Two-Car Units for Lackawanna

Operator's Control Booth Showing Controller and Brake Valve Below Window and Auxiliary Control Box Above

THE cars used in the Lackawanna suburban electrification incorporate a number of innovations, such as 1500/3000-volt motors for multiple-unit cars, motor ventilating air inlets in the roof of the car, 3000-volt heater circuits, and pantographs with self-aligning roller bearings. All but five of the motor cars have roller journal bearings and all cars are equipped with electro-pneumatic brakes.

There are 70 miles of line, including 160 miles of track, to be operated electrically and service will be provided by 141 motor cars and 141 trailers. Motor cars and trailers are semi-permanently coupled together in two-car units and standard M. C. B. couplers are used for coupling units together to make trains of from 2 to 12 cars.

Both motor cars and trailers are of all-steel construction except that the motor cars have aluminum doors, inside finish and roof sheets. All cars have vestibules with trapdoors but without diaphragms and the underframes are of the open channel center sill type.

The motor cars are 70 ft. 3½ in. long over the bumpers, seat 84 passengers and weigh 147,200 lb. The trucks are Commonwealth with wheel bases 8 ft. 6 in. long; the distance between center pins is 45 ft. The trailers are 70 ft. ¾ in., and 70 ft. 6 in. long, weigh 106,400 lb. and seat respectively 78 and 82 passengers. There are toilets in the trailers but none in the motor cars. Included in the 282 cars to be used in electric service are six club cars, 15 combination baggage and passenger cars and two combination mail and passenger cars.

All but five of the motor cars are equipped with Hyatt roller bearings, the five having plain bearings. Five of the trailers have roller bearings and all of the remainder plain bearings. This arrangement permits making up one ten-car train completely roller bearing equipped and another ten-car train equipped entirely with plain bearings. The motor cars to be used in these two trains are provided with watt-hour meters so the power consumption of the two trains may be compared.

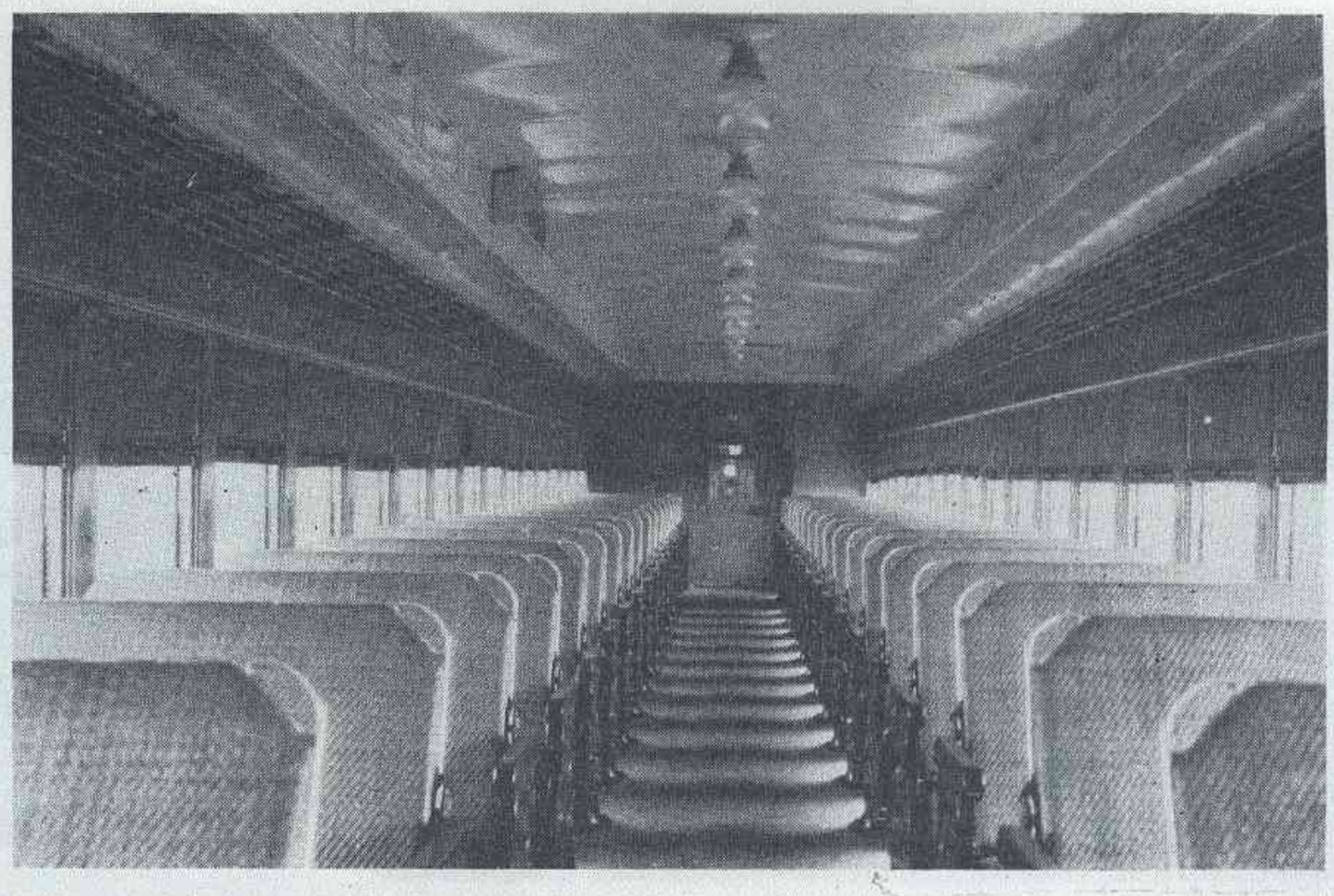
The interiors of the cars are finished in unusually light colors. The ceilings are cream and the upper side walls a light buff. The seats are light yellow rattan with dark green metal frames and mahogany side arms. The lower parts of the side walls are also dark green and the floors are battleship gray.

