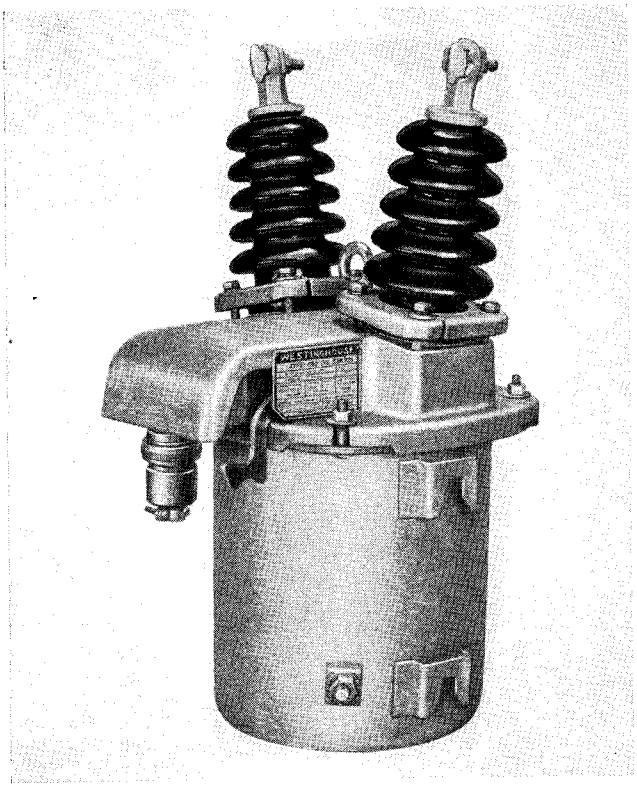
INSTALLATION • OPERATION • MAINTENANCE

# INSTRUCTIONS

## TYPE CSO OIL SWITCH

**Single Pole, 200 Amperes, 14,400 Volts**

**Maximum Interrupting Capacity—200 Amperes**



TYPE CSO OIL SWITCH is a single pole, self-contained, automatic switching device. Its principal applications will be to switch capacitor banks and outdoor lighting circuits; or for isolating rural and suburban distribution circuits.

**Storing.** The capacitor switch is filled before shipping with the correct amount and type of oil. Therefore, it may be stored either indoors or out, but it must be placed in a vertical position.

The capacitor switch, however, should never be placed in storage unless its tank is filled with the proper type and amount of oil.

### INSTALLATION

**Mounting.** The capacitor switch is contained in a seamless drawn steel tank on which two mounting lugs are welded. It can be mounted to the crossarm, or on the pole mounting brackets as shown in Fig. 6 on page 6. In either case, the capacitor switch can be positioned in the tank so that the hood will face in any desired position. This is accomplished by merely loosening the clamping bolts, rotating to the desired position, and retightening the bolts.

To mount the capacitor switch, attach the mounting brackets to the crossarm (or pole). Loosen the two captive carriage bolts and push the heads away from the bracket so that the tank lugs can be slipped down into position (see Fig. 1), then retighten captive bolts.

**Electrical Connections.** The capacitor switch is connected between the line and the load. Clamp-type terminals are supplied on the bushings. A ground lead may be attached to the stud which is welded to the tank adjacent to the lower tank lug.

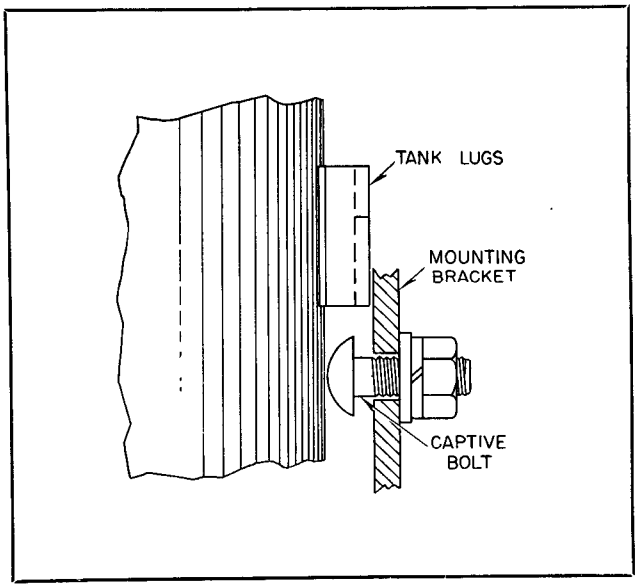



FIG. 1. Mounting Bolt Details

**To Place in Service.** The Type CSO Capacitor Switch is ready to place in service after the electrical connections have been made. The switch may be either electrically or manually closed. Manual operation is possible by operating the handle with a hookstick.

