



DESCRIPTION • INSTALLATION • MAINTENANCE

# INSTRUCTIONS

## Type FO-22-B OIL CIRCUIT BREAKER

600 Amperes

7200 Volts

Manually or Electrically Operated  
Automatic or Nonautomatic Trip

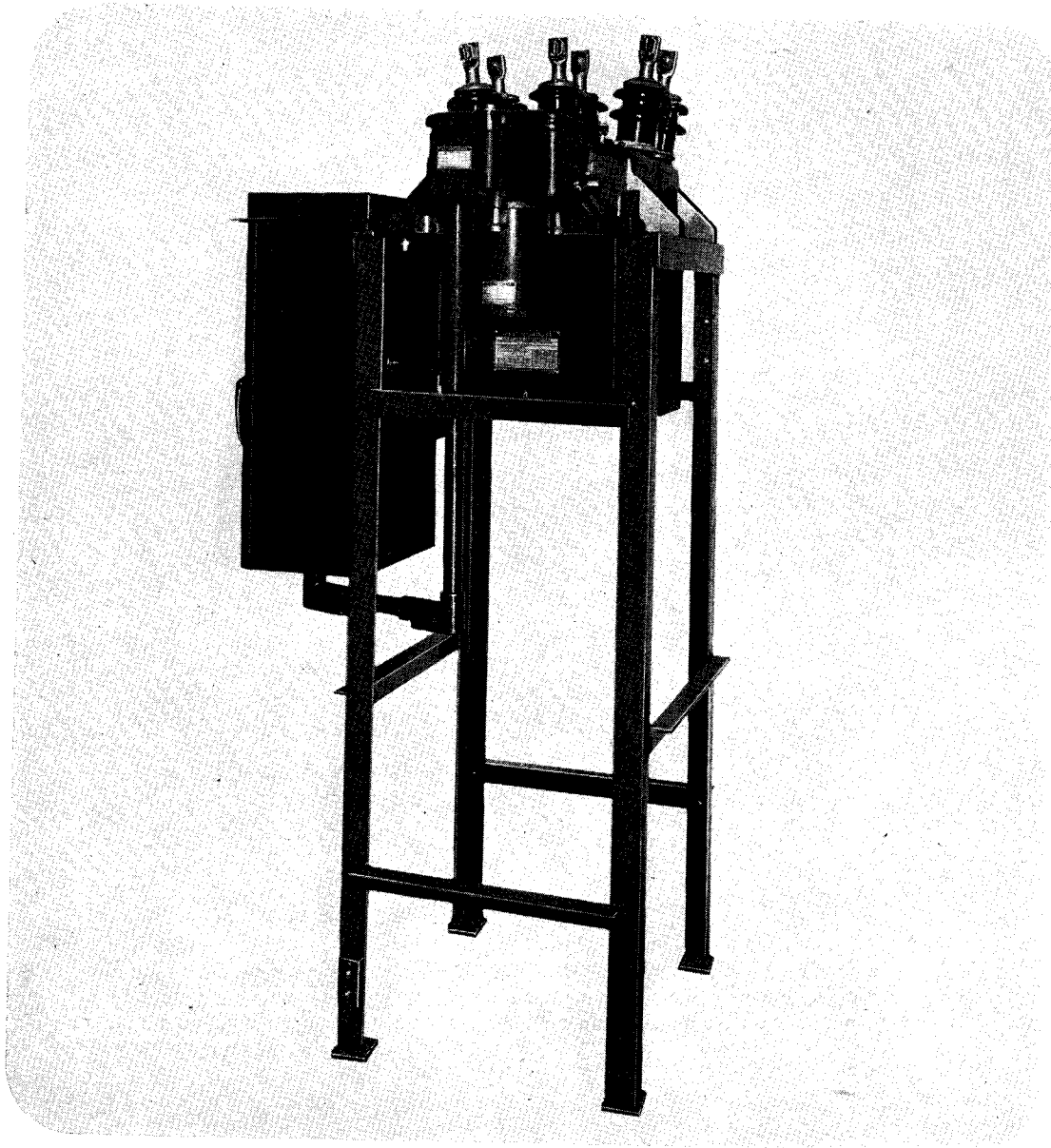
### WESTINGHOUSE ELECTRIC CORPORATION

SWITCHGEAR DIVISION

EAST PITTSBURGH PLANT  
SUPERSEDES I. B. 5766

EAST PITTSBURGH, PA.  
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**Frame Mounted Type FO-22-B Oil Circuit Breaker**