Motors and Motor Ventilation

The motors, and the method of ventilating them, are probably the most radical departure from the usual low voltage railway practice. Each motor develops 235 shaft horsepower (one hour rating) with 1500 volts impressed on the commutator and has a weight of approximately 6900 lb., including gears, gear case, axle linings and other motor accessories. At the same time, the motor is insulated for a working potential of 3000 volts to ground. There are

Electrification

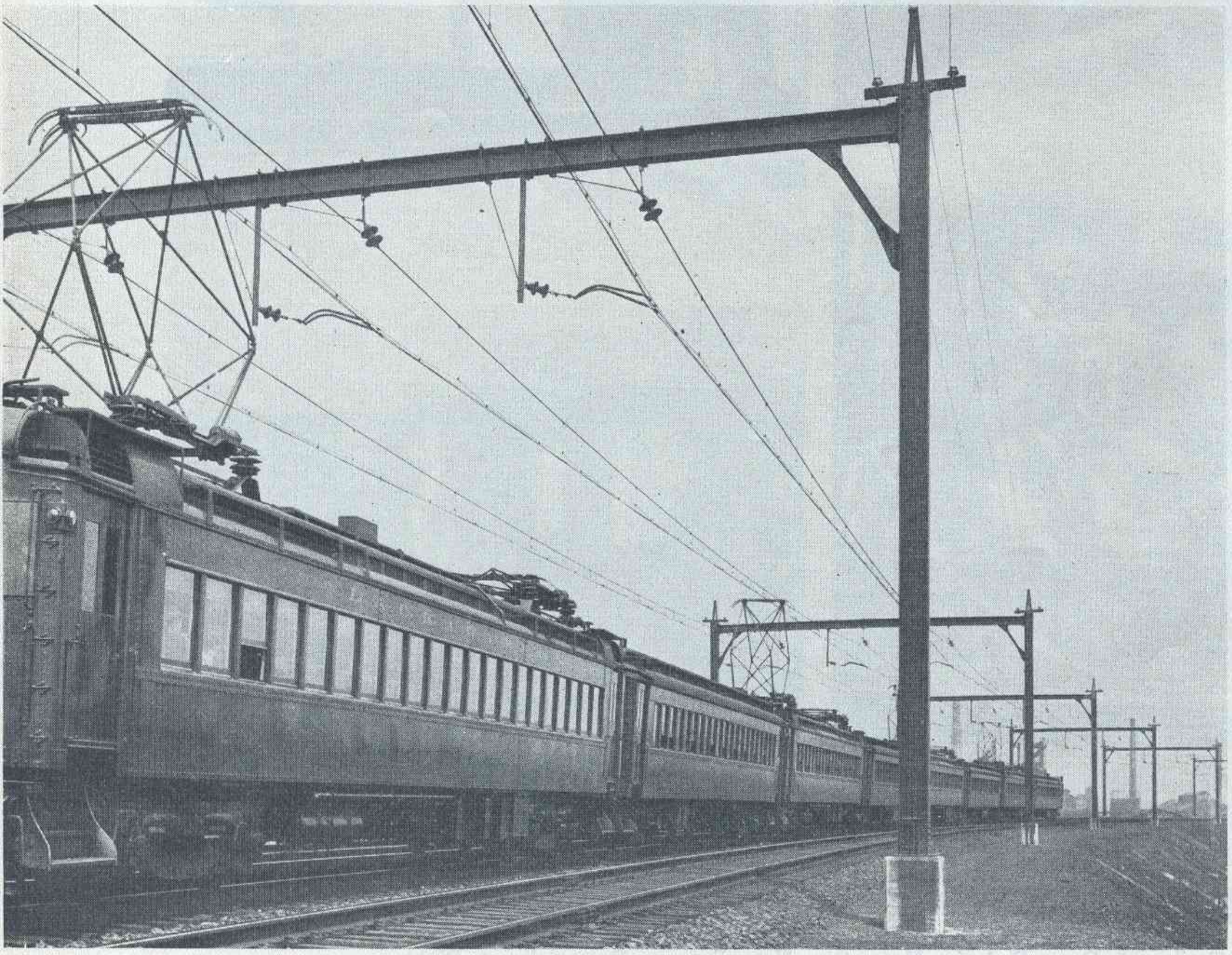
Multiple-unit cars are the first in America to operate from a 3000-volt, direct-current, contact system



