The SAFETY CAR



GENERAL ELECTRIC COMPANY

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GENERAL ELECTRIC COMPANY
SCHENECTADY, NEW YORK.

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A FEW OF THE 66 SAFETY CARS OPERATED IN TERRE HAUTE, IND.

During the past few years the electric railways of the country have been confronted with rapidly increasing cost of operation while their gross income has remained practically unchanged. A vast amount of study and attention has been given by the engineering and financial interests to assist the railways in the continuance of business under the existing unfavorable conditions.

The most encouraging results achieved by these studies have been the development and the many successful installations of the one-man light weight Safety Car. Examples of what may be accomplished by this radical departure from the ordinary method of street railway transportation may be found in almost every section of the United States. Briefly stated the reasons for the success of this innovation are the following:

1. Improvement in service.
2. Freedom from accidents.
3. Increase in riding habit.
4. Lower maintenance cost.
5. Reduction in labor cost.
6. Reduction in power consumption.

As a result of these features, the operating company's net income has shown a marked improvement in almost every case. This increase in gross receipts combined with the marked reduction in cost of operation effects sufficient saving to insure profitable operation on roads previously run at a loss.



106 SAFETY CARS ON THE BROOKLYN RAPID TRANSIT SYSTEM EQUIPPED WITH GE-264 MOTORS AND K-63 CONTROL

Report of A. E. R. A. Committee

The conclusions of the committee on one-man car operation presented to the American Electric Railway Association in October, 1919, present the findings of a competent body of operating men on this subject:

1. The Safety Car is one of the most important improvements in street railway service that has appeared for many years. Its valuable features in the order of their importance are:
   (a) Greatly improved service to the public, both as to frequency and safety.
   (b) Increased earnings for the company.
   (c) Decreased operating expenses.
2. One-man operation alone, while useful in saving platform expense in the smaller communities, is not comparable with the improved service that can be obtained with the Light Weight Safety Car with its more frequent headway and greater average speed.
3. The savings obtainable from one-man cars should be shared with the trainmen in the form of a higher hourly rate for the operators of such cars than is paid to the trainmen on two-man cars.
4. When inaugurating one-man car service, it is good policy to assure the trainmen that no one will lose his job due to putting in the new cars. They are installed, as a rule, a line at a time, and experience has proved that the company is not burdened with extra men through this policy.
5. From the nature of the traffic available, the Safety Cars can accomplish more in a large city than in a small one, for the reason that the possibilities of increasing riding in the small community are limited. This statement is made to correct the erroneous impression existing in some minds that the Safety Car is useful only for saving expense in the smaller cities.
6. Where traffic is believed to be too heavy on peak to be successfully handled by Safety Cars, the larger, heavy cars may be used for tripper service on peak, thus making the light cars handle the long hour runs.
7. Similarly, where snow storms require the use of the heavier equipment at rare intervals, the Safety Cars can still be used to advantage during other times.
8. The Safety Car, though light, is just as substantial and with the same care in maintenance should last just as long as the former types of car. It has a steel frame and thoroughly modern, ventilated, interpole motors.
9. Regarding the matter of standardization, your Committee was not unanimous, but the majority opinion favored adhering to the present standard design of the Safety Car in the interest of cheaper costs through quantity production.
10. Experience has shown that the overwhelming majority of both riding public and trainmen favor the One-Man Safety Car; that it can, at one and the same time, improve the public's service, increase the trainman's wages and raise the company's profits; that it can be operated for about half the cost of an ordinary car; and that most of the companies that have tried it want more. We predict an increasingly rapid extension of the use of a device that can make a showing like the above.

General Features of the Safety Car

The standard Safety Car which is most commonly used is approximately 28 feet in length and seats 32 passengers, when arranged for double end operation. By utilizing the rear end, three additional seats can be obtained when the car is desired for single end operation only. The body is mounted on a single truck with 26 inch wheels and wheel base of about 8 feet. The construction of the truck is such that the car has excellent riding qualities and it is possible to use accelerating speeds, comparable to those of the competing automobile, without discomfort to passengers.



SAFETY CAR IN LEVIS, QUEBEC, EQUIPPED WITH GE-258 MOTORS AND K-63 CONTROLLERS

The Safety Car, completely equipped, weighs about 8 tons. It is of all steel construction and is built to a standard form and size. The roof is of the arch type and the sides are of steel with windows arranged for opening when desired. The platform is on the same plane as the body floor and folding doors and steps are equipped with mechanical opening and closing devices under control of the operator.

The electric equipment of the car consists of two 25-h.p. ventilated type railway motors, a type K-63 controller, special light weight grid resistors and a motor-driven air compressor, with a capacity of 10 cu. ft. per minute. Air brakes include various safety features and labor saving devices. The safety control equipment is especially adapted to the one-man operation; the brakes, doors, steps and sanders being controlled by a single brake handle and mutually interlocked.

As may be gathered from the above and from the following detailed description of air brakes and safety devices, the requirements of this type of car have been studied out with a great deal of care and to quote again from the report of the American Electric Railway Association, the development of this equipment has resulted in:

> "The creation of an entirely new type of car of low weight, greatly improved safety, and more rapid acceleration and deceleration. This car of the light weight safety type not only saves platform and accident expense, but permits an improvement in service, such as well nigh to revolutionize the street railway business."



MADISON RAILWAY COMPANY SAFETY CAR EQUIPPED WITH GE-258 MOTORS
K CONTROL AND CP-25 COMPRESSORS

Improvement in Service

The effect of improved service by the use of Safety Cars is best shown by actual results in the following cities:

	% INCREASED SERVICE	% INCREASED GROSS RECEIPTS
Houston, Texas	80	60
El Paso, Texas	44	43
Tacoma, Washington	45	43
Seattle, Washington	55	67
Gary, Indiana	62	46
Terre Haute, Indiana	77	44
Tampa, Florida	51	51
Bridgeport, Connecticut	125	100

Power Consumption

Owing to the increased cost of power, due to the high price of coal, labor and materials, the reduction in energy consumption secured by the use of light weight Safety Cars is an important factor in their success. In some cases the adoption of this equipment has actually postponed indefinitely the purchase of additional



SAFETY CAR AT KEOKUK, IOWA, EQUIPPED WITH GE-258 MOTORS

power equipment. The power consumption is, of course, dependent upon the weight of the car, the number and duration of stops, speed, profile of the line, etc. It is, therefore, difficult to make any definite statement as to the actual power consumed except for a specific case, but it is evident that a car weighing 8 tons with two motors should operate with an energy consumption of approximately one-third that of a 24-ton car equipment with four motors. The average consumption on most city railway systems is approximately 3 kilowatt-hours per car mile. According to the A. E. R. A. report, the actual figures from forty-five companies show energy consumption of Safety Cars ranging from .8 to 1.75 kilowatt-hours per car mile.