FO-22-B outdoor oil breakers are built as a 600-ampere, 7200-volt, 3-phase single-throw assembly. They can be either frame-, wall- or pole-mounted; manually or electrically operated. Automatic breakers can be equipped with either series or transformer trip coils.

# INSTALLATION

## RECEIVING

Type FO-22-B breakers are shipped completely assembled with all attachments and auxiliaries mounted in place. Do not remove the crating until the breaker reaches its permanent location.

**Important:** Immediately upon receipt of a circuit breaker, an examination should be made for any damage sustained while in transit. If injury is evident, or indication of rough handling is visible, file a claim for damage with the carrier (transportation company), and promptly notify the nearest Westinghouse Sales Office.

Store the crated circuit breaker, previous to installation, in a clean dry location in an upright position. To protect the internal parts against moisture, make sure that tank is filled to proper level with insulating oil.

## INSTALLATION PROCEDURE

1. Remove the crating and frame skids.
2. Mount the breaker on its foundation. The four mounting bolts should be left loose until the frame is leveled by inserting shims under the feet.
3. Remove the mechanism cover and remove the blocking from the mechanism. *Do not insert hands in breaker when removing this blocking as the mechanism may snap open.*
4. Remove the tank and examine the inside for evidence of moisture or foreign matter. Flush with new circuit breaker oil. Tank should not be lowered in wet weather without provision being made for keeping moisture out of it. Protect the internal parts also.

