PENNSYLVANIA RAILROAD
W. JERSEY & SEASHORE R. R.
ELECTRIC TRAIN SERVICE

J. V. B. DUER

PENNSYLVANIA RAILROAD COMPANY.

West Jersey & Séashore R. R.

No. 131

ELECTRIC TRAIN SERVICE.

AUTOMATIC AIR BRAKE,

TRAIN SIGNAL

—AND—

ELECTRICAL EQUIPMENT

INSTRUCTIONS.

Altoona, Pennsylvania.

1911

GENERAL NOTICE.

Every employe whose duties are in any way connected with the operation or maintenance of the Automatic Air Brake, Train Signal and Electrical Equipment used in the Electric Train Service of the West Jersey & Seashore Railroad is required to have a knowledge of the apparatus he is called upon to operate or repair in the performance of his duties.

TRAINMEN are required to familiarize themselves with the name, location and purpose of all apparatus in order that they may carry out instructions given them by the motorman or conductor.

MOTORMEN are required in addition to the above to know in general the principle of operation of the various apparatus, the manner in which it should be operated, and method of procedure in case of failure.

INSPECTORS are required in addition to the above to familiarize themselves with the construction and details of the apparatus and methods of making repairs.

F. L. SHEPPARD,
General Superintendent.

R. N. DURBOROW,
General Sup't Motive Power.

Approved:
S. C. LONG,
General Manager.

OFFICE GEN'L SUP'T MOTIVE POWER,
ALTOONA, PA., July 1st, 1911.

Instructions for the Operation of the Automatic Air Brake and Alarm Whistle Apparatus.

General Description of Air Brake Apparatus.

1. THE MOTOR CARS of the West Jersey and Seashore Railroad are equipped with the Westinghouse Automatic Air Brake with Motor Driven Compressor.

2. AN AUTOMATIC BRAKE is one which applies when, from any cause, a reduction in brake pipe pressure takes place.

3. THE BRAKE EQUIPMENT requires two lines of pipe:

THE BRAKE PIPE, by which the application and release of the brakes and the recharging of the auxiliary reservoirs is accomplished;

THE CONTROL PIPE, by which a graduated release of the brakes is obtained and the recharging of the auxiliary reservoirs assisted.

4. EACH MOTOR CAR is provided with a brake valve and air gauge at each end of car in motorman's compartment. The brakes may be operated from any brake valve on the train.

5. THE BRAKE EQUIPMENT for each motor car consists of the following:

One AIR COMPRESSOR, which supplies the compressed air;

One COMPRESSOR GOVERNOR, which controls the operation of the air compressor;

Two MAIN RESERVOIRS, in which the compressed air is stored;

COOLING COILS, for cooling the compressed air;

One SAFETY VALVE, to prevent excessive pressure in main reservoirs;

One SLIDE-VALVE FEED VALVE, which reduces main reservoir pressure and maintains a constant pressure in the control pipe;

One CONTROL PIPE, which has a branch to each brake valve and to the triple valve on each car, and which, by means of hose couplings between cars, connects the main reservoirs of all the cars in the train through their respective feed valves.

One COMBINED AIR STRAINER AND CHECK VALVE, which prevents the entrance of dirt into the triple valve from the control pipe and loss of auxiliary reservoir pressure in case of broken control pipe;

Two MOTORMAN'S BRAKE VALVES, either of which may be used to operate the brakes;

One CONDUCTOR'S VALVE, for use in case of emergency to apply the brakes;

Two DUPLEX AIR GAUGES, which indicate main reservoir and brake pipe pressures;

ONE BRAKE PIPE, which connects the operating brake valve with the triple valve on that car, and, by means of hose couplings, with the triple valves of all cars in the train;

One DOUBLE CUT-OUT COCK, used to cut out a defective brake;

One TRIPLE VALVE, by which the automatic application and release of the brakes and charging of auxiliary reservoir is accomplished;

One AUXILIARY RESERVOIR, from which compressed air is supplied to the brake cylinder;

One BRAKE CYLINDER, which, through its piston, applies the brakes.

6. COMPRESSED AIR is first delivered through a cooling coil to main reservoir No. 1, then through another cooling coil to main reservoir No. 2; thence through the slide-valve feed valve, which reduces the

air from main reservoir pressure to control pipe pressure; thence (1) through the control pipe to the motorman's brake valve, thence into the brake pipe and to the triple valve and auxiliary reservoir; (2) through the control pipe to the triple valve and auxiliary reservoir.

AIR COMPRESSOR AND AIR COMPRESSOR GOVERNOR.

7. The Air Compressor (Plate No. 1) is mounted on two oak planks supported in a cradle made of wrought iron bars. The cradle is suspended beneath the car near the motor end, and is permanently bolted to the car sills.

The air compressor consists of a duplex, single acting air pump, driven by a herringbone gear and pinion from a railway type motor, the frames of the pump and motor being bolted together.

8. The Motor (Plate No. 2) has four poles, is series wound and is entirely enclosed. The frame is of cast steel made in one piece with a removable head on one end of sufficient size to permit the armature to be drawn out of the field. The pole pieces are bolted to the frame, which forms a part of the magnetic circuit. The field coils are held in place by the pole tips. There are two brush holders, each of which is rigidly secured to, but insulated from, the motor frame. The brush holders are removable, and can be adjusted to the wear of the commutator.

9. THE AIR PUMP consists of the following main parts: A crank case and two horizontal cylinders cast in one piece, a casting forming the two cylinder heads and containing the inlet and discharge valves, a top crank case cover, a crank shaft, two pistons, two piston rods, and the necessary crank shaft bearings. The gear end of the crank shaft bearing is contained in a removable housing, which enables the crank shaft to be drawn out. The inlet and discharge valves are tubular, operate in a vertical position, and are removable.

10. ALL BEARINGS, with the exception of the crank pin and wrist pin brasses, are lubricated by oil waste packed in the boxes. Care should be taken that the waste extends to the bottom of the box. The crank case is filled with oil to such a height that when the crank shaft rotates, the connecting rod heads strike the oil, splashing it over the inside of the crank case and such parts of the cylinder as are exposed, thus lubricating the crank shaft bearings, wrist pins and cylinders. Small pumps are attached to the connecting rods so as to lubricate these parts should the oil get low in the crank case.

There is an opening from the crank case to the atmosphere to equalize the pressure in the crank case due to mechanical action of the rotating parts in the oil. The gears are lubricated through a small hole in the case, which connects with the oil well in the bottom of the gear case. The oil in the crank case should be replenished once a month.

11. THE OPERATION of the air compressor is as follows: When the motor rotates the crank shaft, the pistons are moved backward and forward horizontally. On the forward stroke, air is drawn into the pump cylinders through the inlet valve, passing through a dirt collector to prevent the entrance of dust and dirt. On the return stroke the inlet valve is closed and the air compressed until it opens the discharge valve and passes from the compressor into the main reservoir. The motor armature must always rotate so that the top segments of the commutator travel towards the observer when viewing the commutator through the inspection door.

12. TO REMOVE ARMATURE—Unbolt top and bottom halves of gear case from the frame, after which the gear and pinion can be removed. Unbolt the removable head and slide armature out, care being taken to prevent damage to the armature by allowing it to rub on the pole pieces.

13. TO REMOVE PISTON—Unbolt the cylinder head casting and top crank case cover. Disconnect the oil pumps and uncouple the hinged bearing of the connecting rod of the piston to be removed. The piston and connecting rod can then be drawn out through the cylinder.

14. TO CLEAN AIR STRAINER BOX—Remove the box and clean the curled hair by means of compressed air. If necessary, remove the hair from the box and clean separately.

15. To Prevent Pounding of the Pumps—Remove the top crank case cover and take out one of the liners between the halves of the connecting rod bearing, tightening up the bolt so that there will be no play between the crank and connecting rod bearing. Care should be taken not to make bearing too tight.

16. Undue Friction in the air compressor is frequently the cause of the motor compressor fuse blowing. To locate the trouble, examine the discharge valves and see that they are not sticking; examine the pistons for undue friction and the shaft bearings to see if they are running hot.

17. The Compressor Should Operate, under normal conditions and without excess leakage in the air brake piping, not more than one-third of the time. A compressor found continually operating, in a train of two or more cars, should be cut out of service by opening the compressor switch on the switchboard.

18. The Air Compressor Governor (Plates Nos. 3, 4, 5) is located beneath the car near the air compressor.

The air compressor governor is a combination of diaphragm, piston, springs and operating levers connected to a single pole, single throw switch.

The cap covering the diaphragm is provided with a tapped hole and is connected to the compressor reservoir through an insulated pipe. The cap is bolted to the frame, and holds the rubber diaphragm "A" (Plate

No. 5) against the retaining ring, which serves as an abutment for the piston "B", and against the upper surface of which the diaphragm "A" is pressed. The lower side of the piston is acted upon by the operating spring "C", the pressure of which is adjusted by means of screws "R" bearing against the washer "S."

Fastened rigidly to the piston "B" is a rod "D", the lower end of which is connected to one of the operating levers. The largest of these levers contains a recess holding a mica insulated stud. This stud forms a terminal for the cable and the spring carrying the contact finger. This finger completes an electric circuit through the stationary contact. Both movable and stationary contacts have renewable tips and are enclosed in an arc chute of moulded insulating compound.

A blow-out coil "O" is placed in series with the circuit near the contact to extinguish the arc formed when the circuit is opened. The blow-out coil is made of enameled copper ribbon wound edgewise, and is provided with a line terminal to which the line wire is clamped by two set screws.

The projecting cover is hinged at the back of the frame and held in the closed position by a spring catch. The inside of the cover is lined with insulating material in order to prevent the arc from coming in contact with the metal.

19. THE OBJECT OF THE AIR COMPRESSOR GOVERNOR is to maintain the pressure in the main reservoir within certain limits. The action is as follows:

As the pressure of air in the reservoir increases, the pressure in the chamber above the diaphragm "A" (Plate No. 5) also increases and forces the diaphragm "A" against the piston "B". The piston rod "D" is forced downward against the action of the operating spring "C", and turns the lever "E" about its fulcrum "F."

This brings the pivot "H" above the center line of the tension springs "J", which connect the intermediate lever "G" with the contact carrying lever "E". As soon as the pivot "H" rises above the center line of the tension springs "J", the springs pull the end of the intermediate lever downward. This movement quickly carries the center line of the springs past the pivot "P", reversing the action of the springs on the contact lever "K" and causing the free end of this lever to be drawn downward, separating the contacts "M" and "N."

The object of this double system of levers is to maintain a constant pressure between the contacts until the tripping point is reached, thus preventing burning at the contacts.

As the pressure in the reservoir is reduced, the piston rod "D" raises the rear end of the lever "E," a projection on which engages with the intermediate lever "G"; this carries the center line of the tension springs "J" above the pivot of the contact carrying lever "K", thereby pulling the contact finger upward and closing the circuit. Current to operate the com-

pressor motor is taken from the bus line connection at the switchboard, and after passing through a single pole switch and enclosed fuse, mounted on the switchboard in the motorman's compartment, passes through the compressor governor and then in series through the compressor motor armature and field to ground.

20. THE GOVERNOR should be adjusted to stop the compressor when the pressure in the main reservoir reaches 95 pounds, and to start the compressor when the pressure falls to 85 pounds. This range of pressure permits a number of applications of the brakes before reducing the main reservoir pressure sufficiently to start the compressor. This gives the compressor a rest between periods of operation, allowing it to cool.

DETAIL DESCRIPTION OF AIR BRAKE APPARATUS.

21. THE MAIN RESERVOIRS, in which the compressed air is stored, consist of two steel tanks. The tanks are connected by a coil of pipe known as a cooling coil, which cools the air and condenses any moisture that may be held in suspension. The tanks are provided with drain cocks and should be drained daily, and after every trip in very cold weather.

The main reservoirs on all cars are connected to the control pipe which is joined between adjacent cars by the control pipe hose.

22. THE SAFETY VALVE (Plate No. 6) is located on the main reservoir pipe near the end of main reservoir No. 2.

The safety valve is of the pop type and consists of a brass body (2); a cap (3); a valve (4), which seats in the body (2) and fits snugly in its bushing; the adjusting spring (6), which holds the valve stem (5) against the valve; and the adjusting nut (7) by which the valve is adjusted.

When the main reservoir pressure, which is always under the valve, is great enough to overcome the resistance of the spring, the valve is raised. As the valve is large in diameter, a small lift affords a large passage for the air to escape. After passing the valve, the air goes through the ports in the bush and the body to the atmosphere.

The safety valve serves to prevent the pressure in the main reservoir from becoming excessive, due to failure of compressor governor to stop compressor.

The safety valve should be adjusted to lift at 110 pounds. Care should be taken to keep the ports in valve body free from dirt and other obstructions.

23. THE SLIDE-VALVE FEED VALVE (Plate No. 7) is located in the pipe between the main reservoir and the control pipe.

The slide-valve feed valve consists of a supply valve (7); a supply valve piston (6); a regulating valve (12); a diaphragm (17); a regulating spring (19), and a supply valve piston spring (9).

The air pressure from the main reservoir entering through port "a", to the supply valve chamber "B" forces supply valve piston (6) to the left, compressing piston spring (9) and opening communication with the control pipe through the ports "c" and "d" and with the diaphragm chamber "L" through port "e". The main reservoir pressure feeds into the control pipe until the pressure exerted upon diaphragm (17) becomes slightly greater than the tension of the spring (19) at which time spring (13) forces regulating valve (12) to its seat. This permits the air pressure on both sides of supply valve piston (6) to equalize. Spring (9) now forces supply valve piston (6) to a position where supply valve (7) closes communication between the main reservoir and control pipe.

Plate No. 7 illustrates the type of slide-valve feed valve now being installed upon electric cars. Certain of the older cars are at present equipped with a different type of valve, which, however, operates upon the same principle as the one described above. These older types of slide-valve feed valves are being gradually replaced.

24. THE CONTROL PIPE (Plate No. 13) receives its air supply from the main reservoir through the feed valve and has branches to the triple valve and brake valves.

The control pipe is connected between adjacent cars by means of hose couplings, so that the supply of air at the brake valve is drawn from all of the main res-

ervoirs in the train, and if a compressor fails, the work of supplying air is divided among the remaining compressors.

25. THE COMBINED AIR STRAINER AND CHECK VALVE (Plate No. 8) is located in the branch pipe leading from the control pipe to the triple valve, and allows the air from the control pipe to flow toward the triple valve, but not in the opposite direction. Thus, if a break should occur in the control pipe, the air stored in the auxiliary reservoirs cannot pass back into the former and escape. The combined air strainer and check valve is placed so that the check valve end is toward the triple valve.

26. A DUPLEX AIR GAUGE is located at each end of the car in the motorman's compartment.

The duplex air gauge consists of two separate gauges mounted in a single case. The red hand indicates the pressure in the main reservoir; the black hand, the pressure in the brake pipe.

27. THE MOTORMAN'S BRAKE VALVES (Plate No. 9) are located in the motorman's compartment, one at each end of car.

The brake valve is of the rotary type, having all the operating parts contained in a body mounted upon a pipe bracket.

Three pipes are connected to the brake valve, as follows:

The Control Pipe.

The Brake Pipe.

The Exhaust Pipe.

The different positions of the brake valve handle in order from the left are:

First—RELEASE AND RUNNING POSITION:—In which all brakes are released, and air passes from the control pipe to the brake pipe, charging the latter to control pipe pressure, and also helping to charge auxiliary reservoirs.

Second—HOLDING POSITION:—The same as Release and Running Position. Formerly this position released the brakes on all cars in the train except that on the car from which the train was operated.

Third—LAP POSITION:—In which control pipe is cut off from brake pipe, and brake pipe from atmosphere.

Fourth—FIRST SERVICE POSITION:—(*Used when operating a single car train*)—In which the brake pipe is partly opened to the atmosphere, so as to cause a gradual reduction of pressure.

Fifth—SECOND SERVICE POSITION:—(*Used when operating a two-car train*)—In which the opening of the brake pipe to the atmosphere is correspondingly larger.

Sixth—THIRD SERVICE POSITION:—(*Used in operating trains of three or more cars*)—In which the opening of the brake pipe to the atmosphere is larger than in the two other service positions.

Seventh—EMERGENCY POSITION:—In which the opening of the brake pipe to the atmosphere is sufficiently large to cause a sudden reduction in brake pipe pressure.

The handle of the brake valve can be removed and replaced only when the rotary valve is in lap position.

28. THE CONDUCTOR'S VALVE (Plate No. 10) is located in each car, and when open connects the brake pipe to the atmosphere. It is operated by a cord running the entire length of the car, and should be used only in case of emergency.

29. THE BRAKE PIPE (Plate No. 13) has branches on each car to the triple valve, conductor's valve and brake valves. The brake pipe throughout the train is connected between adjacent cars by hose couplings so that the brakes may be applied and released throughout the entire train from the brake valve on the car from which the brakes are being operated.

An air strainer is placed in the brake pipe at the branch pipe connection leading to the triple valve to prevent the entrance of dirt and scale.

30. THE DOUBLE CUT-OUT COCK (Plate No. 11) is placed in the branch pipes leading to the triple valve, and has a connection from both the brake pipe and control pipe, so that should it become necessary to cut out the brake on a car, the handle of this cock can be turned, until it is parallel with the pipes leading through it, and communication closed from both the brake and control pipes to the triple valve. This arrangement is of prime importance, as under no circumstances should one pipe be cut out and not the other, as might readily occur if a single cock were placed in each of the branch pipes.