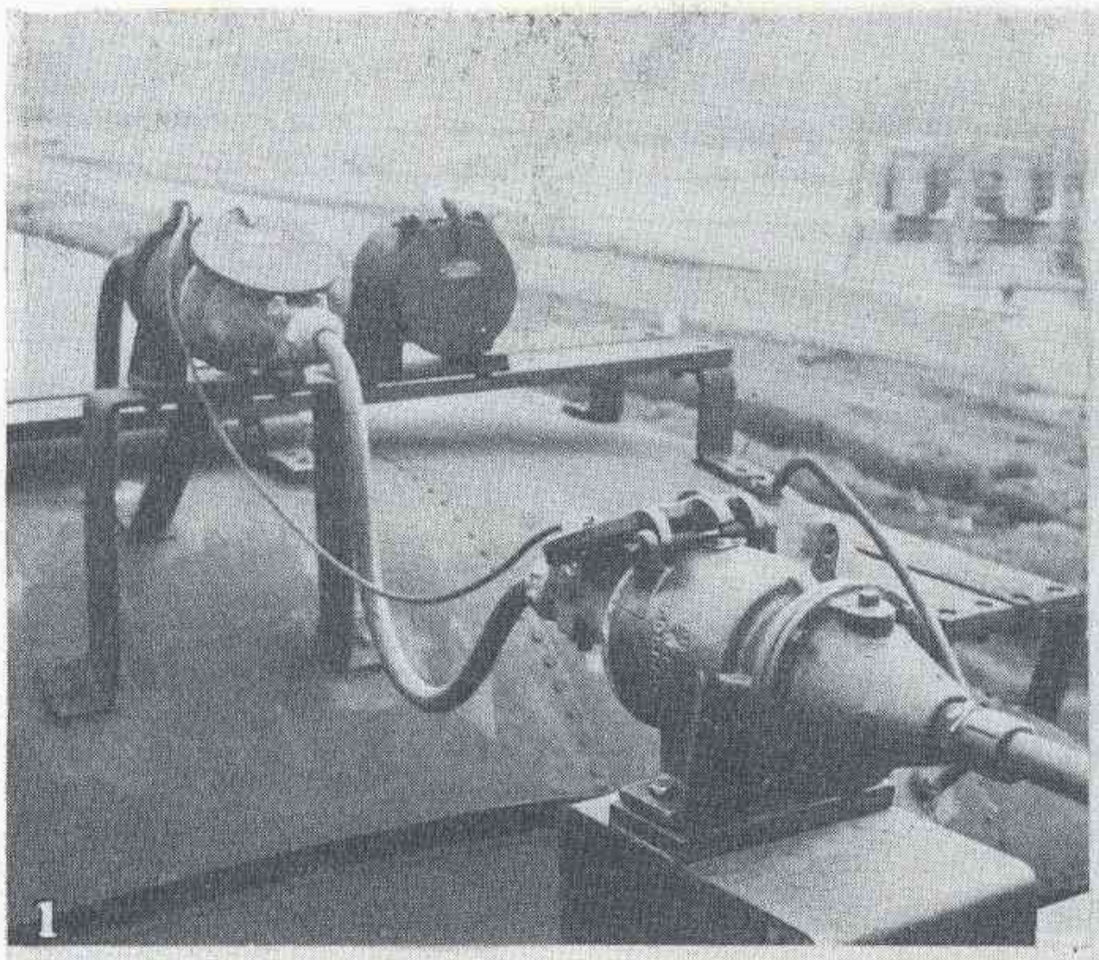
Interior of One of the Motor Cars

four motors on each motor car in pairs and connected permanently in series. The successful operation of a high voltage motor depends to a great extent on keeping the interior of the motor, particularly the commutator end, clean and free from road dirt, brake shoe dust, snow and other foreign material. To satisfy this requirement, the motor frame operates at all times either at or slightly above atmospheric pressure in order that loose commutator covers and similar conditions will not allow the entrance of foreign material. This condition could have been accomplished by the use of motor-driven blower sets, but it was desired to dispense with these blowers for the sake of simplicity because of the noise and vibration which it was expected they would produce in the motor car. It was also considered desirable to avoid air filters with attendant expense for cleaning.

Experiments made on the test track on a motor-trailer unit showed conclusively that snow and road dirt picked up by the moving train does not swirl around the cars at a height much above the center of the side windows. It was decided therefore to take air for ventilating the motors at each side of the roof at each end of the motor car, and pass it through a



An 8-Car or 4-Unit Train On the Electrified Section Between Hoboken and Newark, N. J.



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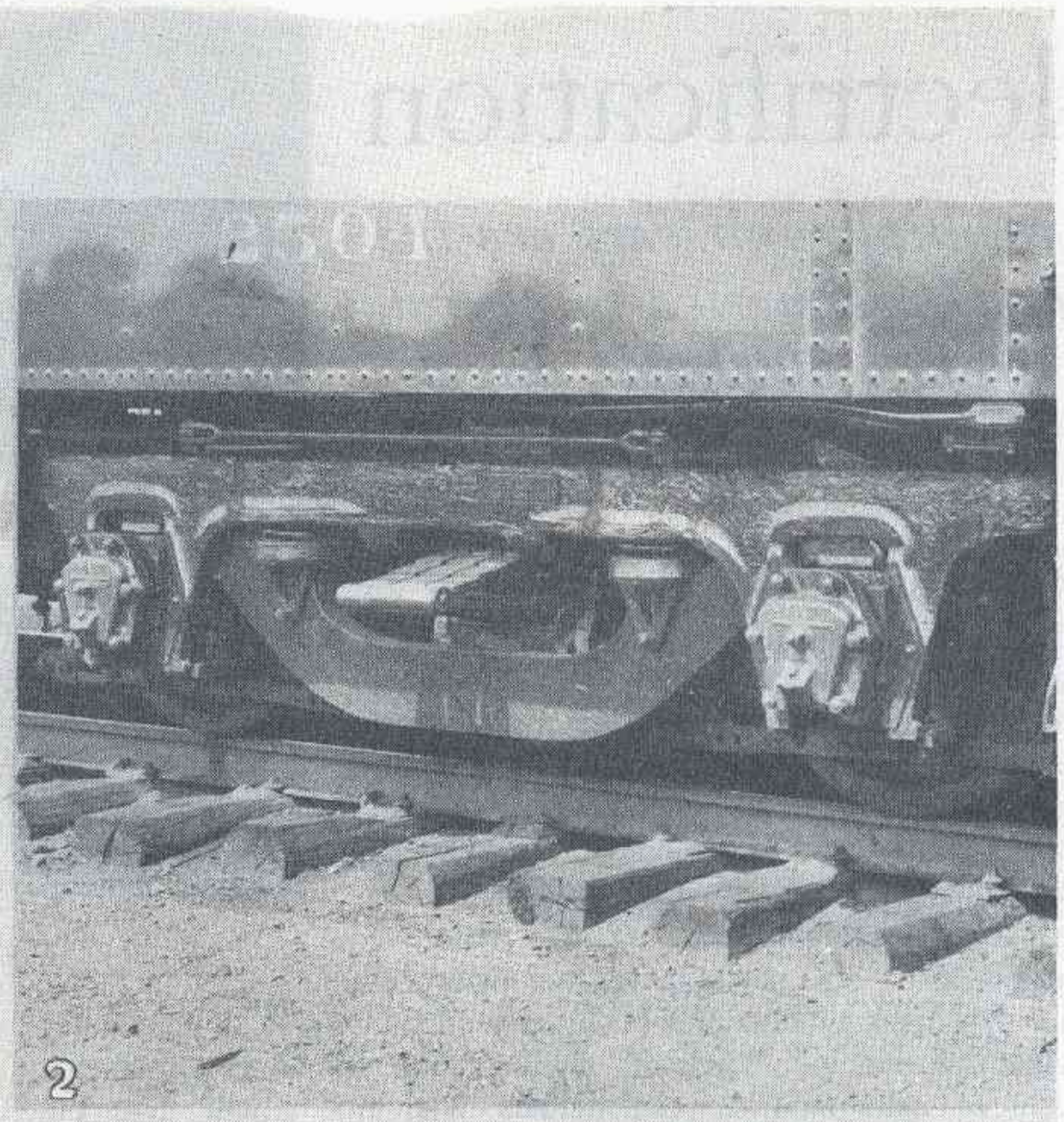