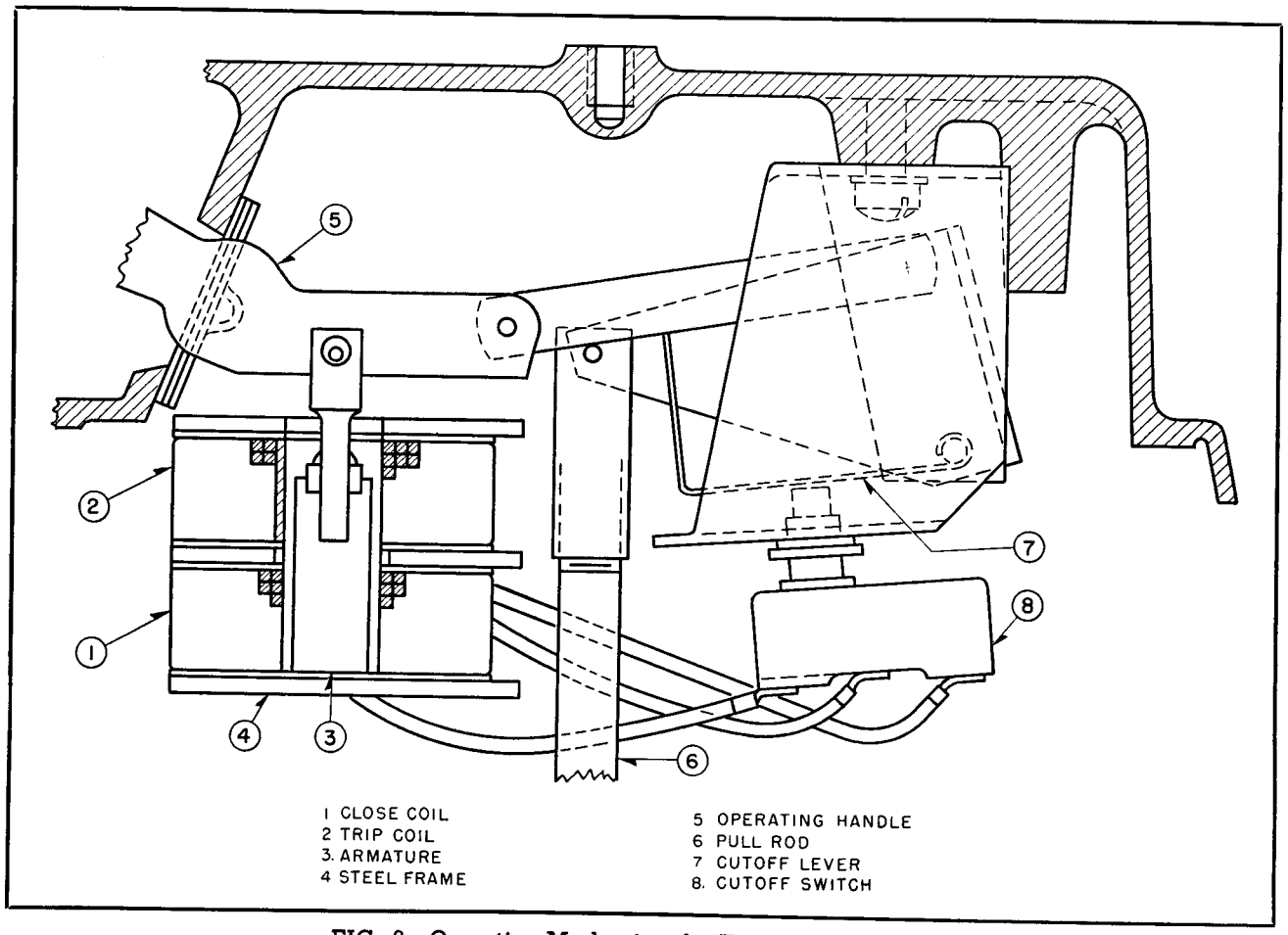



FIG. 2. Operating Mechanism for Type CSO Oil Switch

**Caution:** Do not operate the capacitor switch electrically unless it is filled with oil.

**Operating Principle.** The operation of the solenoid operated Type CSO Capacitor Switch is dependent upon a closing and tripping solenoid and a cutoff switch. (See Fig. 2). The solenoid consists of a close coil (1), a trip coil (2), a steel armature (3), and a steel frame (4).

The armature is fastened to the operating handle linkage mechanism. This toggle mechanism operates the main contacts of the switch. The close coil and trip coil in the magnet assembly are identical in size and rating.

When the close coil is energized the armature is pulled down drawing the toggle mechanism over toggle, lifting the pull rod (6) and closing the main contacts. The downward force exerted by the main contacts on the pull rod then holds the toggle mechanism in the closed position until the trip coil is energized. A cutoff lever (7) whose operation depends on the position of the toggle mechanism controls the plunger of the cutoff switch (8). The cutoff switch is connected in series with the close coil and disconnects the coil when the cutoff switch is actuated by the cutoff lever. At the same time the close coil is disconnected by the cutoff switch the circuit to the trip coil is set up.

When the trip coil is energized the procedure is reversed, and the upper half of the solenoid draws the armature up pulling the toggle mechanism through toggle. This operation opens the main contacts of the capacitor switch. As the main contacts open, the trip coil is disconnected and the circuit is set up to the close coil.

Whenever the main contacts are open the indicating handle will be down.

## TESTING

**Electrical Operation.** If it is desired to test the electrical operation of the switch on solenoid operated switches the switch should be connected to a supply circuit of the voltage indicated on the nameplate. The wiring should be as shown in the diagram (see Fig. 3).

Operation of the close and trip buttons should open and close the switch. If the adjustment of

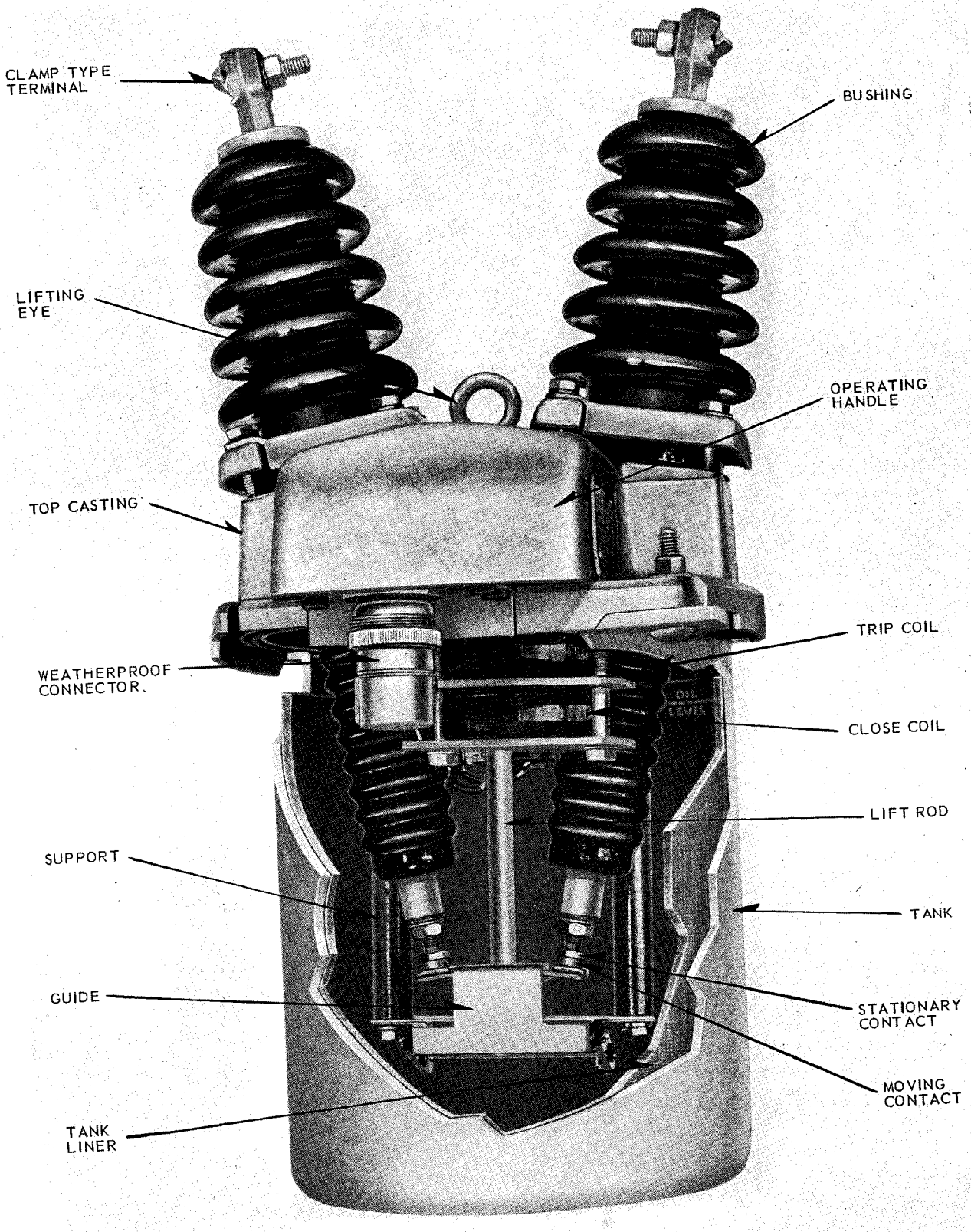



FIG. 4. Cutaway View of Type CSO Oil Switch

bly and slide it back up on the pull rod. Replace the guide link pin being sure to replace the flat washer between the guide link and contact guide. Replace the cotter pin in the end of the guide link pin.