Safety Car Installations

The total number of light weight Safety Cars in operation and on order in the United States at the present time is approximately 3600, not including rebuilt cars, many of which have been equipped with safety features and operated by one man. In general, the rebuilt cars have been used only on lines of light traffic, and their general use is not recommended.

The following tabulation shows the location, number of cars and names of operating companies, using light weight Safety Cars equipped with G-E motors and control:

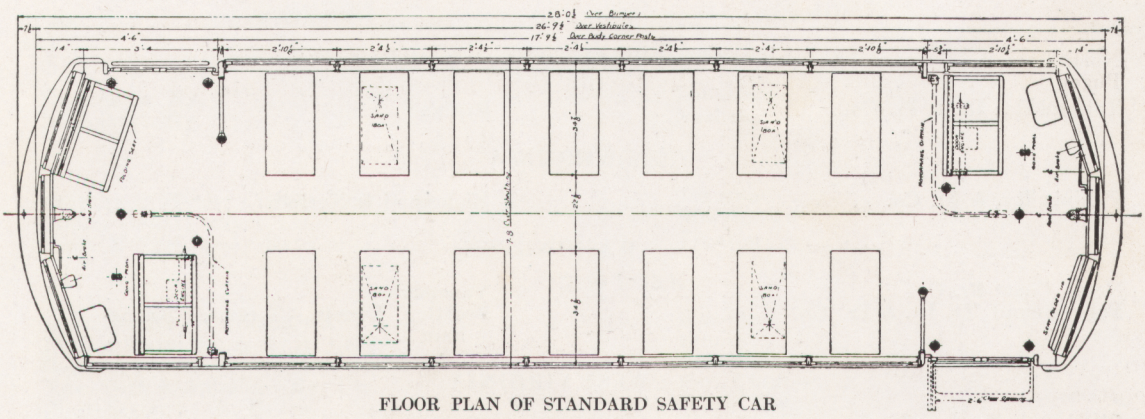
SAFETY CARS WITH GENERAL ELECTRIC EQUIPMENT

RAILWAY	LOCATION	NO. OF CARS
ALABAMA		
Alabama Pr. Co	Huntsville	2
Mobile Lt. & R.R. Co.	Mobile	10
ARKANSAS		
Fort Smith Lt. & Tr. Co.	Fort Smith	8
Hot Springs St. Ry. Co.	Hot Springs	7
Southwestern Gas & Elec. Co.	Texarkana	4
CALIFORNIA		
Los Angeles Ry. Corp.	Los Angeles	22
Pacific Elec. Ry. Co.	Los Angeles	13
Pacific Gas & Elec. Co.	Sacramento	6
Sacramento Northern R. R.	Sacramento	2
San Francisco, Oakland Terminal Ry. Co.	Oakland	12
San Diego El. Ry. Co.	San Diego	13
Southern Pacific R. R.	Los Angeles and other properties	64
Stockton Elec. R. R. Co.	Stockton	5
COLORADO		
Colorado Springs & Int. Ry.	Colorado Springs	35
Denver & So. Platte Ry. Co.	Denver	2
CONNECTICUT		
Bristol & Plainville Tramways Co.	Bristol	1
Connecticut Co.	Bridgeport, New Haven & Hartford	80
Danbury & Bethel St. Ry. Co.	Danbury	7
FLORIDA		
Tampa Elec. Co.	Tampa	14
GEORGIA		
Columbus R. R. Co.	Columbus	17
Athens St. Ry.	Athens	6
ILLINOIS		
Aurora, Elgin & Chicago Ry.	Aurora	40
Central Ill. Public Serv. Co.	Mattoon	10
Centralia & Central City Traction	Centralia	4
Chicago, North Shore & Milwaukee R.R.	Waukegan	10
Illinois Northern Utilities Co.	Freeport	3
Illinois Trac. System	Peoria ,Quincy, Decatur, Galesburg, Wichita, Kansas and other properties	113
No. Kankakee El. Lt. & Ry. Co.	Kankakee	3
Pekin Municipal Ry.	Pekin	4
INDIANA		
Chic. So. Bend & Northern Ind. Ry. Co.	So. Bend	10
Fort Wayne & Northern Ind. Traction Co.	Fort Wayne	65
Gary St. Ry. Co.	Gary	10
Gary & Hobart Tract. Co.	Hobart	1
Indiana Rys. & Lt. Co.	Kokomo	10
Louisville & South. Ind. Tract.	New Albany	10
Terre Haute Trac. & Lt. Co.	Terra Haute	66
Washington St. Ry. Co.	Washington	3

RAILWAY	LOCATION	NO. OF CARS
IOWA		
Cedar Rapids & Marion City Ry.	Cedar Rapids	8
Keokuk Elec. Co.	Keokuk	3
Mason City & Clear Lake R.R.	Mason City	2
Ottumwa Ry. & Lt. Co.	Ottumwa	16
KANSAS		
Arkansas Valley Int. Ry. Co.	Newton	1
KENTUCKY		
Owensboro City R. R. Co.	Owensboro	10
LOUISIANA		
Baton Rouge Elec. Co.	Baton Rouge	8
New Orleans Ry. & Lt. Co.	New Orleans	40
MAINE		
Bangor Ry. & Elec. Co.	Bangor	15
Biddeford & Saco R. R. Co.	Biddeford	8
Lewiston, Augusta & Waterville St. Ry.	Lewiston	12
Cumberland County Pr. & Lt. Co.	Portland	31
MARYLAND		
United Ry. & Elec. Co.	Baltimore	23
MASSACHUSETTS		
Berkshire St. Ry. Co.	Pittsfield	17
Boston Elev. Ry. Co.	Boston	31
Brockton & Plymouth St. Ry.	Plymouth	2
Eastern Mass. St. Ry.	Boston	101
Worcester Const. St. Ry.	Worcester	10
MICHIGAN		
Benton Harbor & St. Joe Ry. & Lt. Co.	Benton Harbor	2
Grand Rapids Ry. Co.	Grand Rapids	19
Ironwood & Bessemer Ry. & Lt. Co.	Ironwood	3
Michigan Ry. Co.	Jackson	20
Michigan Ry. Co.	Kalamazoo	16
Saginaw, Bay City Ry.	Saginaw	26
MINNESOTA		
Duluth St. Ry.	Duluth	6
St. Cloud Public Serv. Co.	St. Cloud	2
Wisconsin Ry. Lt. & Pr. Co.	Winona	8
MISSISSIPPI		
Vicksburg Lt. & Trac. Co.	Vicksburg	2
MISSOURI		
City Lt. & Tr. Co.	Sedalia	8
Kansas City Rys.	Kansas City	29
St. Joseph Ry. Lt. & Pr. Co.	St. Joseph	12
St. Louis Water Works Ry.	St. Louis	2
Union Depot Bridge & Ter. Co.	Kansas City	8
NEBRASKA		
Lincoln Traction Co.	Lincoln	32
Omaha & Council Bluffs St. Ry. Co.	Omaha	5
Omaha, Lincoln & Beatrice Ry. Co.	Lincoln	1

