CUTLER-HAMMER AUTOMATIC DC MOTOR STARTERS
DESCRIPTION

1. GENERAL

1.1 Cutler-Hammer automatic DC motor starters may be used with motors ranging in size from 1/4 HP to 7.5 HP where automatic or remote control is desired.

Starters of this type permit a smooth start of the associated motor due to the time limit method of acceleration regardless of load conditions. With a given setting of the dash-pot, the resistor is always cut out of the circuit in approximately the same period of time.

Bell System Practice Section 026-390-701 gives the installation and maintenance requirements for these starters.

1.2 Section 2 describes the starters and will be called ***"Description"***.

1.3 Section 3 describes the operation of the starters and will be called ***"Operation"***.

1.4 Section 4 describes the various conditions which may interfere with the proper operation of the starters and will be called ***"General Troubles"***.

1.5 The following figures are attached to and form a part of this section.

Figure 1 — Schematic Power Circuit for Cutler-Hammer DC Motor Starters. Automatic Control

Figure 2 — Schematic Power Circuit for Cutler-Hammer DC Motor Starters. Remote Control

Figure 3 — Auxiliary Relay for Cutler-Hammer DC Motor Starters. Automatic Control

2. DESCRIPTION

2.1 ***Mounting:*** The motor starter is mounted on a small slate panel. Each starter has an associated resistance with internal connections mounted in the rear of the panel and enclosed in a perforated sheet metal cover. In some instances an auxiliary relay with associated connections for controlling the starter from a separate circuit is also included in the equipment. Each unit is controlled by an automatic or remote control switch and is mounted either on the wall or on the rear of a panel in the regular power board lineup.

2.2 ***Stationary Contacts:*** The stationary contacts consist of hexagonal copper nuts screwed onto studs mounted on the face of the panel. They are easily removed if necessary (without disturbing the connections at the rear of the slate panel) but should last indefinitely with little or no attention.

2.3 ***Contact Fingers and Support:*** The contact fingers are metal punchings equipped with copper contacts which may be replaced if the contacts become rough or badly burned.

The support is a metal punching which holds the fingers in the proper position at all times, insuring their closing in the proper sequence during the operation of the motor starter.

2.4 ***Coil:*** The motor starter solenoid coil is clamped in an iron mounting frame and equipped with two screw terminals serving as connections for the coil.

2.5 ***Dash-Pot:*** Each starter is provided with a dash-pot to delay its closing action. Either oil or air may be employed as the delaying agent but the two cannot be used interchangeably.

2.51 ***Oil Dash-Pot:*** In this type of dash-pot the timing element consists of a cast iron chamber into which is fitted a cast brass piston with a clearance of a few thousandths of an inch, a needle valve, by-pass, and connecting port. The piston is equipped with a poppet valve arrangement for quick resetting. Variation in

the upward speed of the piston controlling the operation of the contact fingers is accomplished by adjusting the needle valve.

2.52 ***Air Dash-Pot:*** The starter can be furnished with an air dash-pot into which is fitted a piston made up of two pliable and air-tight leather diaphragms held in place by metal plates or washers instead of the cast brass piston. The other details are similar to the oil dash-pot.

2.6 ***Connections:*** Schematic wiring diagrams for these starters are shown in Figures 1 and 2 attached. All connections excepting those to the outside service, to the motor and to the remote control or automatic switches, are made at the factory by the manufacturer. External connections are made in accordance with drawings for the particular installation.

2.7 ***Accessories***

2.71 ***Auxiliary Relay:*** An auxiliary relay for controlling the starter from a separate source (usually the 24 or 48 volt battery) is sometimes incorporated in the motor starter circuit.

Refer to Fig. 3. The relay is made up of a single magnet coil (8) and two normally open contacts (6). The armature (5) (pivoted at (4)) of the relay is so connected to the contacts (through the moving contact support (1) and cross bar (2) pivoted at (3)) that when the relay coil (8) is energized both contacts (6) are closed simultaneously.

A spring (7) opens the relay when the magnet coil (8) is deenergized.

2.72 ***Resistance:*** Where the auxiliary relay is provided, a resistance is connected in the relay magnet coil circuit in order to limit the short-circuit current which otherwise would be present when the stop switch is operated and the magnet coil shunted out.

2.8 ***Theory of Operation***

2.81 ***General:*** The wiring (remote control) is so arranged that the coil of the motor starter is energized directly upon the closing of a switch (See Fig. 2). The starter in operating connects the associated motor across the power supply in series with the starting resistance, portions of which are automatically and successively shunted with the closing of each finger.

In addition to the above where an auxiliary relay is used for controlling the starter (automatic control), the coil of the auxiliary relay is energized from a low voltage supply by the operation of an automatic control switch, thereby causing the relay to operate and close its contacts (See Fig. 1). One contact in closing, completes a holding circuit for the relay itself. The other contact completes the motor starter solenoid circuit, thereby energizing the motor starter solenoid coil and closing the contact fingers under the control of the dash-pot.

