



### Instructions for Installation of 120 and 240 Volt AC Electrical (Solenoid) Operators on EHD, FDB, FD, HFD, FDC, FW, HFW, FWC, EB, EHB, FB and HFB Circuit Breakers and Molded Case Switches and F-Frame HMCP.



#### WARNING

DO NOT ATTEMPT TO INSTALL OR PERFORM MAINTENANCE ON EQUIPMENT WHILE IT IS ENERGIZED. DEATH, SEVERE PERSONAL INJURY, OR SUBSTANTIAL PROPERTY DAMAGE CAN RESULT FROM CONTACT WITH ENERGIZED EQUIPMENT. ALWAYS VERIFY THAT NO VOLTAGE IS PRESENT BEFORE PROCEEDING WITH THE TASK, AND ALWAYS FOLLOW GENERALLY ACCEPTED SAFETY PROCEDURES.

CUTLER-HAMMER IS NOT LIABLE FOR THE MISAPPLICATION OR MISINSTALLATION OF ITS PRODUCTS.

The user is cautioned to observe all recommendations, warnings, and cautions relating to the safety of personnel and equipment as well as all general and local health and safety laws, codes, and procedures.

The recommendations and information contained herein are based on Cutler-Hammer experience and judgment, but should not be considered to be all-inclusive or covering every application or circumstance which may arise, if any questions arise, contact Cutler-Hammer for further information or instructions.

#### PART 1. INTRODUCTION

##### General Information

The electrical operator (Fig. 1-1) is a single-solenoid mechanism for remote circuit breaker ON and OFF (reset) switching. The electrical operator is mounted on the cover within the trimline of the circuit breaker and provides high speed switching with operating times of less than 5 cycles (80 ms), making it suitable for small generator synchronizing operations. The electrical operator is available with pigtail leads or integral terminal block for control connections as shown in Table 1-1. The electrical operator is Underwriters Laboratories, Inc. listed as a circuit breaker accessory suitable for field installation under UL File E64983.

The electrical operator is suitable for application with 3- and 4-pole Series C circuit breaker types EHD, FDB, FD,

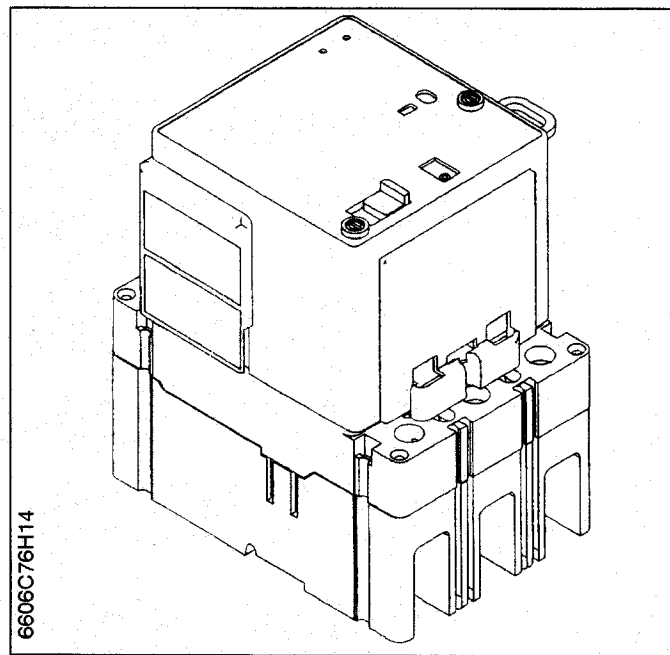


Fig. 1-1. Electrical (Solenoid) Operator Installed on F-Frame Circuit Breaker

HFD, FDC, FW, HFW, FWC, F-Frame HMCP as well as existing types EB, EHB, FB, and HFB.

Table 1-1. Electrical (Solenoid) Operator Electrical Rating Data ①②③④⑤ (See Fig. 1-5 for Additional Data)

Catalog Numbers	Terminal Block	Voltage <sup>⑥</sup> (V)	Inrush Current (A)	Fuse (A)
18-inch Pigtail Lead	Terminal Block			
EOP1P07	EOP1T07	120	10	3
EOP1P11	EOP1T11	240	5	2

- ① Frequency: 50/60 Hz
- ② Maximum operating time: 5 cycles (80 ms).
- ③ Maximum rate of operation: 4 operations per minute.
- ④ 1 KVA transformer minimum recommended.
- ⑤ 18 second max. operating pulse recommended.
- ⑥ Tolerance: ±10% of nominal voltage at operator terminal block.

## Mechanical Operation

The electrical operator has a bistable latching mechanism to switch the circuit breaker ON and OFF using one solenoid. A manual operating shaft designed for use with a hexagonal wrench or socket permits the electrical operator and circuit breaker to be switched without electrical power. The bistable latching mechanism consists of an intermittently rated solenoid, magnet and armature drive plates, and the bistable latch. The drive plates slide on bearing surfaces and move the circuit breaker handle from one position to another. The solenoid consists of an armature, a coil, and a magnet. The armature and magnet move the drive plates when the coil is energized. The bistable latch determines in which direction the solenoid components and drive plates move.

