this season has made contracts for about 40,000 joints.

THE ELECTRICAL INSTALLATION COMPANY, of Chicago, is furnishing the overhead construction for the Northeast Electric Railway of Kansas City, and the Grand Avenue division of the Brooklyn Avenue Railway Company of Kansas City, and also about a thousand iron poles for the Metropolitan Street Railway Company of Kansas City. It has also recently secured a contract for building an extension to the Vicksburg Electric Railway, Vicksburg, Miss.

C. TOWNSEND BLAKE, of Philadelphia, Pa., reports that he is now installed in his new offices at 612 Girard Trust Building, Philadelphia, and is prepared to transact business in his former prompt manner. He is prepared to buy and sell and to quote prices on all unlisted street railway, steam railroad and gas bonds. In addition to this he has opened a municipal department under the management of Robert Hancocks, and will be pleased to negotiate either for the purchase or sale of any issue of municipal bonds.

LAING, WHARTON & DOWN, LTD., of London, are sending out a neat catalogue describing the Vril electric launches, which are manufactured by this firm. These launches are operated by storage batteries, and the machinery is fitted in water-tight compartments, taking up no room that can be occupied for passenger accommodation. During the time the launch is running the machinery requires little attention, and is free from danger. The services of but one man are required to both control the machinery and steer.

THE GARTON-DANIELS ELECTRIC COMPANY, of Keokuk, Ia., is sending out some interesting leaflets describing Garton lightning arresters. A paragraph from one of these is particularly worthy of note. It is as follows: "Use plenty of pole arresters—they cost much less than repairs, and do not require constant attention. Never ground your lines. Offer the discharge many paths to earth before coming to your station. Relieve the strain on the insulation of your entire system." The manufacturers of the Garton arresters claim that these instruments contain all the desirable features of a lightning protective device.

SPECIAL CATALOGUE.—The Peckham Truck Company, of Kingston, N. Y., and New York city, has just issued another one of its series of elaborate and valuable catalogues. This one is devoted to the Peckham system of single electric trucks, and consists of fourteen sheets, 15 ins. x 8 ins., of heavy paper bound together with fasteners, with heavy covers. Upon one side of each sheet is printed a handsome engraving of some special type of single truck, and on the opposite side of many of the sheets appears an engraving of a car mounted upon that particular truck. The engravings of the trucks are printed with tinted background, and the details of all the parts are clearly brought out. This company has also issued a catalogue of the same general style devoted to double trucks.

MERCHANT & COMPANY (Inc.), of Philadelphia, New York and Chicago, have recently received an order from the War Department for 786 of their galvanized "Star" ventilators, for use on the officers' quarters and barracks to be erected at Havana and Matanzas, Cuba. There will be 587 "Star" ventilators, 24 ins. in diameter, and 199, 14 ins. in diameter. Some idea of the size of the order can be had, when it is stated that if these ventilators were placed in a line with their edges touching, they would cover a distance of nearly half a mile. Within the last few months Merchant & Company (Inc.) have also supplied 500 ventilators, 18 ins. in diameter, for the new government hospitals at Fortress Monroe and Savannah.

THE KEUFFEL & ESSER COMPANY, of New York city, the well-known manufacturers of everything required in the science of drawing and measuring, report a constantly increasing demand for their goods. This company is known throughout the world, and its goods are recognized as standard by a very large number of leading architects, surveyors, draftsmen, etc., of the country. This firm makes most of its goods in its own factory and absolutely controls nearly all goods which it imports. It warrants all materials and instruments to be exactly as represented. Its profusely illustrated catalogue of over 400 pages should be in the hands of everyone interested in any way in drawing or measuring instruments or materials, and this pamphlet will be sent free of charge on request.

THE W. R. GARTON COMPANY, of Chicago, of which W. R. Garton is president and treasurer, and Ray P. Lee is secretary, has just moved into its new quarters, suite 603-604 Manhattan Building, where it enters the second year of its existence under the most auspicious of circumstances. This company represents, among others, the Electric Railway Equipment Company, of Cincinnati, Ohio, whose exceptional line of iron and steel, tubular and ornamental poles, brackets and trimmings, as well as a most complete line of figure 8, and round trolley, overhead material is so well and favorably known. The W. R. Garton Company has closed several very large contracts in these lines; in fact, reports a business for the various manufactures whom its represents of over $50,000 during the last forty days.