RAILWAY	LOCATION	NO. OF CARS
NEW HAMPSHIRE		
Laconia St. Ry.	Laconia	4
Nashua St. Ry.	Nashua	8
NEW JERSEY		
Trenton & Mercer County Trac. Co.	Trenton	62
Morris County Tract. Co.	Morristown	14
Penn. & New Jersey Ry. Co.	Trenton	13
NEW YORK		
Brooklyn Rapid Transit Co.	Brooklyn	106
Elmira Water Lt. & R. R. Co.	Elmira	7
Geneva, Seneca Falls & Auburn R. R. Co.	Seneca Falls	2
New York & Stamford Ry. Co.	Port Chester	7
Westchester St. R. R. Co.	White Plains	6
NORTH CAROLINA		
Carolina Pr. & Lt. Co.	Raleigh	10
North Carolina Public Serv. Co.	Greensboro	4
Southern Public Utilities Co.	Charlotte	21
NORTH DAKOTA		
Grand Forks St. Ry. Co.	Grand Forks	6
OHIO		
Northern Ohio Tr. & Lt. Co.	Akron	25
Richland Public Serv. Co.	Mansfield	7
Ohio Service Co.	Coshocton	2
OKLAHOMA		
Oklahoma Union Ry.	Tulsa	18
Pittsburgh County Ry.	McAlester	6
OREGON		
Portland Ry. Lt. & Pr. Co.	Portland	25
PENNSYLVANIA		
Mahoning & Shenango Ry. & Lt. Co.	New Castle & Sharon	18
Conestoga Traction Co.	Lancaster	4
Northumberland County Ry. Co.	Sunbury	4
Eastern Penn. Ry.	Pottsville	10
Northwestern Penn. Ry.	Meadville	6
Reading Transit & Lt. Co.	Reading	12
Trenton, Bristol & Phila. St. Ry.	Bristol	6
RHODE ISLAND		
Newport & Providence Ry.	Newport	3
SOUTH DAKOTA		
Aberdeen R. R. Co.	Aberdeen	8
TEXAS		
Austin St. Ry.	Austin	20
Dallas St. Ry. Co.	Dallas	12
Eastern Texas Elec. Co.	Beaumont	13
El Paso Elec. Co.	El Paso	30
Houston Elec. Co.	Houston	39
Marshall Traction Co.	Marshall	2
Northern Texas Tract. Co.	Fort Worth	75
Texas Elec. Ry.	Waco	16
Wichita Falls Tr. Co.	Wichita Falls	4

RAILWAY	LOCATION	NO. OF CARS
VERMONT		
Rutland Ry. Lt. & Pr. Co.	Rutland	1
VIRGINIA		
Virginia Ry. & Pr. Co.	Richmond & Norfolk	40
WASHINGTON		
North Coast Pr. Co.	Vancouver	2
Puget Sound Tr. Lt. & Pr. Co.	Seattle, Everett, Tacoma, Bellingham	83
WEST VIRGINIA		
Charleston-Dunbar Tr. Co.	Charleston	4
WISCONSIN		
Beloit Trac. Co.	Beloit	4
Eastern Wisconsin Elec. Co.	Sheboygan	15
Eastern Wis. El.Co.	Oshkosh	15
Madison Rys. Co.	Madison	13
Milwaukee El. Ry.& Lt. Co.	Racine	40
Wisconsin Ry.Lt. & Pr. Co.	La Crosse	8
Wisconsin Valley El. Co.	Wausau	3
CANADA		
Cape Breton Elec. Co., Ltd.	Sydney, N. S.	2
Levis County Ry.	Levis, Quebec	12
Nova Scotia Tramway & Pr. Co.	Halifax, N. S.	24
Peterboro Radial Ry.	Peterboro, Ont.	2
CUBA		
Matanzas Elec. St. Ry.	Matanzas	15
MEXICO		
Mexico Tramways Co.	Mexico City	6



FLOOR PLAN OF STANDARD SAFETY CAR

By taking the results of many investigations as a basis it is possible to make a study of the financial results of replacing the ordinary types of heavy rolling stock using present day costs of operation, and thus secure a fairly accurate idea of what return can be counted upon for an investment made in Safety Cars. All such studies so far made, confirmed by actual results in every existing installation, indicate that the majority of roads cannot well neglect placing some of these cars in their service.

For instance, there are thousands of standard city cars which weigh about 40,000 lbs. and seat an average of 40 passengers. The Safety Car weighs 16,000 lbs. and seats 32 passengers. Its motive power consumption is approximately 50 per cent that of the heavier car. Its maintenance will be about 40% less. In many instances, where the cars replaced are exceptionally old or obsolete, the saving on maintenance will be much greater. The power ratio shown above has been repeatedly checked and verified; and the maintenance records of the earliest installations indicate the ratio shown is accurate after the cars have been in service from two to three years.

We show below the saving in equipment, maintenance and power which can be secured by the use of Safety Cars.

POWER AND MAINTENANCE CHARGES—CENTS PER CAR MILE

	40,000 LB. CAR	16,000 LB. CAR
Equipment maintenance	3.5	2
Power	4.2	2
Total	7.7	4

A car operating 18 hours daily on an 8.5 m.p.h. schedule which is the average for city service in practically all parts of the country will run approximately 56,000 miles a year. The heavy car costs for power and maintenance when making this mileage $4,312; the Safety Car $2,240; a saving of $2,072.

Platform expense for a two-man car averages 14.1 cents per car mile. An all-day car, including a 5% allowance for reporting and lay-up time, will run approximately 58,800 hours per year, costing in wages $8,280.

It has been customary to pay the operator of a one-man car a higher wage than either member of a two-man car. The average platform expense for a safety car is 7.75 cents per car mile. At this rate the platform expense for the safety car operators would be $4,554 annually or a saving of $3,726 as compared with a two-man car.

Car for car, therefore, the Safety Car on all day runs can save over $5,700 per year, and would pay for itself within 14 months. Car for car replacement is not recommended, as the best results are obtained by operating more cars on shorter headway, thus providing improved service. Experience has proved that most lines will stand at least 40% improvement in servie. This can best be accomplished by operating about 30% more cars and increasing the schedule speed 10%. For instance, instead of operating ten cars on a 10-minute headway, operate thirteen cars on a 7-minute headway, giving 8.5 cars per hour instead of six, a 40% increase. Reduced stops and higher accelerating and braking rates of the Safety Cars enable such a schedule speed increase to be easily made.