A molded trigger fits over the circuit breaker handle to transfer the drive plate force to the circuit breaker handle.

When the circuit breaker handle is in the OFF position (Fig. 1-2), the bistable latch blocks the magnet and allows the armature to move when the coil is energized. When the coil is energized, the armature is drawn to the magnet and pushes the armature drive plate, moving the circuit breaker handle to the ON position. As the circuit breaker handle moves, it toggles a cutoff switch (handle position/cutoff) to disconnect power to the solenoid. The circuit breaker handle movement also toggles the bistable latch so that the latch blocks the armature the next time the solenoid is energized.

An electrical cutoff switch operates to indicate that solenoid has completed its ON stroke.

When the circuit breaker handle is in the ON or trip position (Fig. 1-3), the bistable latch blocks the armature. When the solenoid is energized, the magnet is drawn to the armature and pushes the magnet drive plate, moving the circuit breaker handle to the OFF (reset) position. As the circuit breaker handle moves, the cutoff switch disconnects power to the solenoid, and the bistable latch toggles so that the latch blocks the magnet the next time the solenoid is energized.

The cutoff switch operates to show that the solenoid has completed its stroke. Solenoid power must then be disconnected by the external control switch.

## Electrical Operation

The electrical operator includes the solenoid, a full-wave bridge rectifier, and interlock and control switches. Color-coded pigtail leads or a terminal block are provided for control connections. The following paragraphs describe

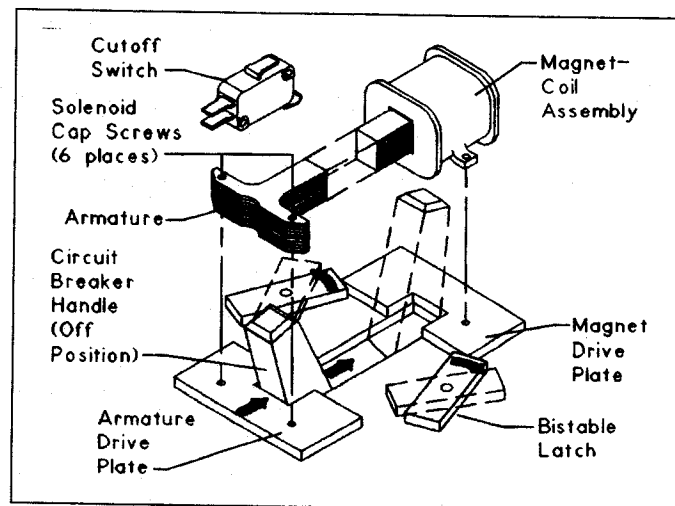


Fig. 1-2. Circuit Breaker Handle in OFF Position

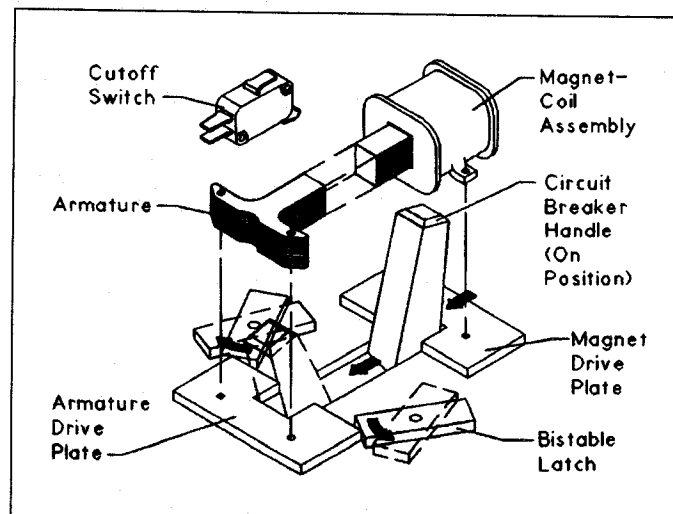


Fig. 1-3. Circuit Breaker Handle in ON Position

the electrical sequence of operation. Fig. 1-4 shows the schematic diagram for the electrical operator.

Customer installed connections provide power to the rectifier. The solenoid is connected to the rectifier output.

The cover interlock/REMOTE OPERATION switch (S3) disconnects power to the solenoid when the cover is removed or when the REMOTE OPERATION slide switch on the cover is in the OFF position. The switch is held closed when the cover is in place and the slide switch is in the ON position. The switch is disconnected when the operator is padlocked.