A WELL-KNOWN SUPPLY AGENCY.—Charles N. Wood, of Boston, Mass., agent and representative for many of the leading street railway supply houses in America, reports a constantly increasing business. Mr. Wood has recently formed a consolidation with the Frank Ridlon Company, with offices at 200 Summer Street and 31 State Street, Boston, and this has resulted in a very large increase of orders. Among the firms represented by Mr. Wood are the R. D. Nuttall Company, International Register Company, American Heating Corporation, Wilson, Thompson & Company, Van Wagoner & Williams Hardware & Mining Company, etc., so he is in a position to execute promptly contracts for almost any specialty required by a street railway company. Mr. Wood's extensive exhibit at the last convention, at Boston, will be remembered by all convention goers.

THE GENERAL ELECTRIC COMPANY, of Schenectady, N. Y., has issued from its press during the past month the following catalogues and circulars: Bulletin No. 4168, describing single-phase alternating current generators, 60-cycle revolving armature type; Bulletin No. 4169, describing the two-rate meter and system; Bulletin No. 4170, running light tell-tale boards; pamphlet by Carl D. Haskins, on the "Management of Central Station Meter Systems;" and an exceedingly tasteful brochure devoted to the subject of fan motors. The latter is profusely illustrated, showing all the various types of alternating and direct current fan motors for ceilings, walls and desks, and other special requirements. The company has also issued Bulletin No. 4106, on direct current lightning arresters, magnetic blowout type, M. D.; No. 4167, on assembled commutator segments for railway motors; and No. 4171, on railway line material.

THE MANHATTAN RAILWAY COMPANY, of New York, has recently placed one of the largest single orders for transfer tickets ever given. This company has made transfer arrangements with the Third Avenue Railroad, and as the system went into effect April 29, it was necessary to have the tickets printed on very short notice. To inaugurate the system many millions of tickets were required, there being 427 stations, each requiring its special ticket. The general style was not decided upon until Tuesday noon, April 18. A special paper was required, therefore it had to be made for the purpose. Geometric lathe work tints had to be engraved, and owing to the work required special machinery had to be arranged. All this had to be done, and at least three million transfer tickets delivered by Tuesday noon, April 25. The work of furnishing these tickets was given to the Globe Ticket Company, of Philadelphia, and the confidence placed in this concern by the Manhattan Railway Company speaks well for its resources and reputation.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, Mo., is pushing the street railway branch of its business this season, and is evidently receiving some very gratifying results. The head of this department, Charles Scudder, Jr., reports some very flattering results and a constantly increasing demand for the company's goods, of which it has a most excellent assortment, and of a quality that will bear inspection. The company is now Western agent for some of the most prominent manufacturers in the country and has taken every precaution in the selection of the goods represented. This has resulted in the company offering to the trade a very high grade of supplies necessary in the construction and maintenance of a street railway. The company is carrying a very complete railway stock in St. Louis, which has been found to be of great assistance and value in sustaining its reputation for prompt shipment, which its experience has shown to be second only to the quality of the goods furnished.

THE WARREN-WEBSTER COMPANY, of Camden, N. J., report the following recent sales of Webster vacuum feed water heaters and purifiers: S. S. Mascotte; Creedmore Mining Company, Creede, Col.; Freemont Electric Light Company, Cripple Creek, Col.; Washington County Court House, Washington, Pa.; St. George's Hotel, Evansville, Ind.; St. Louis Club, St. Louis, Mo.; New York, New Haven & Hartford Railroad Company Depot, Providence, R. I.; Gaensslen Fisher Glue Company, Gowanda, N. Y.; Cleveland Twist Drill Company, Cleveland, Ohio; Masonic Temple, Boston, Mass.; Arapahoe County Poor Farm, Denver, Col.; Winship Machine Company, Atlanta, Ga.; J. R. Keim & Co., Philadelphia, Pa.; Boston Rubber Shoe Company, Malden, Mass.; Walworth Con. & Supply Company, Boston, Mass.; Morris Building Company, Mills No. 3, Brooklyn, N. Y.; Massachusetts Cotton Mills, Lowell, Mass.; Hazard Manufacturing Company, Wilkesbarre, Pa.; Calvin, Pardee & Company, Harwood Colliery, Pa.; Conkling Chemical Company, S. Chicago, Ill.