RUSH HOUR AT INDIANA STEEL COMPANY, GARY, IND. SAFETY CAR EQUIPPED WITH GE-258 MOTORS, K-63 CONTROL AND CP-25 COMPRESSORS

The costs and effect of such an increase can be shown as follows: assuming that only the regular all-day cars are replaced; using existing equipment for rush hour trippers.

The ten old cars running 8.5 m.p.h. make 560,000 car miles annually at a cost for power, maintenance and crew wages of $122,200.

Thirteen Safety Cars at 9.3 m.p.h. make 795,000 car miles per year; their cost for power and maintenance and crew wages will be $88,300; a saving of $33,900, while providing 40% more service.

The average receipts per car mile on street railways in the United States is 37.7 cents. The total receipts, therefore, for the ten old cars in this case will be $211,120. Experience shows that a 40% increase in service means approximately a 40% increase in receipts. Assuming only a 20% increase, this amounts to $42,200. The combined effect of reduced cost and increased gross is a net increase in earnings of $76,100 or approximately $7,600 per car annually for each heavy car displaced,



SAFETY CAR IN BUSINESS SECTION, GARY, IND.

which is equivalent to an annual return of 78% on the first cost of fifteen safety cars. This provides two spare cars. Taking increased fixed charges on the increased capital account, at 18% to cover interest, depreciation, taxes and insurance, there is still left a profit to the purchaser of better than 58% annually—enough to wipe out their cost in approximately two years.

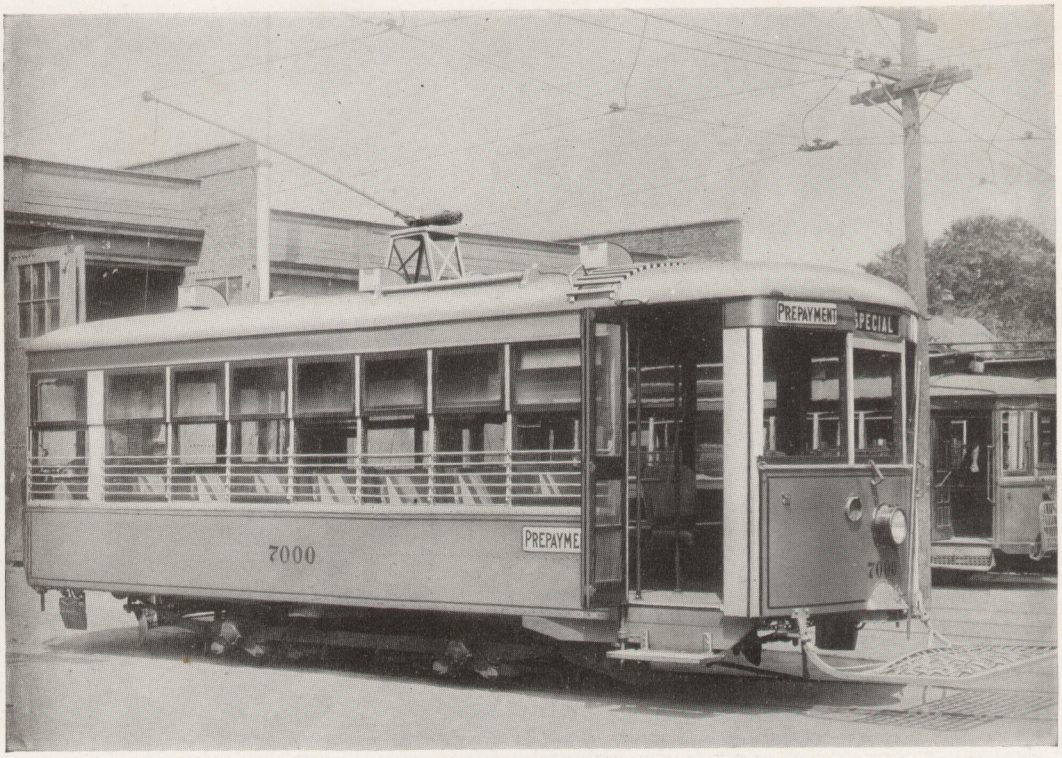
Where traffic does not warrant increased service and the replacement is made car for car, 11 cars would probably be sufficient for a ten car line. The net savings would be approximately $58,000, equivalent to an annual return of approximately 80% of the first cost of eleven safety cars.

Probably in wide spread applications some lines would fall into one category, some into the other. An average result would unquestionably show, after paying all increased fixed charges including amortization, between $5,000 and $6,000 profit for each car displaced, a sum sufficient to pay the interest at 6% on $80,000 to $100,000 worth of securities.

The tabulated data following illustrates the economies and increased earning possibilities for each car displaced.

Column A—based on running equal mileage—no increase in cars.

Column B—based on running 40% more mileage with 30% more cars.

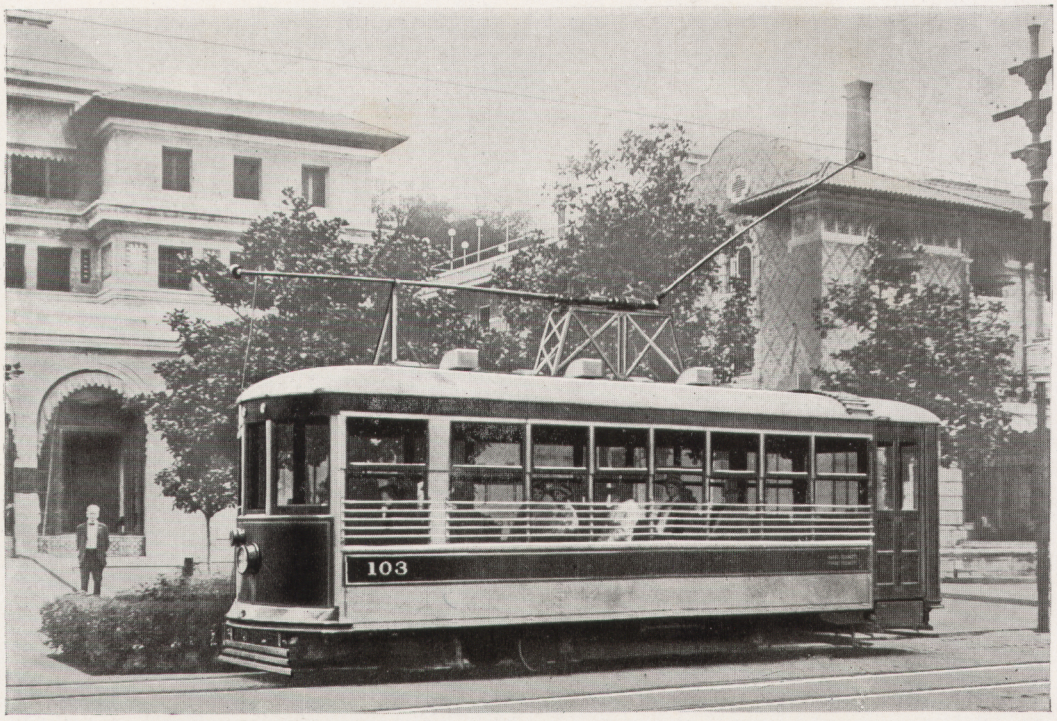


EASTERN MASSACHUSETTS ST. RY. SAFETY CAR EQUIPPED WITH GE-264 MOTORS, K-63 CONTROL

	Saving Made With A Equal Mileage	Saving Made With B 40% Increase
Maintenance of equipment annual saving	$840.00	$370.00
Power	1,232.00	760.00
Crew wages	3,726.00	2,280.00
Total savings	$5,798.00	$3,410.00
Increased receipts at 20%		4,222.00
Increase in net earnings	$5,798.00	$7,632.00
Annual return on cost of safety car, approximately	80%	78%