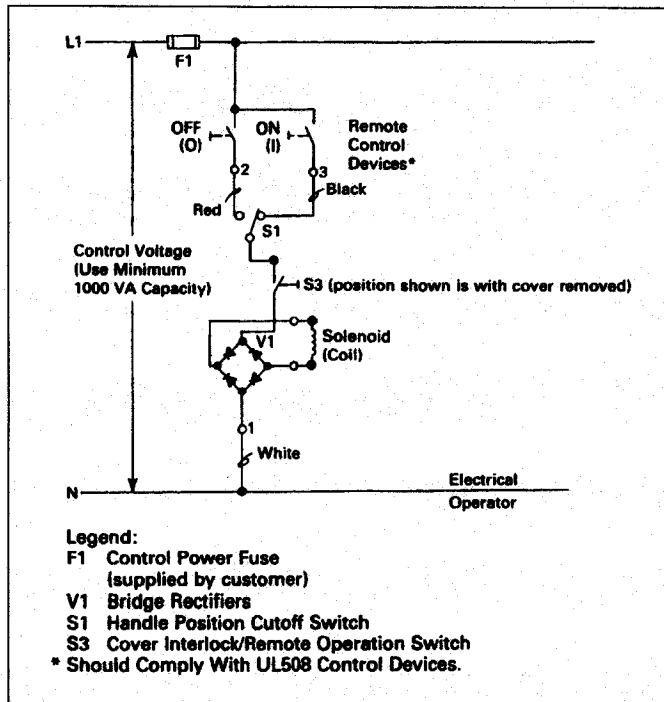


Fig. 1-4. Electrical Operator Schematic Diagram

A delay time (of approx. 1 to 2 seconds min.) between electrical operations is required to allow the latch to reset before the next operation. The maximum rate of operation is 4 operations per minute.

Accessories like the UVR must be properly operated before energizing the electrical operation, even during startup tests.

## PART 2. INSTALLATION

The electrical operator is normally supplied as a separate item for mounting on an uninstalled circuit breaker. An installed circuit breaker must be removed before the electrical operator can be mounted.

The installation procedure consists of inspecting and mounting the electrical operator and connecting control wiring. To install the electrical operator, perform the following steps:



## WARNING

**BEFORE REMOVING A CIRCUIT BREAKER INSTALLED IN AN ELECTRICAL SYSTEM, MAKE SURE THE CIRCUIT BREAKER IS SWITCHED TO THE OFF POSITION AND THAT THERE IS NO VOLTAGE PRESENT WHERE WORK IS TO BE PERFORMED. SPECIAL ATTENTION SHOULD BE PAID TO REVERSE FEED APPLICATIONS TO ENSURE NO VOLTAGE IS PRESENT. THE VOLTAGES IN ENERGIZED EQUIPMENT CAN CAUSE DEATH OR SEVERE PERSONAL INJURY.**

- 2-1. Where installed, remove the circuit breaker. If the circuit breaker was connected in a panelboard, retain line terminal hardware and discard other mounting screws. If the circuit breaker was mounted in an enclosure, discard all mounting screws.
- 2-2. Remove electrical operator from package. Inspect it for completeness and damage. Check the electrical operator nameplate to make sure that the rating agrees with the installation requirements; and make sure that mounting hardware is included.

**Note: Two types of molded trigger are supplied with each electrical operator. Type FD is installed during manufacture and is for use with Series C circuit breaker types. Type FB is included in the carton for use with existing circuit breaker types EB, EHB, FB, and HFB. When the electrical operator is for installation on circuit breaker types EB, EHB, FB, or HFB, the Type FD molded trigger must be removed and the alternate molded trigger installed.**

- 2-3. If it is necessary to change the molded trigger, spread the two latch springs away from the molded trigger positioning flanges, and lift the molded trigger from the assembly. (See Fig. 2-1.)
- 2-4. To install the molded trigger (Type FB), spread the latch springs, position the molded trigger in the slot, and release the springs. Make sure springs rest on top of molded trigger flanges (see Fig. 2-1).
- 2-5. Check that the molded trigger is correctly installed by moving manual operating handle ON and OFF several times and see if molded trigger moves inside the operator arm.

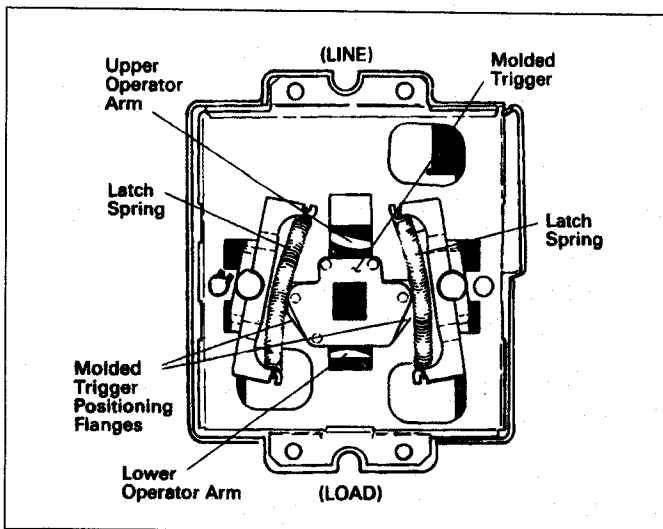


Fig. 2-1. Molded Trigger

**Note:** When the electrical operator is mounted on the circuit breaker, the circuit breaker nameplate is not visible. Before mounting the electrical operator, make sure the circuit breaker nameplate information is recorded for future reference. A blank nameplate is supplied for this purpose. The nameplate should be placed on the side of the electrical operator or circuit breaker, or on a permanent surface adjacent to the circuit breaker when installed. The circuit breaker ampere rating should be marked in the space provided on the electrical operator nameplate.

For F-Frame Motor Circuit Protectors or W Model circuit breakers, thermal and/or magnetic initial settings should be made prior to installation of the electrical operator.