31. THE TRIPLE VALVE (Plate No. 12) is located so as to form a connection between the brake pipe, control pipe, auxiliary reservoir and brake cylinder, and performs three distinct operations in response to variations in brake pipe and auxiliary reservoir pressures, viz:

First Charging auxiliary reservoir.

Second Applying brakes.

Third Releasing brakes.

CHARGING.

When the triple valve is in release position, the brake cylinder exhaust port is open to the atmosphere and

the auxiliary reservoir is charged from both brake and control pipes. Fig. 1, Plate No. 12, shows a vertical cross section of the triple valve in release position.

Fig. 2 shows a distorted diagrammatic view of the triple valve in release position. Air from the brake pipe enters the triple valve through passage *"a"* and charges the auxiliary reservoir by two separate channels: One through passage *"a"*, check valve and ports *"y"*, *"j"* and *"u"* to chamber *"R"* and auxiliary reservoir; the other through passages *"a"* and *"e"*, chamber *"f"*, port *"g"*, chamber *"h"*, and feed groove *"i"* to chamber *"R"* and auxiliary reservoir.

At the same time air from the control pipe passes through ports *"x"* and *"k"*, to chamber *R* and the auxiliary reservoir.

When the difference in pressure between the auxiliary reservoir and the control pipe and brake pipe becomes slight, the check valve in the triple valve and the check valve in the control pipe are closed by their springs, shutting off communication between the brake pipe and auxiliary reservoir through the slide and graduating valves, and the control pipe and the auxiliary reservoir. The auxiliary reservoir and brake pipe pressures then equalize through the feed groove *"i."*

SERVICE APPLICATION.

When a slight reduction in brake pipe pressure is made, the main piston, which carries on its stem a graduating valve, moves towards the left to the service

position shown in Fig. 3. While this reduction is being made, the check valve is held to its seat by its spring, preventing any back leakage of auxiliary reservoir pressure to the brake pipe.

In moving, the piston first closes feed groove *"i"*, charging ports *"j"* and *"k"* and the exhaust port *"m"*. Further movement of the piston carries the slide valve toward the left. In this position air from the auxiliary reservoir flows through ports *"z"* and *"r"* to the brake cylinder and at the same time the air in the brake pipe at *"a"* raises the check valve and momentarily flows through the ports *"y"*, *"o"*, *"v"*, *"q"* and *"r"* into the brake cylinder, applying the brake. As the opening from the auxiliary reservoir to the brake cylinder exceeds in area that of the brake pipe to the brake cylinder, the pressure in the auxiliary reservoir reduces more rapidly than that of the brake pipe. The result is, that when the reduction of brake pipe pressure to the atmosphere is stopped by the motorman lapping his brake valve, the slight excess in pressure in the brake pipe on the left of the piston moves the piston and graduating valve to the right, closing ports *"z"* and *"r"*, and preventing any further flow of air to the brake cylinder. This position, Fig. 4, is known as the "service-lap" position.

If a further reduction in brake pipe pressure is made, the piston and graduating valve will again move to the left re-opening the service port *"z"* and allow-

ing air to again flow from the auxiliary reservoir to the brake cylinder until the operation just described is repeated.

RELEASE.

To release the brake the brake pipe pressure is increased above that of the auxiliary reservoir. This forces the piston, slide and graduating valves to the extreme right, as shown in Fig. 2, exhausting the brake cylinder pressure to the atmosphere and recharging the auxiliary reservoir.

To release the brakes gradually a slight rise in brake pipe pressure is made. The piston, slide and graduating valves return to release position. In this position the auxiliary reservoir is being charged from both brake and control pipes. The flow of air from the control pipe to the auxiliary reservoir raises the latter pressure slightly above that of the brake pipe, forcing the piston to the left and closing, by means of the graudating valve, the brake cylinder exhaust and communication between the brake and control pipes to the auxiliary reservoir. This brings the triple valve into what is known as the "release-lap position", Fig. 5. This operation may be repeated until the brake cylinder pressure is exhausted.

EMERGENCY.

When a sudden reduction in brake pipe pressure is made, the piston, slide and graduating valves move to the extreme left, compressing the graduating spring

until the piston strikes the gasket. In this position, Fig. 6, the large port "*r*" to the brake cylinder is open and air flows more rapidly from the auxiliary reservoir to the brake cylinder than is possible in a service application.

HANDLING OF BRAKES IN SERVICE.

32. PRESSURES—The Main Reservoir Pressure should be between 85 and 95 pounds.

The Control Pipe Pressure should be 70 pounds.

The Brake Pipe Pressure should be 70 pounds.

33. TO MAKE UP A TRAIN—Connect both the brake pipe and control pipe by means of the hose, making sure that the couplings are securely fitted together. Then open the cocks in the control pipe, and afterwards those in the brake pipe. If the brake pipe cocks are opened first, the rotary valve in the brake valve might be raised from its seat, allowing the air in the brake pipe to escape. On the end cars of the train the hose couplings should be fastened to the dummy couplings hung from the end of the cars.

34. TO CHARGE BRAKE PIPE AND AUXILIARY RESERVOIRS—Apply brake valve handle to brake valve to be operated and turn handle to release position. Only one of the brake valves should be used at a time, usually the one on the front end of the forward car.

35. To Test Brakes—Turn the brake valve handle on operating car to the full service position and hold there until the gauge shows a reduction of twenty-five (25) pounds in brake pipe pressure, then return handle slowly to lap position.

The valve handle should be left in this position until the brakes have been examined by the trainmen or inspectors. Upon the signal from the rear car, four blasts of signal whistle, for the release of brakes, the motorman shall turn the valve handle to release position.

The brakes should then be re-examined as quickly as possible to see that they have released properly. Should a re-application of the brakes be desired, four blasts of the signal whistle will again be used. The condition of the brakes, together with the number of cars in the train, should then be reported to the motorman. When the make-up of a train is changed, the test of brakes must be repeated. BEFORE STARTING, THE MOTORMAN MUST KNOW THAT THE BRAKES HAVE BEEN TESTED.

36. To Make a Full Service Application—Turn the brake valve handle to service position and make a reduction of twenty-five (25) pounds in brake pipe pressure and return handle SLOWLY to lap position, to prevent "surging" of the air in the brake pipe.

37. To Graduate the Release—Turn the brake valve handle from lap to holding position, in a train of one or two cars and from lap to release position

for three or more cars, and return quickly to lap position, as the longer it remains in release or holding position the lower the brake cylinder pressure will reduce. This operation may be repeated a number of times in order to gradually reduce the brake cylinder pressure to a point as low as possible, so as to obtain a smooth stop and to allow the auxiliary reservoirs to recharge.

38. In Lap Position—All ports in the brake valve are closed.

This position should be used after a service application when it is desired to hold the brake applied; to graduate the release; to close communication between the control pipe and brake pipe, and when a reduction in brake pipe pressure, which is not caused by the motorman, takes place.

The brake valves on all cars, with the exception of the brake valve operated by the motorman, must be in lap position.

39. To Make an Emergency Application—Turn the brake valve handle to emergency position and leave it there until the train stops or the danger is past.

An emergency application may also be made by removing hand from controller, when running, as explained in paragraph 103 of "Train Operation."

To make an emergency application by means of the conductor's valve, pull the conductor's cord so as to open the valve wide and hold open until the train stops.

When brakes are applied from conductor's valve or through accident, motorman should immediately place the brake valve handle in lap position and return controller handle to the "off" position.

40. To Cut Out Defective Brake—Close double cut-out cock and open drain cock in auxiliary reservoir, leaving it open.

41. To Cut Off Car—Release the brakes, close the cocks in the brake and control pipes, uncouple the hose by hand and hang up properly by means of the dummy couplings. Never let the hose be pulled apart by the cars separating.

42. When a Car is Left in Yard or on Siding, the air brake should be released and the hand brake applied.

BRAKE FAILURE.

43. If the Brake Releases After a Service Application, it is due to an increase in brake pipe pressure or a decrease in auxiliary reservoir pressure.

An increase in brake pipe pressure may be due to—

A brake valve not fully lapped, or

A leaky rotary valve.

Examine all brake valves and determine if they are properly lapped.

To detect leaky rotary valve, close cocks in brake pipe at all brake valves except the one being operated. Make a service application of the brake and return handle to lap position. If the brake pipe pressure immediately increases, as observed by gauge, the brake valve being operated has a leaky rotary valve. Repeat this test, if necessary, on each car, making sure that all brake pipe cocks are closed as above.

A decrease in auxiliary reservoir pressure is due to a leak in reservoir, pipe, triple valve gasket or slide valve in triple valve. If such leakage is excessive the brake should be cut out.

44. IF THE BRAKES FAIL TO RELEASE after making a slight reduction, make an additional reduction of fifteen (15) pounds in brake pipe pressure and return brake valve handle to release position. If a brake on a particular car should fail to release, due to being held applied by air pressure, open the drain cock on the auxiliary reservoir until the air can be heard exhausting through the triple valve to the atmosphere.

45. IF A CONTROL PIPE HOSE BURSTS, close the control pipe stop cocks immediately ahead and behind the burst hose and proceed.

46. IF A BRAKE PIPE HOSE BURSTS, close the brake pipe angle cocks immediately ahead and behind the burst hose, remove the hose and replace with a new hose. A wrench for this purpose will be found on top of the salon in the smoking car. The usual test of the brakes must be made before train proceeds.

47. If the Cross-Over Pipe connecting the brake pipe and triple valve breaks between the double cut-out cock and the triple valve, close the double cut-out cock and open the drain cock in the auxiliary reservoir under the car.

If the cross-over pipe connecting the brake pipe and triple valve breaks between the double cut-out cock and the brake pipe, close the brake pipe cock at the front end of the disabled car and open the drain cocks in all auxiliary reservoirs behind the disabled car, as well as on that car.

48. Under no circumstances should trains be run with less than 85 per cent. of the cars in the train having their air brakes properly coupled up and in operative condition, without specific instructions from the Superintendent. All cars having air brakes in operative condition must be coupled up.

49. The Application of the Brakes Should be Adapted to the Speed. At high speed a full application should be made and the release graduated until at the stop there is a very slight pressure in the brake cylinder. If train is on a level, complete the release; if on a grade, hold the brakes until the signal to start is given.

DESCRIPTION OF ALARM WHISTLE APPARATUS

50. The Alarm Whistle Apparatus on each motor car consists of the following:

TWO ALARM WHISTLES, one on each end of car.

TWO CUT-OUT COCKS, for cutting off the supply of air to whistle valves and alarm whistles, in case of failure.

ONE WHISTLE RESERVOIR, from which compressed air is supplied to the alarm whistles.

TWO WHISTLE VALVES, for controlling the passage of air to alarm whistles.

ONE DUPLEX CHECK VALVE, for preventing the reduction of the main reservoir pressure below a certain amount through frequent or prolonged use of the whistle, and also to utilize the whistle reservoir as a part of the main reservoir system.

51. THE ALARM WHISTLES are located one at each end of car above the roof of the motorman's compartment.

52. THE CUT-OUT COCKS are located in the whistle pipes, at each end of car, below the platform.

53. THE WHISTLE RESERVOIR consists of a steel tank located under the car body. The tank is provided with a drain cock and should be drained daily, and after every trip in very cold weather. To the whistle reservoir two pipes are connected: one leading to a

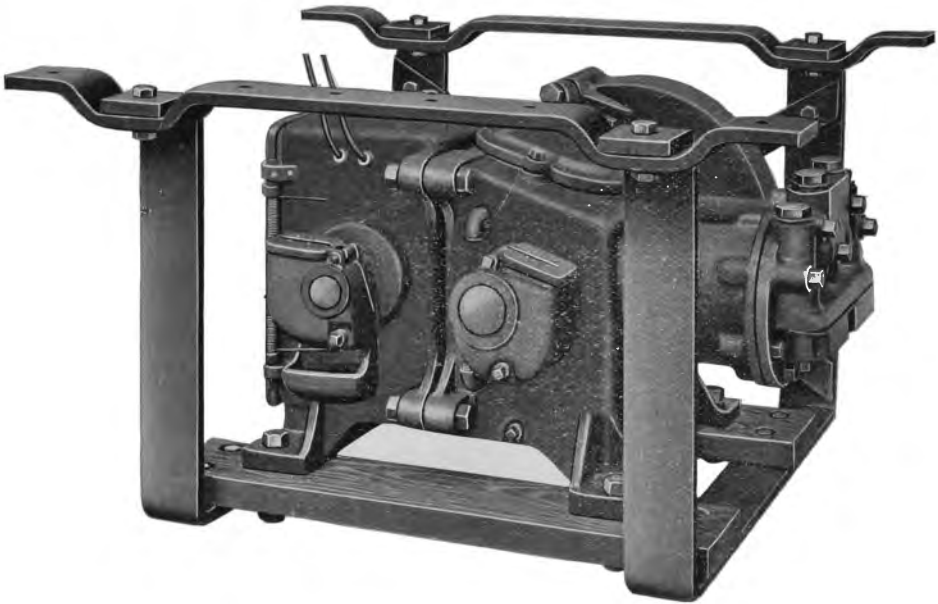
whistle valve and alarm whistle at one end of car, and one leading to one inlet of the duplex check valve. This latter pipe also has a connection leading to the whistle valve and alarm whistle at the other end of car.

54. THE WHISTLE VALVES are located one at each end of car in motorman's compartment. The whistle valve (Plate No. 15) is of the globe pattern, having its valve held on its seat by a spring (5), assisted by air pressure. The stem (4) passes through the body of the valve and engages with lever (6), to which the whistle cord is attached. When the cord is pulled the stem is pushed in by the lever, compressing the spring and unseating the valve, allowing air to pass to the whistle. When the cord is released, the valve, assisted by the spring and the air pressure, returns to its seat, shutting off the air supply to the whistle.

55. THE DUPLEX CHECK VALVE is located in the pipe leading from main reservoir No. 2 to the whistle reservoir. The inlet marked "PR" is connected to the pipe leading to main reservoir No. 2. Air passing through inlet "PR" (Plate No. 16) enters chamber *"a"* and acts upon the upper side of diaphragm (11). Chamber *"b"* below the diaphragm leads to the atmosphere through a small hole *"d"* in the spring case (3). The spindle (15) is secured to the diaphragm by nut (9) and washer (10). Spring (14) is adjusted by nut (16) to a pressure three pounds below that at which the compressor governor is adjusted to operate the compressor—85 pounds. When the air pres-

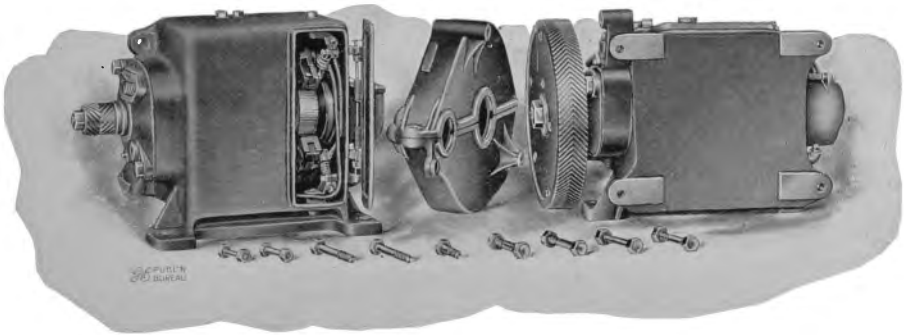
sure in chamber *"a"* is above 85 pounds, diaphragm (11) and spindle (15) are forced downward, unseating plug valve (8) and allowing air to flow into chamber *"c"* and thence to whistle reservoir. If, for any reason, the main reservoir pressure falls below 85 pounds, spring (14) forces diaphragm (11) upward and seats plug valve (8), thereby cutting off further supply of air to the whistle set until the main reservoir pressure is above 85 pounds. Should the pressure in the main reservoir fall below that of the whistle reservoir, check valve (6) is unseated, allowing air to pass from the whistle reservoir to the main reservoir, thus making the whistle reservoir part of the main reservoir and increasing the air storage of the car by a considerable amount, so that when necessary the whistle reservoir supply is available. When the air pressure equalizes, check valve (6) is returned to its seat by spring (7).

PLATE No. 1.



AIR COMPRESSOR—ASSEMBLED.

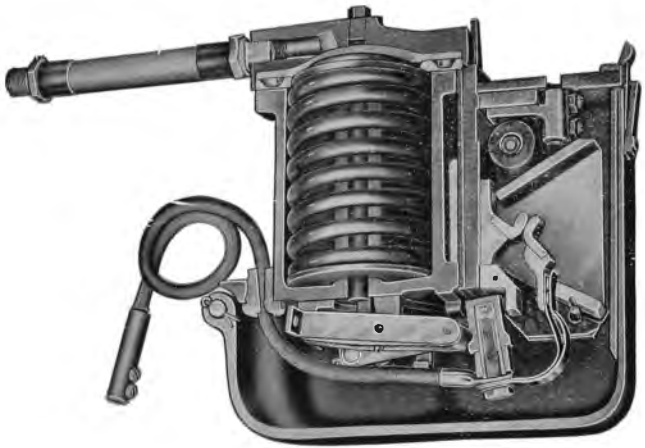
PLATE No. 2.