The motor is stopped by opening the double-throw switch or in the case of automatic control by shunting the coil of the auxiliary relay, thereby permitting the relay contacts to open and interrupt the coil circuit of the motor starter. This disconnects the motor from the power supply. During the time the coil of the auxiliary relay is shunted, and until such time as the opening of the relay opens the coil circuit, the associated resistance limits the high circulating current which otherwise would be present and prevents the tripping of circuit breakers or the blowing of fuses in the circuit.

2.82 ***Oil Dash-Pot:*** As the motor starter solenoid coil is energized the piston immediately pulls up a sufficient amount to close the first contact finger. Further movement of the piston, however, is retarded by the partial vacuum beneath the piston. The normal air pressure above the piston forces the oil through the port and past the needle valve to the under side of the piston. The speed with which the piston travels upward is governed by the rate of oil flow, which in turn is regulated by the adjustment of the needle valve. As the piston travels upward the remaining fingers of the starter are closed in succession shunting out consecutive portions of the starting resistance.

The oil piston has a poppet valve which acts as a quick release when the motor starter coil circuit is opened.

2.83 ***Air Dash-Pot:*** The action of the air dash-pot is similar in all respects to the action of the oil dash-pot except that the cushioning

effect is accomplished by air instead of oil. The rate of acceleration may be adjusted in the same manner as the oil dash-pot type. The air piston is not provided with a poppet valve for quick release but the same result is secured by the air passing around the edge of the leather diaphragm on the downward movement of the piston.

3. OPERATION

3.1 The operation of the motor starter upon the closing or opening of the starting circuit (either manual or automatic) is entirely automatic and no further attention is required of the attendant.

4. GENERAL TROUBLES

4.1 The operation of the Cutler-Hammer DC motor starter being entirely automatic upon the closing or opening of the starting circuit (either manual or automatic), unsatisfactory operation (eliminating minor mechanical difficulties) will usually be caused only by an open circuit, failure of the contacts or gummed or caked oil in the dash-pot.

4.2 Failure of the starter to operate may be due to:

CAUSE	REMEDY
1. No Voltage	— Check Service
2. "Open" Fuses	— Replace
3. Loose Connections	— Check Wiring
4. Rough Contacts or Contacts not properly aligned	— Clean, smooth, adjust or replace as required
5. Coil "open"	— Replace
6. Resistance "open"	— Replace
7. Dash-Pot Piston sticking	—Air Type — Clean and Oil Oil Type — Clean and refill Dash-Pot with fresh oil.

4.3 Incorrect Operation of Starter.

CAUSE	REMEDY
1. Needle Valve open too far	— Adjust
2. Dirt under Poppet Valve	— Oil Type — Clean and refill Dash-Pot with fresh oil.