The electrical operator, with cover installed, can be mounted on the circuit breaker using the imperial or metric hardware provided in the carton.

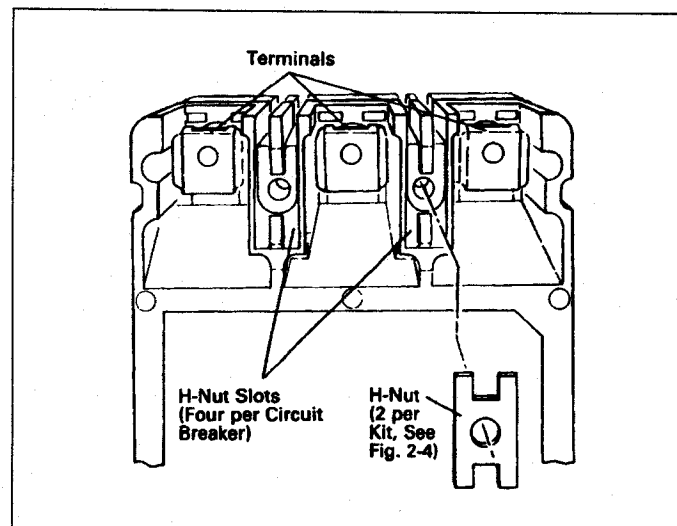


Fig. 2-2. H-Nut Installation Slots

- 2-6. Position H-nuts in slots in the rear of the circuit breaker. (See Fig. 2-2.)
- 2-7. Check that circuit breaker handle is in the OFF position.
- 2-8. Line up the circuit breaker handle and the molded trigger as shown in Fig. 2-3, and position electrical operator on the circuit breaker.
- 2-9. Secure electrical operator to circuit breaker using hardware as shown in Fig. 2-4 and Table 2-1.
- 2-10. When mounting assembly to a panelboard, position and connect line end of circuit breaker to panelboard connecting straps. Insert pan-head screw ③ (Table 2-1) through electrical operator and circuit breaker and secure to Z-bracket. (See Fig. 2-5.)
- 2-11. When mounting assembly in an enclosure, position electrical operator and circuit breaker on installation surface and secure with two pan-head screws ③ (Table 2-1). (See Fig. 2-5.)