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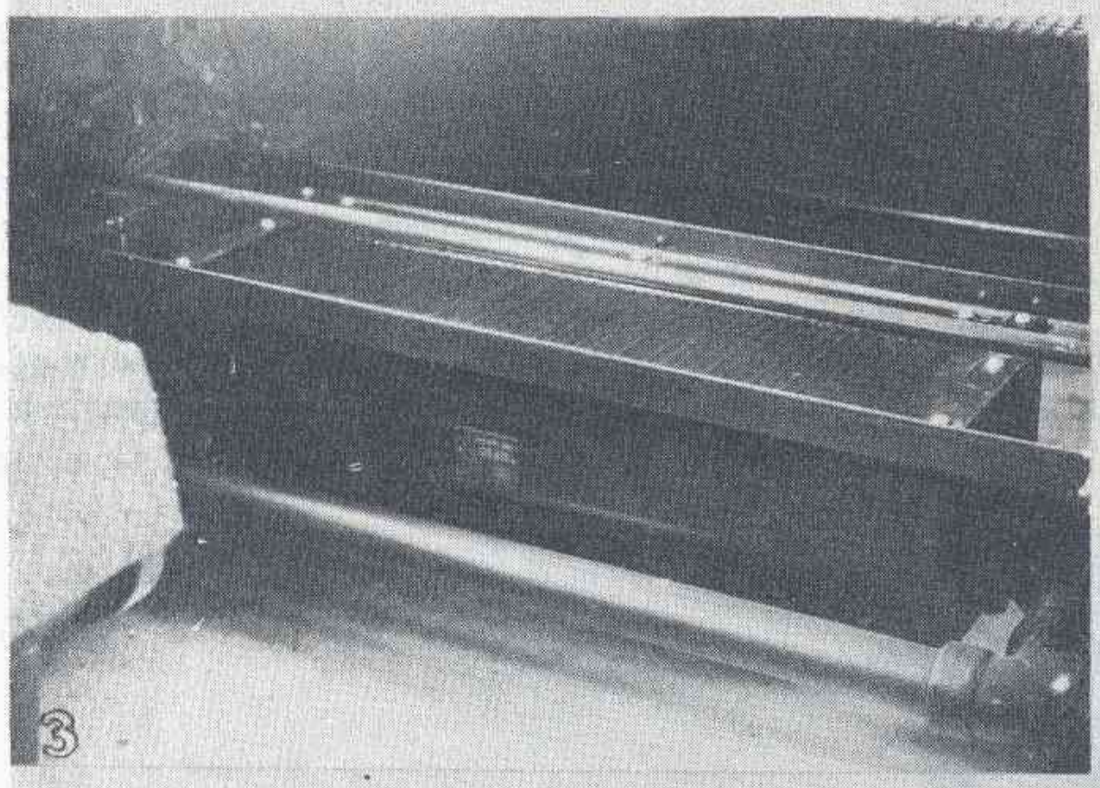

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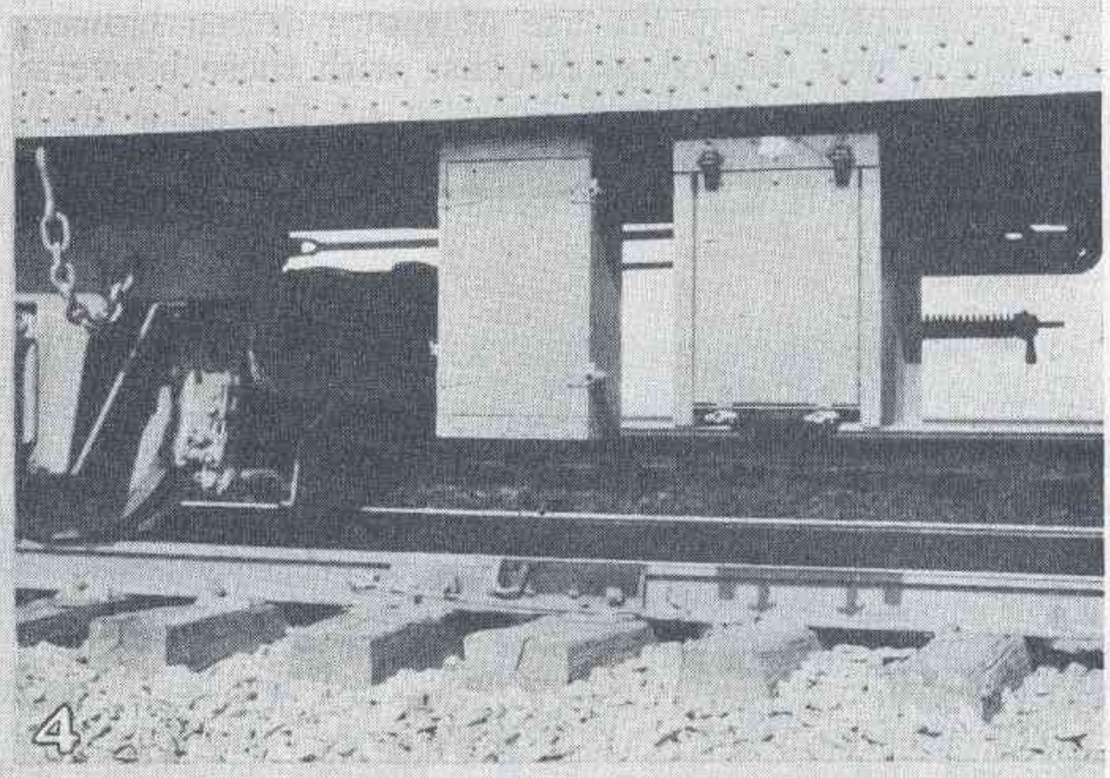