**3. Contact Adjustment.** After both the moving and stationary contacts have been replaced close the switch by moving the operating handle to the fully closed position. Then run the stationary contacts up or down as required to cause a separation between the contact guide and movable contact of 1/8 to 3/16 of an inch. This compresses the contact spring and provides the contact pressure necessary for proper operation of the switch. Operate the switch several times to be sure the moving contact centers itself on the stationary contacts. Tighten the locknuts on the stationary contacts and recheck the separation between the contact guide and movable contact. See Fig. 5.

## TO REPLACE BUSHINGS

In the event that a bushing is damaged and must be replaced, proceed as follows:

**1.** Remove the capacitor switch from the tank and inspect to make sure only the bushing is damaged.

**2.** Remove the four bolts holding the removable bushing flange and lift the damaged bushing from the top casting.

**3.** Unscrew clamp-type terminal from bushing and stud assembly and remove stud assembly from bushing.

**4.** Place the stud assembly in the new bushing and, with a new gasket in position under the clamp-type terminal, replace the terminal and tighten it. This gasket should be cemented to the bushing with any good gasket cement. A bit of vaseline on the top of the gasket will prevent it sticking to the terminal while the terminal is tightened.

**5.** A new gasket should then be cemented to the top casting and the new bushing placed into position. The flange gasket and flange are then placed in position and the bolts tightened.

**6.** Before placing the capacitor switch back in service check the stationary contacts to make sure that they are approximately on the same horizontal plane. Any misalignment can be corrected by means of the adjustable stationary contact. See Contact Replacement instructions.

## INSULATING OIL

When the switch is in service, the oil will gradually become contaminated with carbon due to arcing at the contacts from switching operations, and with moisture due to breathing and condensation. The oil should be renewed before this contamination goes too far. Oil replacement every two years is suggested but this will depend upon service conditions and frequency of switching operations which the user should determine by visual inspection.

The replacing oil should be a good grade of insulating oil such as "Wemco C" and may be either the inhibited or non-inhibited type.

It is recommended that switches held in storage be filled with oil to proper level to protect the insulation and mechanism.

## SPARE PARTS

MAINTENANCE KITS△

| Description of Kit | Style Number |
|---|---|
| tank lining kit<br>side and bottom liner | 161A571G03 |
| bushing kit<br>one bushing and 3 gaskets | 1585 442 |
| contact kit<br>two stationary contacts and one moving contact bridge | 1733 688□ |

□ supersedes style number 1634 629. This kit includes stationary contact style 1733 398 which has 3/8 inch threads and is used on switches styles 1594 527-G and later and 1594 528-G and later. If older switches are being maintained, specify switch style number complete with sub letter as contacts on older switches have 1/4 inch threads.

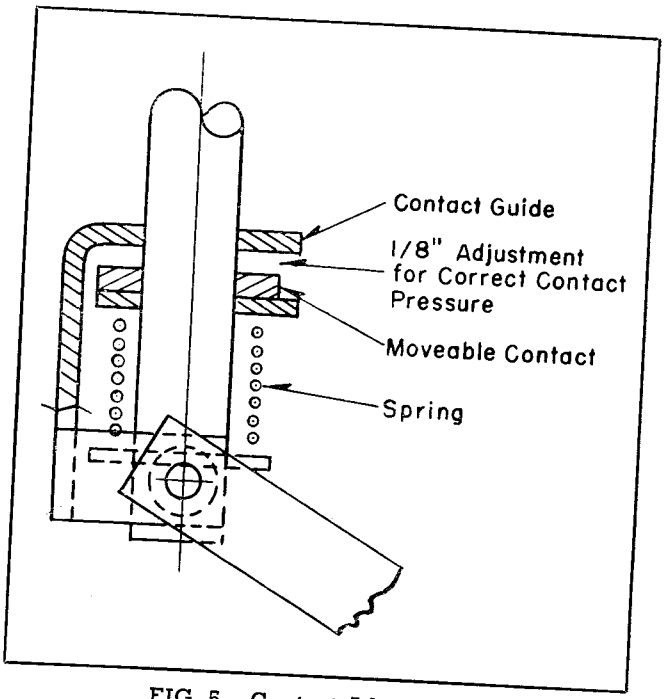



FIG. 5. Contact Adjustment

the cutoff switch is not proper the switch may chatter or fail to disconnect the close coil. If the cutoff switch disconnects the close coil too soon the main contacts will chatter. This may be remedied by moving the cutoff switch down so that the cutoff lever does not disconnect the cutoff switch too soon.

This can best be checked by connecting a light to the close circuit of the cutoff switch. The main operating handle should then be moved very slowly towards the closed position. When the cutoff switch contacts open the main operating handle should move on to the full closed position or remain stationary. In no case should it move back towards the open position. If the cutoff switch fails to disconnect the close coil in the full closed position it should be moved up until it does. Care should of course be taken to see it is not moved too far so that the cutoff switch opens too soon as described above.

## INSPECTION AND MAINTENANCE

**Routine Inspection.** At least one inspection every two years is recommended, at which time the capacitor switch should be removed from the tank and the tank drained of oil. The switch is removed from the tank by loosening the four carriage bolts and then removing the four clamps from the flange of the tank.

Oil should be changed once every two years or after the number of operations given in the table depending on the current interrupted.

### LIFE OF CONTACTS

| LOAD CURRENT SWITCHED | APPROXIMATE LIFE BETWEEN MAINTENANCE PERIODS |
|---|---|
| 200 Amps. | 2500 Operations |
| 150 Amps. | 3500 Operations |
| 100 Amps. | 5000 Operations |
| 50 Amps. and Below | 10000 Operations |

Check the condition of the contacts. These contacts should have a life equal to that given in the above table. The contacts, which are faced with arc resisting tungsten alloy, are suitable for further operation as long as this facing is intact.

**Maintenance Procedure.** Before remounting the capacitor switch in the tank the following procedure should be followed:

**1.** Wipe the inside of the tank clean with lint-free cloth. Do not use waste.

**2.** Wipe the bushings clean.

**3.** Check electrical connections for tightness.

**4.** Check the stationary contacts for tightness.

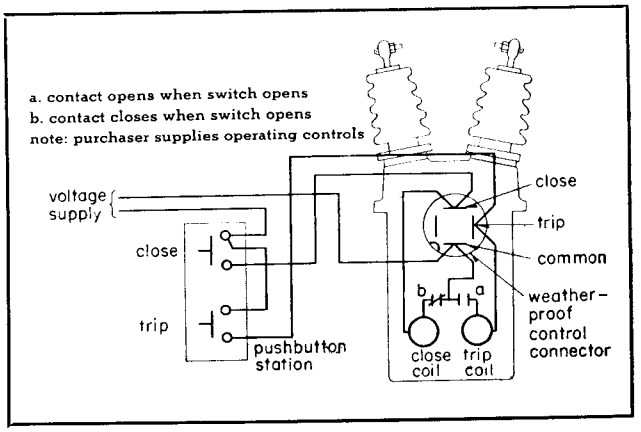



FIG. 3. Schematic Diagram of Electrically Operated Switch Connections

**5.** Check tank liner and replace if damaged.

**6.** Refill the tank with clean oil.

**7.** Operate the capacitor switch manually before remounting in the tank to make certain all parts of the mechanism are free.

