

resistance of this rheostat, depends on the quantity of liquid which is forced and regulated into it by compressed air. When the liquid has reached a certain height an automatic arrangement short circuits the rotor windings. With the motors in concatenation the speed is approximately twenty miles an hour. It is well to mention here that before a start is made the controller is placed in position with the motors in concatenation before the primary switch D is made, throwing the 3,000 volt on the primary motors stator windings.

To obtain full speed, that is forty miles an hour, the primary switch D is opened, the controller is placed on third notch, cutting the low tension motors out of circuit and connecting the liquid rheostat to the rotor of the primary motors, the high tension switch is then closed, the primary motors are then alone in circuit. This method of control is very similar to the ordinary series-parallel control.

Fig. 3 gives a general idea of the construction of the 300 volt reversing switch. It consists of six copper plungers, which, when lowered, fit into an equal number of copper cylinders, by rotating the switch through sixty degrees the connections of the phases are changed, thus reversing the direction of rotation of the motors. This switch is operated from the end platforms by compressed air or if this fails, by hand.

The controller shown in Fig. 4 has only three points.

First point : Rotor of primary motors open circuited.

Second point : Concatenation control.

Third point : Secondary motors out of circuit and the liquid rheostat connected to the rotor of the primary motors.

This controller is operated by hand as the voltage on it does not exceed 300 volts. Freight trains are hauled by electric locomotives.

Fig. 5 gives a general view of these. They weigh 40 tons and are capable of hauling a 250 ton train on a 2% grade at a speed of 20 miles an hour. The body of these locomotives is mounted upon two four-wheel trucks and upon each of the four axles a motor is directly mounted, no gearing being used. Concatenation control is not used in these, the four motors are high tension motors and rheostatic control in the rotor circuit is employed.

Great difficulty was at first experienced in working an overhead trolley circuit with two wires under 3,000 volt pressure between wires, the third phase wire being the track. The trolley wire in size is equivalent to our No. O. B. & S.; these wires are placed 2' 9"