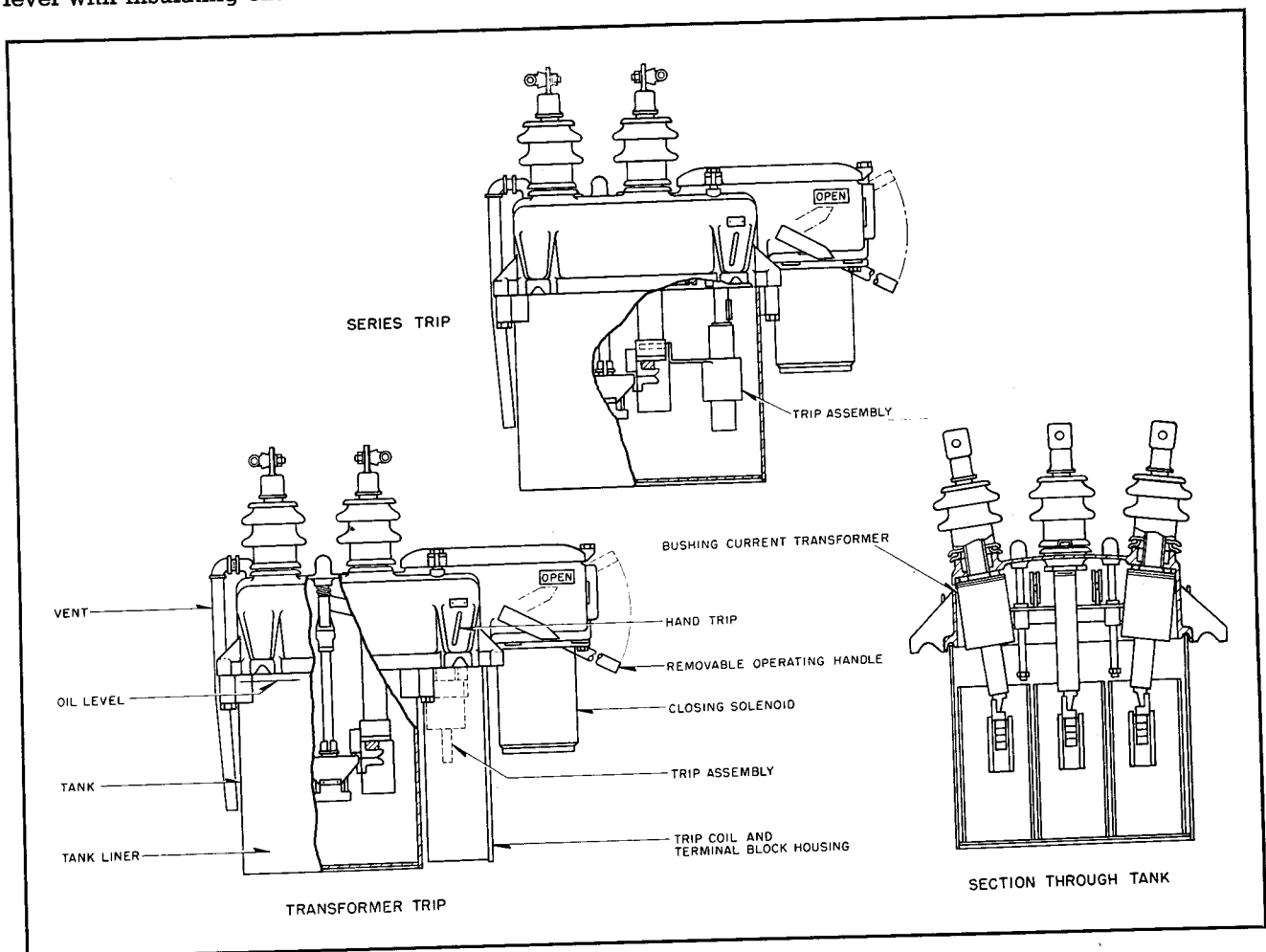


FIG. 1. General Assembly Views

## INSTALLATION

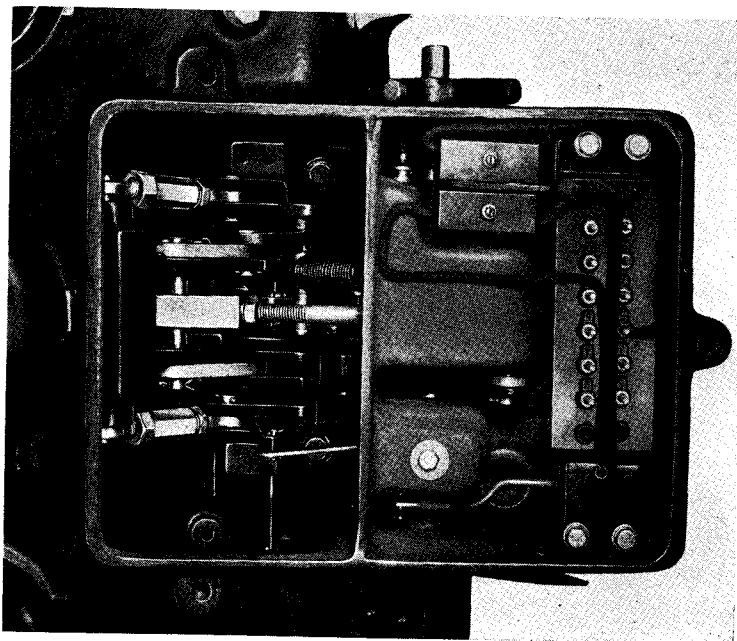


FIG. 2. Mechanism Assembly (Top View)

5. Examine the contacts to see that they are clean and in alignment. For adjustment, see section covering "Adjustments" beginning on page 5.

6. Operate the breaker by hand several times, watching each contact and the operating mechanism to be sure that all parts move freely.

**Caution:** Always remove the hand closing lever after closing breaker. Do not trip breaker when lever is in place.

7. Install connections to the breaker studs. All contact surfaces should be cleaned and made free of burrs. The terminal studs are not designed to be subjected to undue strain due to cable or bus loads. Any excessive strain may loosen the porcelain weather casing and permit moisture to enter.

8. With the tank removed, fill with oil in accordance with name plate instructions. When bolting in place, be sure the tank is drawn up evenly and tightly all around.