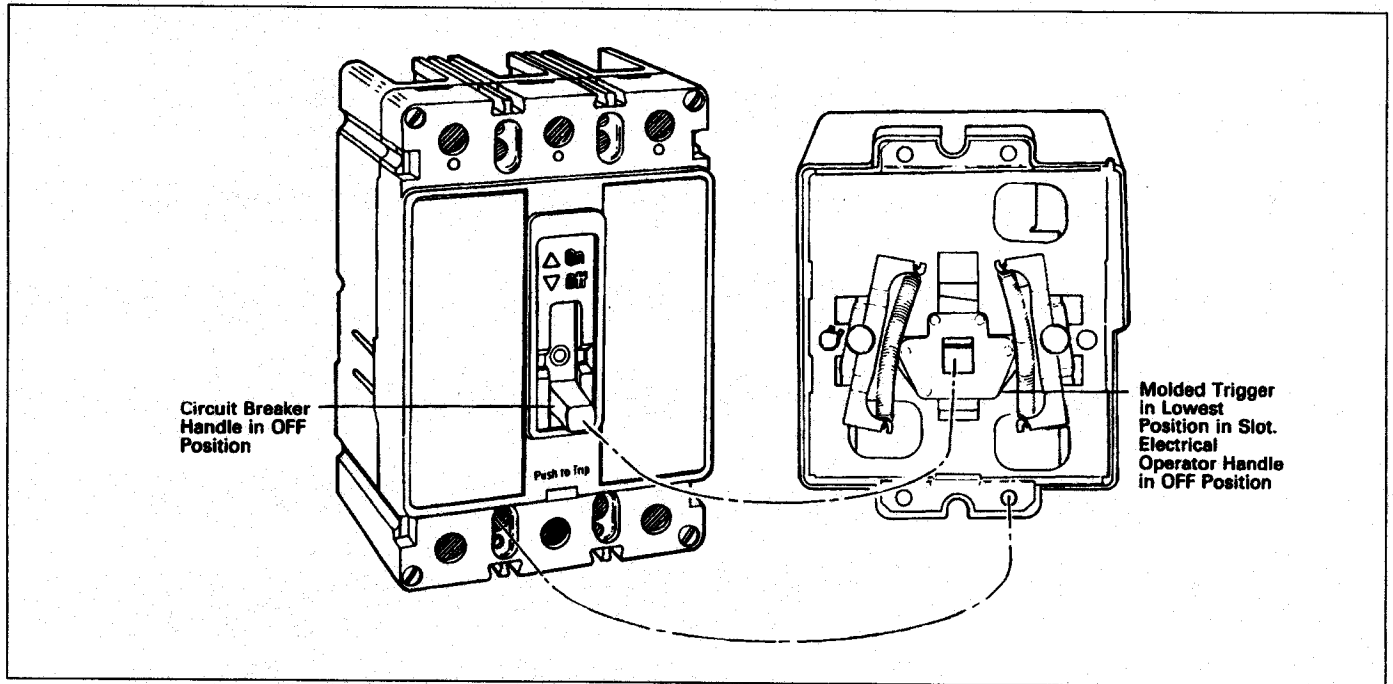


Fig. 2-3. Position for Mounting Electrical Operator to Circuit Breaker

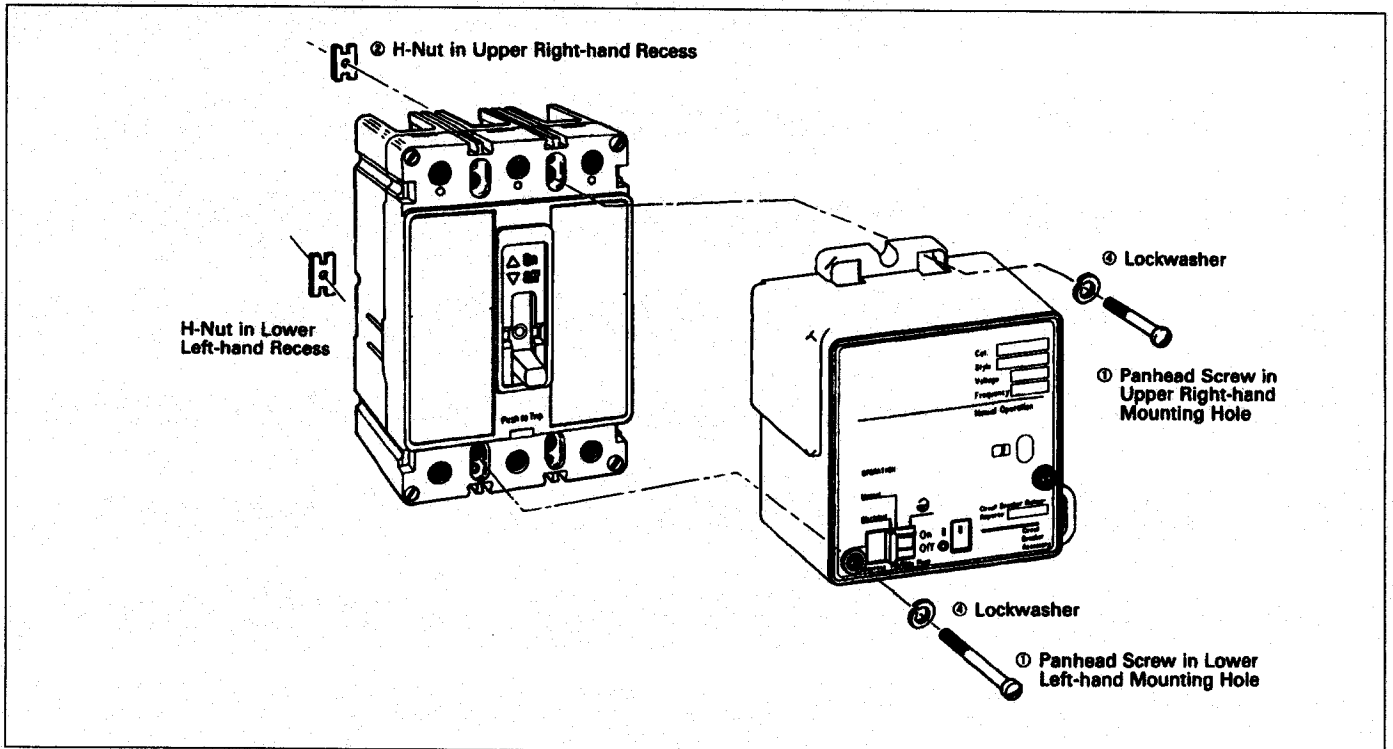


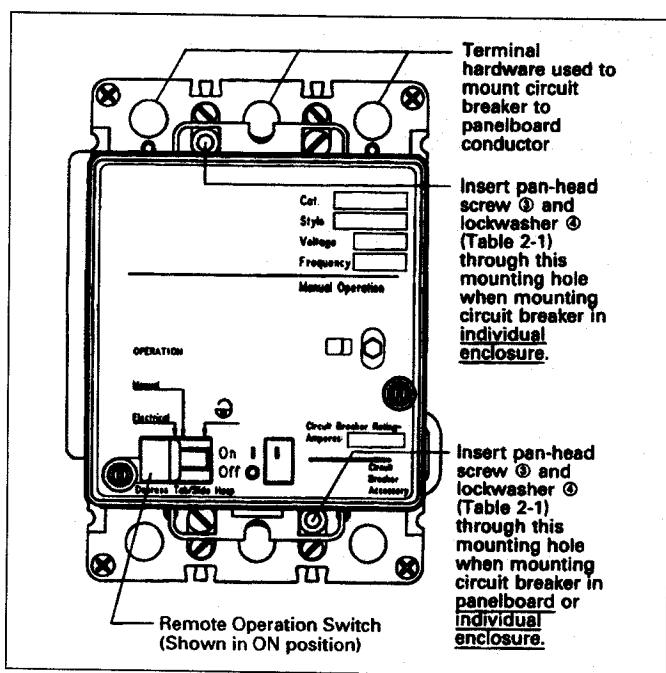
Fig. 2-4. Electrical Operator Mounting Hardware (See Table 2-1)