MOTOR PUMP

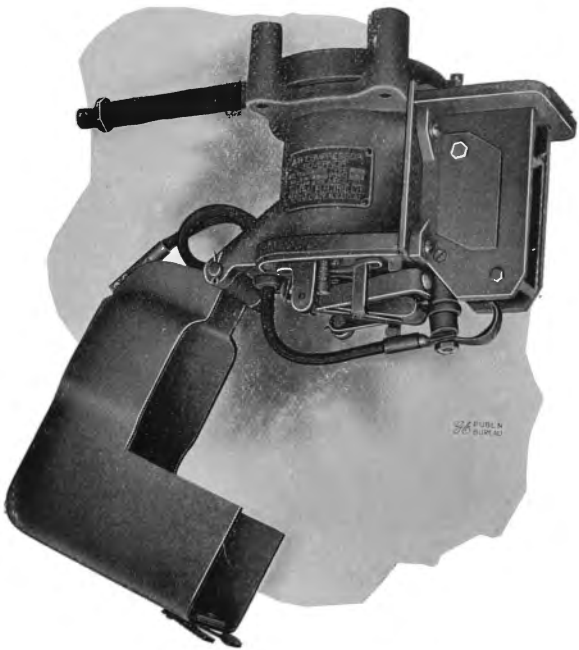
AIR COMPRESSOR—UNASSEMBLED.

PLATE No. 3.



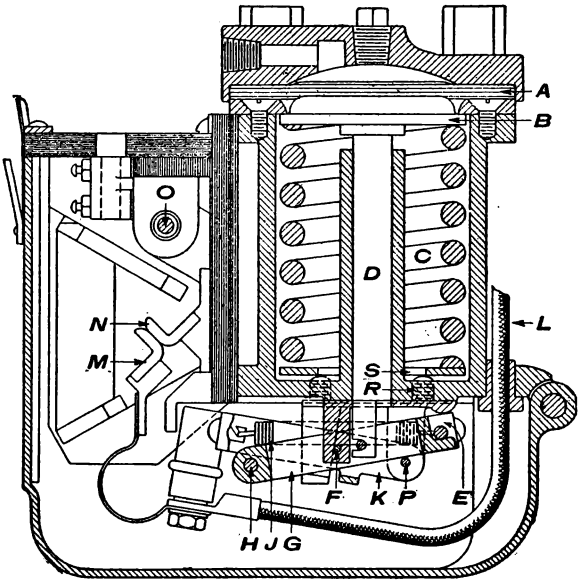
SECTION OF AIR COMPRESSOR GOVERNOR.

PLATE No. 4.



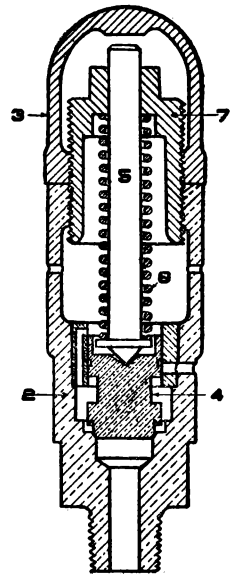
AIR COMPRESSOR GOVERNOR.

PLATE No. 5.



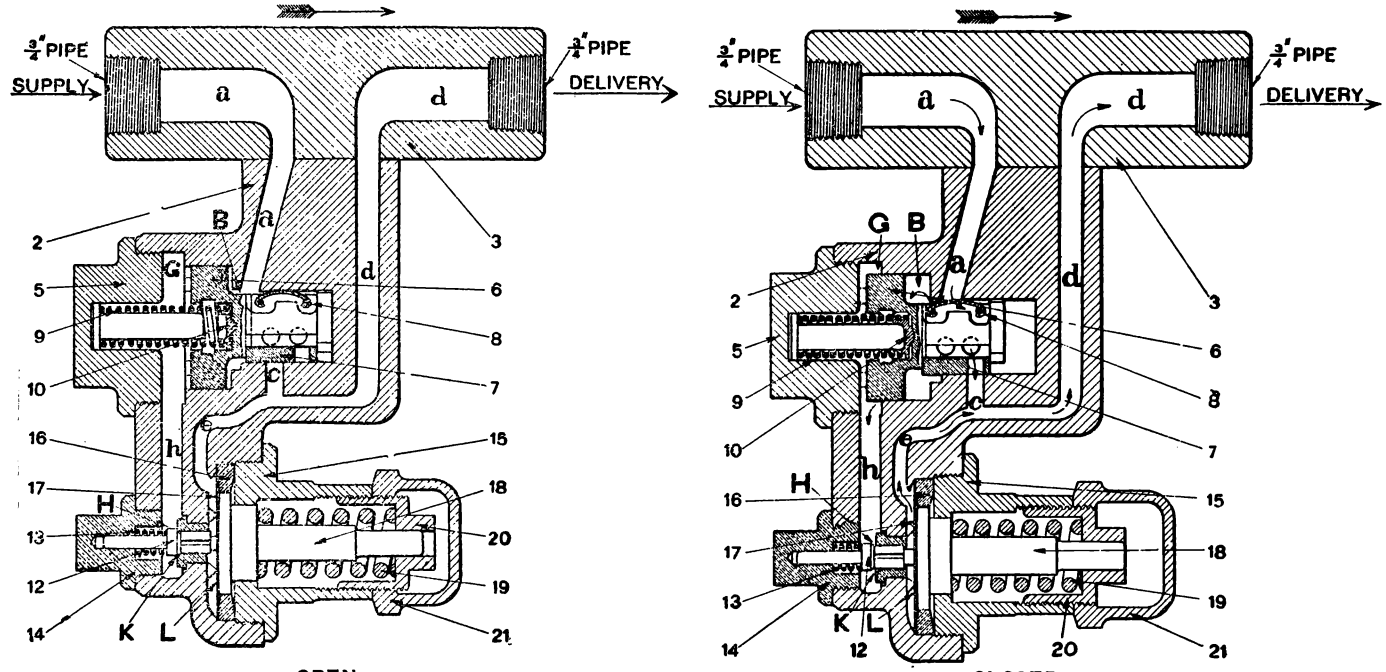
DIAGRAMMATIC SECTION OF AIR COMPRESSOR GOVERNOR.

PLATE No. 6.



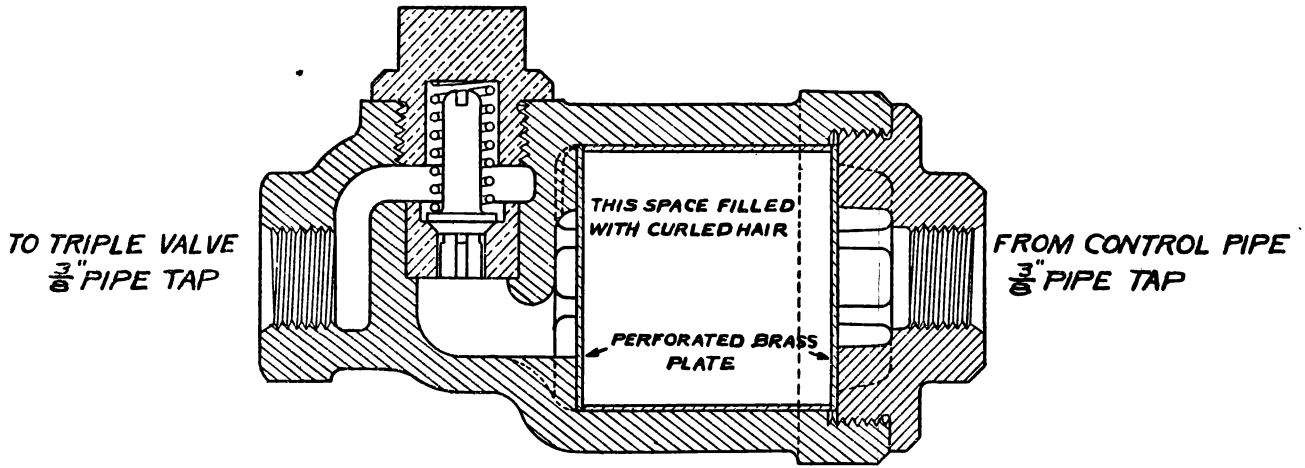
SAFETY VALVE.

PLATE No. 7.



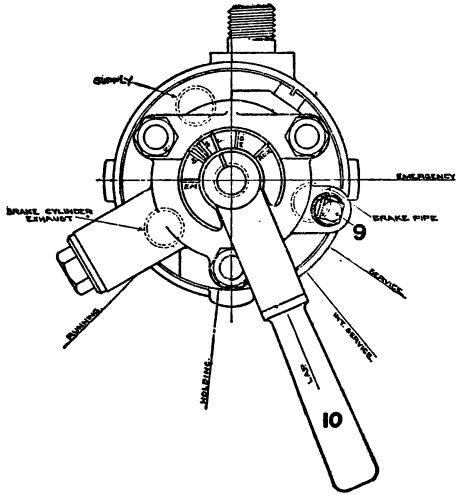
SLIDE VALVE FEED VALVE.

PLATE No. 8.

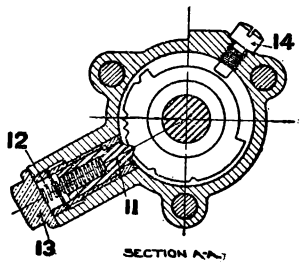


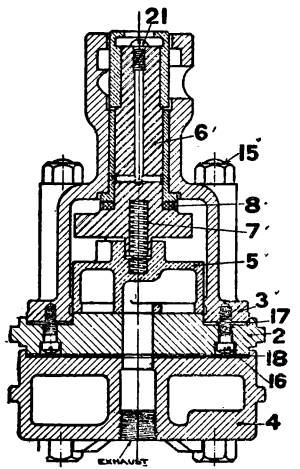
COMBINED AIR STRAINER AND CHECK VALVE.

PLATE No. 9.

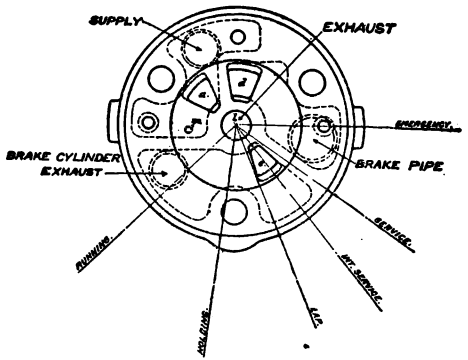


BRAKE VALVE QUADRANT.

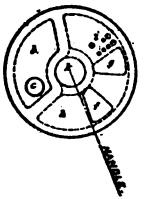




PLAN AND VERTICAL SECTION.



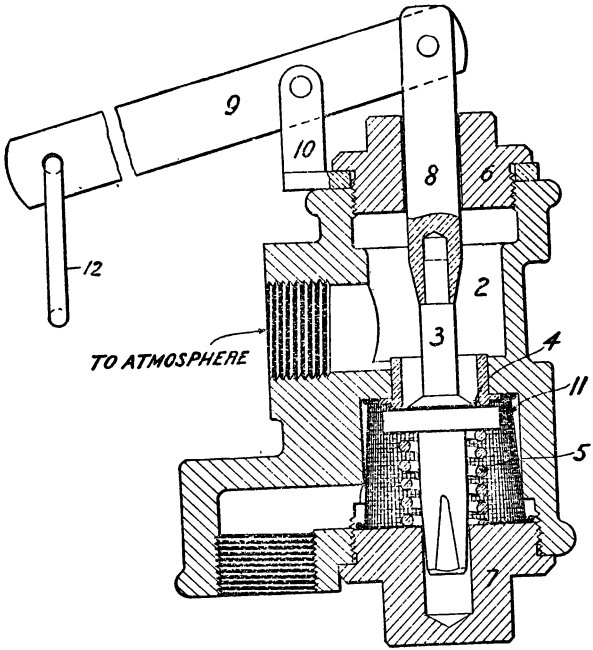
ROTARY VALVE SEAT.



ROTARY VALVE.

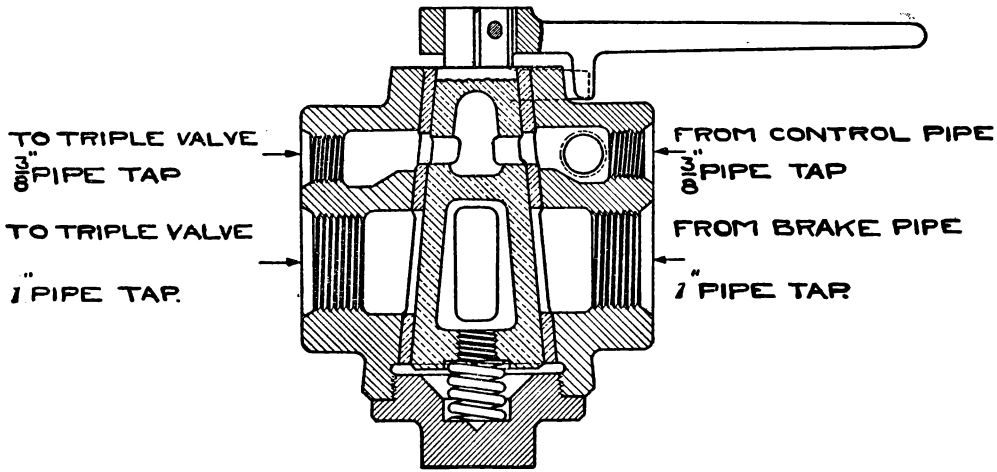
MOTORMAN'S BRAKE VALVE.

PLATE No. 10.



CONDUCTOR'S VALVE.

PLATE No. 11.



DOUBLE CUT-OUT COCK.

PLATE No. 12.

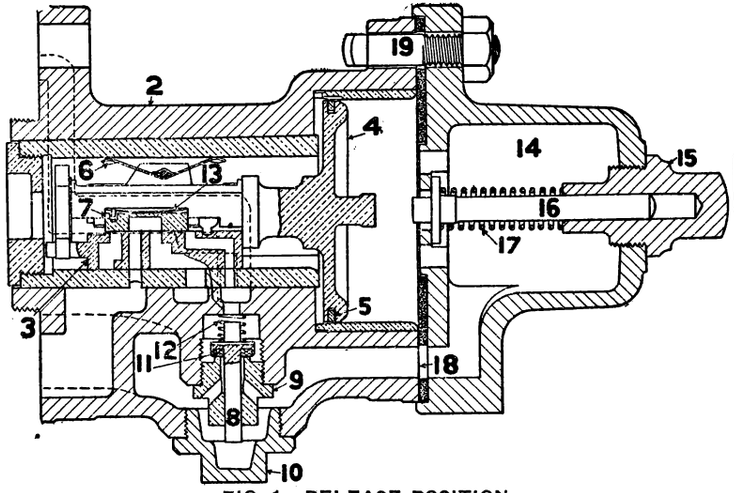


FIG. 1. RELEASE POSITION.

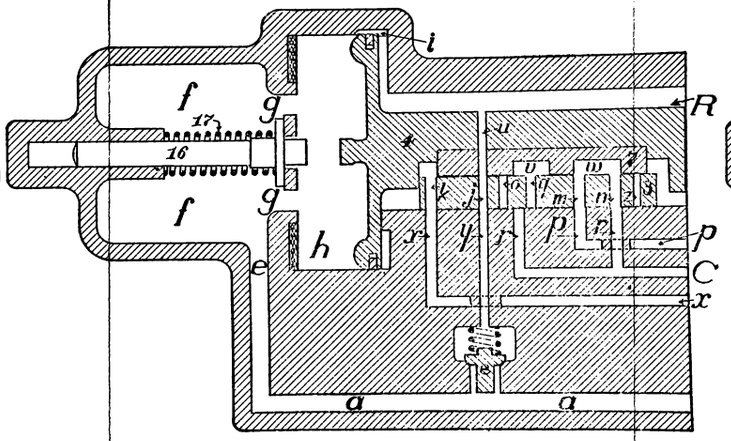


FIG. 2.—RELEASE POSITION.

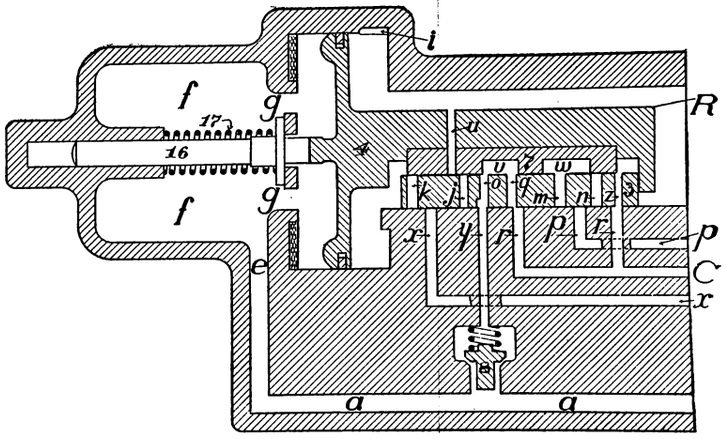


FIG. 3. SERVICE POSITION.

