Section 2 Theory of Operation

2.1 Loaded car moves over trestle or pit.

2.2 Extended third rail pickup shoe on car body engages a third rail.

2.3 A 24 Volt signal is sent through the third rail and the pickup shoe.

2.4 The signal goes from the pickup shoe to the electrically actuated control valve.

2.5 As the valve is actuated, it sends air to the air drive cylinder.

2.6 As the cylinder extends, it actuates the main lever.

2.7 As the main lever rotates about the center point, the bottom of the lever pushes the operating beam in a linear direction.

2.8 As the operating beam moves, it pushes the door mechanism tri-lever over center, which unlocks and opens the mechanism and doors. This is done sequentially, pocket to pocket.

2.9 Some systems are designed to operate manually only. Their operating process is described as follows. Automatic systems may also be operated manually.

2.9.1 Make sure the train has come to a complete stop.

2.9.2 Locate the control valve or Mini I Valves / manual levers (manual doors).

2.9.3 Instruct anyone near the car to **STAND CLEAR.**

2.9.4 **Caution -** The operator must stand clear of door operating cylinder when manually opening or closing doors. Protective eyewear and hearing protection are required.

2.9.5 Depress the button or move the manual lever to the “OPEN” position.

2.9.6 When car has completely unloaded, depress the button on the opposite end of the control valve, Mini I Valves or rotate the manual lever, and doors will close.

2.10 As you can see, the door operating system has two subsystems on cars equipped with manual operation doors (no electrical) and three subsystems on cars equipped with fully automatic doors; these are the pneumatic system, the electric control system and the door operating mechanism.

2.11 Air is introduced to the system through the auxiliary trainline. From there it passes through the filter and into the "pressure" port of the control valve sub-base. The piston-actuated slide valve provides two-position operation of the air drive cylinder. The valve has a ported sub-base, which is piped to the air drive cylinder. Changes in airflow through the valve occur when the piston is moved from one end of the valve to the other. A slide valve attached at the center of the piston moves along the surface of the sub-base and connects airflow to the cylinder and exhaust ports of the sub-base. The piston stops at full travel against the cap at each end of the body. The caps have ports through which shifting pressure from the solenoid operators is delivered to the piston. The cap end designated "M" contains a steel piston stop piece. When the piston magnet (located on the "M" end of the valve body) contacts this stop, a magnetic detent is established to hold the piston in the "closed gate" position when shift pressure is removed.

2.12 The electrical signal is received through the pick up shoes, which are mounted on diagonally opposite sides of the hopper car. The signal is carried through a diode switch circuit, which is located in the control valve. When a positive (+) 24 Volt D.C. signal is received through the shoe with the running rails negative (-) the control valve is energized causing the valve slide to shift and in turn allows air to flow to the door-opening side of the cylinder. When a negative (-) 24 volt signal is received through the shoe with the running rail positive (+) the control valve is energized causing the valve to shift and in turn allows air to flow to the door-closing side of the cylinder.

2.13 The door operating mechanism is powered by a double acting air cylinder, which unlocks and opens the doors when its rod is extended. It closes and locks the doors when the rod is retracted. This is accomplished through the use of a mechanical linkage system, which operates as described in steps 2.6, 2.7, 2.8 above.