## TO CHANGE RATING

The control voltage rating of the capacitor switch can be changed by replacing the coils with ones having the desired rating. Refer to table on back page to determine the style number for the particular coils desired. To change coils proceed as follows:

**1.** Disconnect the coil leads from the cutoff switch and connector. Do not disconnect common lead from cutoff switch to weatherproof plug connector.

**2.** Remove two bolts holding plates of coil assembly. Remove coils and intermediate plate.

**3.** New coils can now be placed in position and the unit reassembled.

## CONTACT REPLACEMENT

For replacing worn contacts the following procedure is suggested:

**1. Stationary Contacts.** Loosen the checknut on the stationary contact and unscrew the stationary contact assembly. Remove the locknut and lockwasher from the old stationary contact and install on the new contact. Enter the new stationary contact into the stud but do not tighten at this time.

**2. Movable Contacts.** Remove the cotter pin from one end of the guide link pin. Then remove the guide link pin by compressing the contact spring slightly. Once the guide link pin has been removed the contact guide, spring, magnet plate, and movable contact can be withdrawn from the pullrod as a unit. Replace the movable contact in this assem-

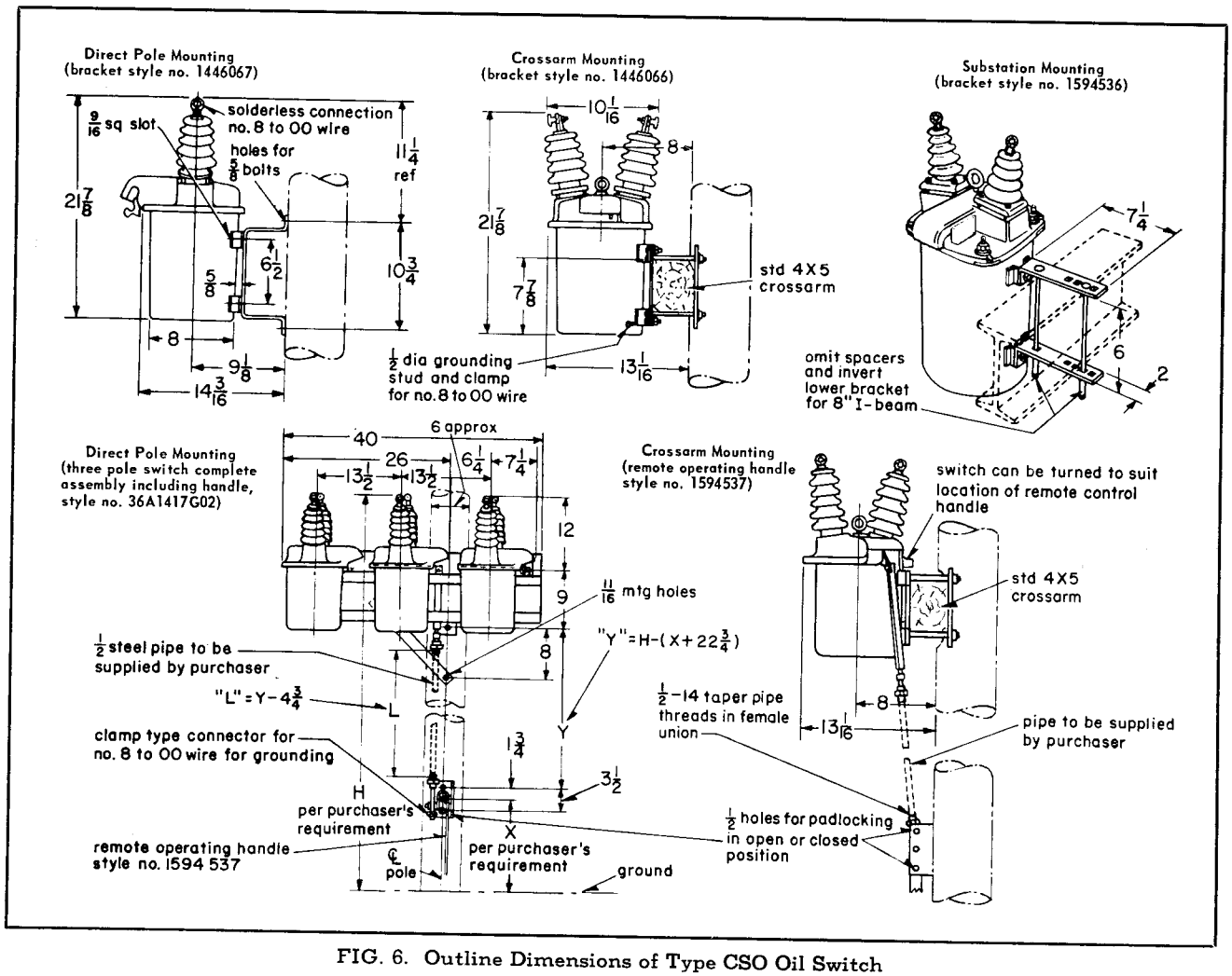



FIG. 6. Outline Dimensions of Type CSO Oil Switch

## SELECTOR GUIDE

### TYPE CSO SWITCHES

| Description | Style Number |
|---|---|
| **SINGLE POLE** | |
| manually operated | 505D229G06 |
| electrically operated (120 volt) with male (fixed) part of connector only | 505D229G04 |
| electrically operated (120 volt) with complete connector | 505D229G08 |
| electrically operated (240 volt) with male (fixed) part of connector only | 505D229G05 |
| electrically operated (240 volt) with complete connector | 505D229G09 |
| **TWO POLE** | |
| manually operated | 42A3854G02 |
| electrically operated (120 volt) | 25B9891G08 |
| electrically operated (240 volt) | 25B9891G09 |
| **THREE POLE** | |
| manually operated | 36A1417G02 |
| electrically operated (120 volt) | 25B9891G06 |
| electrically operated (240 volt) | 25B9891G07 |

*further information*

prices: price list 38-810

### ACCESSORIES

| Description | Style Number |
|---|---|
| **MOUNTING BRACKETS** | |
| crossarm mounting bracket (for single pole switch) | 1446 066 |
| direct pole mounting bracket (for single pole switch) | 1446 067 |
| substation mounting bracket (for mounting single pole switch on 6-inch or 8-inch I-beam or channel) | 1594 536 |
| adapter bracket (for connecting CSO switch to NEMA standard three and four-unit capacitor bracket) | 1767 463 |
| **LIGHTNING ARRESTERS** | |
| note: for direct mounting (one required per switch) | |
| 9 kv De-ion ® expulsion type for system voltages 6001-9000 ungrounded or 9001-12800 effectively grounded | 1767 569 |
| 10 kv valve type for system voltages 12800-13800 effectively grounded | 1767 568 |
| **MISCELLANEOUS** | |
| porcelain terminal insulating cap | 1571 747 |
| remote operating handle (for single pole switch) | 1594 537 |
| female (removable) part of weatherproof connector | 1743 427 |
| junction box (with 72-inch leads). Used to provide factory wired cable connections for three single pole switches, style number 505D229G04 or 505D229G05. | 505D344G04 |