9. Connect the breaker frame to ground. The National Electric Code requires grounding cable to have one-fifth the main circuit capacity, except that it must never be smaller than No. 8 and need not be larger than No. 0.

10. Run the conduits to the breaker mechanism and transformer trip coil housing (when supplied). See the outline drawings (Figs. 21 and 23) for conduit locations.

11. Connect the control and transformer circuits according to the diagram furnished. Control voltage marked on the name plate should be maintained at the coil with the coil energized.

**Caution.** Always be sure the current transformer secondary connections are completed before impressing primary current on the breaker.

12. Check the operation of the breaker and attachments when operating electrically.

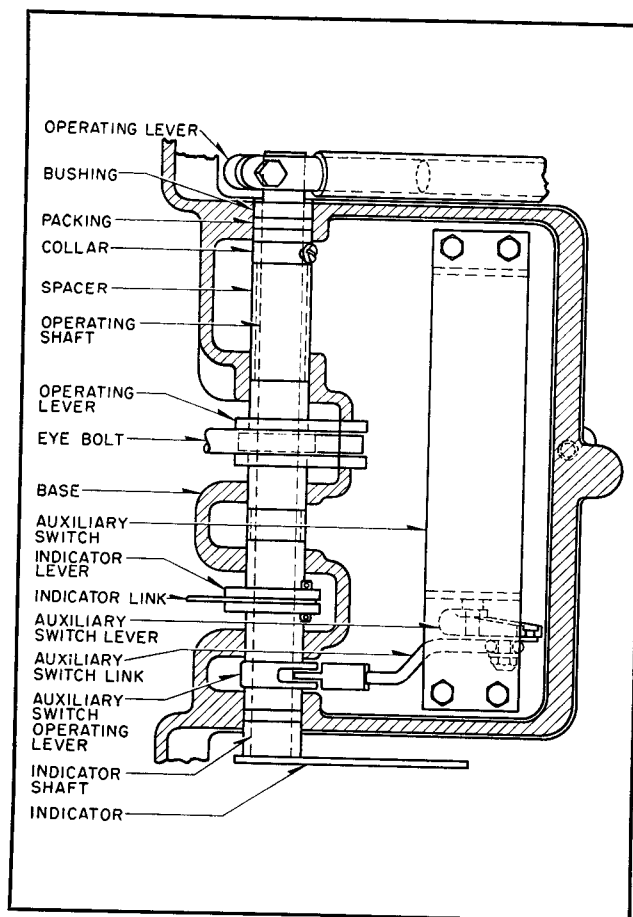


FIG. 3. Manually Operated Lever Assembly

# ADJUSTMENT

## CONTACTS

The contact arrangement is shown on Fig. 4. The main and arcing contacts are both of the butt type, the arcing contacts leading the main contacts by approximately  $\frac{1}{4}$  inch. The contact pressure on the main contacts is obtained by the compression spring. With the breaker closed the top of the main moving contact should be  $\frac{1}{4}$  inch below the shoulder on the lift rod end. If necessary to adjust, remove the moving arcing contact bracket with arcing contacts, loosen the lift rod end and turn the assembly up or down as necessary.

It is important that the  $\frac{1}{4}$ -inch dimension be maintained as this determines the main contact pressure. A limited amount of horizontal adjustment can be secured, when replacing a terminal, by loosening the clamp nut and shifting it in the top casting.

The main contacts make a silver-to-silver contact and it is therefore unnecessary to use an abrasive to keep them clean. The oxide of silver does not increase the contact drop. In fitting new contacts it is not necessary to secure perfect line contact—good contact is obtained after a few operations, the silver flowing slightly under the pressure.