The foregoing is based on average costs for labor and on the replacement of the heavier types of city cars. Average wage scales in many properties are materially lower and power consumption less. Many, moreover, will show lower average receipts per car mile. Under such conditions the savings of the Safety Car become less, but are still remarkable, as evidenced by the following figures representing about the lowest costs anywhere in the country today; they are the averages of representative roads operating in the smaller cities of the middle west and south. The average weight of the cars they operate is 30,000 lbs.; their average platform expense is 11.3 cents per car mile and their average receipts 30 cents per car mile.

Making a similar comparison to the one formerly shown, financial results would be as follows:



HOT SPRINGS ST. RY. SAFETY CAR EQUIPPED WITH GE-258 MOTORS, K-63 CONTROL AND CP-25 COMPRESSORS

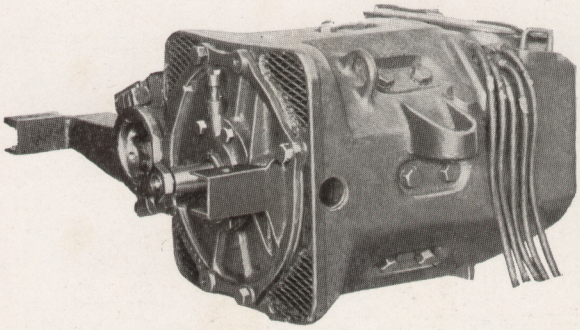
OPERATING COSTS—CENTS PER CAR MILE

	30,000 LB. CAR	SAFETY CAR
Maintenance of equipment	2.5	1.5
Power	3.4	2
Total	5.9	3.5
Platform expense	11.3	6.23

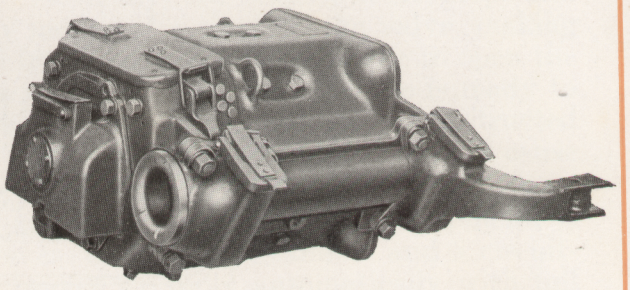
SAVINGS AND EARNINGS—ALL DAY SERVICE

	EQUAL MILEAGE	40% INCREASE
Annual savings on maintenance	$560.00	$210.00
Annual savings on power	780.00	320.00
Annual savings on platform expense	2840.00	1870.00
Annual savings on total	$4180.00	$2400.00
Increased receipts at 20%		3360.00
Increased net earnings	$4180.00	$5760.00
Annual return on cost of safety car approximately	58%	63%

Even under these circumstances, the new cars would pay for themselves in less than two years; or if from these increased earnings be deducted interest, depreciation, taxes and insurance, there remains a clean profit of from $3,500 to $5,000 for each car displaced.



GE-258 MOTOR



GE-264 MOTOR

G-E EQUIPMENT

The equipment developed by the General Electric Company, for the Safety Car, includes two 25-h.p. railway motors, a light weight platform type controller adapted for use with standard safety features, special light weight grid resistor, modified straight air brake equipment, also suitable for use with safety devices, and a ten-foot air compressor for supplying the air brake and accessory requirements.

MOTOR EQUIPMENT

The G-E 258 and G-E 264 motors have been most generally adapted for use on safety cars. They were designed for this service and are, for their capacity, the lightest weight railway motors manufactured. The G-E 258 has ball bearings on the armature shaft and weighs approximately 885 pounds. The G-E 264 has sleeve bearings of liberal design and weighs approximately 1000 lbs. The continuous capacity of these machines is so great that they operate at unusually low temperatures, and their performance, during the past five years, has been extremely satisfactory. These motors are fully described in Bulletins 44417A and 44470.