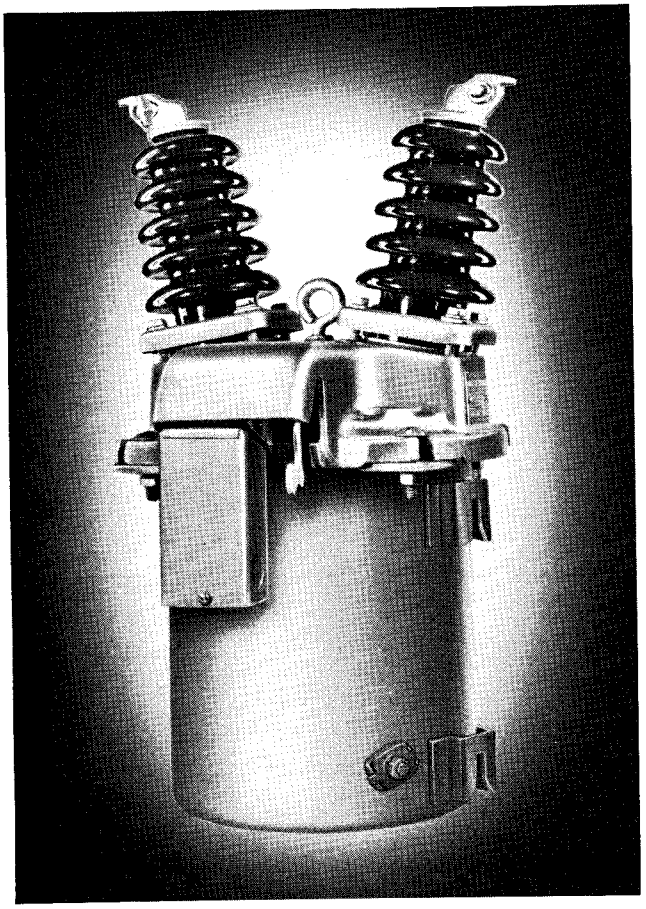
INSTALLATION • OPERATION • MAINTENANCE

# INSTRUCTIONS

## TYPE CSO-1 OIL SWITCH

**Single Pole, 200 Amperes, 15,000 Volts**

**Maximum Interrupting Capacity—200 Amperes**



TYPE CSO-1 OIL SWITCH is a single pole, self-contained, automatic switching device. Its principal applications will be to switch capacitor banks and outdoor lighting circuits; or for isolating rural and suburban distribution circuits.

**Storing.** The capacitor switch is filled before shipping with the correct amount and type of oil. Therefore, it may be stored either indoors or out, but it must be placed in a vertical position. No particular care need be taken of the capacitor switch while in storage because it is designed for use outdoors and may be stored anywhere.

The capacitor switch, however, should never be placed in storage unless its tank is filled with the proper type and amount of oil.

### INSTALLATION

**Mounting.** The capacitor switch is contained in a seamless drawn steel tank on which two mounting lugs are welded. It can be mounted to the crossarm, or on the pole mounting brackets as shown in Fig. 6 on page 6. In either case, the capacitor switch can be positioned in the tank so that the hood will face in any desired position. This is accomplished by merely loosening the clamping bolts, rotating to the desired position, and retightening the bolts.

To mount the capacitor switch, attach the mounting brackets to the crossarm (or pole). Loosen the two captive carriage bolts and push the heads away from the bracket so that the tank lugs can be slipped down into position, (see Fig. 1) then retighten captive bolts.

**Electrical Connections.** The capacitor switch is connected between the line and the load. Clamp-type terminals are supplied on the bushings. A ground lead may be attached to the stud which is welded to the tank adjacent to the lower tank lug.