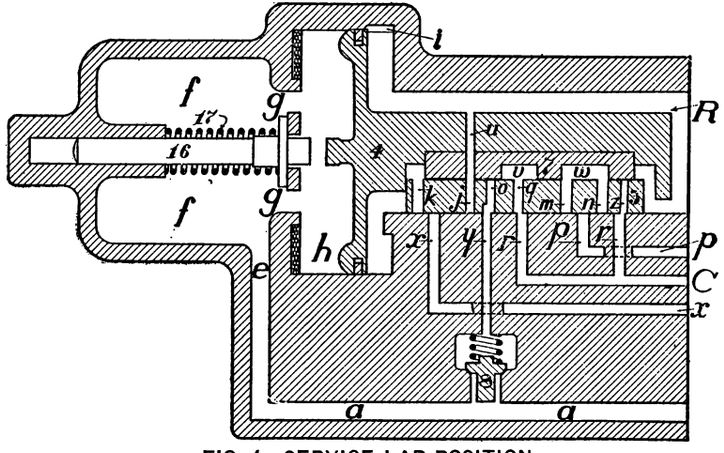


FIG. 4. SERVICE LAP POSITION.

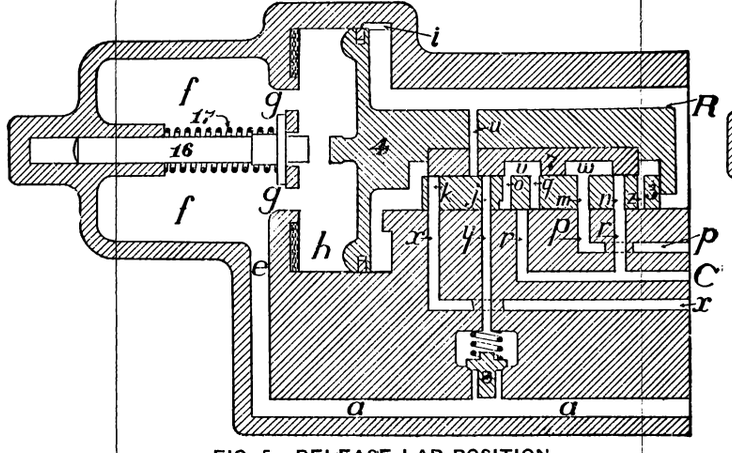


FIG. 5. RELEASE LAP POSITION.

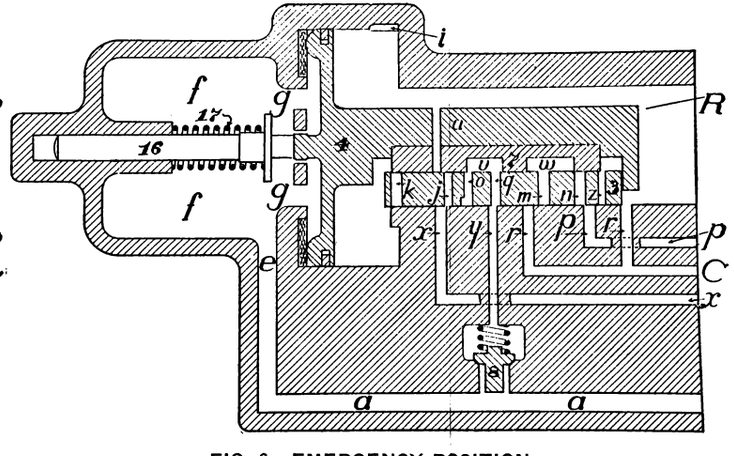
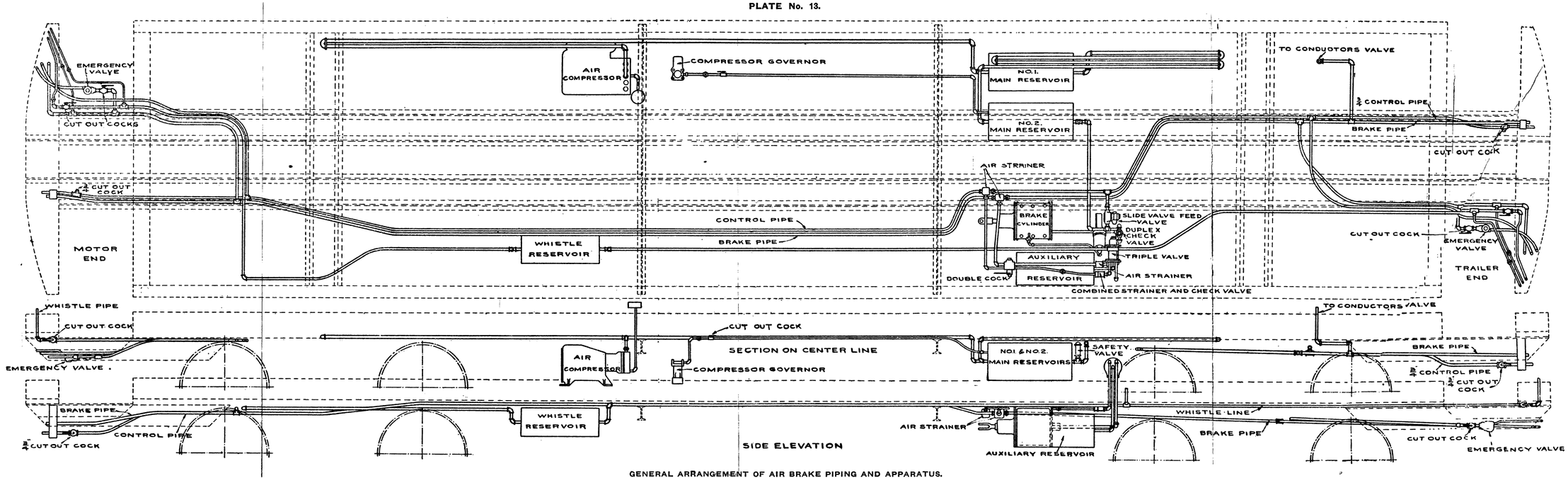


FIG. 6. EMERGENCY POSITION.

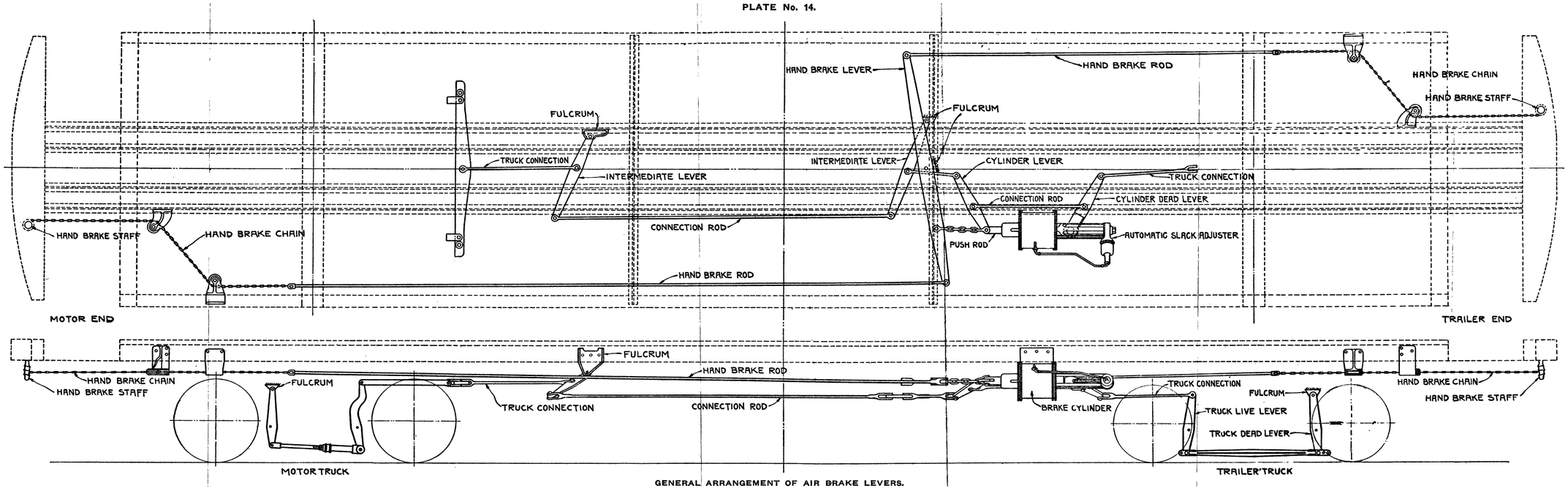
TRIPLE VALVE.
TYPE T-2.

PLATE No. 13.



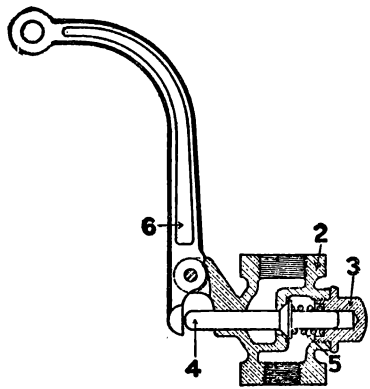
GENERAL ARRANGEMENT OF AIR BRAKE PIPING AND APPARATUS.

PLATE No. 14.



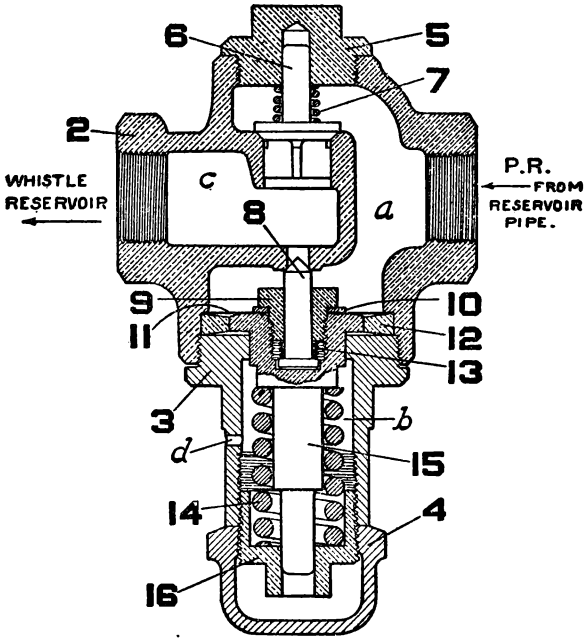
GENERAL ARRANGEMENT OF AIR BRAKE LEVERS.

PLATE No. 15.



WHISTLE VALVE.

PLATE No. 16.



DUPLEX CHECK VALVE.

Instructions for the Operation of Multiple Unit Control.

General Description of Apparatus.

56. THE MOTOR CARS ON THE WEST JERSEY AND SEASHORE RAILROAD are equipped with two General Electric (No. 69-C) 200 horse power railway motors, both of which are mounted on one truck, known as the MOTOR TRUCK. The Sprague-General Electric (type M) multiple unit system of control is used.

57. BY MULTIPLE UNIT CONTROL is meant the operation of a train of two or more motor cars from a single master controller on any car in the train; that is, a train of several cars, each propelled independently by its own motors, is controlled as one car.

58. THE CONTROL EQUIPMENT of each car requires two circuits:

THE MASTER CONTROL CIRCUIT, which is directly operated by the motorman;

THE MOTOR CONTROL CIRCUIT, which is operated by means of the master control circuit.

Both master control and motor control circuit cables are enclosed in iron pipe conduits.

59. EACH MOTOR CAR is provided with two master controllers, one at each end of the car in the motorman's compartment. All master controllers are connected to a seven-wire TRAIN CABLE running the entire length of each car and connected together between cars by the TRAIN CABLE JUMPER. Current received through the master controller and train cable operates electrically controlled switches known as CONTACTORS on each car, and establishes the motor control on their respective cars. The motor control is local with each car and can be governed by any master controller on the train.

60. EACH MOTOR CAR TAKES CURRENT from the third rail through the third rail shoes or from the trolley wire through the trolley. All third rail shoes and trolleys are connected through switches to a BUS LINE, which runs the entire length of each car and is connected together between the cars by the BUS LINE JUMPER; therefore, if any third rail shoe or trolley is in contact with the third rail or trolley wire, all motors of the train can be supplied with current through the bus line.

MOTOR CONTROL.

61. THE MOTOR CONTROL CIRCUIT (Plate No. 17) is the circuit forming the path for the current from the third rail shoes or trolley through the motor control apparatus and motors to the track rails, and is THE MAIN CIRCUIT.

62. THE ESSENTIAL PARTS of the motor control of each car comprise the following apparatus:

One set of fifteen CONTACTORS, which close and open the circuit to the motors.

One REVERSER, which determines the direction of train movement.

One set of eight RESISTANCES, which limit the flow of current to the motors when starting.

One CIRCUIT BREAKER, which protects the motors and motor control apparatus against excessive current.

One MAIN FUSE, which—like the circuit breaker, and in addition to it—protects the motors and motor control apparatus against overload in case the circuit breaker fails to operate.

One MAIN SWITCH, by which the current can be cut off from motor control circuit for inspection or in case of defective apparatus.

One THIRD RAIL SWITCH, by which current can be cut off from third rail shoes when operating from trolley.

One TROLLEY SWITCH, by which the trolley can be cut off from the bus line.

Four THIRD RAIL SHOES, which collect current from the third rail.

Four SHOE FUSES, which protect the apparatus and car wiring against excessive current.

Two TROLLEYS, either of which takes current from the trolley wire.

One TROLLEY FUSE, which protects the apparatus and car wiring from excessive current.

One BUS LINE, which, together with the bus line jumper, connects all shoes and trolleys of a train together.

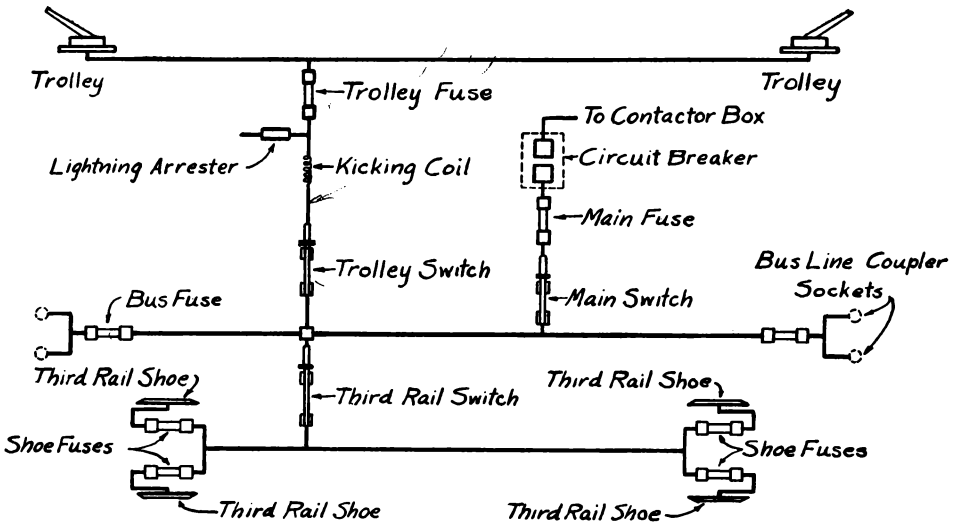
Two BUS LINE FUSES, which protect the bus line against excessive current.

One KICKING COIL and one LIGHTNING ARRESTER, which protect the circuits and apparatus against lightning discharges.

63. THE FOUR THIRD RAIL SHOES are connected together through the shoe fuses by a cable from which a connection is made through the third rail switch on switchboard, through the main switch, main fuse, circuit breaker, contactors, resistances, reverser and motors to the track rails.

64. THE TWO TROLLEYS are connected together by a cable, from which a connection is made through the trolley fuse, then through the kicking coil and trolley switch, located in a box on the roof of the car, to the bus line, from which a connection is made to the main switch. From the main switch the circuit is the same as from the third rail shoes. A connection is made between the trolley fuse and kicking coil through a lightning arrester, located in the box with the kicking coil on the roof of the car, to ground.

PLATE NO. 17.



MOTOR CONTROL CIRCUIT.

DESCRIPTION OF MOTOR CONTROL APPARATUS.

65. THE CONTACTORS, fifteen in number, are enclosed in an iron box, known as the contactor box, located under the car.

The Contactor (Plate No. 19) is a switch, the movable portion of which is operated by an electro-magnet receiving line current through the master controller and the train cable. The main contact is made between two heavy copper tips which are enclosed in an arc chute. A magnetic blowout is provided, having poles extended along two sides of the arc chute, for extinguishing the arc formed in breaking the circuit.

By means of the contactors the motor control is established upon individual cars.

66. THE CONTACTOR BOX (Plate No. 20) is located beneath the car, about midway between the trucks.

This box is of iron, lined with asbestos and other insulating materials to prevent short circuits, and is provided with two hinged sheet iron covers. When it is desired to inspect the contactors, the sheet iron covers can be dropped by releasing the catches which hold them in place.

67. THE REVERSER (Plate No. 21) is enclosed in a metal box, and located near the end of the contactor box toward the motor truck.

The movable part of the reverser is a rocker arm controlled by two electro-magnets, one for each direction of car movement. These magnets are operated by current from the master controller through the

train cable, the connections being made so that only one magnet can receive current at a time. Cables from the motor armatures and fields are connected to the fingers of the reverser, and by means of contact pieces mounted on, but insulated from, the rocker arm, proper connections of armatures and fields are established for producing forward and backward movement of the car.