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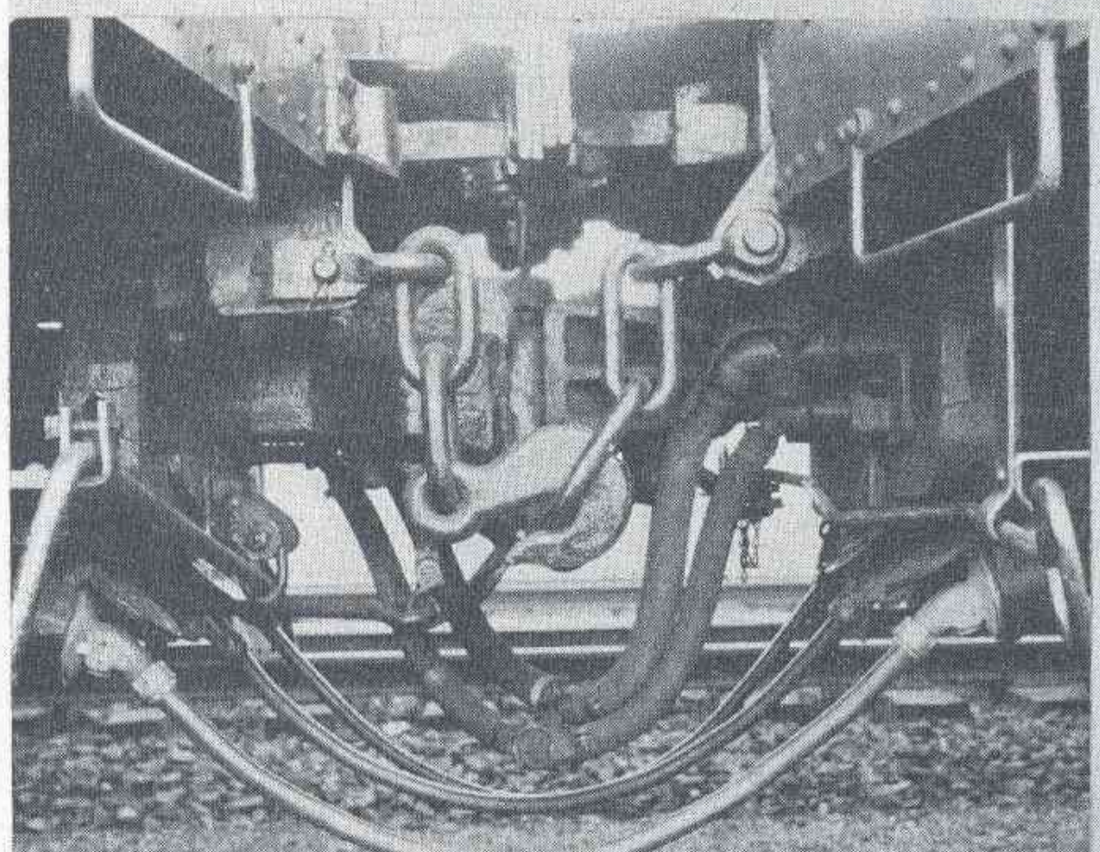

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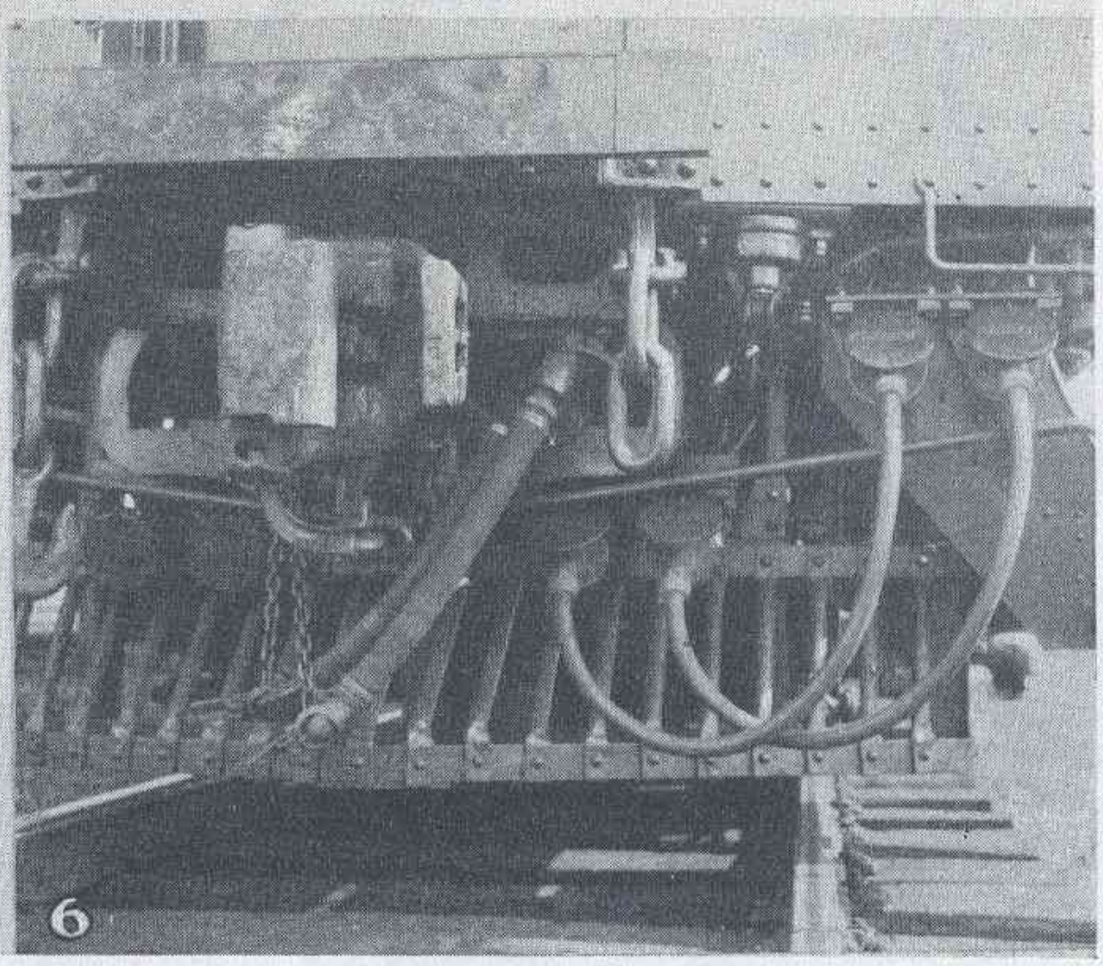