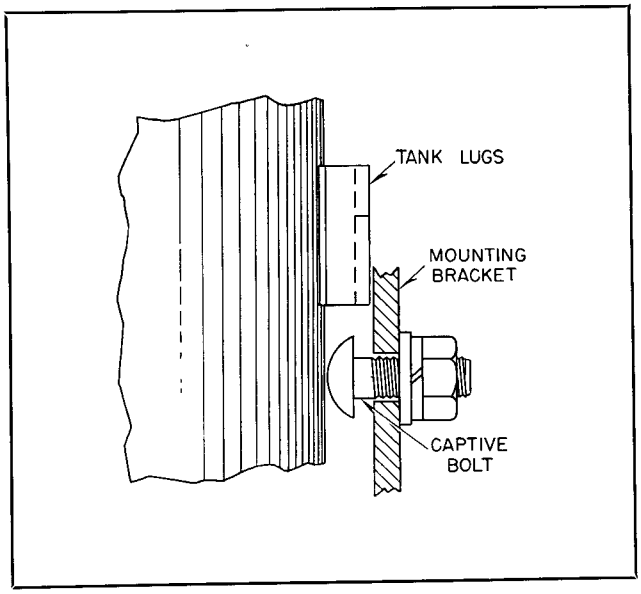



FIG. 1. Mounting Bolt Details

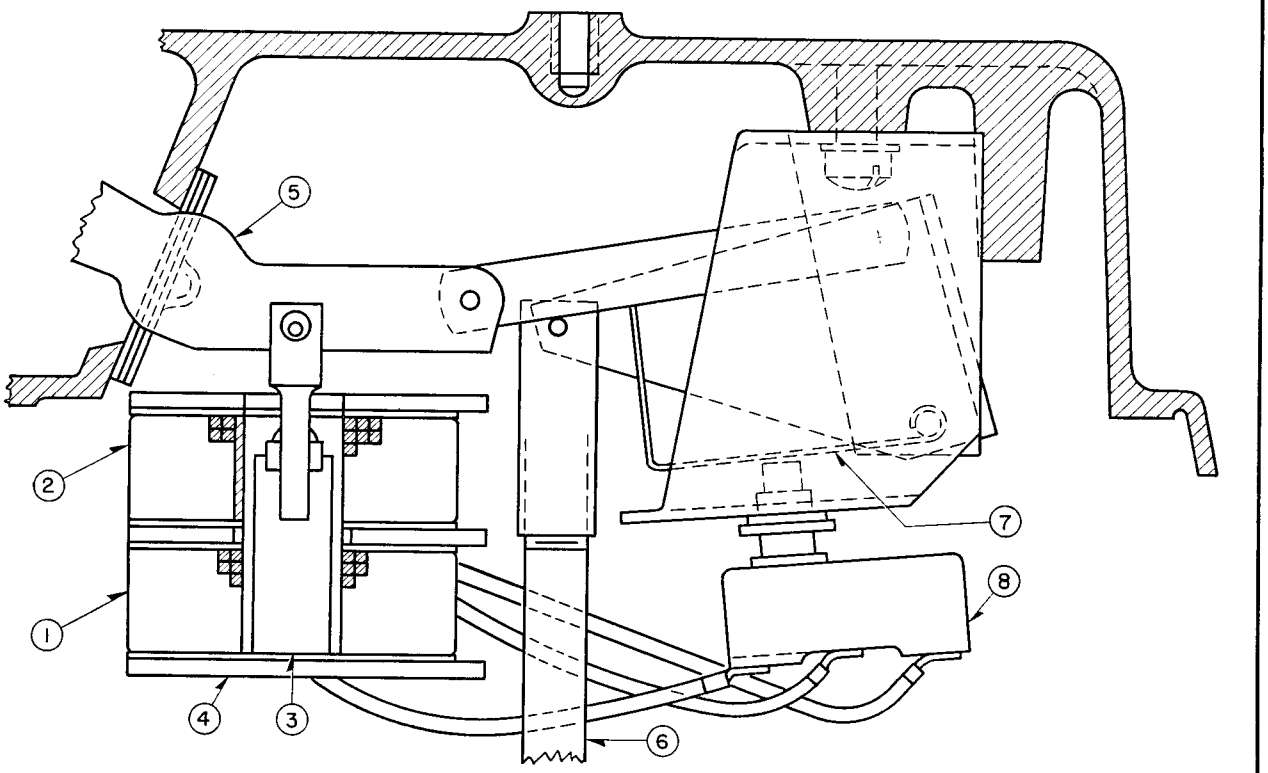



FIG. 2. Operating Mechanism for Type CSO-1 Oil Switch

On solenoid operated switches a source of control voltage to suit the voltage rating of the solenoid mechanism is also necessary. These connections are made to the junction box. The identifications for the control leads are stenciled beside the terminal block in the junction box. These include a close, a trip, and a common terminal.

**To Place in Service.** The Type CSO-1 Capacitor Switch is ready to place in service after the electrical connections have been made. The switch may be either electrically or manually closed. Manual operation is possible by operating the handle with a hookstick.

**Caution: Do not operate the capacitor switch electrically unless it is filled with oil.**

**Operating Principle.** The operation of the solenoid operated Type CSO-1 Capacitor Switch is dependent upon a closing and tripping solenoid and a cutoff switch. (See Fig. 2). The solenoid consists of a close coil (1), a trip coil (2), a steel armature (3), and a steel frame (4).

The armature is fastened to the operating handle linkage mechanism. This toggle mechanism operates the main contacts of the switch. The close coil and trip coil in the magnet assembly are identical in size and rating.

When the close coil is energized a field of magnetic flux is set up around the lower half of the solenoid. The armature is pulled downward drawing the toggle mechanism over toggle, lifting the pull rod (6) and closing the main contacts. The downward force exerted by the main contacts on the pull rod then holds the toggle mechanism in the closed position until the trip coil is energized. A cutoff lever (7) whose operation depends on the position of the toggle mechanism controls the plunger of the cutoff switch (8). The cutoff switch is connected in series with the close coil and disconnects the coil when the cutoff switch is actuated by the cutoff lever. At the same time the close coil is disconnected by the cutoff switch the circuit to the trip coil is set up.

When the trip coil is energized the procedure is reversed. The magnetic field set up around the

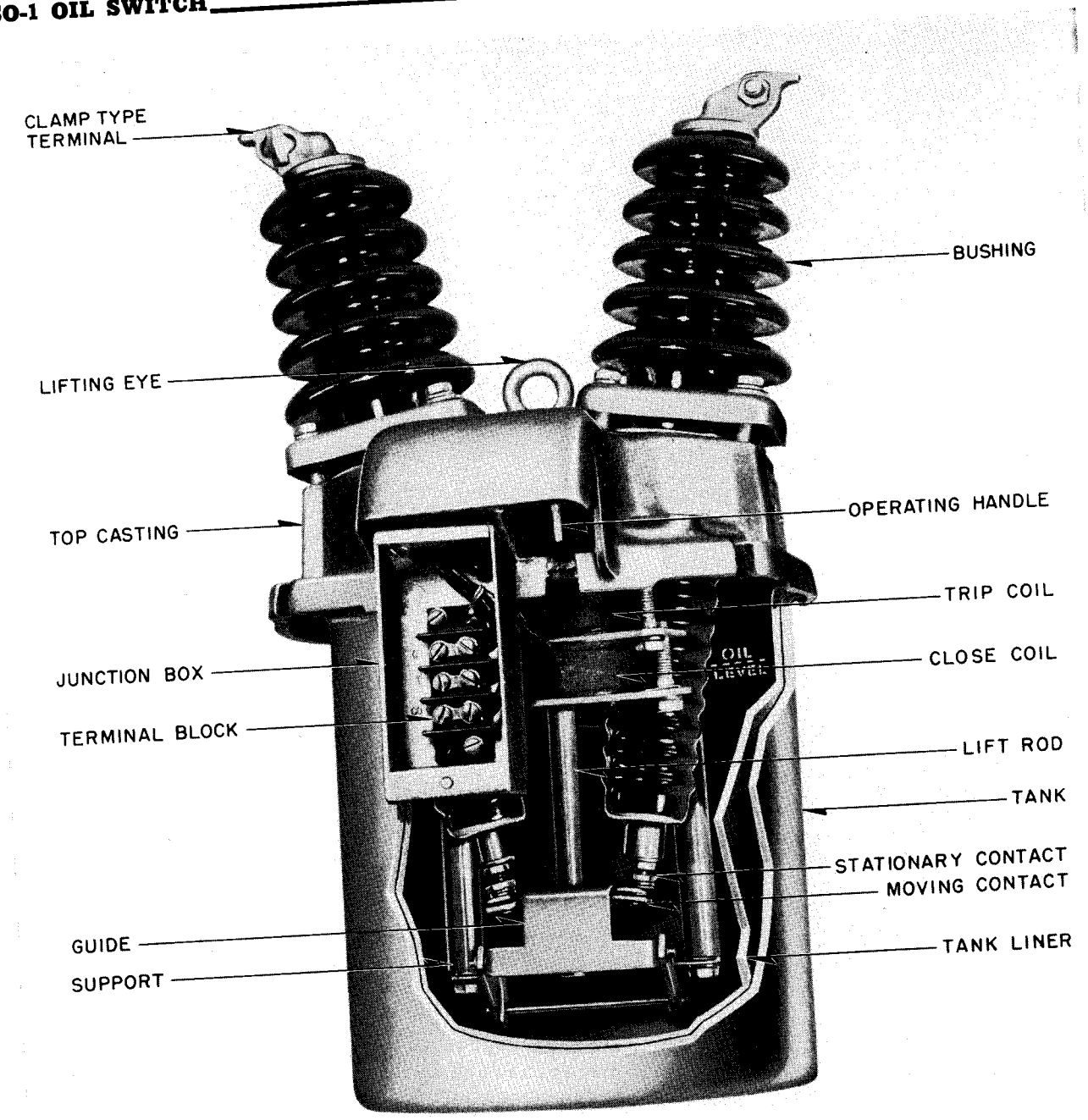



FIG. 4. Cutaway View of Type CSO-1 Oil Switch

**4.** Check the stationary contacts for tightness.

**5.** Check tank liner and replace if damaged.

**6.** Refill the tank with clean oil.

**7.** Operate the capacitor switch manually before remounting in the tank to make certain all parts of the mechanism are free.