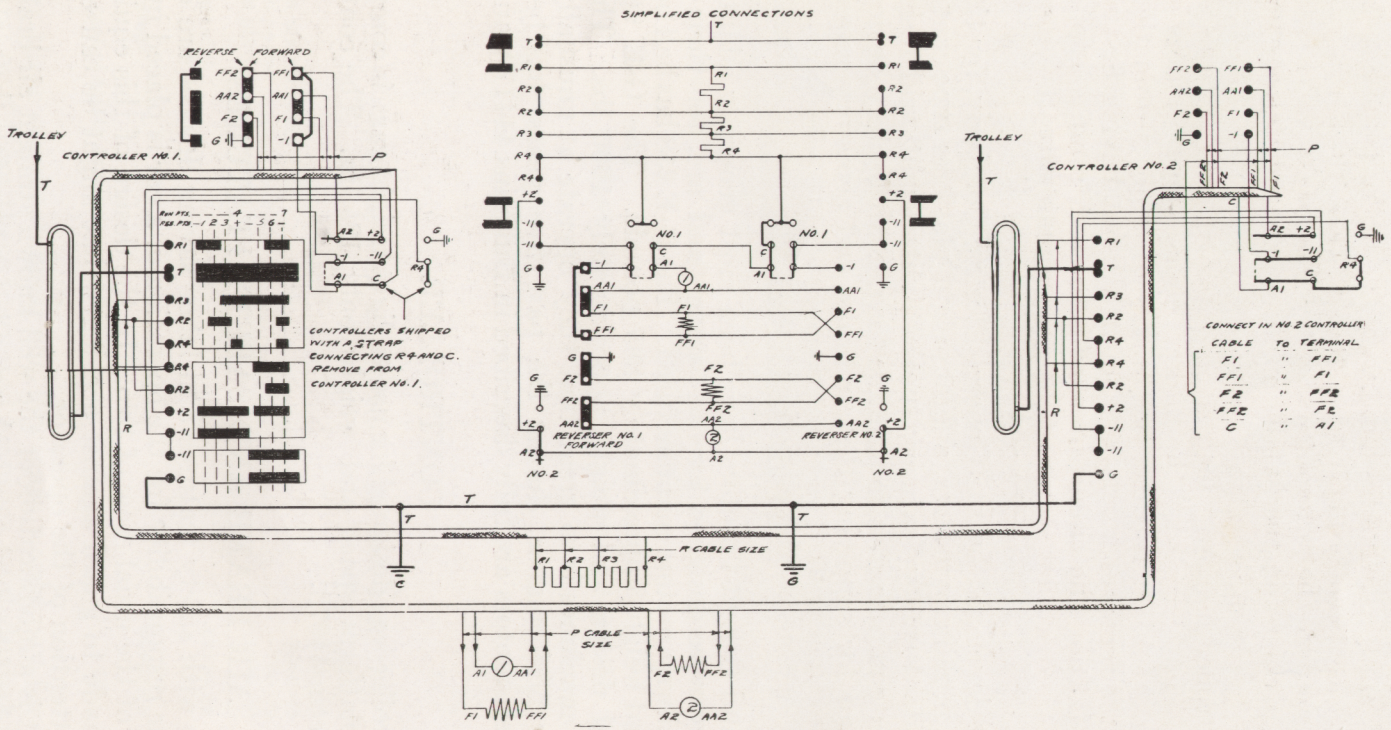
CONTROLLER

The K-63 controller was designed for use on light weight cars, is compact, occupies a minimum of platform space and weighs only 135 lbs. The controller is fully described in Bulletin 44678.

AIR BRAKE AND SAFETY FEATURES

The air brakes with safety features and labor saving devices are of special importance when the responsibility for the operation of a car is placed in the hands of one man instead of the usual crew of two. In the design of this equipment, every effort has been made to guard against accidents that might be caused by the disability or the inattention of the operator.

This equipment is a modification of the well known straight air brake with emergency features and safety devices which provide for bringing the car to a standstill automatically, should the operator by reason of sudden physical or mental disability



WIRING DIAGRAM FOR SAFETY CAR CONTROL EQUIPMENT

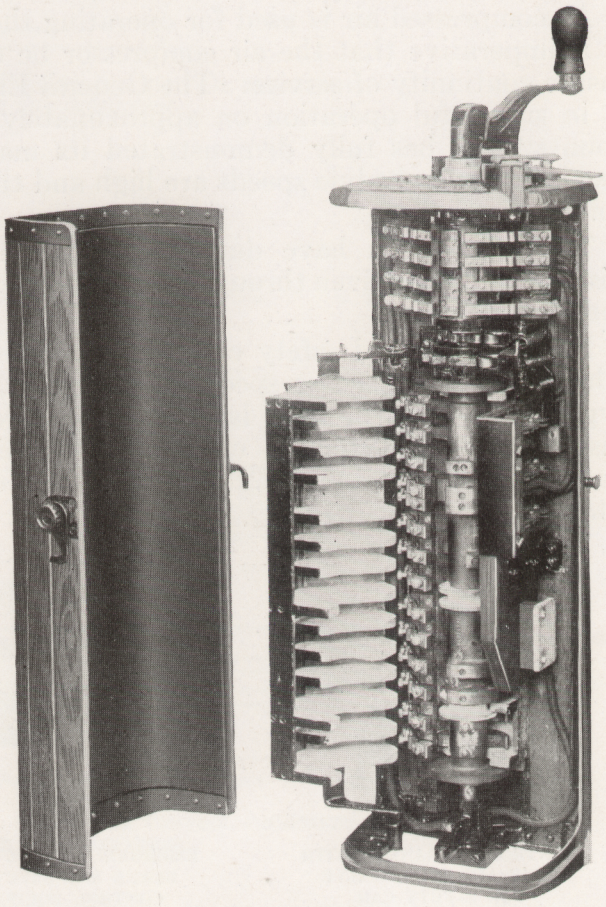
be unable to properly perform his duties. Normally, the brakes, doors, steps and sanders are controlled by the operator by means of a single brake valve, making it unnecessary for him to remove his hand from the brake valve handle to open the doors after the car has been brought to a stop, to close them when he is ready to proceed, or to manipulate the automatic sander. The brake valve is so constructed that a downward pressure on the handle in any of the several positions will cause sand to be applied to the rails.

The safety controller handle, which is an important part of this equipment, is so interlocked pneumatically with the brakes, doors, steps, sanders and a circuit-breaker tripping device, as to cause the brakes to apply automatically with full force if the operator removes his hand from it without having first made a brake application. In addition the circuit breaker is opened, sand is applied to the rail and doors are balanced so that they may be opened manually, if desired.

To relieve the operator of the necessity of keeping his hand on the controller handle at all times while the car is in motion, a relief valve known as the combined foot and cut-off valve is provided. This valve is installed in the safety control pipe and is located on the platform in such a position that the operator can reach it with his right foot. By holding this valve closed, the "dead-man's" feature is transferred from the controller handle to the foot valve. The latter is automatically held closed when a brake application of sufficient force to insure bringing the car to a stop has been made.

It is impossible for the brakes to "leak" off through carelessness on the part of the operator in leaving the car with the brake valve handle in "lap" position by reason of the fact that the combined foot and cut-off valve will automatically open if the brake cylinder pressure falls below a safe minimum. The opening of the foot valve under these conditions will result in emergency operation under which the brakes are applied with full force and maintained against leakage.

An emergency valve, which is located inside the car, automatically controls the brakes, door engines, sanders and circuit breaker cylinders under emergency conditions. This valve is actuated by a sudden reduction in pressure in either the safety control pipe



K-63 CONTROLLER

or emergency pipe, hence it will operate (1) if the operator removes his hand from the controller handle (or his foot from the foot valve) when the brakes are not applied; (2) if the operator moves the brake valve handle to emergency position; or, (3) if the pipe on either end of the car is accidentally broken or ruptured.

In all positions of the brake valve, except the door opening position, the door closing pipe is connected to the emergency line, hence when emergency operation takes place from any causes, pressure is automatically removed from the closing side of the door engines which permits of the doors being opened manually.

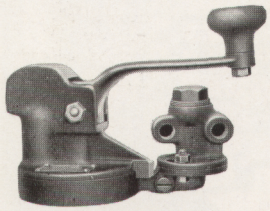
In the normal position of the emergency valve the sander reservoir is connected to the main reservoir thus keeping the former fully charged. When the emergency valve operates the sander reservoir is connected to the sanders and sand is blown onto the rail until the pressure in the sander reservoir is exhausted. This arrangement limits the time of automatic sanding in emergency and thus avoids an undue waste of sand.