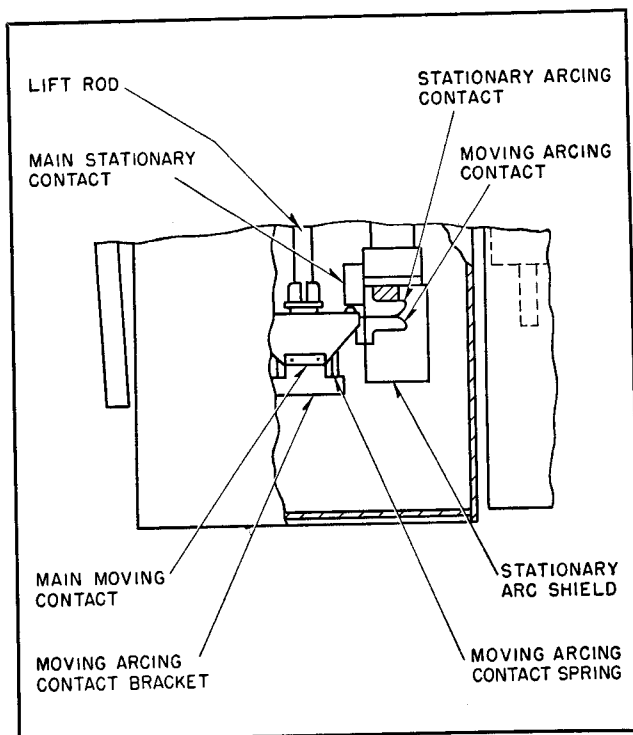


FIG. 4. Contact Arrangement

## DE-ION\* INTERRUPTERS

The De-ion Interrupters control the arc and quickly extinguish it by de-ionization. These devices need little attention other than an occasional inspection. They must be kept tight and properly aligned so that the moving contacts move freely. The fiber insulation should be inspected occasionally and assembly replaced if excessive deterioration is found.