The top casting and tank are galvanized and therefore require no maintenance other than touching-up of areas damaged by abrasion.

## TO CHANGE RATING

The control voltage rating of the capacitor switch can be changed by replacing the coils with ones having the desired rating. Refer to table on back page to determine the style number for the particular coils desired. To change coils proceed as follows:

**1.** Disconnect the coil leads from the cutoff switch and terminal block. Do not disconnect common lead from cutoff switch to terminal block.

**2.** Remove two bolts holding plates of coil assembly. Remove coils and intermediate plate.

**3.** New coils can now be placed in position and the unit reassembled.

**Important:** Short coil leads go to the terminals on the cutoff switch; long coil leads go to the terminal block. The nameplate supplied with the coils should then be attached to the top casting.

## TO REPLACE BUSHINGS

In the event that a bushing is damaged and must be replaced, proceed as follows:

**1.** Remove the capacitor switch from the tank and inspect to make sure only the bushing is damaged.

**2.** Remove the four bolts holding the removable bushing flange and lift the damaged bushing from the top casting.

**3.** Unscrew clamp-type terminal from bushing and stud assembly and remove stud assembly from bushing. Be careful not to lose the pin and washer from the terminal end of the stud assembly.

**4.** With the pin and washer on the stud assembly (see Fig. 5) place the assembly in the new bushing and, with a new gasket in position under the clamp-type terminal, replace the terminal and tighten it. This gasket should be cemented to the bushing with any good gasket cement. A bit of vaseline on the top of the gasket will prevent it sticking to the terminal while the terminal is tightened.

**5.** A new gasket should then be cemented to the top casting and the new bushing placed into position. The flange gasket and flange are then placed in position and the bolts tightened.

**6.** Before placing the capacitor switch back in service check the stationary contacts to make sure that they are approximately on the same horizontal plane. Any misalignment can be corrected by means of the adjustable stationary contact.

## INSULATING OIL

The care of the insulating oil used in this capacitor switch is of the utmost importance to its successful operation. Contamination by dirt, moisture, metallic particles, lint and other types of foreign particles, reduces the dielectric strength of the oil upon which the operation and current interrupting ability of the capacitor switch depends. Consequently, careful attention should be given to keeping the oil clean, not only in filling the tank, but in storage.

Only the highest grade of insulating oil such as Wemco "C" should be used. The oil should be new or at least thoroughly reconditioned by means of filter press or centrifuge.

If the capacitor switch has been allowed to stand with no oil in the tank, the tank should be thoroughly cleaned and flushed out with insulating oil before filling. The same treatment should be given the capacitor switch mechanism itself. Care should be used during inspection and maintenance which should preferably be done only under favorable weather conditions.

## SPARE PARTS

Replacement Contact Kit—Refer to nameplate of switch.

For style numbers 1594 527-G or later, 1594 528-G or later, and 1594 539-F or later, order kit Style No. 1733 688.

For switches earlier than and including Style Nos. 1594 527-F, 1594 528-F, and 1594 539-E, order kit Style No. 1634 629.

Tank Liner, complete—Style No. 1576 472

Bushing Replacement Kit, complete—Style No. 1585 442

Cutoff Switch—Style No. 1616 707

*Note: Renewal parts for this capacitor switch can be found in Renewal Parts Data 38-695-1.*

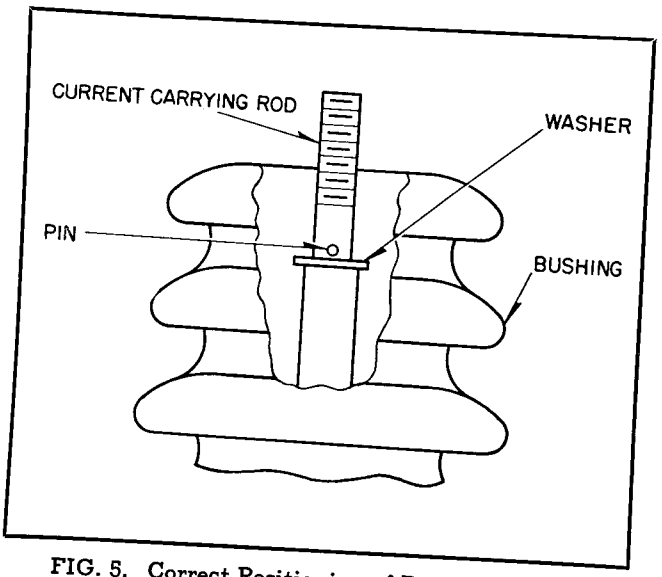



FIG. 5. Correct Positioning of Pin and Washer in Bushing Assembly

upper half of the solenoid draws the armature up pulling the toggle mechanism through toggle. This operation opens the main contacts of the capacitor switch. As the main contacts open, the trip coil is disconnected and the circuit is set up to the close coil.

Whenever the main contacts are open the indicating handle will be down.

## TESTING

No testing of the capacitor switch should be required other than the manual operation of the operating lever. When this lever is pushed upward the contacts should close. The operating lever will indicate the opening of the capacitor switch contacts.

**Electrical Operation.** If it is desired to test the electrical operation of the switch on solenoid operated switches the switch should be connected to a supply circuit of the voltage indicated on the nameplate. The wiring should be as shown in the diagram (see Fig. 3).

Operation of the close and trip buttons should open and close the switch. If the adjustment of the cutoff switch is not proper the switch may chatter or fail to disconnect the close coil. If the cutoff switch disconnects the close coil too soon the main contacts will chatter. This may be remedied by moving the cutoff switch down so that the cutoff lever does not disconnect the cutoff switch too soon.

This can best be checked by connecting a light to the close circuit of the cutoff switch. The main operating handle should then be moved very slowly towards the closed position. When the cutoff switch contacts open the main operating handle should move on to the full closed position or remain stationary. In no case should it move back towards the open position. If the cutoff switch fails to disconnect the close coil in the full closed position it should be moved up until it does. Care should of course be taken to see it is not moved too far so that the cutoff switch opens too soon as described above.

## INSPECTION AND MAINTENANCE

**Routine Inspection.** At least one inspection every two years is recommended, at which time the capacitor switch should be removed from the tank and the tank drained of oil. The switch is removed from the tank by loosening the four carriage bolts and then removing the four clamps from the flange of the tank.

Oil should be changed once every two years or after the number of operations given in the table depending on the current interrupted.