**Table 2-1. Electrical Operator Mounting Hardware****Imperial**

- ① 3.25 inch x 8-32 Pan-Head Screw
- ② H-Nut (8-32)
- ③ 3.5 inch x 8-32 Pan-Head Screw (Not Illustrated)
- ④ .164 Lockwasher

**Metric**

- ③ 90 mm x M4 Pan-Head Screw (Not Illustrated)

**Fig. 2-5. Mounting Configurations**

**Note:** When the electrical operator is supplied with a terminal block and the assembly is mounted on an insulated surface, connect a ground conductor (green) as shown in Fig. 2-6 to ground the electrical operator frame. The ground connection is not required where the electrical operator is mounted to a grounded metal surface by means of the mounting screws.

When pigtail leads are supplied, a grounding conductor (green) is always provided.

For electrical operator supplied with pigtail leads, omit step 2-12.

**Note:** The electrical operator cover is manufactured to fit closely over internal components. Care should be taken when removing and replacing the cover.

- 2-12. After the electrical operator supplied with a terminal block is mounted, remove the cover and connect the control wires to the terminal block. (See Fig. 2-6.)

**CAUTION**

**WHEN INSTALLING THE ELECTRICAL OPERATOR COVER, MAKE SURE THAT INTERNAL AND CONTROL WIRING IS CLEAR OF THE COVER. WIRING CAN BE PINCHED OR DISCONNECTED IF THE COVER IS NOT INSTALLED CAREFULLY. FAILURE TO MAKE SURE THAT CONTROL WIRING EXITS THE ELECTRICAL OPERATOR THROUGH THE COVER SLOT AND THAT INTERNAL WIRING IS CLEAR OF THE COVER CAN RESULT IN EQUIPMENT DAMAGE.**

- 2-13. After the control wiring is connected to the terminal block, slide the remote operation switch to the OFF or padlock position and install the cover. Slide the cover over the electrical operator making sure that the control wiring exits through the slot in the side of the cover. Position and tighten cover mounting screws. Torque to 4 to 5 lb-in (.44 to .6 N.m).
- 2-14. Connect control wires to remote control devices. Short lead lengths will supply adequate coil voltage. (See Fig. 2-6.)

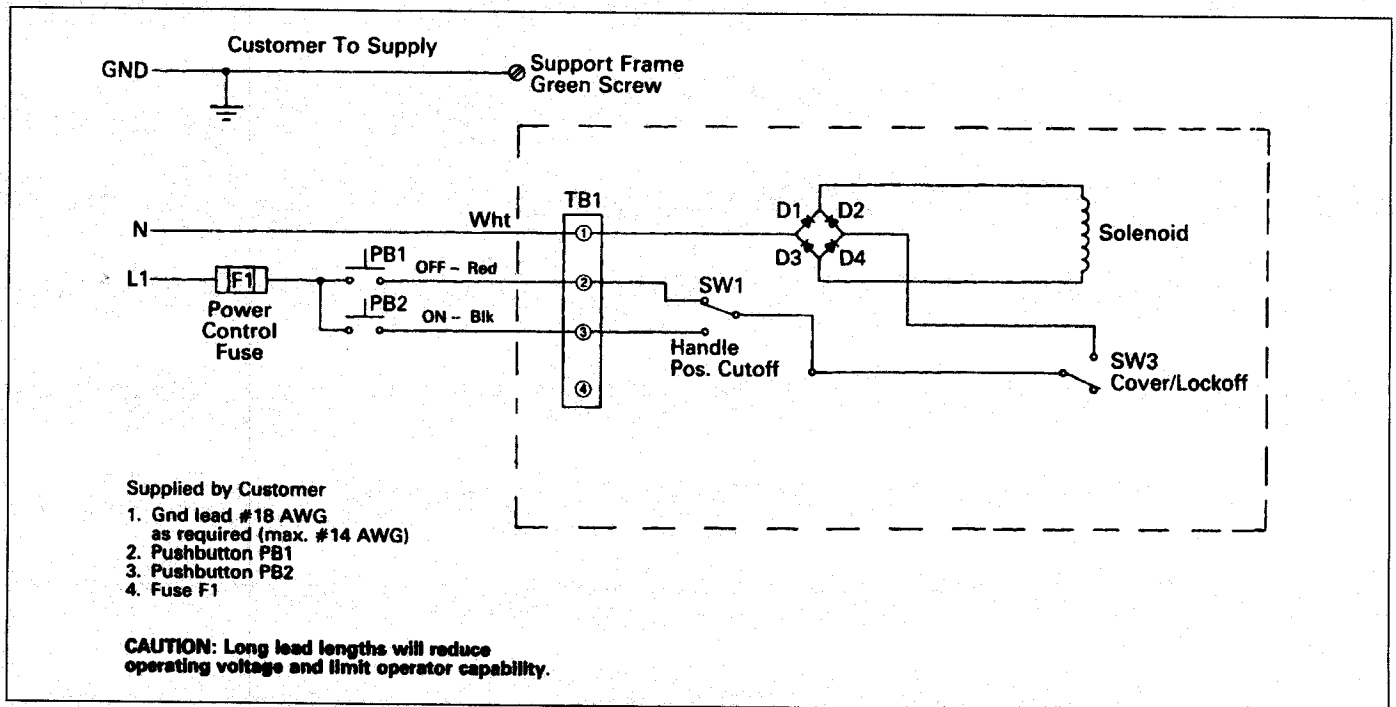


Fig. 2-6. Electrical Operator Wire Connection Diagram

**PART 3. OPERATION**

The following procedures describe the operation of the electrical operator and address electrical and mechanical ON/OFF operation and manual operating handle locking.