The reverser is always closed, either in forward or backward position, depending upon whether the master controller handle has been moved to the left or to the right. When the reverser is in the correct position it cannot be operated while the motors are taking current, as it is then electrically locked.

The control circuits to the reverser are so arranged that unless the reverser is set in the correct position, current is cut off from the motors. If the control circuit is complete the reverser will respond to the movement of the master controller handle, setting in the correct position for direction of movement desired, but if the control circuit through the reverser on any car is interrupted, the motors on that car will not receive current, and cannot oppose the motors of the other cars in the train.

68. THE RESISTANCE (Plate No. 22) is located beneath the car, near the contactors, and is made up of cast iron grids mounted in, and insulated from, an iron frame.

These resistances are used to regulate the flow of current to the motors while the car is accelerating. Cables connect the various resistances to different contactors, so that sections of the resistance may be cut out to increase the speed. Resistances are used only in starting, switching, or moving at low speeds, and are entirely cut out either in the one-half or full speed positions of the master controller handle.

69. THE CIRCUIT BREAKER (Plate No. 23) is enclosed in an iron box, located beneath the car at the end of the contactor box toward the trailer truck.

The circuit breaker is similar in construction to the contactor, but is designed to carry and break the full current taken by the car. It is closed by means of an electro-magnet acting independently, and operated by current through the train cable and the circuit breaker closing switch (Plate No. 35), which is located in the motorman's cab above the master controller. The circuit breaker on any car opens automatically when excessive current flows through the motor circuits on that car. As the closing circuit of all circuit breakers of a train are connected through the train cable, all circuit breakers are closed simultaneously by operating the circuit breaker switch.

The circuit breakers are normally closed when the train is ready for operation.

70. THE MAIN FUSE (Plate No. 24) is located beneath the car, at the trailer end, near the main switch.

It is made from a thin copper ribbon and is contained in a box composed of insulating material. Sheet iron poles partially surround the insulation and provide a magnetic blowout for extinguishing the arc formed when the fuse blows.

The fuse is held in place by copper clamps fastened with thumb screws having insulated handles. It may be replaced after opening the main switch, loosening the clamps and removing the ends of the old fuse. Ordinarily the circuit breaker will open automatically from excess current before the fuse has time to blow.

71. THE MAIN SWITCH (Plate No. 25) is located in a box beneath the car. It is a quick-break, knife-blade switch, and is used to cut off the supply of current to the motor control circuit from both trolley wire and third rail. This switch is normally closed, BUT SHOULD ALWAYS BE OPEN when examining or working upon the motor control apparatus.

72. THE THIRD RAIL SWITCH is located on the switchboard (Plate No. 36). It is a quick-break, knife-blade switch, and is used to cut off current from the third rail to the motor control circuit and to cut out the third rail shoes when operating from the trolley wire.

This switch is normally closed. THE SWITCH SHOULD NOT BE OPENED WHILE THE MOTORS ARE TAKING CURRENT, EXCEPT IN AN EMERGENCY.

73. THE TROLLEY SWITCH is located in a box on the car roof. It is a quick-break, knife-blade switch, and is used to cut off the trolley and its fuse from the bus line circuit. This switch is normally closed, BUT SHOULD ALWAYS BE OPEN WHEN WORKING ON THE TROLLEY OR RENEWING A TROLLEY FUSE.

74. THE BUS LINE COUPLER SOCKETS, four in number, are located under the platforms, two at each end of the car.

The coupler socket (Plate No. 26) is composed of a body of moulded insulating material containing a large split plug contact. Supporting feet of malleable iron are screwed to this insulating body for attaching to the under side of the car platform. The socket is provided with a hinged lid, having a projection on the inside to hold the jumper plug in place. The cover also excludes dirt and water when the jumper is not inserted. Only one of the two bus line coupler sockets at each platform is in use at a time.

75. THE BUS LINE JUMPER (Plate No. 27) is used to connect the bus line coupler sockets on adjacent cars. It consists of a short section of flexible cable with a plug attached to each end and completes the bus line between the cars. Only one bus line jumper is required for connecting between adjacent cars, the additional sockets being provided so that cars may be turned end for end or coupled in any desired relation.

76. THE BUS LINE FUSES, two in number, are located beneath the car, one at each end. They are similar to the main fuse. These fuses are placed in the bus line circuit to protect it against excessive currents.

77. THE BUS LINE JUNCTION BOXES, two in number, are located beneath the car, one at each end.

The box is made of cast iron and contains an insulated board to which is secured a single stud bolt for holding the cable terminals. This box is provided for connecting the bus line coupler sockets to the bus line cable.

78. THE BUS LINE CONNECTION BOX is located beneath the car, midway between the trucks.

This box is similar to the bus line junction box, and is provided for connecting the third rail and trolley circuits to the bus line cable.

79. THE SHOE FUSE BOXES, four in number, are located on the wooden shoe beams, one on each side of each truck. The box is similar to the main and bus line fuse boxes and contains the shoe fuse.

80. THE TROLLEY FUSE BOX is located on the roof of the car. It is similar to the main and bus line fuse boxes and contains the trolley fuse.

MASTER CONTROL.

81. THE MASTER CONTROL CIRCUIT (Plate No. 18) is the circuit forming the path for the current from the bus line, through the master controller and the train cable, to the operating coils of the motor control apparatus.

82. THE ESSENTIAL PARTS of the master control of each car comprise the following apparatus:

Two MASTER CONTROLLERS, which operate the motor control.

Two MASTER CONTROLLER SWITCHES, used to cut off current from their respective master controllers when not in use.

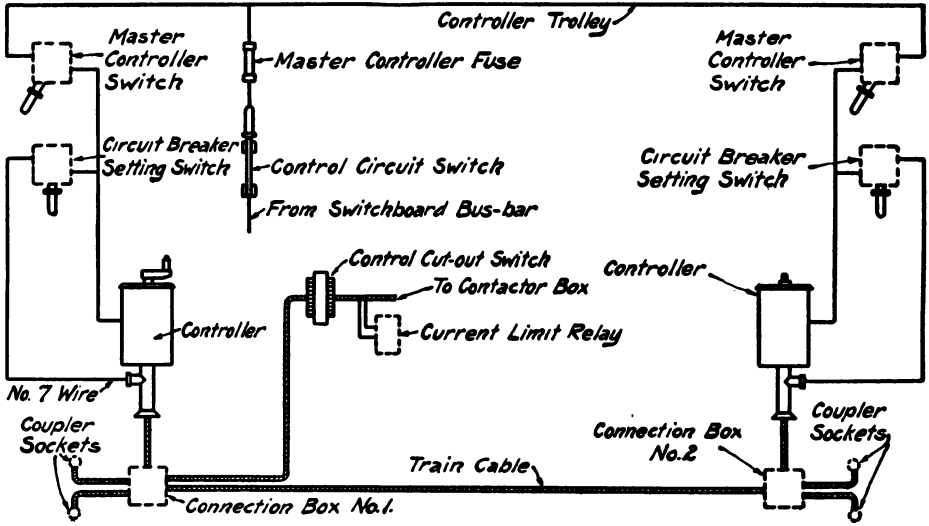
One CONTROL CIRCUIT SWITCH, to cut off current to master controller and circuit breaker switches.

One TRAIN CABLE, which connects the master controllers to the motor control apparatus.

Four TRAIN CABLE COUPLER SOCKETS, to which the train cable jumpers are connected.

One TRAIN CABLE JUMPER, which connects the train cable between cars.

PLATE No. 18.



MASTER CONTROL CIRCUIT.

Two Train Cable Connection Boxes, where connection is made to master controllers, coupler sockets and seven-point cut-out switch.

One Set of Resistance Tubes, which limit the current in the master control circuits.

One Current Limit Relay, which limits the rate of acceleration.

One Potential Relay, which opens the master control circuit when power is cut off from the train.

One Seven-Point Cut-Out Switch, to disconnect motor control apparatus from the train cable.

Two Circuit Breaker Closing Switches, for closing the circuit breakers.

Control Fuses, which protect the master control wiring against excessive current.

DESCRIPTION OF MASTER CONTROL APPARATUS.

83. The Master Controllers, two in number, are located in the motorman's compartments, one at each end of the car.

The master controller (Plate No. 28) contains a single movable contact cylinder and stationary fingers mounted on an insulated support. The controller has

a single handle for both forward and reverse direction of train movement. Four points are indicated on the cap plate for forward direction, and two for reverse. The first point in either direction is called the "Switching" or "Lap" position; the second, "Full Series." The third point is called the "Parallel Lap" position, and the fourth, "Full Parallel."

The master controller governs the admission of current to the train cable for operating the reverser and contactors.

84. THE MASTER CONTROLLER SWITCHES, two in number, are located above each master controller, one at each end of the car.

The master controller switch (Plate No. 29) is a pivoted switch mounted in an iron box and having a projecting handle. It is provided with a magnetic blowout. This switch is used to cut off current from its master controller when the latter is not in use. It also serves as an emergency switch in case of any failure of the master controller.

85. THE CONTROL CIRCUIT SWITCH is located on the switchboard and is of the quick-break knife-blade type.

This switch is used to cut off current from the master controller and the circuit breaker switches. The normal position of the switch is open except when the train is being operated from a master controller on that car.

86. THE TRAIN CABLE is located in an iron pipe placed beneath the car.

The train cable is composed of seven conductors, each being covered with a different colored outer braid for identification. These conductors are attached to numbered plugs in the coupler sockets at the ends of the car. Branch cables run from connection boxes in the train cable to the master controllers, seven-point cut-out switch and coupler sockets.

The train cable is used to connect the operating master controller to the motor control apparatus of the car or train. The seven wires are used as follows:

No. 1 (Red) For accelerating or "notching up."

No. 2 (White) For series connection of motors.

No. 3 (Green) For parallel connection of motors.

No. 4 (Green and White) For operating reverser one direction.

No. 5 (Yellow) For operating reverser other direction.

No. 6 (Red and black) For train signal circuit.

(This wire was formerly used for opening circuit breakers.)

No. 7 (Black) For closing circuit breakers.

87. THE TRAIN CABLE COUPLER SOCKETS (Plate No. 30), four per car, are attached to the under side of the car platforms, one under each side of each plat-

form. These sockets are of malleable iron and contain a body of moulded insulation, into which are set seven bronze split plugs, one being attached to each conductor of the train cable.

Each socket is provided with a hinged cover adapted to hold the jumper plug in place and to prevent the entrance of dirt and moisture when no jumper is inserted.

88. The Train Cable Jumper (Plate No. 31) is used for connecting the train cables on adjacent cars. It consists of a short length of seven-conductor cable with iron heads or plugs attached to the ends, each containing seven insulated contacts, one being secured to each conductor. The jumper heads fit into the coupler sockets on adjoining cars, and connect together their train cables.

89. The Train Cable Connection Boxes, two in number, are located beneath the car.

The train cable connection box (Plate No. 32) is of iron and is used for making the connections from master controller, circuit breaker, coupler sockets and cut-out switch to the train cable. Seven screw studs which are held in an insulating board are used for securing the terminals attached to the ends of the entering cables.

Conductors provided with the same colored covering are connected together, except at one connection box on each car, where Nos. 4 and 5, which operate

the reverser, are crossed in order to obtain a direction of car movement to agree with the position of controller handle in either controller.

90. THE RESISTANCE TUBES are located in the contactor box, and consist of twelve tubes wound with resistance wire. They are used to regulate the current in the operating coils of the contactors.

91. THE CURRENT LIMIT RELAY (Plate No. 33) is located on the switchboard. It consists of an electromagnet provided with two coils. The master control circuit passes through the upper coil and the main circuit for motor No. 1 through the lower coil. The master control circuit coil lifts the plunger for each step during acceleration and interrupts the contactor pick-up circuit. If the current flowing through the main circuit coil is more than a certain amount the plunger is held in its upper position and cannot drop until the motor current has fallen to the desired amount.

The relay is provided for the purpose of producing an automatic control during acceleration.

92. THE POTENTIAL RELAY (Plate No. 34) is mounted in the contactor box. It is similar to the current relay in construction, but is used for a different purpose. This relay has a coil which is connected between a point in the motor circuit, ahead of the first motor, and ground. If for any reason the motor current is interrupted on a car, this relay will open the

master control circuit to the contactors on that car, causing them in turn to open. When current is restored to the car, the relay will again pick up and complete the master control circuit. The contactors will then pick up in regular succession, the same as if the motorman had shut off power and immediately turned the master controller handle on again.

93. THE SEVEN-POINT CUT-OUT SWITCH is mounted upon the switch board. It consists of copper contacts mounted on an insulated drum, and two sets of fingers fastened to the switchboard. It is provided for the purpose of disconnecting the master control circuit to the contactors, reverser and circuit breaker on the car, from the train cable.

94. THE CIRCUIT BREAKER CLOSING SWITCHES two in number, are located one above each master controller.

The circuit breaker switch (Plate No. 35) is mounted in a cast iron box and consists of a pivoted blade with a handle extending below the box.

The handle, when turned to the right, makes connection through a contact with the closing coils of the circuit breakers. This position is indicated by the word "ON" on the face of the box.

The normal position of the handle is vertical, and is held in this position by two springs.

These switches were originally used to both close and open circuit breakers, but are used at present to close circuit breakers only.

95. CONTROL FUSES are mounted on the switchboard beside the control cut-out switch. A fuse is placed in each of the seven control circuits between the train cable and the cut-out switch.

96. THE SWITCHBOARD (Plate No. 36) is located in the vestibule at the trailer end of the car, and has mounted upon it the following apparatus:

The THIRD RAIL SWITCH. (Paragraph No. 72.)

The SEVEN-POINT CUT-OUT SWITCH AND FUSES (Paragraphs Nos. 93 and 95.)

The CURRENT LIMIT RELAY. (Paragraph No. 91.)

The CONTROL CIRCUIT SWITCH AND FUSE. (Paragraph No. 85.)

SWITCHES AND FUSES FOR AIR COMPRESSOR, LIGHTS, HEATERS, AND TRAIN SIGNAL SYSTEM.

EMERGENCY AIR BRAKE ATTACHMENT.

97. THE EMERGENCY AIR BRAKE ATTACHMENT for master controller (Plate No. 28) consists of a main valve outside of the controller (Plate No. 37), and a small pilot valve (Plate No. 38) within it. The main valve contains a chamber "A" divided into two parts by a piston "B" connected to a valve "C" exhausting

to atmosphere. The lower part of the chamber "A" connects directly to the brake pipe. The upper part of "A" connects to the pilot valve through "F" and pressure in both parts is equalized by a small hole in the piston "B." When the pilot valve is opened, pressure in the upper part of the main valve is reduced, and the piston lifts, allowing the brake pipe to exhaust through a hole in the bottom of the main valve to atmosphere. The pilot valve is opened by a loose collar on the cylinder shaft in the controller which presses against the stem of the valve when the controller handle is at the "OFF" position and the button released.

TRAIN OPERATION.

98. GENERAL—The apparatus will be inspected and the train put in condition for operation by the inspectors, but the motorman will be held responsible for the operation of the apparatus while in his charge, and he must therefore familiarize himself with the location, use and operation of all apparatus on the cars, and carefully follow the instructions below:—

99. PREPARATIONS FOR STARTING—When the train is turned over to the motorman, he should,

First—Pass along the outside of train, carefully examining bus line and train cable jumpers between cars, to assure himself that all connections are properly made and that main switches are closed.

Second—Pass through the train, closing air compressor and third rail switches in each car, and opening master control switches in all cars except head car or car from which train is to be operated.

Third—Pass along the outside of train again and satisfy himself that the air compressors are working properly.

Fourth—Take position in the motorman's compartment at forward end of train, noting the brake pipe pressure, which should be seventy pounds, and close master controller switch. The circuit breakers should then be closed by moving the circuit breaker switch, over the master controller to the "ON" position—holding it there about one second to allow time for all circuit breakers to close.

Fifth—Test the brakes as required by "Air Brake Instructions," making, upon request of the trainmen or inspectors, a full service application (twenty-five (25) pound reduction in pressure), holding them on until the trainmen or inspectors have examined the brakes on each car.

If the brakes are found in proper condition, trainmen or inspectors shall signal the motorman, from the rear of the train, who will then release the brakes.

The test is not complete until the trainmen or inspectors have re-examined the brakes, which should be done as quickly as possible, to see that they have released properly, after which the inspectors must report their condition to the motorman. No attempt should be made to start the train before the brakes are fully released, as excessive current will thereby be drawn through the motor resistances, rendering them liable to serious damage.

The train is now ready to be started.

100. To START—Press down the button in the controller handle, insert the handle key and give it a quarter turn. The button must now be held down to prevent the pilot valve in the controller from operating and applying the brakes. Move the controller handle to the left as far as it will go, holding it there against the spring which tends to return it to the "OFF" position. The motor control will then "notch up" to full speed position by the automatic progression of the contactors, in successive steps, under the control of the current limit relay. In this position it is not necessary to hold the button down to prevent application of the brakes.

101. COASTING—Hold the button down and move controller handle to "OFF" position. In this position power will be shut off and the train may coast free.

102. SERVICE STOP—The service stop will be made by the brake valve in accordance with "Air Brake Instructions."

103. EMERGENCY STOP—The emergency stop may be made by releasing the controller handle, which will then return to the "OFF" position, shutting off the power and applying the brakes.