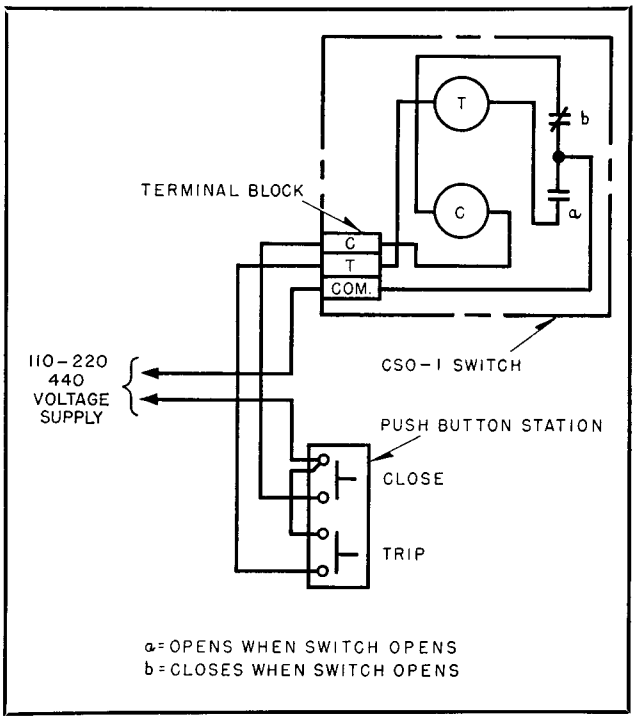



FIG. 3. Test Circuit

## LIFE OF CONTACTS

| LOAD CURRENT SWITCHED | APPROXIMATE LIFE BETWEEN MAINTENANCE PERIODS |
|---|---|
| 200 Amps. | 2500 Operations |
| 150 Amps. | 3500 Operations |
| 100 Amps. | 5000 Operations |
| 50 and Below | 10000 Operations |

Check the condition of the contacts. These contacts should have a life equal to that given in the above table. The contacts, which are faced with arc resisting tungsten alloy, are suitable for further operation as long as any of this material is present.

*Note: It is not necessary to dress the contacts even though they may appear mottled and uneven as they will carry their full rated current within the rated temperature rise as long as this arc resisting alloy is present.*

The moving contacts are attached to the main operating rod by a pin which is locked in place with cotter keys.

**Maintenance Procedure.** Before remounting the capacitor switch in the tank the following procedure should be followed:

1. Wipe the inside of the tank clean with lint-free cloth. Do not use waste.
2. Wipe the bushings clean.
3. Check electrical connections for tightness.

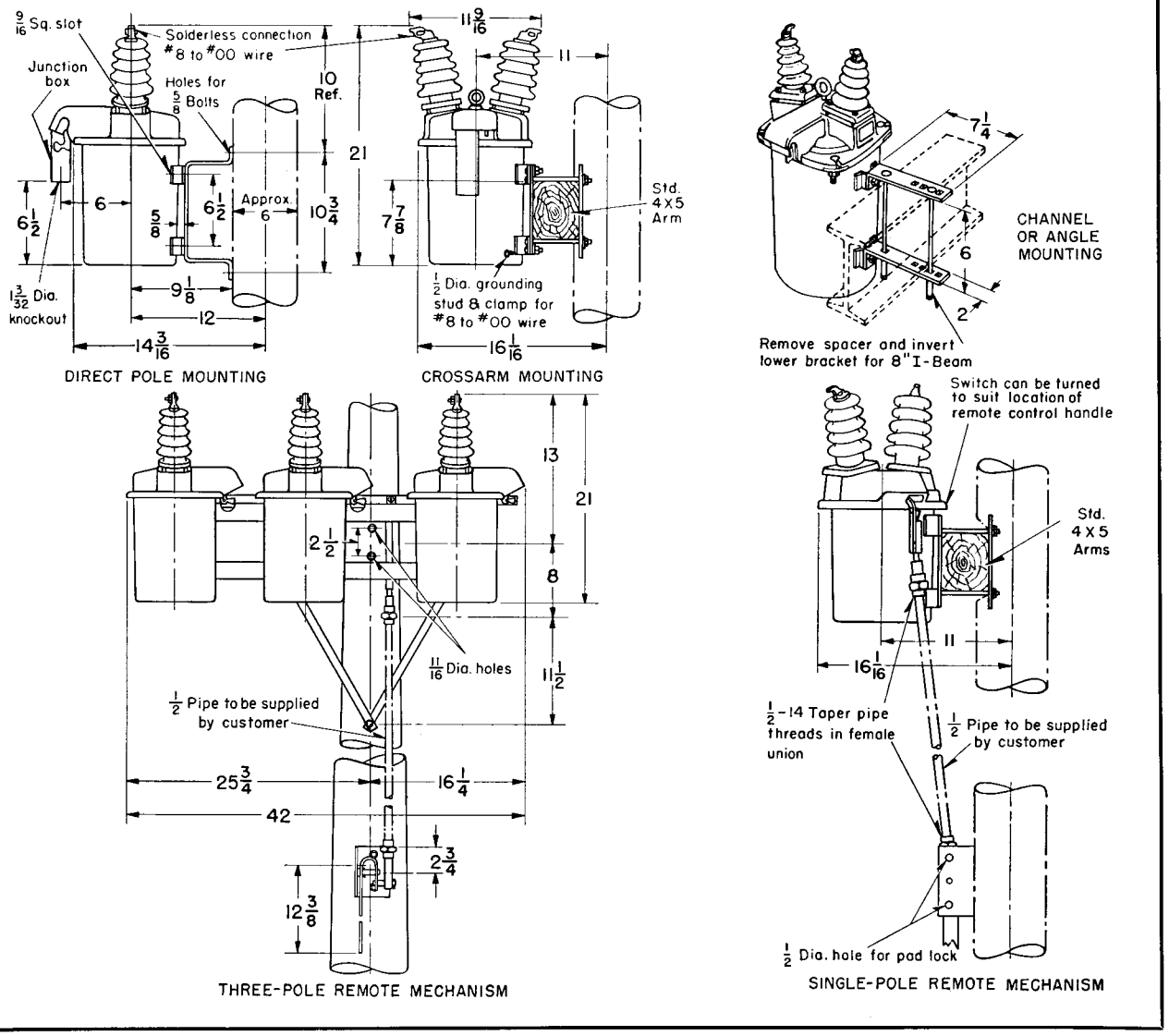



FIG. 6. Crossarm and Pole Mounting Details

## TABLE OF RATINGS

| MAXIMUM VOLTAGE KV | CONTROL VOLTAGE | SWITCH STYLE NO.* COMPLETE | COIL STYLE NUMBERS | |
|---|---|---|---|---|
| | | | COIL ONLY | NAMEPLATE AND TWO COILS |
| 15 | 115 | 1594 527 | 1594 516 | 1616 402 |
| 15 | 230 | 1594 528 | 1594 517 | 1616 403 |
| 15 | 440 | 1594 529 | 1594 518 | 1616 404 |
| 15 | Manual | 1594 539 | None | None |

* Oil capacity—7 quarts
Net weight with oil—54 pounds
Shipping weight with oil—64 pounds
Crossarm Mounting Bracket—Style No. 1446 066
Direct-to-Pole Mounting Bracket—Style No. 1446 067
Extended Pole Mounting Bracket—Style No. 1446 068
Channel Iron Mounting Bracket— Style No. S 1594 536

*Note:*

*The capacitor switch frame is identical for all ratings so that the electrically operated ratings may be changed by changing only the coils. This operation is described on page 4.*

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**EAST PITTSBURGH PLANT • SWITCHGEAR DIVISION • EAST PITTSBURGH, PA.**

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