Motor Driven Air Compressor

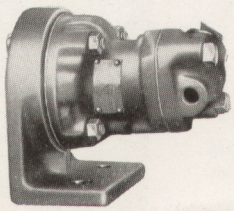
As compressed air is used for operating the brakes and all of the safety devices, it is imperative that the air compressor be of such design and construction as to insure continuity of service. The General Electric center gear type air compressor is in successful operation on approximately 1000 safety cars in all parts of the country and has fully demonstrated its many superior qualities in this class of service where schedule speeds are high and the demand for air is greater than heretofore.

These machines have duplex cylinders fitted with single acting trunk type pistons, and are driven through herring bone gearing by series wound motors having four salient poles.

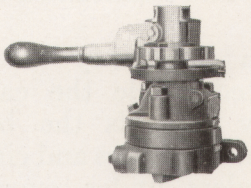
For the standard safety car, we recommend the CP-25 (10 cu. ft.) compressor which, unless otherwise specified, is regularly furnished with equipments of this type. If desired, the next larger size compressor, the CP-27, which has a piston displacement of 15 cu. ft. of free air per minute, will be furnished. A complete description and data on CP-25 and CP-27 compressors are given in Bulletin No. 44591A.



CONTROLLER HANDLE WITH BASE AND PILOT VALVE FOR SAFETY CAR CONTROL



EMERGENCY VALVE FOR AIR BRAKE AND SAFETY CAR CONTROL EQUIPMENT



BRAKE VALVE WITH SANDING FEATURE

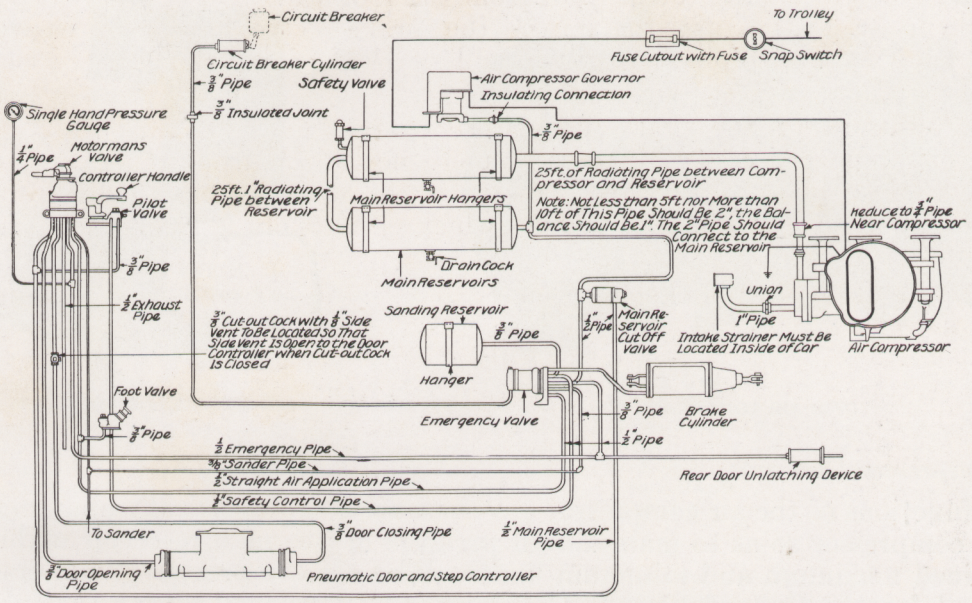


DIAGRAM OF AIR BRAKE AND SAFETY CAR CONTROL EQUIPMENT
FOR SINGLE END OPERATION

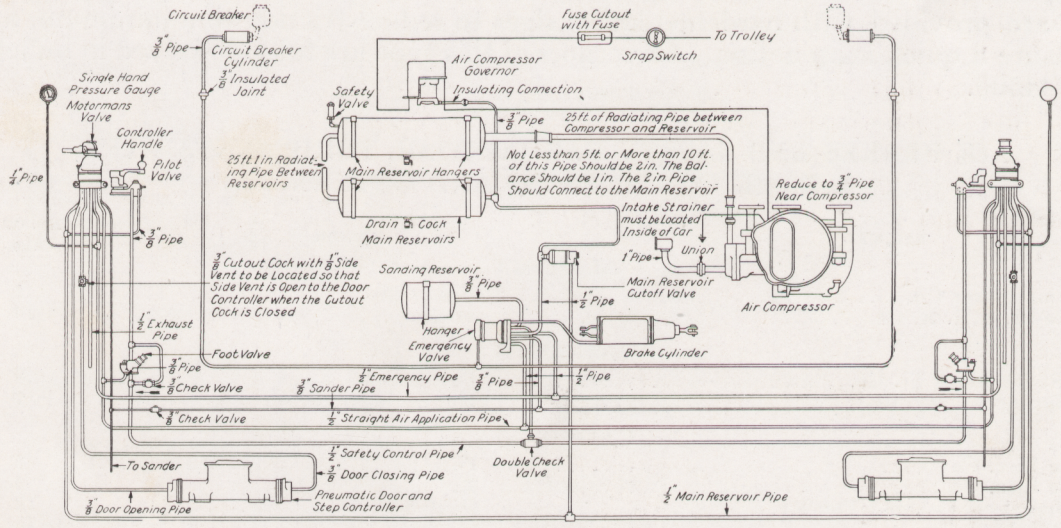
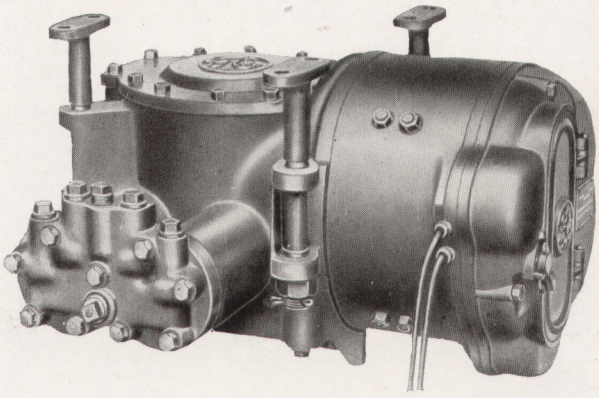
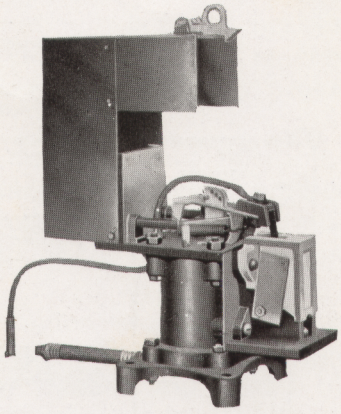


DIAGRAM OF AIR BRAKE AND SAFETY CAR CONTROL EQUIPMENT
FOR DOUBLE END OPERATION



CP-25 AIR COMPRESSOR



AIR COMPRESSOR GOVERNOR

Air Compressor Governor

The functions of the air compressor governor are to automatically start and stop the air compressor so as to maintain air pressure in the main reservoir within predetermined maximum and minimum limits. The air compressor governors manufactured by the General Electric Company were developed after a careful study of the rigid requirements of electric railway service, and are in successful use on thousands of cars throughout the country.