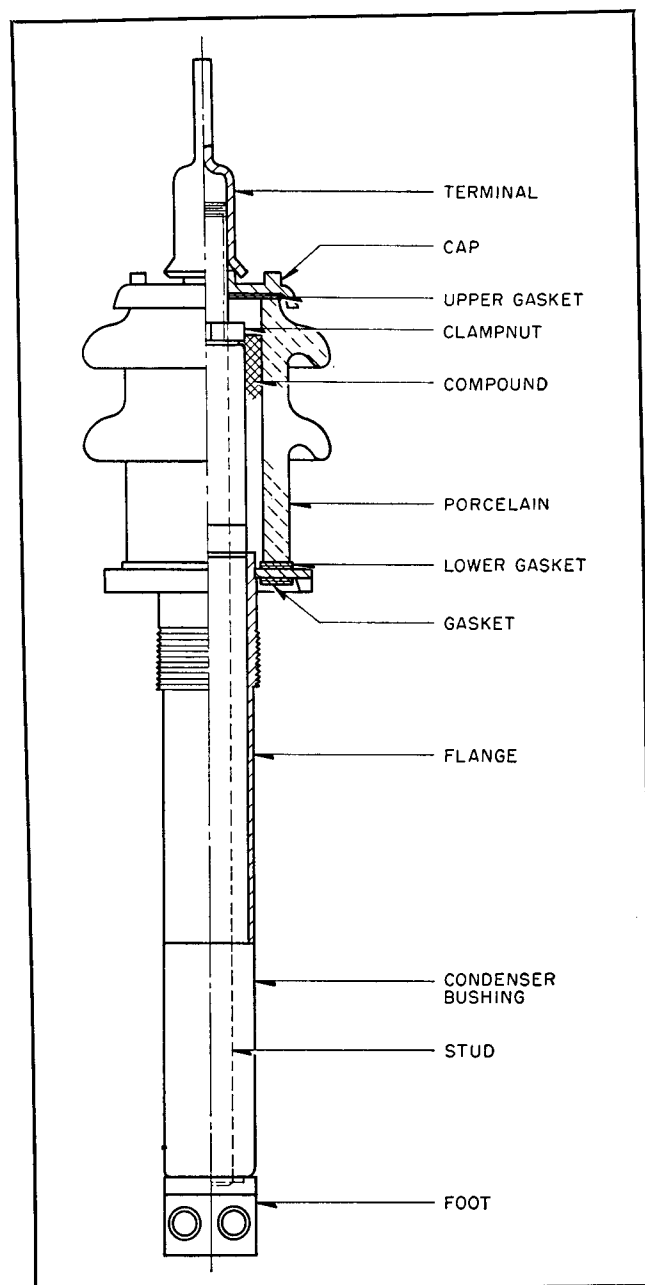


FIG. 5. Condenser Bushing

\*Registered trade-mark

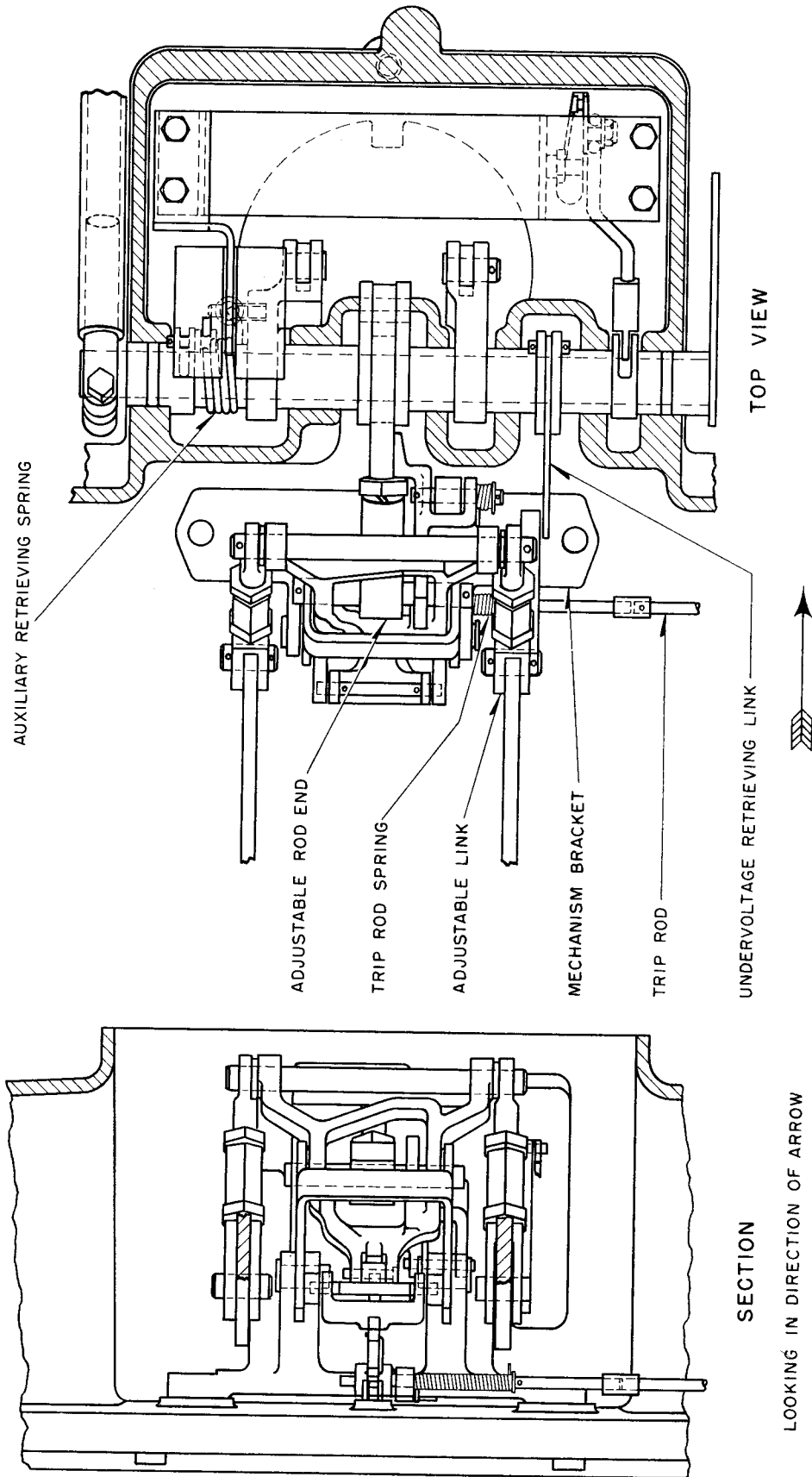


FIG. 6. Operating Mechanism (Top and End Views)