104. TO START SLOWLY—Move the controller handle to the left to first point. In this position both motors on each car are connected in series with all resistance in circuit and the motor control will not notch up to higher speed.

105. TO INCREASE SPEED SLIGHTLY—Move the controller handle to the second point and quickly return it to first point. This operation results in the cutting out of one step of resistance, and may be repeated until all the resistance is cut out, thus slowly notching up under the control of the motorman and not automatically.

If the controller handle is left on the second point for a sufficient length of time, all resistance will be automatically cut out in successive steps, under the control of the current limit relay, until full series, or half speed, is reached.

106. RUNNING POSITIONS—The second and fourth notches are running positions, and the train should

not be operated for more than a few minutes at a time with the controller handle on intermediate notches.

107. To REVERSE—Move the controller handle to the right to the first point. The reverser will change the direction of train movement, and the motors will be connected in series with all resistance in circuit.

It is not possible to run above half speed in the reverse direction, and if higher speed is required, it can only be obtained by operating the master controller at the other end of the car or train.

TRAIN FAILURE.

108. A TRAIN FAILURE, that is, a failure of a train of one or more cars to move or to attain full speed, when the directions for train operation have been followed, may be due to one or more of the following causes:

First—FAILURE OF POWER.

Second—DEFECT IN MASTER CONTROL CIRCUIT.

(*a*) Master control fuse blown or imperfect.
(*b*) Grounded train cable.
(*c*) Poor contact in master controller.
(*d*) Loose train cable jumper.

Third—DEFECT IN MOTOR CONTROL CIRCUIT.

(*a*) Circuit breakers open.
(*b*) Bus fuses blown.

(*c*) Loose or disconnected bus jumper.
(*d*) Main fuse blown.
(*e*) Shoe or trolley fuses blown.

Fourth—FAILURE OF BRAKES TO RELEASE.

(*a*) Hand brakes set.
(*b*) Brake rigging fouled.
(*c*) Brake shoe caught or frozen on flange.
(*d*) Failure of air brake to release.

FAILURE OF POWER.

109. A FAILURE OF POWER can be detected by closing the lighting switches; if lights burn, power is on.

DEFECT IN MASTER CONTROL CIRCUIT.

110. TO DETERMINE IF MASTER CONTROL CIRCUIT IS OPEN turn master controller handle to the first notch and open the master controller switch. The noise of slight arcing indicates that the master control circuit is closed and that the trouble is elsewhere. No arcing shows that the master control circuit is open and indicates that fuse is blown or imperfect. A black or charred spot in the center of the label, called a "Tell-tale," indicates that the fuse is blown and should be replaced. A fuse which shows no indication of being blown should be tested to detect faulty construction by removing a fuse from a lighting circuit and inserting the fuse to be tested. The lights burning indicate that the fuse is good, and it can then be replaced.

III. To Determine if Train Cable is Grounded operate the master controller. If the master control fuse blows, it indicates that one or more wires of the train cable are in contact with the ground, and the cable is said to be "grounded."

To locate a ground in the train cable, disconnect train cable on operating car from rest of train by removing train cable jumper from its socket on second car. If the fuse now blows, when the controller handle is operated, it indicates that the ground is either in the operating car or its train cable jumper.

To determine whether ground is in train cable or jumper, remove the jumper. If the fuse blows when the controller is operated, the ground is in the car. If it does not blow, the ground is in the jumper, and a new one should be inserted. If the fuse does not blow when the jumper is disconnected from the second car, the jumper should be replaced, and the one between the second and third car disconnected from its socket on the third car, and so on until the fault is located.

If the fault is found to be caused by a defective jumper, and if the train is not provided with an extra jumper, the jumper between the last two cars of the train should be taken to replace the defective one.

If the fault is found to be on the car and not in the jumpers, the seven-point control cut-out switch on that car should be turned to the "Off" position, and the test repeated. If the fuse still blows when the handle is operated the fault is in the train cable. If the fuse

does not blow, the ground is between the cut-out switch and the contactors, reverser and circuit breaker. If this is the case, the cut-out switch on the defective car should remain in the "OFF" position, thus cutting out the fault as well as rendering that car inoperative, but in no way interfering with the train cable, and permitting the operation of other cars in the train, through the train cable in the usual manner.

If opening the cut-out switch does not remove the fault, that is, if the fault is in the train cable and the defective car is near the rear end, the train should be operated from the front car as usual, the defective car and those following being cut out by removing both train cable jumpers on that car; if at or near the head of the train, the train should be run under the rules prescribed by the Division Superintendent.

112. TO DETECT POOR CONTACT IN MASTER CONTROLLER, open the master controller switch, remove the cover from the controller and turn the handle slowly, noting if each finger makes good contact with the drum. If any contact is poor and cannot readily be readjusted by the motorman, he should run the train under the rules prescribed by the Division Superintendent.

113. TO DETECT LOOSE TRAIN CABLE JUMPER, the trainmen should note if the contactors on each car are working while the train is accelerating. If there is a loose train cable jumper, all cars ahead of the jumper will operate; others will not. The motorman should be immediately informed if any car is not operating.

Insert in Instruction Book No. 131 over corresponding page 65.

DEFECT IN MOTOR CONTROL CIRCUIT.

114. IF ONE OR MORE CIRCUIT BREAKERS OF A TRAIN BLOW when starting or running, return the controller handle to the "OFF" position and move the handle of the circuit breaker switch to the "ON" position. If the circuit breakers again blow when the controller handle is operated, the brakes should be examined to see if they are released.

If the circuit breaker on any car repeatedly blows, an examination should be made to see that it is properly adjusted. If the trouble is not with the circuit breaker, the car should be cut out by opening the seven-point cut-out switch on the switchboard and the main switch beneath the car.

Blowing of the circuit breaker is accompanied by a loud report.

115. AN OPEN CIRCUIT IN BUS LINE may be detected when the train is at a crossing and current cannot be obtained on operating car, although other cars of the train have current. This indicates that the bus line fuse or fuses are blown, or that a bus line jumper is loose or disconnected between the operating and adjacent cars.

The motorman should inspect the bus line jumpers, and if trouble cannot be quickly remedied, he should go back to the first car having current and move the train over the crossing. The motorman should then return to the first car and proceed in the usual manner.

116. WHEN THE MAIN FUSE IS BLOWN, the motors will not operate, although the contactors may be in working order and the circuit breaker closed. This should occur very seldom, as it can only be caused by short circuit or grounding in the motors or motor circuits, which are usually protected by the quicker acting circuit breaker. This fuse should not be replaced on the road except to avoid serious delay to the service, as in the case of single cars. BEFORE RENEWING MAIN FUSE, OPEN THE MAIN SWITCH.

117. A SHOE FUSE MAY BLOW from short circuit, grounding of the car wiring on some part of the car or truck, or may be caused by a contact shoe on the car or train grounding, due either to being broken or from fouling or picking up something along the line. If it is necessary to replace a shoe fuse on the road so as to prevent delay to service, the motorman should open the third rail switch on the switchboard and insert the wooden paddles, provided for that purpose, between all shoes on that car that are in contact with the third rail.

118. A TROLLEY FUSE MAY BLOW from short circuit or grounding of the car wiring on the car or truck or because it has been overloaded by running in a train with other trolleys down and taking current for the whole train through the one fuse. If this latter has been the cause, the fuse should be replaced on the road if it is required to prevent delay to service. Before replacing the fuse, pull down the trolley and open the trolley switch on that car.

FAILURE OF BRAKES TO RELEASE.

119. To Determine if Hand Brakes Are Set, examine carefully and see that brake staff chain is fully unwound.

120. To Determine if Brake Rigging is Fouled, examine brake levers and rods to see that they are entirely free.

121. To Detect a Brake Shoe Caught or Frozen on Flange, examine all brake shoes carefully. If trouble is not readily located, a member of the crew should stand beside the train while it is moved slowly, and note if all the wheels revolve.

122. If Air Brakes Fail to Release, note if proper pressure is obtained in main reservoir and brake pipe, and if so, proceed as in paragraph No. 44. If proper pressure is not obtained, place handle of brake valve in lap position. If the black pointer falls, it denotes a leaky brake pipe, which includes emergency air brake attachment and pilot valve. The emergency air brake attachment can be cut out by the cut out cock located beneath the platform and the pilot valve can be cut out by the cut out cock in Motorman's cab. If the red pointer falls, it denotes a leaky main reservoir or pipe connection, which includes control pipe and pipe leading to alarm whistle.

INSTRUCTIONS FOR THE OPERATION OF ELECTRIC HEATERS.

123. HEATER SWITCHES, MARKED HEATER NO. 1 AND HEATER NO. 2, RESPECTIVELY, are located in the upper left-hand corner of the switchboard. These switches are of the single-pole knife-blade type, and, in the case of the early type of cars with wooden fronts, control the heating of the entire car, including the motorman's compartments. The heating of the motorman's compartments in the later type of steel front cars is controlled independently, connection being made for the circuit in the main switch box, where a five (5) ampere fuse for protecting the compartment heating circuit is installed. The heaters in the motorman's compartments of all cars are in every case controlled by means of a switch located within the compartment.

124. EACH HEATER IS COMPOSED OF ONE SMALL AND ONE LARGE COIL. The small coils of the heaters are energized through heater switch No. 1; the large coils through heater switch No. 2. For minimum heating effect, close heater switch No. 1; for medium heating effect, open heater switch No. 1 and close heater switch No. 2; for maximum heating effect, close heater switches No. 1 and No. 2. The maximum heating effect should be employed in very severe weather only.

125. TRAINMEN SHOULD USE CAREFUL JUDGMENT as to the amount of heating required, handling the

proper switches accordingly. In opening or closing the heater switches, the movement of the switch blade should be rapid so that destructive arcing will not occur at the switch contacts. Trainmen should open heater switches on all cars when approaching terminus of run where they are to leave train.

OPERATION OF EXTRA TENSION DEVICE FOR SLEET SHOES.

126. An Extra Tension Spring is fitted to each third rail sleet shoe, which, when applied, increases the pressure of the shoe upon the third rail from 20 pounds to approximately 100 pounds. Inspectors should see that the extra tension springs of all sleet shoes are applied, when weather conditions make it advisable, before the train leaves the terminal.

127. To Apply Extra Tension Springs, place socket wrench on post on shoe beams and turn the handle of wrench to the right, as shown in Plate No. 41. Plate No. 41 shows the position of spring before being applied, and Plate No. 42 the position of spring when applied.

128. A Special Wrench With Insulated Handle for applying the extra tension springs is carried in the motorman's compartment of all smoking, baggage and combined cars.

INSTRUCTIONS FOR THE OPERATION OF TRAIN SIGNAL SYSTEM.

129. THE TRAIN SIGNAL SYSTEM applied to each motor car is of the electro-pneumatic type, and is operated by current from the third rail or overhead trolley and by air from the control pipe. The signal will not operate when current is off or train is not in contact with the third rail or trolley.

130. THE TRAIN SIGNAL SYSTEM for each motor car consists of the following apparatus:

Two AIR SIGNAL WHISTLES, located one at each end of car in motorman's compartment.

Two MAGNET VALVES, for operating the air signal whistles, located one at each end of car in motorman's compartment.

Two INDICATING SNAP SWITCHES, for opening and closing the circuits to the magnet valves, located one at each end of the car in the motorman's compartment.

One CONDUCTOR'S SWITCH, to which the signal cord is attached, and which controls the operation of the air whistles.

One SUPPLY SNAP SWITCH WITH FUSE, for opening and closing the current supply circuit to the conductor's switch, located on the switchboard in the motorman's compartment.

One SIGNAL CORD, which runs from end to end of car, and which, when pulled, operates the conductor's switch.

131. THE NORMAL POSITION OF THE INDICATING SWITCH, at the north end of each car, is "ON," while the switch at the opposite end of car is "OFF," except on south-bound trains, when the motorman should turn the switch "ON" in his compartment so as to receive the signal. Upon arrival at the terminal with south-bound train, the motorman should turn the switch to "OFF" position.

132. TO SIGNAL MOTORMAN, pull signal cord down and release quickly.

133. TO TEST SIGNAL, which must be done before leaving the terminal, the car inspector or brakeman should signal the motorman from the rear car of the train when the brakes are being tested. This will insure that all train cable jumpers are in place and that the signal system is in working order.

134. INSPECTORS SHOULD OBSERVE whether signal cord is of the proper length, so that the conductor's switch may open far enough to break the arc at the contacts when the cord is released.

135. WIRE NO. 6 OF THE TRAIN CABLE, which was formerly used for opening circuit breakers, is now used exclusively for the operation of the train signal.

In Case Whistle Blows When Controller or Circuit Breaker Switch is Operated, examine train for short-circuited train cable or train cable jumper as in rule 111.

DETENTION REPORTS

136. Motormen Shall Report at the End of Each Trip all train detentions for that trip on M. P. Blanks 390-F (Page 76), which will be furnished by the Road Foreman of Engines.

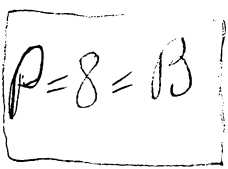
137. Each Report Shall Be Made Out in Duplicate and the original (white sheet) handed to the inspector, who will meet the train upon its arrival at the terminal. The carbon copy (yellow sheet) shall be forwarded to Road Foreman of Engines.

138. All Detentions Due to Failure of Equipment shall be noted in detail, using list printed on cover of M. P. 390-F blank forms as guides, (Page 76), with such information as will aid the inspectors in readily locating the trouble. All detentions over which the motorman has no jurisdiction will not require detailed explanation, but the motorman should note the number of minutes delay, place of detention and state cause.

139. Conductors Shall Report All Defects to Equipment, which do not properly belong to the motorman, on M. P. Blanks 217-A, which should be

obtained from the Train Master. These blanks shall be filled out in accordance with the instructions printed upon their backs and handed to the inspector at the terminals.

140. CONDUCTORS SHALL REPORT ALL TRAIN DETENTIONS PROMPTLY upon arrival at the terminal upon C. T. Blank 15, after consulting with the motorman regarding detentions due to failure of motive power equipment.



LIST OF DEFECTIVE EQUIPMENT FOR USE IN REPORTING TRAIN DETENTIONS.

MASTER CONTROL:
- Control Fuse Blown
- Controller Switch
- Circuit Breaker Switch
- Train Cable
- Train Cable Jumper
- Current Limit Relay
- Potential Relay
- Controller
- Jumps in Series
- Jumps in Parallel
- Slow in Parallel
- Slow in Series

MOTOR CONTROL:
- Main Fuse
- Shoe Fuse
- Trolley Fuse
- Bus Fuse
- Contactors Sticking
- Loose Bus Jumper
- Reverser
- Resistance Grids
- Circuit Breaker
- Bus Line

MOTORS:
- Flash Overs
- Grounded Armature
- Short Circuited Armature
- Open Circuited Armature
- Grounded Field
- Dropped Brush Holder
- Motor Leads
- Motors Cut Out
- Broken Gears
- Loose Gears
- Broken Pinion

HEAD LIGHT:
- Burnt Out
- Fuse Blown

HOT BEARINGS:
- Armature
- Motor Axle
- Journal
- Compresssor Motor

COUPLERS:
- Defective

TRUCK TROUBLES:
- Contact Shoes
- Contact Shoe Beam

TROLLEY:
- Trolley Pole
- Trolley Wheel
- Trolley Rope
- Retriever

AIR BRAKES:
- Compressor Fuse Blown
- Governor Does Not Cut Out
- Brakes Failed to Release
- Brake Rigging
- Defective Hose
- Defective Piping
- Brakes Cut Out
- Emergency Attachment Cut Out
- Feed, Triple, Brake Valves
- Drain Cock

WHISTLE:
- Whistle Out of Order

MISCELLANEOUS:

SPECIMEN REPORT OF DEFECTS AND TRAIN DETENTIONS.

M. P. 390-F. 1539. 12-17-08
4 x 7¼

PENNSYLVANIA RAILROAD COMPANY
West Jersey & Seashore Railroad Company
ELECTRIC TRAIN SERVICE
MOTORMAN'S REPORT OF DEFECTS AND TRAIN DETENTIONS.

This Copy to Inspector at Terminal

Date Aug. 10, 1910 Train No. 1144
Total Length of Detention 13 Time Made Up. 3
Conductor Brown Motorman Smith

Car No.	Minutes	Place of Detention	Cause of Detention
6764			Gauge light burned out
6718			
6779	5	Newfield to Camden	Dead Car
6755			
6421			
	5	Newfield	Red Block
	3	Woodbury	Loading Baggage
No. 11	Contac	tor stuck car 67	79

MOTORMEN shall report in duplicate ALL train detentions at the end of each trip. If any are due to failure of equipment he shall make proper note of same, using list printed on cover as guide. If there are no detentions or defects to report, mark blank "O. K."

INSPECTORS on receiving these reports will examine the equipment in question and will either endorse his approval of the motorman's report or accompany same with a more complete account of the defect or defects found, forwarding same to the Foreman of Electric Cars at Camden.

NOTE—Motormen should place car numbers consecutively on the above report in the order in which they stand in the train, reporting any defect opposite the car number.

GENERAL DIRECTIONS.

141. When Trains Are Taking Power from the Trolley Wire, each car must have one pole up, so that trolley wheels and bus line shall not be damaged by excessive current.