**CAUTION**

**MAKE SURE THAT ALL SENSITIVE EQUIPMENT CONNECTED TO THE LOAD SIDE OF THE CIRCUIT BREAKER IS DISCONNECTED BEFORE OPERATING THE ELECTRICAL OPERATOR. SWITCHING OPERATIONS COULD CAUSE DAMAGE TO EQUIPMENT, ESPECIALLY EQUIPMENT REQUIRING A CONTROLLED SHUTDOWN.**

**DO NOT ENERGIZE THE ELECTRICAL OPERATOR MORE THAN FIVE TIMES PER MINUTE. EXCEEDING THE MAXIMUM OPERATING RATE CAN DAMAGE THE OPERATING SOLENOID.**

**DO NOT CONNECT THE ELECTRICAL OPERATOR TO VOLTAGES ABOVE THE RATED VOLTAGE OF THE DEVICE. VOLTAGES THAT EXCEED THE RATED VOLTAGE CAN CAUSE DAMAGE.**

**Note:** The operating solenoid will operate within 10% of the electrical operator rated voltage. If the supply voltage is below this limit, it is possible for the solenoid to attempt to toggle the circuit breaker handle but not have enough energy. If this occurs, it will operate the cutoff switch, S1. Therefore, it is necessary to reverse the operation of the solenoid to reset the operating sequence, but only when the correct operating voltage is restored.

**Remote Electrical ON/OFF Operation**

Check remote electrical ON/OFF operation using the remote ON and OFF control devices. Perform the following steps:



## CAUTION

WHEN PERFORMING STEPS 3-1 THROUGH 3-9, OBSERVE THE MAXIMUM OPERATING RATE OF ONE OPERATION PER MINUTE. FAILURE TO OBSERVE THIS OPERATING RATE CAN RESULT IN DAMAGE TO THE ELECTRICAL OPERATOR.

- 3-1. Slide OPERATION switch to the electrical position. (See Fig. 3-1.)
- 3-2. Determine the electrical operator mechanism position (ON, TRIP, or OFF).
- 3-3. Operate the remote control device corresponding to the electrical operator mechanism position. (If display indicates the ON position, operate ON remote control device.) Verify that the electrical operator does not switch the circuit breaker.
- 3-4. Operate the other remote control device. Verify that the electrical operator switches the circuit breaker.
- 3-5. If the circuit breaker is in the trip position, operate the OFF remote control to reset the breaker.
- 3-6. Operate the first remote control device again, and verify that the electrical operator switches the circuit breaker. If the display indicates the handle is not in the ON position, operate the ON remote control device to move it to the ON position.
- 3-7. With a screwdriver, press the manual PUSH-TO-TRIP button on the circuit breaker. (See Fig. 3-1.) Verify that the circuit breaker moves to the TRIP position.
- 3-8. Operate the OFF remote control device, and verify that the display indicates the handle moves to the OFF (Reset) position.
- 3-9. Operate the ON remote control device, and verify that the display indicates the handle moves to the ON position.

### Manual ON/OFF Operation

Check the mechanical ON/OFF operation with a hexagonal or socket wrench. Perform the following steps:

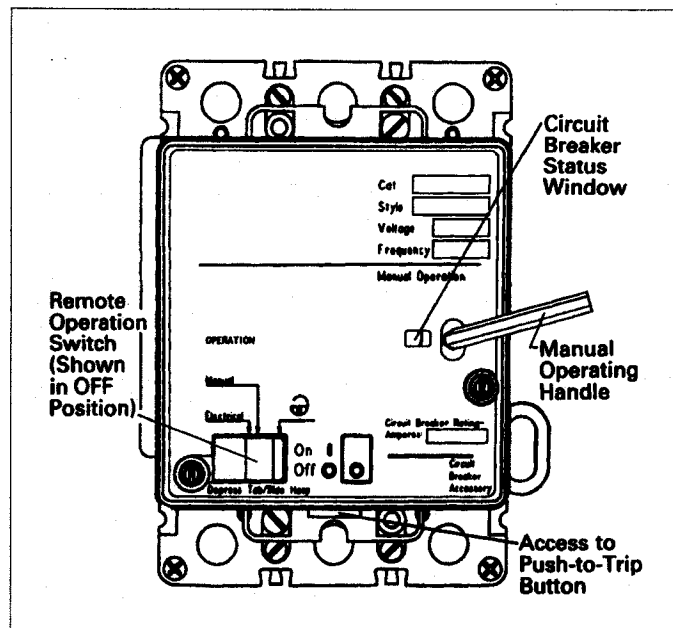


Fig. 3-1. Location of External Operating Devices

- 3-10. Slide the OPERATION switch to the manual position. (See Fig. 3-1.)
- 3-11. Use hexagonal wrench or socket to turn the manual operation shaft. Move electrical operator mechanism through each circuit breaker position and back again. Leave mechanism in the ON position.
- 3-12. Press the manual PUSH-TO-TRIP button on the circuit breaker. Check that the display indicates the TRIP position.
- 3-13. Move the electrical operator mechanism to the OFF (reset) position.

