Operation, Maintenance and Performance of Storage Battery Cars

ON THE LONG ISLAND RAILROAD

By

R. W. BRODMAN

General Foreman Electrical Equipment,
Long Island Railroad Company

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IN SEPTEMBER, 1914, two storage battery cars equipped with multiple-unit control were placed in service on a short connecting line of the Long Island Railroad, known as the New York Bay Extension, between the towns of Mineola, on the main line, and Valley Stream on the Montauk division, both important junctions on the Long Island System. This branch line is 7.3 miles long, has six intermediate stations, and was formerly operated by steam. Nine round trips constitute the daily schedule, and connections are made at both terminals with the main line trains. The running time is 23 minutes. Both of the above-named towns lie within the electrified zone, yet the branch line was not electrified; hence the selection of storage battery cars. The third-rail voltage in the electrified zone is approximately 675 volts and, as the cars require but 415 volts for charging, a resistance was mounted on each car in connection with suitable switches and portable jumper, by means of which the cars could be charged anywhere where third rail was available. This rather unique self-contained arrangement eliminated regular charging stations and made the cars available anywhere within the electrified zone. The jumper is a flexible, well-insulated cable, fitted at one end with a standard head that fits into a receptacle on the car body, while a prong-shaped contact with suitable handle is provided on the other end. This prong is thrust against the third rail.

CAR BODIES AND TRUCKS

There are two types of cars, one for passengers only, and the other a combination passenger-baggage car. Both cars have the same dimensions and the same design of steel underframe. End doors are provided in the vestibules to enable multiple operation, but body end bulkheads are omitted.

The bodies are 32 ft. 9 in. long over platforms 8 ft. 4 in. wide, and are mounted on Continental type single trucks, with a 12 ft. wheel base. Standard M.C.B. 4.5 x 8 in. journals and 30 in. wheels are used, and the car complete with equipment weighs 28,000 lbs. Seating capacity of passenger car, 32.

ELECTRICAL EQUIPMENT

As the cars were intended to be operated either singly or in multiple as a train, as traffic demand, Westinghouse multiple-unit control, PK type, was installed. This equipment consists of a main or motor controller with PK attachment, mounted on a platform; limit switch and overload relay are placed overhead on the same platform. The line switch and resistors are underneath the car, and a master controller mounted on each platform. The control wires terminate in a standard seven-point receptacle at each end of the car, and by means of a single seven-point jumper between the two cars multiple operation can be obtained from any master controller on the train. All control and power wiring is installed in conduit, terminating in suitable junction boxes, according to established standards used on the large third-rail equipment operated by this company. Many of the control parts are also interchangeable with similar parts used on the larger cars, thus minimizing the number of repair parts to be carried in stock.

There are two 20 hp, 250 volt, Type 65-A3, ball-bearing motors per car, one geared to each axle. These motors are also of Westinghouse make, and specially designed for this service, field control being used to reduce the heavy current demands while starting. The motors are water and dust proof and, on account of their small size, are easily accessible for inspection.

AIRBRAKE SYSTEM

Westinghouse "Featherweight" type airbrake, with automatic feature, is used. Each car is equipped with a motor compressor, mounted under the car, a synchronizing governor and a pneumatic pump switch placed overhead on No. 2 platform, and the necessary engineer's valves, brake cylinder, reservoirs, etc., in their respective places. The train pipe is carried to each end and fitted with standard hose and coupling for multiple operation. The automatic feature is obtained in connection with the master controller. Contacts are provided so that if the motorman takes his hand off the handle it returns automatically to the central position, and a magnet valve, controlling the train brake relay valve, is energized, the relay is opened and the brakes are automatically applied.

STORAGE BATTERY

The passenger car has a battery of 224 Edison A-H-4 cells; 219 of these are used for power; the remaining five are used for the lighting system, the compressor synchronizing circuit and the electropneumatic signal whistle. The air compressor and the PK control are operated from the power battery. The batteries are

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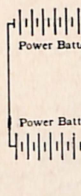

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placed under the seats and insulated by means of special glass insulators. The power battery in the combination car consists of 231 cells. This is due to more space being available, as the baggage compartment extends to the end of the car, the platform being eliminated, and the master controller, etc., being mounted in the baggage compartment.

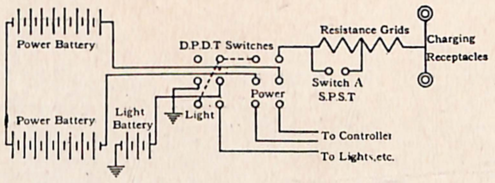

FIG. 1—DIAGRAM OF CHARGING CIRCUITS

The battery is rated at 150 ampere-hours and, by means of a single-pole, single-throw knife switch, mounted in a cabinet at No. 2 end of car, the battery can be charged either at a 70 ampere or 35 ampere rate, as conditions demand. The light batteries, when requiring charge, are connected in series with the power battery. Fig. 1 is a diagram of the charging circuits. The two double-pole, double-throw knife switches are also mounted in a cabinet on No. 2 platform. The cars receive a regular four-hour charge every night. This is done by the substation operator at Valley Stream, who also flushes the batteries and keeps them clean. During the day, when cars are in service, the motorman charges the batteries at both terminals during layovers.