142. Motormen, When Changing from Third Rail to Trolley, must not turn power on until they receive the signal denoting that the trolley poles are up. This signal consists of one blast of the train signal whistle.

143. Retrievers Are Located at Each End of All Cars for automatically pulling down the pole in case the trolley wheel leaves the wire.

144. All Trolley Poles Not in Use must be secured under the hooks on the roofs of cars. Conductors will be held responsible for the observance of this rule.

145. The Trap and Side Doors of Vestibule Cars on the third rail side of all trains must be kept closed. On express trains, the doors on the station side of the train, in addition, must be kept closed between stations; on local trains these doors must be kept closed as far as possible.

146. To Prevent Tampering With the Controllers and Air Brake Apparatus, the doors designed for their protection must be locked. The only persons authorized to open these doors are motormen and terminal inspectors.

147. To Cut Off a Car from a Train, unhook the safety chains between the cars, open heater switches on cars to be cut off, disconnect the bus lines and afterward the air hose. The safety chains must always be hooked in position between all cars on the train and across the rear vestibule at end of train.

148. In Case of Fire Beneath Any Car, the train should be stopped and the power cut off by inserting the wooden paddles between the third rail shoes of all cars and the third rail, or by pulling down the trolley poles. The trouble should then be located and the defective circuit cut out. The train should then proceed.

149. If Smoke or Fire is Observed by the trainmen in any of the lighting or heater circuits within the car, they should IMMEDIATELY open the switch controlling the circuit, and extinguish the fire with sand or with the fire extinguisher.

150. Unusual Noises in train movement should at once be located. To avoid delay the conductor or brakeman should stand beside the train while it is moved slowly. If noise is caused by brake rigging, the same should be tied up; if the noise is located within the motors, the motors should be cut out by opening the seven-point cut-out switch on that car.

151. A Broken Third Rail Shoe or shoe support should be broken completely off or tied up, whichever, in the judgment of the motorman, will cause the least

delay. In either case, open the third rail switch on switchboard and insert wooden paddles between third rail and all contact shoes on the car. To break off remainder of shoe, use some tool with a wooden handle, as a hammer or ax. NEVER USE A CROWBAR FOR THIS PURPOSE. A hammer and other tools are located in a sealed box over the salon of all smoking cars.

152. TO STOP TRAIN WHEN AIR BRAKES FAIL, turn controller to first notch in reverse position. THIS SHOULD ONLY BE DONE IN CASE OF EMERGENCY AND TO AVOID ACCIDENTS.

153. CAUTION—Employes should exercise extreme care while working about or on car wiring. The switch controlling the circuit on which work is being done should always be open.

RESUSCITATION FROM APPARENT DEATH FROM ELECTRIC SHOCK.

The increasing use of electricity about the shops, stations and other property of the Pennsylvania Railroad, makes it necessary that employes be qualified to render intelligent assistance in case of electrical accidents. To this end employes should be instructed in the approved methods of resuscitation of those apparently dead from shock and in the methods to be followed for the safe recovery of bodies in contact with live wires or third rails.

Prompt and intelligently directed efforts are necessary for successful results in the removal of the body from contact with live wires or third rails and in resuscitation from electric shock. It is important, therefore, that some one thoroughly familiar with all of the precautions to be observed should be on hand to take charge of and direct the operations. While promptness is essential, undue haste is to be condemned, and the person in charge should select from those about the ones who are most apt to remain cool in such an emergency and who can be depended upon to give the most intelligent assistance. A physician should be sent for immediately and the case put in his care upon his arrival. The arrival of the physician, however, should not delay efforts at resuscitation.

Electric shocks may not result in death if proper assistance is rendered promptly. In the majority of cases the shock is only sufficient to temporarily suspend animation; it is vitally important, however, that this state be not allowed to continue, so efforts toward resuscitation should be started immediately. If results are not apparent in a short time, this should not cause discouragement, as cases are on record where resuscitation has been accomplished after several hours.

RECOVERY OF BODIES FROM LIVE WIRES OR THIRD RAILS.

Remove the body from contact with live wires or third rails, using a dry stick of wood, such as a shoe paddle, broom handle, pike pole or ladder, for holding

the wires out of contact with the body while another person drags the body away. The live wire may be safely lifted from the body by the use of a coat or rope, which may be thrown under the wire and lifted by two persons, one standing on either side of the wire and grasping the sleeve or end of the rope so as to be safe from contact with the wire. If the body should be entangled in wires in such a manner as to render recovery by these methods difficult or impossible, the wires should be cut with an ax or by cutting pliers having long insulated handles. In case the ground or clothing on the body is wet, a dry piece of wood should be used to stand upon while removing the body.

RESUSCITATION.

The body being free from contact with wires, artificial respiration should be started immediately. If the patient can be made to breathe and continue breathing the major part of resuscitation is accomplished and recovery practically assured. A physician only may administer stimulants, and THIS SHOULD NOT IN ANY CASE BE ATTEMPTED BY OTHER PERSONS. The patient should first be removed, if necessary, to the nearest convenient spot away from crowds and where fresh air is abundant.

If the accident happens while on the road or between stations, the patient should be moved to the baggage car, all doors and ventilators of which should be opened to admit fresh air. Artificial respiration

should then be started. Upon the arrival of the train at the first station where a physician is at hand the patient should be turned over to him, together with such assistance as he may require to continue artificial respiration. Artificial respiration should not be discontinued for the purpose of carrying the patient any considerable distance upon removal from the train.

Artificial respiration should proceed as follows: Remove the patient's coat and vest and loosen the remaining clothing at the neck and waist. Place him on his back with a folded coat under his shoulders, so as to elevate the chest and lower the head (Plate No. 43). Open the mouth, using some implement as a pocket knife handle, stick of wood, etc., if necessary, and insert fingers to remove saliva, tobacco, false teeth or other matter which might gag the throat.

Kneel or stand at the patient's head facing toward his feet, grasp both arms at a point about midway between elbows and wrists and bring them in a rather wide sweep (Plate No. 44) out from the patient's side and toward you as far as they will reach over the head until they meet (Plate No. 45). This will cause the chest to expand and air to enter the lungs, or, in other words, produce inspiration. Hold the arms extended over the head for about two seconds, and then without relaxing the hold bring them down in a straight line to the lower front of the chest, firmly compressing the chest walls, to expel the air drawn in by the first movement, or to produce expiration (Plate No. 46). Hold the arms in the last posi-

tion about two seconds, using firm pressure. The above manoeuvers should be repeated at a rate of about twelve to fifteen times per minute and continued for at least three hours or until complete respiration is accomplished. It is essentially important that the operations performed be rhythmic in order that, once natural breathing is started, the movements may continue to aid the same and not oppose it.

If the operator has no assistance he should commence operations by drawing out the patient's tongue over the lower teeth as far as it will go, securing it in that position by means of a string or elastic band passed under the chin, as shown in Plate No. 43. If help is at hand, however, an assistant should take hold of the tongue by means of a cloth or handkerchief, as shown in Plates Nos. 44, 45 and 46, and pull it out over the lower teeth when the patient's arms are extended over his head, allowing it to recede when the chest wall is compressed. During these operations the under part of the tongue should rub against the lower teeth.

Further aid to resuscitation may be had by applying heat to the body to restore it to its normal temperature. This may be done by rubbing the body and limbs with the hands or some rough material, or by means of hot bricks, taking care that the latter are not too hot. Alternate applications of heat and cold over the region of the heart will sometimes produce a gasp and start breathing. The dashing of cold water in the face will accomplish the same object in some instances; care must be taken, however, not to get water

in the mouth. The spine may also be rubbed vigorously with a piece of ice. Efforts at artificial respiration should not be discontinued for these purposes, however.

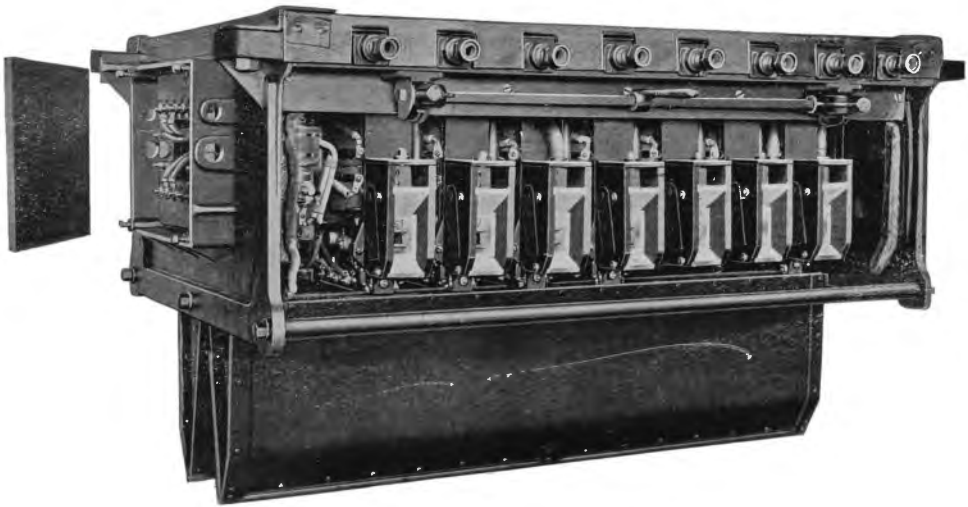
It is absolutely essential, in order to gain efficient results from the above operations, that some one person take charge and direct the work, the others carrying out his instructions. If possible, the men should work in relays at the movements, and constant care should be exercised to insure that, once the patient starts to breathe, the movements be carried on so as to assist him in his natural respiration.

While the above instructions may readily be comprehended, past experience has shown that instructions and even demonstrations on the part of others are not sufficient in themselves to sharply fix the details of the operations in the mind. Actual practice in the movements is necessary to insure a correct understanding of the ends desired and the proper way to attain them. It is necessary for those who desire to be proficient along this line to go through the manipulations from time to time as both patient and operator. In moments of emergency they will then be prepared to proceed without the necessity of reviewing these instructions, thereby saving valuable time.

PLATE No. 19.

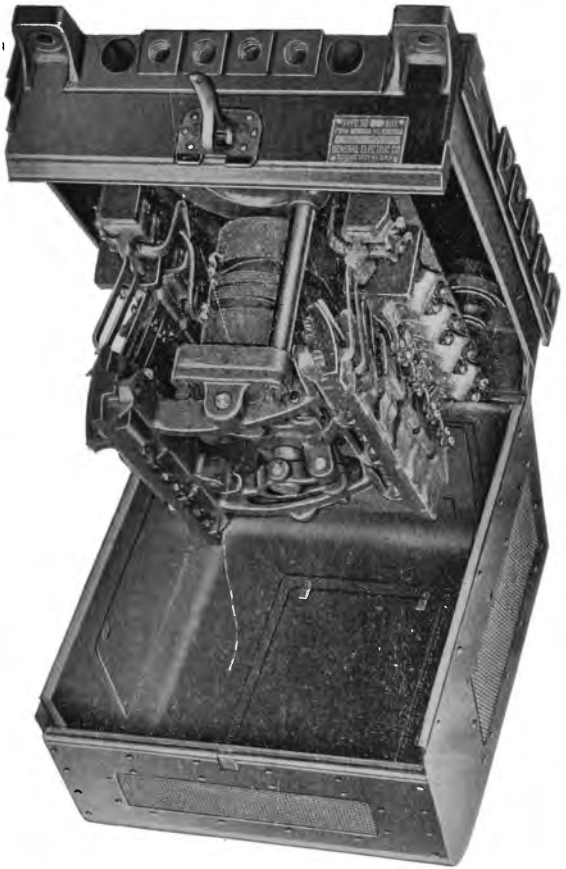
CONTACTOR.

PLATE No. 20.



CONTACTOR BOX.

PLATE No. 21.

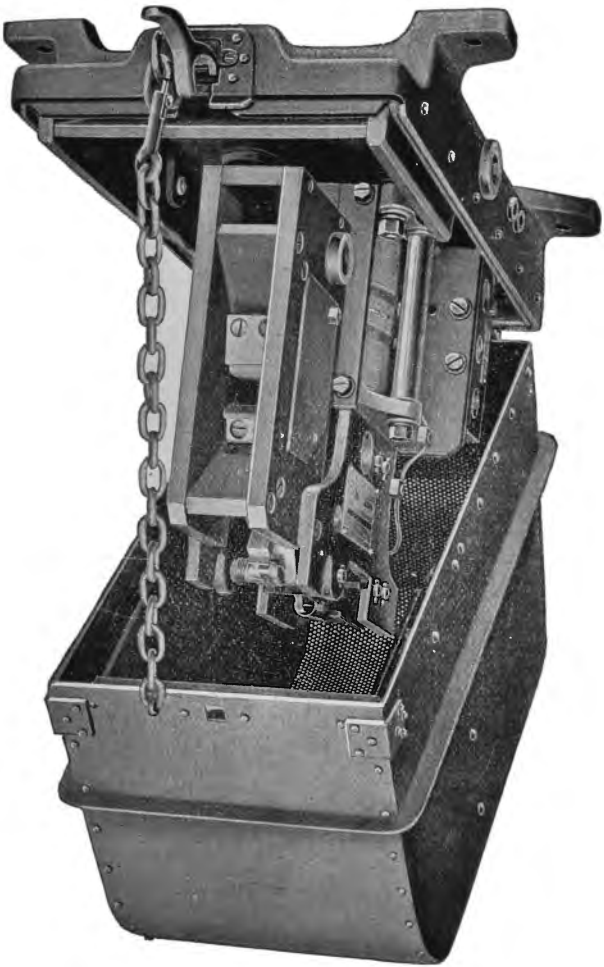


REVERSER.

PLATE No. 22.

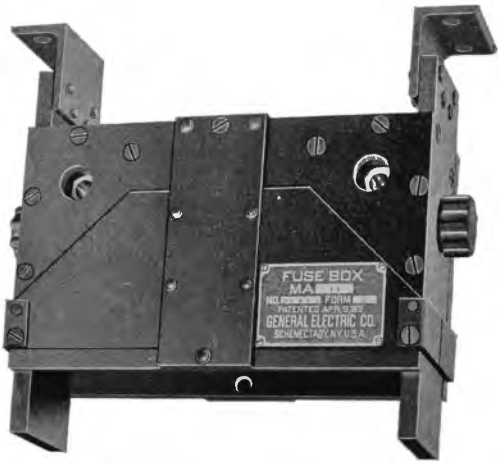
RESISTANCE.

PLATE No. 23.



CIRCUIT BREAKER.

PLATE No. 24.



MAIN FUSE.

PLATE No. 25.

MAIN SWITCH.

PLATE No. 26.

BUS LINE COUPLER SOCKET.

PLATE No. 27.

BUS LINE JUMPER.

PLATE No. 28.

MASTER CONTROLLER.

PLATE No. 29.

MASTER CONTROLLER SWITCH.

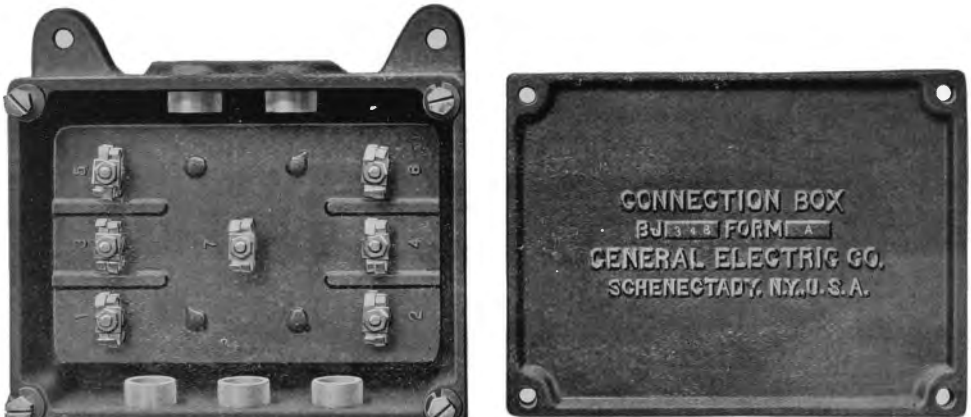
PLATE No. 30.

TRAIN CABLE COUPLER SOCKET.

PLATE No. 31.

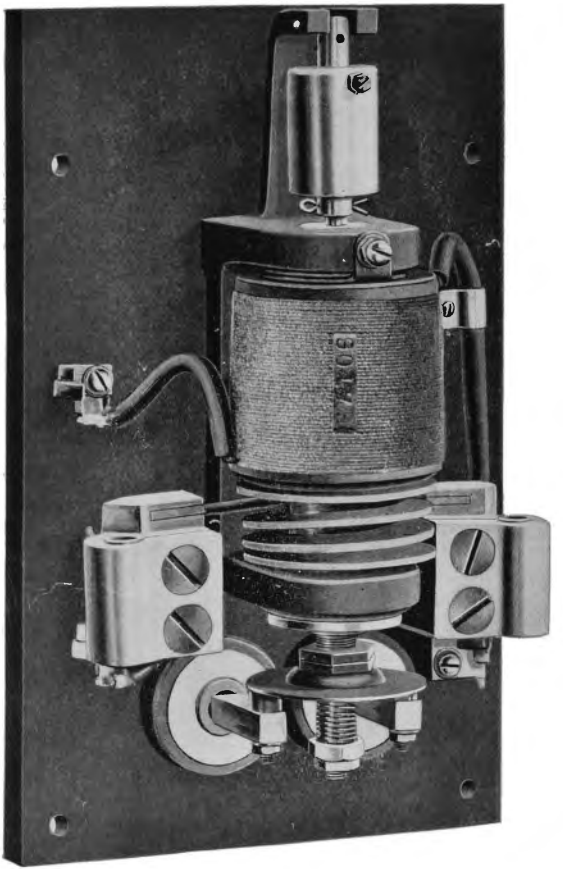
TRAIN CABLE JUMPER.