**Note:** Always remove the allen wrench before operating electrically.

### Manual Operating Handle Locking Procedure

- 3-14. Slide the OPERATION switch to the padlock or OFF position. (See Fig. 3-1.)

**Note:** The operation switch padlock shackle will take three padlock shackles up to 1/4 inch (6 mm) in diameter.



PART 4. INSPECTION



**WARNING**

**BEFORE INSPECTING OR PERFORMING MAINTENANCE ON THE ELECTRICAL OPERATION MAKE SURE THERE IS NO VOLTAGE PRESENT WHERE WORK IS TO BE PERFORMED. SPECIAL ATTENTION SHOULD BE MADE TO REVERSE FEED APPLICATIONS TO ENSURE NO VOLTAGE IS PRESENT. THE VOLTAGE IN ENERGIZED EQUIPMENT CAN CAUSE INJURY OR DEATH.**

After the electrical operator is placed in service, it should be inspected on a periodic basis (after every 500 operations). The inspection should include the following items:

- 4-1. Check wiring for loose connections. Tighten if necessary.
- 4-2. Check hardware including solenoid cap screws (see Fig. 1-2) for looseness. Tighten if necessary.
- 4-3. Electrically and mechanically check operation. (See Part 3. Operation).

**PART 5. DIMENSIONS**

Outline dimensions for the F-Frame Series C electrical operator are shown in Fig. 5-1.

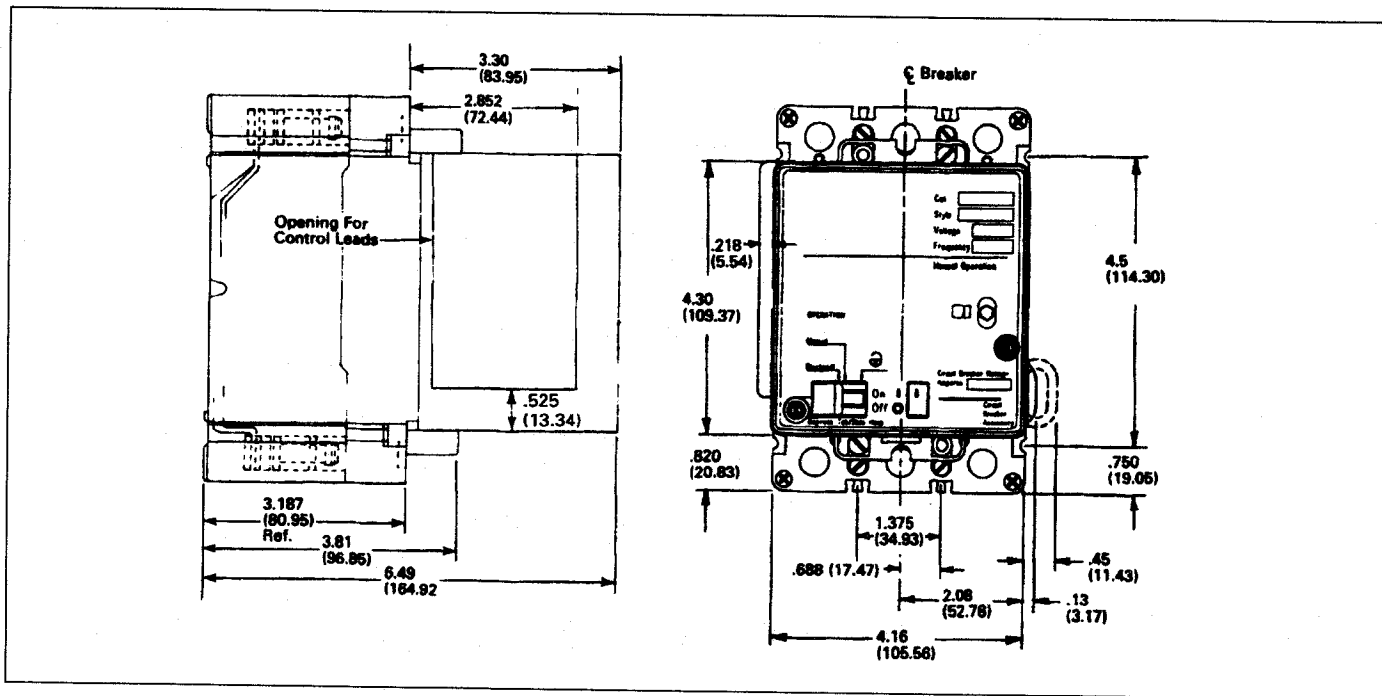


Fig. 5-1. F-Frame Series C Electrical (Solenoid) Operator Dimensions

**NOTES**