THE HARRISBURG FOUNDRY & MACHINE WORKS, through their Boston office, have been awarded the contract for furnishing Harrisburg standard engines of a capacity of over 4000 h.p. There are ten engines in the order, each engine weighing 60,000 lbs., which will develop 350 h.p.; maximum capacity 400. These engines are for the immense new plant of the Great Northern Paper Company, which has purchased thousands of acres of timber land, erected enormous buildings and machinery in the northern part of the State of Maine, and which will be the largest paper producing plant in the world. This order is just one-half of the entire order, which will be nearly 10,000 h.p.. This, it is stated, is the largest order for engines of the wheel governing type ever placed in this country, and was obtained in open competition at better prices than were made by other concerns. The Harrisburg Foundry & Machine Works have been so crowded with work as to necessitate running day and night for the last six months, and it is fortunate that their new plant is so rapidly nearing completion, for it is only on account of this that it has been possible for them to accept the present rush of orders.

A. L. IDE & SONS have recently made the following contracts for "Ideal" engines: Fountain City, Wis., one 70 h.p., belted; Monterey Electric Light Company, Monterey, Mexico, one 250-h.p. and one 110-h.p. tandem compound engines, belted; Kingan & Company, Indianapolis, one 70-h.p., direct connected; Emery, Bird, Thayer Dry Goods Company, Kansas City, one 260-h.p., direct connected; the Kuntz-Remmler Company, Chicago, one 45-h.p., belted; Kingman Plow Company, Peoria, Ill., one 100-h.p., belted; Janney, Semple, Hill & Company, Minneapolis, Minn., one 60-h.p., direct connected; Caro Light & Power Company, Caro, Mich., one 300-h.p., belted; Bonham Electric Light Company, Bonham, Tex., one 60-h.p., belted; F. W. Horne, Yokohama, Japan, one 40-h.p., direct connected; Boston Store, Davenport, Iowa, one 100-h.p., direct connected; Pilgrim Hotel, Marshalltown, Iowa, one 60-h.p., direct connected; Illinois Central Railroad Company, Chicago, Ill., one 80-h.p.; Deadwood & Delaware Smelting Company, Deadwood, S. Dak., one 100-h.p., direct connected; Hillman Building, Chicago, one 125-h.p. and one 150-h p. tandem compound engines, direct connected; Illinois State Reformatory, Pontiac, one 200-h.p., belted; Lancaster Electric Light Company, Lancaster, Wis., one 100-h.p., belted; Kieckhefer Bros., Milwaukee, one 190-h.p., direct connected; C. J. Smith & Sons, Milwaukee, one 125-h.p., direct connected; Anheuser-Busch Brewing Association, two 125-h.p., direct connected; Chicago & Great Western Railroad Company, for shops at Oelwein, Ia., one 180-h.p. and one 300-h.p.; City of Barnesville, Minn., one 60-h.p., direct connected; Empire Zinc Company, Joplin, Mo., one 150-h.p. and one 100-h.p., direct connected; Mississippi River Commission, two 500-h.p. tandem compound engines; W. J. Lemp Brewing Company, St. Louis, two 100-h.p. engines, direct connected, and one 60-h.p., direct connected.

New Publications

Circular No. 10. Published by the Street Railway Accountants' Association of America. Paper. 17 pages. Illustrated.

This pamphlet is being sent out from the secretary's office of the Street Railway Accountants' Association, and is a full and clear explanation of the objects, aims, and advantages of the association. To street railway companies desiring to improve and extend the usefulness of their accounting departments this pamphlet will be of considerable interest. The book contains also the constitution and by-laws of the Accountants' Association, with a list of members.

Preliminary Report on the Income Account of Railways in the United States for the Year Ending June 30, 1898. Paper. 70 Pages. Compiled and published by the Interstate Commerce Commission, Washington, D. C.

As stated in the title, this is a preliminary report of the Interstate Commerce Commission on the income and expenditures of railways in the United States, for the year ending June 30, 1898. From this report it appears that the total gross earnings of the railways during the year were $1,238,523,380, an increase over the previous year of $116,433,607. Of the aggregate gross earnings, $332,892,782 are from passenger service and $874,865,487 from freight service. The operating expenses of the roads were $811,-241,458, an increase over the previous year of $58,716,694. The net earnings for 1898 were $427,281,922, an increase of $57,716,913. The total mileage reported is 181,334 miles of track.

Trade Catalogues

The Ramsey Signal System. Published by Williamson & Co., of Allegheny, Pa. 12 pages. Illustrated.

Vril Electric Launches. Published by Laing, Wharton & Down, Ltd., London. 30 pages. Illustrated.

The Sturtevant Electric Propeller Fans. Published by the B. F. Sturtevant Company, of Boston, Mass. 4 pages. Illustrated.

Catalogue. Published by Ericsson Telephone Company, of New York city. 24 pages. Illustrated.