This type of governor is essentially a single-pole switch of the contactor type operated by means of a rubber diaphragm, a piston and a set of levers. The interrupting switch is provided with an arc chute of highly refractory material, an effective magnetic blowout and easily renewable contacts. The principle bearings are provided with hardened knife edges to reduce friction to a minimum, and to insure a quick snap action. Governors of this type are fully described in bulletin No. 44590.

AIR BRAKES AND SAFETY CAR CONTROL EQUIPMENTS WITH G-E AIR COMPRESSORS AND GOVERNORS

RAILWAY	LOCATION	NO. OF CARS
ALABAMA		
Alabama Power Co.	Huntsville	2
Mobile Lt. & R. R. Co.	Mobile	10
ARKANSAS		
Fort Smith Lt. & Tr. Co.	Fort Smith	8
Hot Springs St. Ry. Co.	Hot Springs	7
CALIFORNIA		
Pacific Elec. Co	Pomona	8
Pacific Elec. Co.	Riverside	5
San Francisco, Oakland Ter. Ry.	Oakland	12
Stockton Elec. Co.	Stockton	12
CONNECTICUT		
Bristol & Plainville Tramway	Bristol	1
Connecticut Co.	Bridgeport	20
Connecticut Co.	New Haven	2
Connecticut Co.		7

RAILWAY	LOCATION	NO. OF CARS
CUBA		
Matanzas Elec. St. Ry.	Matanzas	15
FLORIDA		
Miami Beach Elec. Co.	Miami	10
Miami Traction Co.	Miami	3
Tampa Elec. Co.	Tampa	1
ILLINOIS		
Aurora, Elgin & Chic. R. R. Co.	Aurora	20
Aurora, Elgin & Chic. R. R. Co.	Elgin	20
Central Ill. Public Serv. Co.	Mattoon	10
Chic. No. Shore & Mil. R. R.	Waukegan	10
Illinois Northern Utilities Co.	Freeport	3
Pekin Municipal Ry. Co.	Pekin	3
INDIANA		
Beech Grove Tract. Co.	Beech Grove	3
Chic. So. Bend & No. Ry. Co.	South Bend	20
Gary & Hobart Tr. Co.	Hobart	1
Gary Street Ry. Co.	Gary	10
Indiana Ry. & Lt. Co.	Kokomo	10
Terre Haute Tract. & Lt. Co.	Terre Haute	66
Washington St. Ry. Co.	Washington	3
IOWA		
Ottumwa Ry. & Lt. Co.	Ottumwa	6
Sioux City Service Co.	Sioux City	25
LOUISIANA		
Baton Rouge Elec. Co.	Baton Rouge	8
New Orlean, Ry. & Lt. Co.	New Orleans	40
MAINE		
Bangor Ry. & Elec. Co.	Bangor	3
Biddeford & Saco R.R.	Biddeford	10
Lewiston, Augusta & Waterville St. Ry. Co.	Lewiston	12
MARYLAND		
United Ry. & Elec. Co.	Baltimore	23
MASSACHUSETTS		
Berkshire St. Ry. Co.	Pittsfield	17
Boston Elevated Ry. Co.	Boston	30
Brockton & Plymouth St. Ry. Co.	Plymouth	6
Eastern Mass. St. Ry. Co.	Boston	1
Springfield St. Ry. Co.	Springfield	10
Worcester Cons. St. Ry. Co.	Worcester	10
MEXICO		
Mexico Tramways Co.	Mexico City	6
MICHIGAN		
Benton Harbor St. Joe Ry. & Lt. Co.	Benton Harbor	2
MINNESOTA		
Duluth St. Ry. Co.	Duluth	6
MISSISSIPPI		
Vicksburg Ry. & Lt. Co.	Vicksburg	2
MISSOURI		
Kansas City Ry. Co.	Kansas City	75
St. Joseph Ry. Lt. & Pr. Co.	St. Joseph	12
Union Depot Bridge & Ter. R. R.	Kansas City	5

RAILWAY	LOCATION	NO. OF CARS
NEBRASKA		
Lincoln Traction Co.	Lincoln	25
Omaha & Council Bluff St. Ry. Co.	Omaha	5
Omaha, Lincoln & Beatrice Ry.	Lincoln	1
NEW HAMPSHIRE		
Nashua St. Ry. Co.	Nashua	8
Laconia St. Ry.	Laconia	2
NEW JERSEY		
Salem & Penns Grove Tr. Co.	Penns Grove	6
NEW YORK		
Geneva, Seneca Falls & Auburn R. R. Co.	Seneca Falls	2
New York & Stamford Ry. Co.	Port Chester	7
Westchester St. Ry. Co.	White Plains	6
NORTH CAROLINA		
Carolina Pr. & Lt. Co.	Raleigh	10
Southern Public Utilities Co.	Charlotte	21
NORTH DAKOTA		
Grand Forks, St. Ry. Co.	Grand Forks	6
OHIO		
Richland Public Service Co.	Mansfield	7
Ohio Service Co.	Coshocton	2
OKLAHOMA		
Tulsa St. Ry. Co.	Tulsa	12
PENNSYLVANIA		
Butler Ry. Co.	Butler	7
Conestoga Traction Co.	Lancaster	4
Mahoning & Shenango Ry. & Lt. Co.	New Castle	1
Mahoning & Shenango Ry. & Lt. Co.	Sharon	11
Northumberland County Traction Co.	Sundbury	4
Reading Transit & Lt. Co.	Reading	12
Trenton, Bristol & Phil. St. Ry	Bristol	6
TEXAS		
Austin St. Ry. Co.	Austin	17
Houston Elec. Co.	Houston	1
Marshall Traction Co.	Marshall	2
Northern Texas Tr. Co.	Fort Worth	1
Texas Elec. Co.	Waco	20
Wichita Falls Tr. Co.	Wichita Falls	4
VIRGINIA		
Virginia Ry. & Pr. Co.	Richmond	48
Virginia Ry. & Pr. Co.	Norfolk	7
WASHINGTON		
North Coast Pr. Co.	Vancouver	1
Western Washington Pr. Co.	Bellingham	8
WEST VIRGINIA		
Charleston Dunbar Tr. Co.	Charleston	4
WISCONSIN		
Beloit Traction Co.	Beloit	6
Madison Rys. Co.	Madison	13
Milwaukee Elec. Ry. & Lt. Co.	Racine	40
Wisconsin Valley Elec. Co.	La Crosse	8