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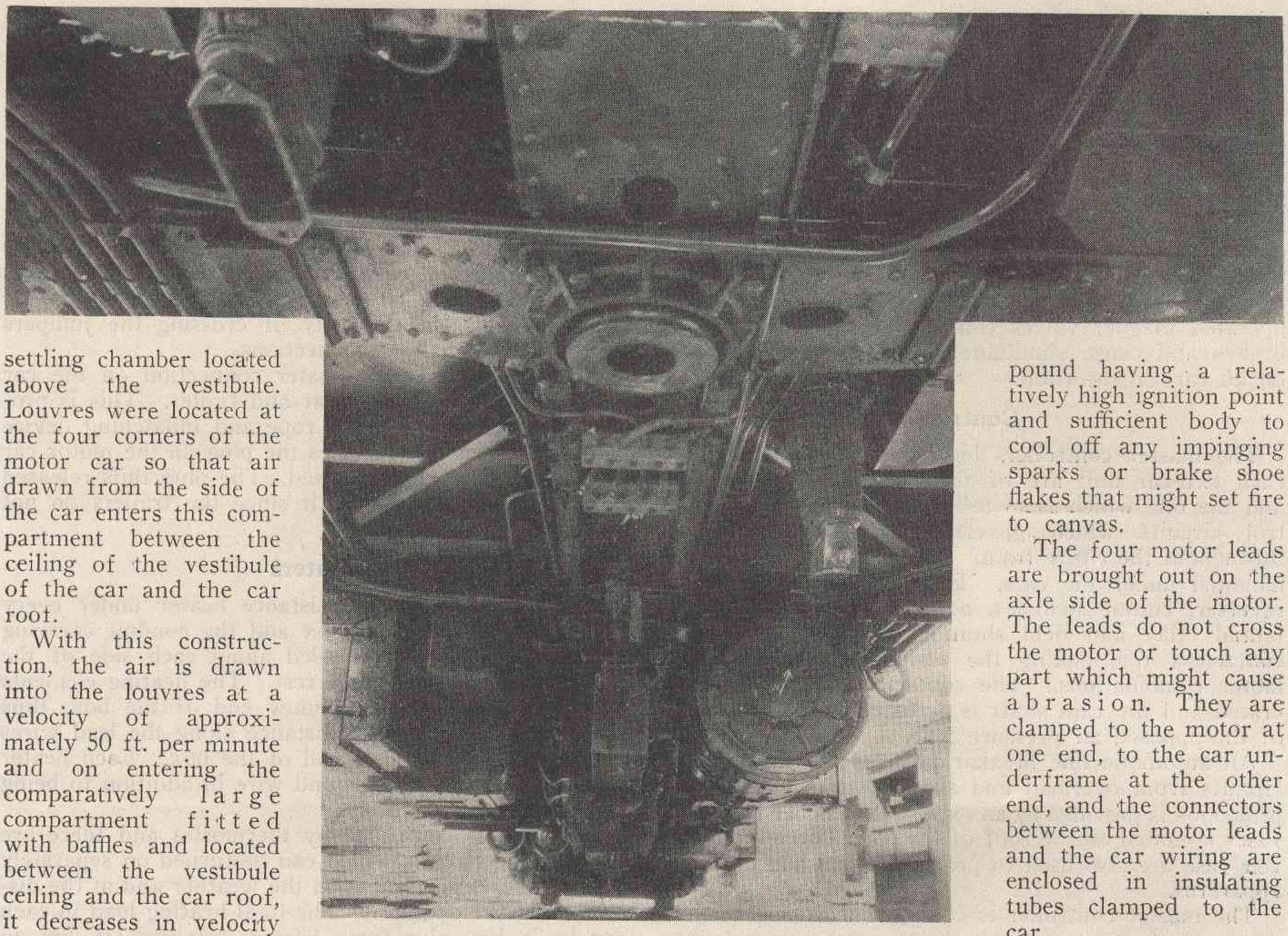
1. Heater Connector Used Between Motor Car and Trailer. 2. One of the Roller Bearing Trucks. 3. The Seat Cushion Has Been Removed to Show the Heater Box. 4. The Only Electrical Apparatus Mounted Under the Trailers are the Heater Fuse and Switch Boxes. 5. Connections Between Motor Car and Trailer. 6. Outer End of a Motor Car—Note Dummy Receptacles at Right



Under Side of Motor Car With One Truck Removed

settling chamber located above the vestibule. Louvres were located at the four corners of the motor car so that air drawn from the side of the car enters this compartment between the ceiling of the vestibule of the car and the car roof.

With this construction, the air is drawn into the louvres at a velocity of approximately 50 ft. per minute and on entering the comparatively large compartment fitted with baffles and located between the vestibule ceiling and the car roof, it decreases in velocity to a sufficient extent to deposit any dirt, snow or foreign material that may have been carried through the louvres.

From the settling chamber the air enters the ducts which carry it to the underside of the car flooring. In these ducts the air velocity is approximately 300 ft. per minute. Two ducts are carried from the compartment over the vestibule at each end of the car to the underside of the car, making a total of four such ducts. Each of these terminates in an opening which is suitably reinforced and is provided with bolts for the receiving of a ring to which the flexible air duct is strapped. This duct consists of two layers of canvas on either side of wire springs which prevent collapsing of the duct. The other end of the duct is clamped to the inlet casting on the motor which in turn is bolted to the commutator end framehead, use being made of a gasket to insure a tight joint.

The ventilating air is delivered to the center of the motor armature at the commutator end by suitable passages in the commutator end framehead. The ventilating fan is located at the pinion end of the armature. It draws the air through the center of the armature and forces it through the motor frame, past the exciting and commutating field coils to the commutator end of the frame, from which it is discharged to atmosphere through the outlet at top of the motor. Inasmuch as the discharge of this ventilating air always takes place at the commutator end, the entire frame is always somewhat above atmospheric pressure when the car is in motion. There is no tendency, therefore, for any foreign matter to be drawn into the motor.