PLATE No. 32.



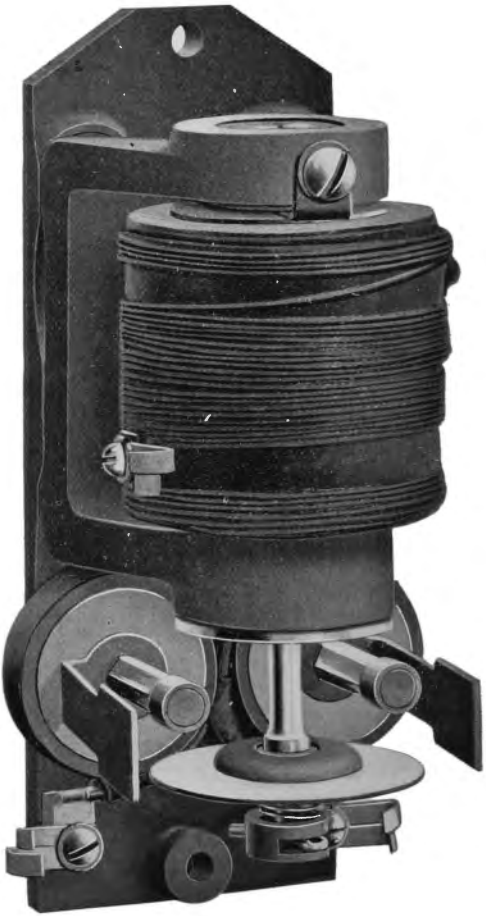
TRAIN CABLE CONNECTION BOX.

PLATE No. 33.



CURRENT LIMIT RELAY.

PLATE No. 34.



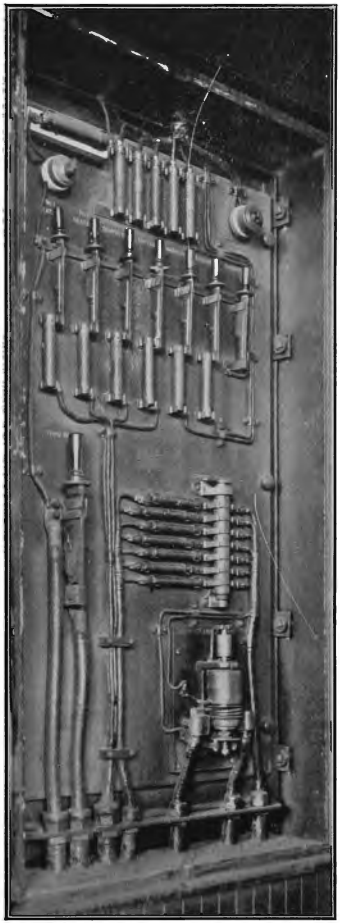
POTENTIAL RELAY.

PLATE No. 35.

CIRCUIT BREAKER CLOSING SWITCH.

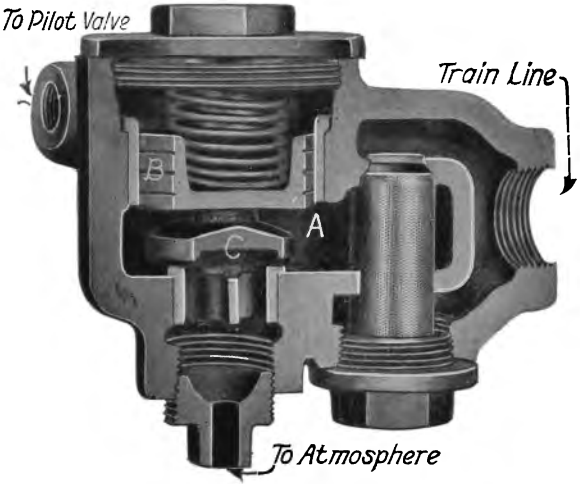
NOTE—This switch was originally used to both close and open the circuit breakers but is used at present to close circuit breakers only.

PLATE NO. 36.



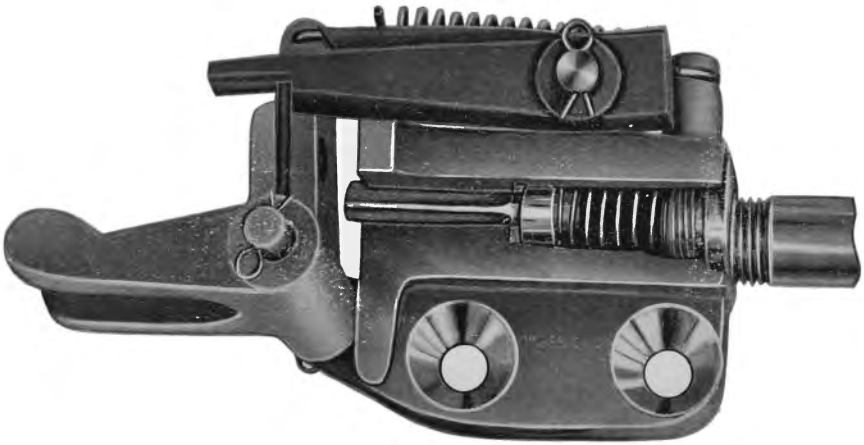
SWITCHBOARD.

PLATE No. 37.



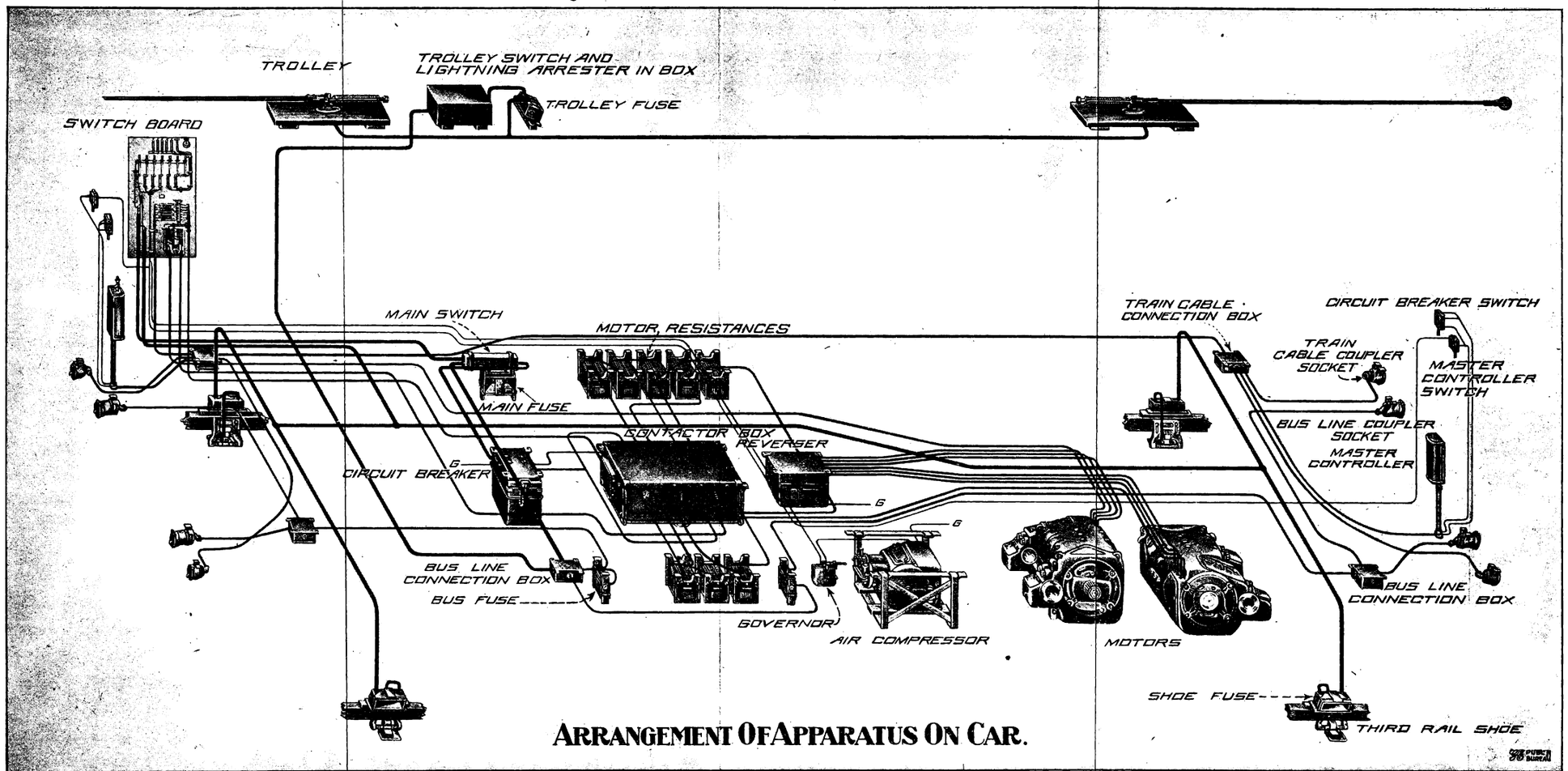
MAIN VALVE.
EMERGENCY AIR BRAKE ATTACHMENT.

PLATE No. 38.



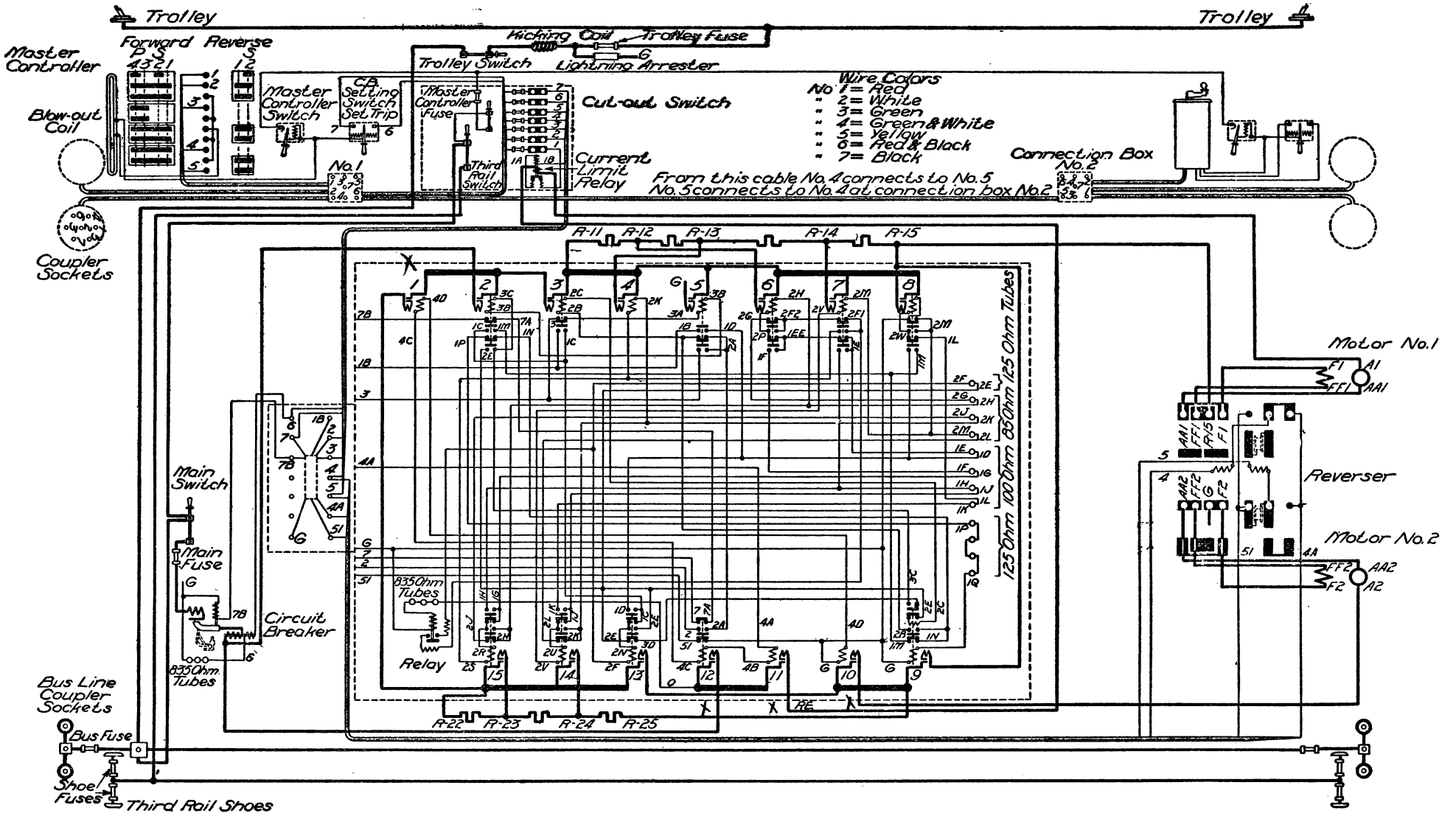
PILOT VALVE.
EMERGENCY AIR BRAKE ATTACHMENT.

PLATE No. 39.



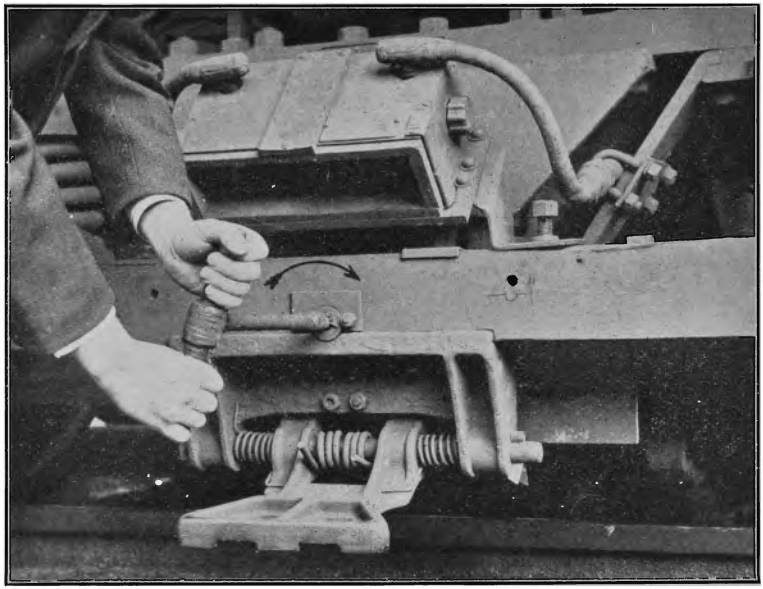
ARRANGEMENT OF APPARATUS ON CAR.

PLATE No. 40.



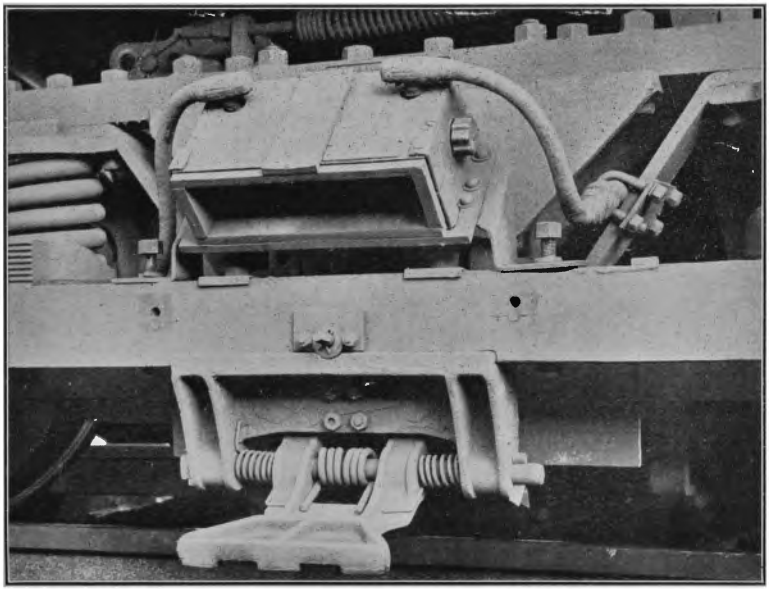
WIRING DIAGRAM.

PLATE No. 41.



EXTRA TENSION SLEET DEVICE
Showing Position of Extra Tension Spring Before Being Applied.

PLATE No. 42.



EXTRA TENSION SLEET DEVICE,
Showing Position of Extra Tension Spring After Being Applied.

PLATE No. 43.

"RESUSCITATION FROM ELECTRIC SHOCK."

PLATE No. 44.

"RESUSCITATION FROM ELECTRIC SHOCK."

PLATE No. 45.

"RESUSCITATION FROM ELECTRIC SHOCK."

PLATE No. 46.

"RESUSCITATION FROM ELECTRIC SHOCK."