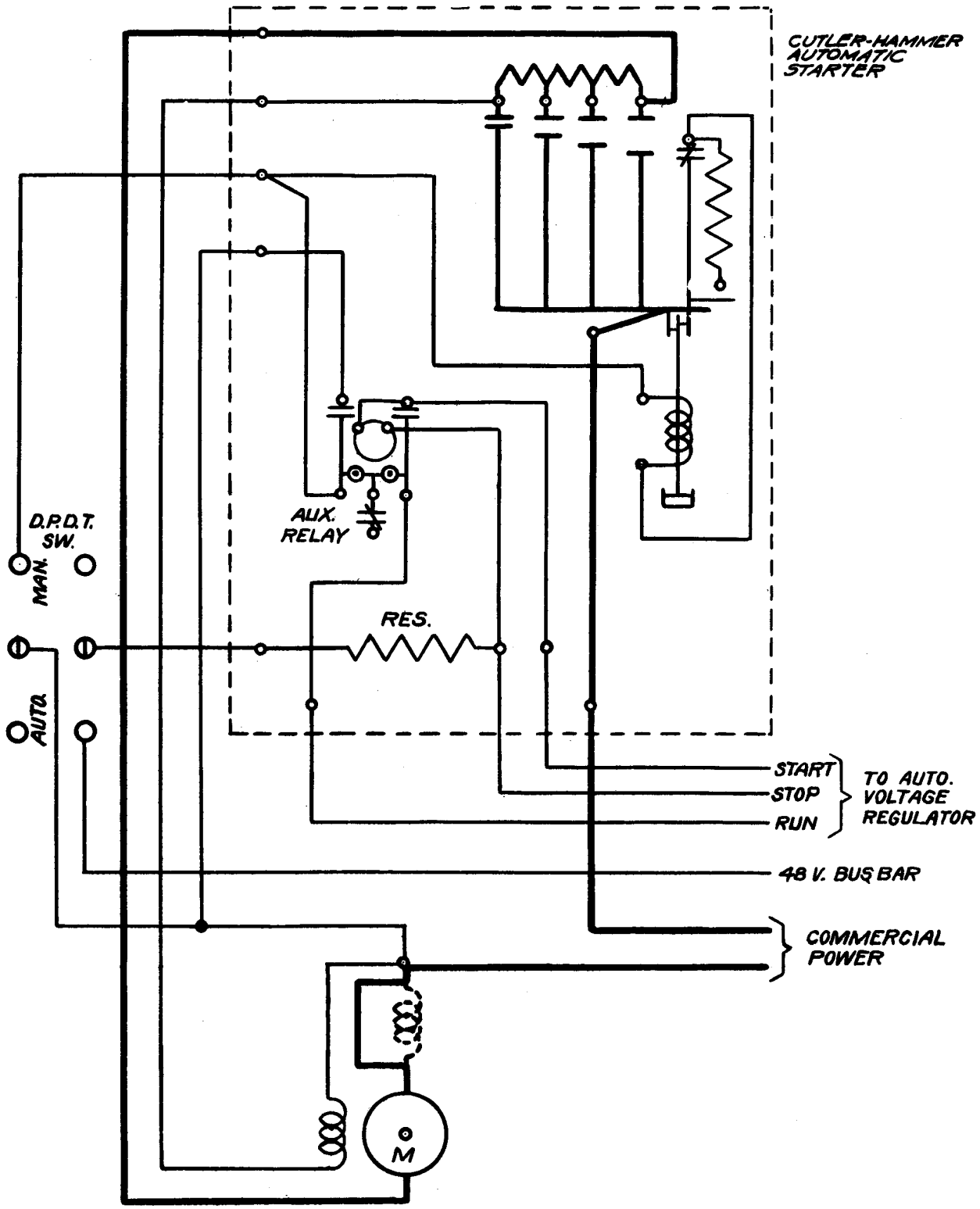


Fig. 1 – Schematic Circuit for Cutler-Hammer DC Motor Starters — Automatic Control