AUXILIARY EQUIPMENT

The lighting system consists of 14 six-watt, six-volt Mazda lamps, and the headlights, which are of the Golden Glow type, are provided with 36 watt, six-volt concentrated filament lamps. Both air whistles and foot gongs are provided for crossing signals.

INSPECTION AND MAINTENANCE

A repairman from the company's main shops at Morris Park is sent to Valley Stream weekly to inspect these cars and make all necessary repairs and adjustments. A small car barn, with pit, is located at Valley Stream for the accommodation of these cars, and one car is placed over the pit and inspected, while the other maintains the service. When the first car is inspected the cars are exchanged and the other car is taken in for inspection. In this manner it has been possible to take care of the equipments without interruption of service.

Should the cars require extensive repairs, such as replacing wheels, or body repairs, that cannot be handled by the inspector, the cars are brought to the Morris Park shops by the crew at the end of the day's run, a distance of 8.5 miles over the Montauk division, under their own power. The cars are brought to the shops once a year for a general overhauling, when the bodies are painted and equipment thoroughly overhauled. In this manner it has been possible to keep the equipment in first-class condition without interruption of service.

FAILURES

During the two years of operation failures have been few, and of no serious nature. Below is a list of the failures and their causes:—

No. of Failures	Cause
1	Line switch interlock loose, due to locknut coming off.
1	Loose resistance lead, due to locknut coming off.
1	Compound used for sealing contact plates on reverser drum in controller, becoming soft and running over the contacts.
1	Broken control cutout switch blade.
1	"On" magnet coil in controller short-circuited.
1	Poor tension on controller finger, failing to cut out resistance in motor circuit.
1	Charging jumper receptacle pulled off, attendant failing to remove jumper before starting car.
3	Pilot governor inoperative, due to pipe scale on valve seat.
4	Brake relay valve stuck open, due to pipe scale on valve seat.
1	Defective fuse (refillable type) in control circuit.
1	Broken resistance grid, due to striking obstruction.
2	Broken charging resistance, due to striking obstruction.

Several failures not listed above were caused by battery containers being grounded to underframe of car, due to careless flushing of batteries, and on one occasion where car was being charged during a severe rainstorm with windows opens. On several occasions trouble was also experienced due to battery being insufficiently charged. These should be considered as man failures. A recent inspection of the electrical equipment showed it to be in excellent condition, with practically no signs of wear. The controllers, line switches and motors appear as if they had just come from the factory, and the battery on a recent test showed 115 percent of normal capacity and mechanically intact. The solution in the batteries has been renewed but once and the present solution is still good for some time. The airbrakes have likewise given no trouble.

TABLE I—RELATIVE COSTS—1915

Equipment.	Two Multiple-Unit Battery Cars.	1 D 53 Locomotive 1 Pass.-Bagg. Car
Investment	$20 535.02	11 683.92
Interest at 5 percent	1 026.75	584.17
Depreciation	1 117.64	350.49
Maintenance	755.44	2 304.81
Handling coal, engine-house expense	....	....
Water Supply	....	1 322.93
Crew costs	3 485.46	7 886.54
Supplies	35.58	63.00
Cost of power or coal	1 309.76	4 790.80
Labor for charging or oil	753.30	41.27
Instrument work	38.70	....
Toatl costs	$ 8 523.63	$17 344.01
Cost per train-mile	0.3928	0.7933

COMPARATIVE COSTS

The relative costs of operation for the year 1915 are given in Table I. The figures for electric service are actual; those for steam service are estimated. The steam service formerly operated was never more than one-third the present schedule, as the traffic then did not warrant the expense.

In estimating the depreciation chargeable to cost of operation, the following percentages were taken:—Three percent for car body, ten percent for storage battery, four percent for electric equipment, and three percent for locomotive. The crew required to operate this service with electric equipment comprises a motorman and conductor; for steam service, an engineer, fireman, conductor and a flagman.

CONCLUSION

At present a single car is sufficient to handle the traffic most of the time. The work is then divided between the two cars. No trouble, however, was experienced when a single car was called upon to handle the entire service for week intervals when the other car was not available for this service. In such cases the night charge is increased slightly. A typical current consumption sheet for 24 hours is given in Table II.

TABLE II—CURRENT CONSUMPTION SHEET

Time of charge	Rate	No. of Single trips	Amp-hr dis-charge	Amp-hr before charge	Meter after charge	Amp-hr. charge
CAR No. 2						
Night.	Low	......	......	50	205	145
12:20— 1:00	Low	......	......	205	165	40
5:25— 5:50	High	4	85	250	220	30
6:43— 7:00	High	2	40	260	245	15
		2	40	285	......	......
Total........			165			
CAR No. 4						
Night.	Low	......	......	60	205	155
8:15— 8:40	High	4	85	290	265	25
9:15—10:40	Low	2	40	5	135	70
12:25— 1:00	Low	2	35	270	240	30
		2	40	280	......	......
Total........			200			280

		Car No. 2	Car No. 4
Total car miles per day..........................	130	75	55
Total single trips per day......................	18		
Max. number of passengers on any one trip	30		

NOTE:

On April 15th 1920, Mr. R. W. Brodman, advises that after 5½ years Cars continue to give as satisfactory service as when first placed in operation.