The flexible air ducts are made of white canvas, painted on the outside with a weatherproofing compound having a relatively high ignition point and sufficient body to cool off any impinging sparks or brake shoe flakes that might set fire to canvas.

The four motor leads are brought out on the axle side of the motor. The leads do not cross the motor or touch any part which might cause abrasion. They are clamped to the motor at one end, to the car underframe at the other end, and the connectors between the motor leads and the car wiring are enclosed in insulating tubes clamped to the car.

The armature and axle bearings are of the constant-level, waste-packed type, insuring uniform lubrication at all times. Each motor is equipped with a 22-tooth pinion having a diametral pitch of 2¼ in., and drives a 59-tooth gear mounted on the axle. Four of these motors are mounted on each motor car and as each motor car handles one trailer in addition to itself, the total weight of the two-car unit handled by four motors is 253,600 lb. The 59-tooth gears are of the non-resonant type and effectively eliminate gear noise. Each motor complete, with pinion, gear, gear case, axle linings, and air ducts, weighs approximately 6900 lb. This is exclusive of the inductive shunts, which provide the reduced field or maximum speed running point on the controller.

Three two-car units (6 cars) carrying one-half passenger load when supplied with 3000 volts at the pantographs are designed to have a free running speed of not less than 67 m.p.h. on level tangent track. This is on the basis of 36-in. wheels, which is 2 in. less in diameter than the wheels are when new. New wheels are 38 in. in diameter and may be worn to 35 in. before the clearances under the motors become limiting.

Dynamotor, Air Compressor and Brakes

For control, operation of the air compressor, and auxiliary power, the 3000-volt current is stepped down by a 3000/1500-volt dynamotor which is hung on the underside of the car body on four rubber cushioned suspension bolts. The dynamotor has two 1500-volt commutators and armature windings connected in series and a separate 40-volt armature on the same shaft, all located between the two bearings for supplying power to the controls and for lighting. A ventil-

ating fan which draws air through the entire set is mounted on the same shaft. The intake air passes through a centrifugal type air cleaner located outside the bearings.

The air compressor is driven by a 1500-volt motor which is connected across the low-voltage commutator of the dynamotor. It is of the center-gear type and has a displacement of 35 cu. ft. of free air per minute. It is hung under the car on a three-point cushion suspension similar to that used for the dynamotor.

Type UCE brakes are used on all cars. Electrically-operated magnet valves control the operation of the brakes and cause simultaneous application of brakes on all cars in the train.

Control

The master controllers located in opposite ends of each two-car unit are of the low-voltage drum type and the one which is in use actuates the 32-volt control circuits which govern the motor controllers throughout the entire train. The motor controllers are mounted under the cars. Each controller includes a reverser, cutout switches, accelerating relay, line potential relay and field shunting relay in addition to contactors for making the series and series-parallel motor combinations. The contactors are all cam-operated and the cam shaft is actuated by an air engine of the opposed air pressure type.

An automatic line breaker protects the high-voltage circuits from overload and short circuits. Additional protection is provided by an explosion chamber type main fuses mounted on the roof of the car. Three-thousand-volt fuse are also used to protect heaters and auxiliary apparatus.

The master controller is equipped with a deadman's release and emergency air brake application feature which functions if the operator's hand is removed from the controller. When the controller is moved to the full-speed position the acceleration of the train is controlled automatically and is limited by the current flowing in the motors. After the motor controller is advanced one position, it remains in that position until the current has dropped to 185 amperes before advancing to the next. The acceleration rate is adjusted to 1½ miles per hour per second with six-car trains and the maximum power at starting required by a 12-car train is 9,000 kw., or approximately 12,000 horsepower.

Above the window at the motorman's position is a push-button control box for operating the pantographs, dynamotors, heaters, circuit breakers, control circuits, headlights, marker lights and vestibule lights. This is a low-voltage control which operates the low-voltage circuits directly and the high-voltage circuits through 3000-volt electrically-operated contactors.

Pantographs and Jumpers

The pantographs used have self-aligning roller bearings. This feature gives only three to four pounds difference in pressure against the contact wire between the up and down movement of the pantograph. The normal pressure against the wire is 28 lb. and the working range is from 15 ft. 6 in. to 25 ft. 3 in. above the rail. The locked down height of the pantograph is 15 ft. 3 in.

There is a grounding switch for each pantograph and the first duty of a man climbing to the top of a car is to close this switch, the operation of which grounds and holds the pantograph in the locked-down position. Fifty of the pantographs have single contact shoes and the other 232 (there are two on each motor car) have double shoes. The pantograph pressure for the single-contact pantographs is 18 instead of 28 pounds.

Two train line jumpers for control circuits are mounted below the bumpers and used between units and two between motor car and trailer. There is also a third jumper between motor car and trailer for the 32-volt lighting and battery circuits. The jumpers used have plugs at each end and there are four sockets on each end of a two-car unit. This duplication of sockets avoids the necessity of crossing the jumpers over with the air hose connections.

There is a 3000-volt heater connection on the car roofs between the motor car and trailer. This is provided with a bronze tiller rope and unlatching device which automatically releases the plug on the motor car in case the cars are separated. The plug thus released does not have voltage on it since the trailers do not have pantographs.

Heaters

There is an electric resistance heater under every seat mounted in a steel box and the conduit carrying the feeder wires is extended along each side of the heater box to form a foot rest. The heating elements are mounted near the window end of the box, thus allowing ample creepage distance along the lead wires which enter at the aisle end of the box. Each heater box is connected to a ground wire in addition to being clamped to the car body.

The heat is controlled by thermostat and there are two heating circuits which can be turned on separately or together, depending upon the weather and at the discretion of the operator. The total heating load in each car is 28 kw. plus three heaters totaling 3½ kw. in the motorman's vestibule.

Lighting

The new motor cars are lighted by eleven, center-mounted, 50-watt lamps in corona bowl glassware and provide a lighting intensity on the reading plane of about nine foot-candles. The generator and lamp voltages are controlled by the same type of regulators that the railroad uses for its axle light equipment. The lights and heater circuits are controlled by Safety toggle switches in a metal cabinet in the regulator locker. There are two heater switches, two interior light switches, one switch for the vestibule lights and one for the marker lights. There is a Pyle-National headlight on each end of a two-car unit controlled from the motorman's position. The 300-ampere-hour lead batteries used are mounted under the motor car. This arrangement places this weight on driving instead of trailing wheels, makes the operation of the motor car independent of the trailer and avoids the voltage drop through connectors which makes proper battery charging difficult when the battery is on the trailer.