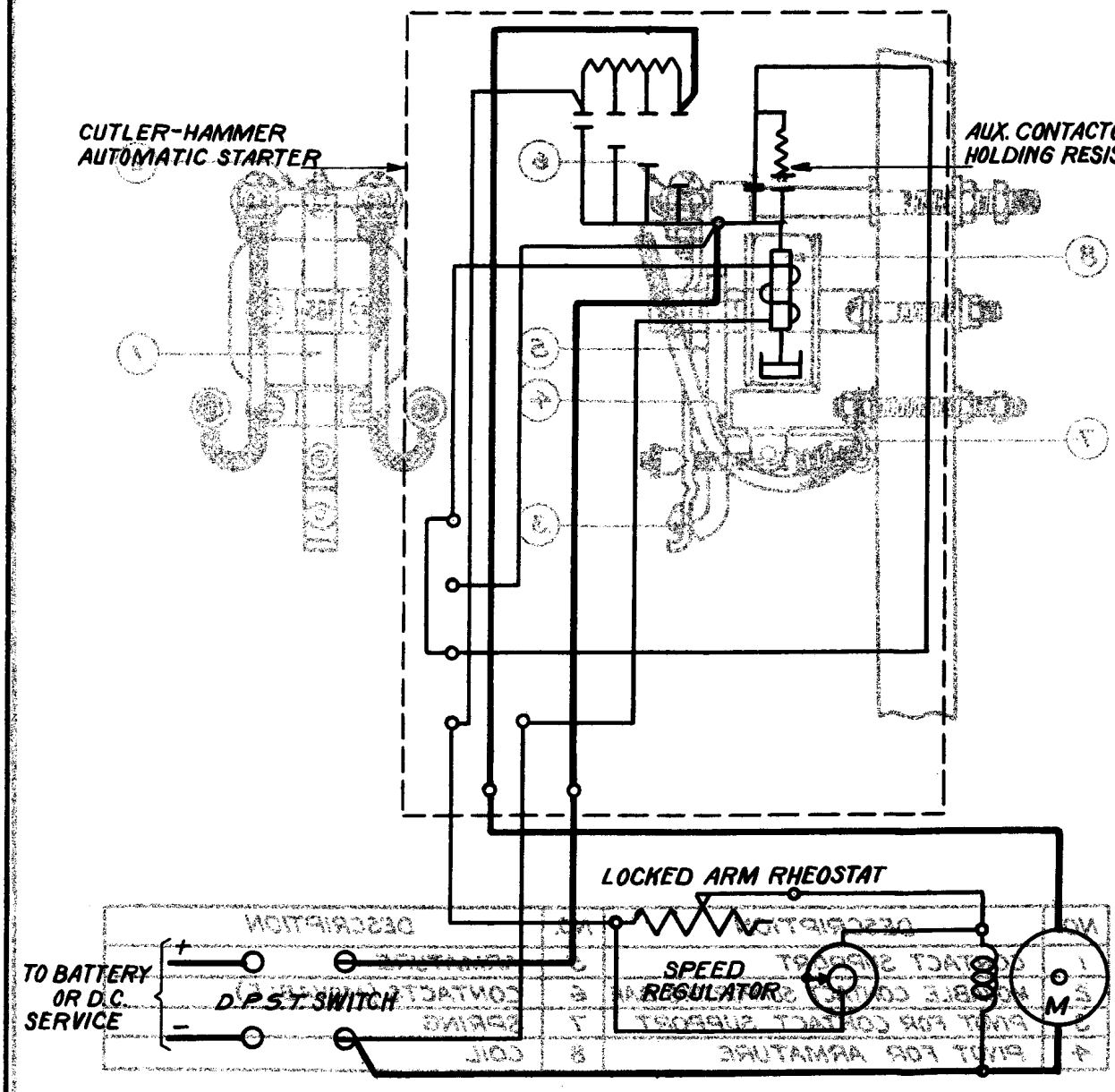
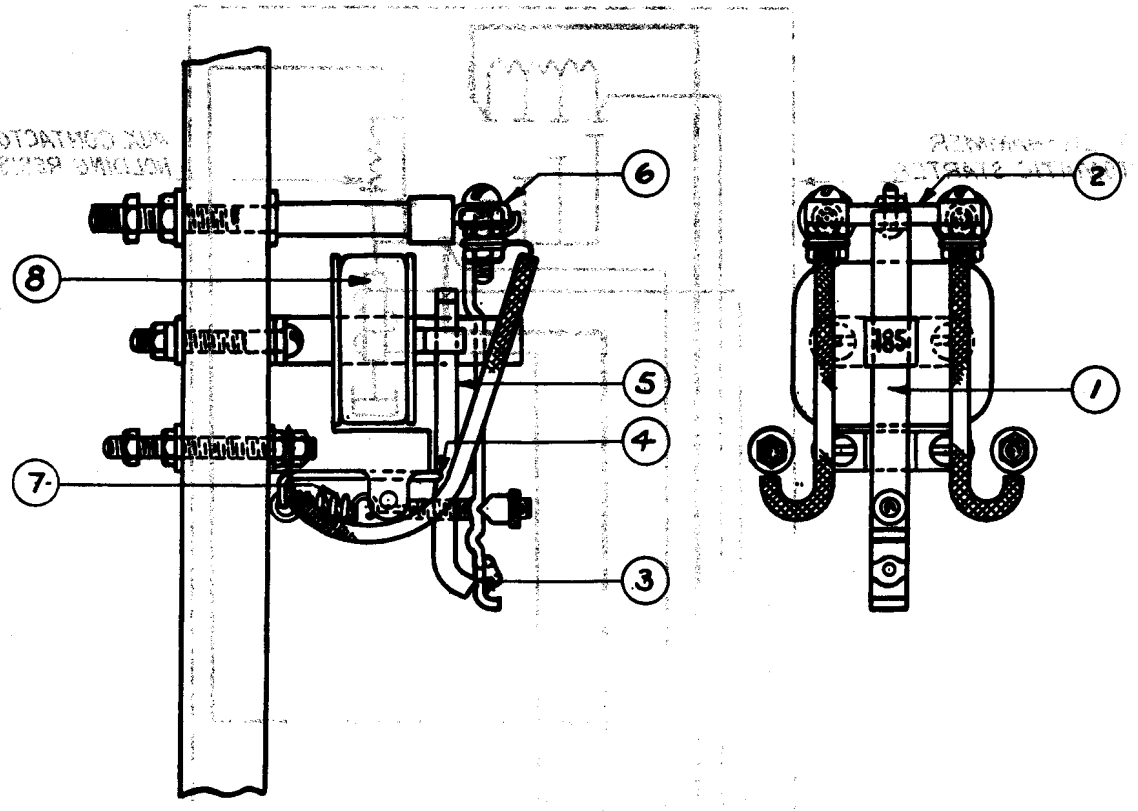


Fig. 2 – Schematic Circuit for Cutler-Hammer DC Motor Starters — Remote Control



NO.	DESCRIPTION	NO.	DESCRIPTION
1	CONTACT SUPPORT	5	ARMATURE
2	MOVABLE CONTACT SUPPORTING BAR	6	CONTACTS (MOVABLE)
3	PIVOT FOR CONTACT SUPPORT	7	SPRING
4	PIVOT FOR ARMATURE	8	COIL

Fig. 3 – Auxiliary Relay for Cutler-Hammer DC Motor Starters