About half of the cars are now delivered and a number are in service on the Montclair branch and for the training of crews. The electrical equipment is being supplied by the General Electric Company and the motor cars were built by the Pullman Company. The equipment, with the exception of the motors, is shipped from Erie, Pa., to Chicago, where it is installed and the cars are shipped to the Kingsland, N. J., shops of the Lackawanna where the motors are installed. Heaters were supplied by the Consolidated Car Heat-

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Two-Car Units for Lackawanna Electrification

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ing Company and the brake equipment by the Westinghouse Air Brake Company.

The trailers are made from steel equipment which has been used in steam service. They are taken from service, a few at a time, and sent to the plant of the American Car & Foundry Company, Berwick, Pa., where they are fitted with vestibules similar to those on the motor cars, the steam heating apparatus is replaced with electric heaters and control equipment is installed.

All of the work of building and equipping the cars is being done under the direction of C. J. Scudder, superintendent of motive power and equipment, and E. M. Jenkins, master car builder. Specifications, inspection, and other engineering work in connection with the electrical equipment is being done by Jackson and Moreland, engineers, of Boston, Mass.

B. & O. Reconstructs 63 Bridges

(Continued from page 534)

support turntables at five places. The pits and substructures for these turntables, comprising about 2,600 cu. yd. of concrete, were constructed by company forces, who also installed the turntables after their delivery.

Incident to this work, 20 timber trestles, comprising a total length of about 1,700 lin. ft., were replaced with permanent structures. Bridge rating was actually raised an average of 20 per cent on a total of 290 miles of line and an additional 56 miles was indirectly affected by the project. As the work on each section was brought to a conclusion, the rating on that territory was immediately raised. The first bridge rating increase was authorized February 18, 1930, and the final increase was made March 24.

Due to the necessity of improving grades on this line as incident to the introduction of heavier power and equipment, it was necessary, at several points, to raise the track materially. Prosecuted during the winter months and performed in 128 working days under extremely adverse weather conditions, the completion of this project well within the limited period assigned signalizes a distinct triumph of up-to-date practice over the vicissitudes of weather and season. It also establishes beyond question the fact that it is possible to carry on construction operations successfully at any period of the year which exigency may demand.

THE CUBAN IMPORT TARIFF on United States box cars has been increased to 28 per cent ad valorem, plus a surtax of three per cent duty, instead of the present rate of 25 per cent, according to reports received by the Department of Commerce.

A PROPOSAL to make the Shanghai-Nanking and the Shanghai-Hangchow-Ningpo the model railroads of China was tendered to the Chinese Ministry of Railways by Liu Wei-tse, managing director of the two lines, recently, according to a report to the Department of Commerce. The scheme provides among other things, for rebuilding the stations at Nanking and Shanghai, modernizing platforms of stations, improvement of third and fourth class coaches, and purchases of additional locomotives and cars.

Looking Backward

Fifty Years Ago

Steel rails are a little variable, and it is said that some sales have been made as low as $58 per ton at mill, while $65 is reported paid for early delivery. New York quotations are $60 to $63 per ton. Iron rails are quiet, with little new business of importance. Quotations are $46 to $47 per ton at mill for 56-lb. sections, and $48 to $50 for light rails.—*Railroad Gazette,* September 10, 1880.

The Cincinnati Southern [now part of the Southern] recently reduced passenger rates from 5 cents to 2 cents per mile, and is selling round trip tickets from Chattanooga, Tenn., to Cincinnati, Ohio, and return, 670 miles, for $6. Stimulated by this action the Louisville & Nashville has reduced round trip tickets to Louisville, Ky., to 2 cents per mile for the next 60 days, with a promise of a reduction of regular rates after that time to 3 cents per mile—*Railway Age,* September 16, 1880.

The committee on rail of the International Roadmasters' Association presented a report at its convention at Chicago on September 9 in which it was concluded that an increase in the weight of rail from 60 lb. to 80 lb. per yard would increase the wearing quality by 100 per cent, while the increased cost would not be more than 33 per cent. The committee on curves recommended that the limit of super-elevation should be 5 in., that the proper elevation at the tangent point of a full elevation should be three-fourths of an inch, and that a full elevation for a speed of 35 m. p. h. should be three-fourths of an inch for each degree of curvature.—*Railway Age,* September 17, 1880.

Twenty-Five Years Ago

James Kurn, trainmaster on the Atchison, Topeka & Santa Fe at Las Vegas, N. M., has been appointed division superintendent at San Marcial, N. M. J. F. Lehane, general freight agent of the St. Louis Southwestern, has been appointed general passenger agent. E. E. Bashford has been appointed assistant purchasing agent of the National of Mexico. R. E. Dougherty has been appointed resident engineer in charge of construction in the exterior zone of the New York Central at New York.—*Railway Age,* September 15, 1905.

The acquisition of control of the Southern Pacific by Union Pacific interests and the subsequent placing of unexpected restrictions on the interchange of traffic with the Denver & Rio Grande between its lines and California points, coupled with the increase of commerce with the Philippines, China and Japan led the D. & R. G. to assist in the promotion of the plans for the construction of the Western Pacific. The president of the Rio Grande, in his annual report, also states that the control of the Western Pacific, including about 38 miles of railway in operation, has been transferred to the former company. A main line for the Western Pacific has been located through the Sierra Nevada mountains with a maximum gradient of 1 per cent, while 85-lb. rail will be used throughout. The construction is now a certainty and its completion within the next three years is confidently anticipated.—*Railway Age,* September 15, 1905.

Ten Years Ago

The Association of Railway Executives, meeting at Chicago on September 3, voted to establish an emergency rate of 5 cents per mile to be paid to railroads which handle empty cars on the order of either the Commission on Car Service or the Interstate Commerce Commission. The name of the Commission on Car Service was changed to Car Service Division of the American Railway Association to obviate confusion arising from the use of the word commission.—*Railway Age,* September 10, 1920.