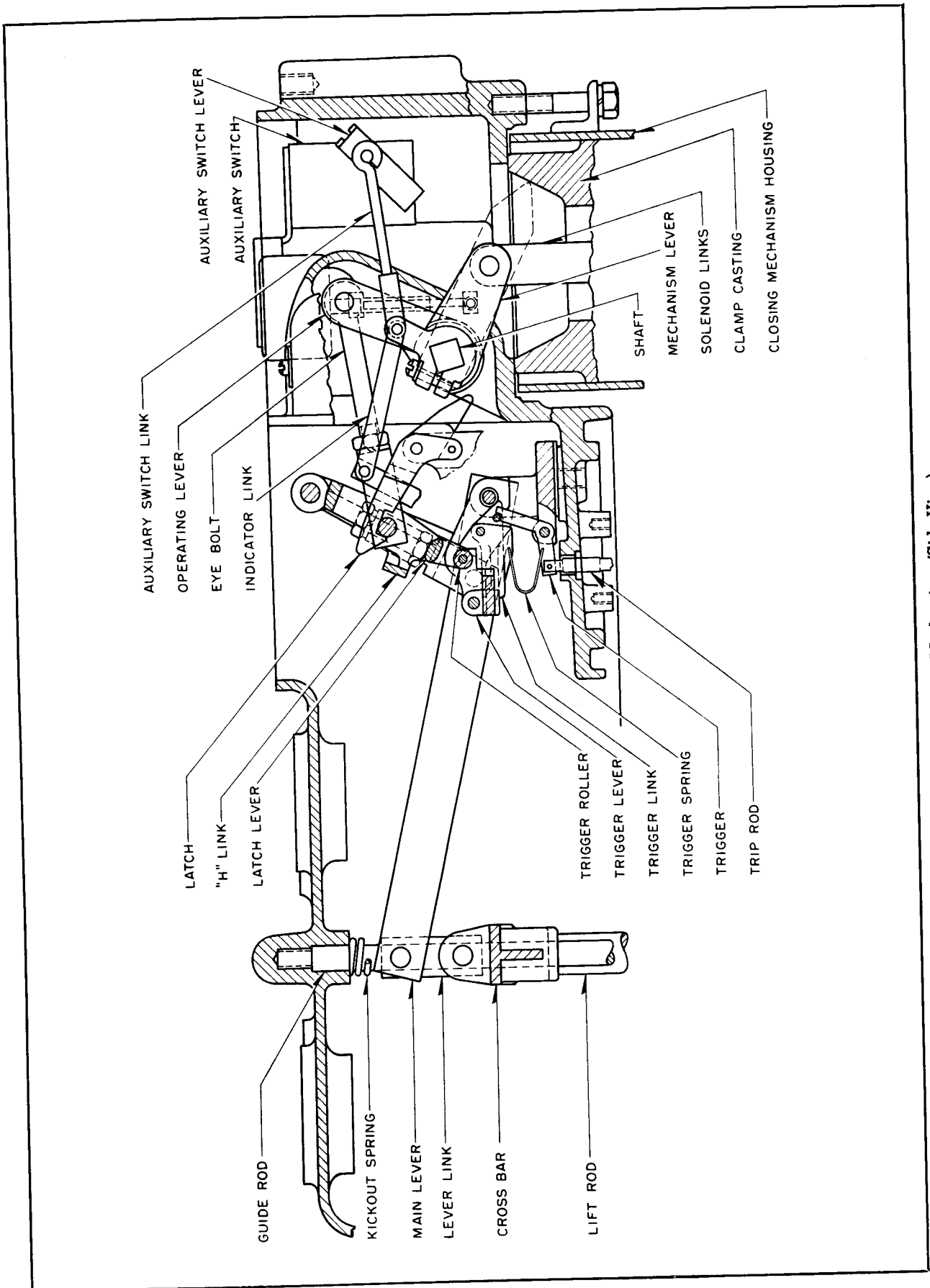


FIG. 7. Operating Mechanism (Side View)

## ADJUSTMENT

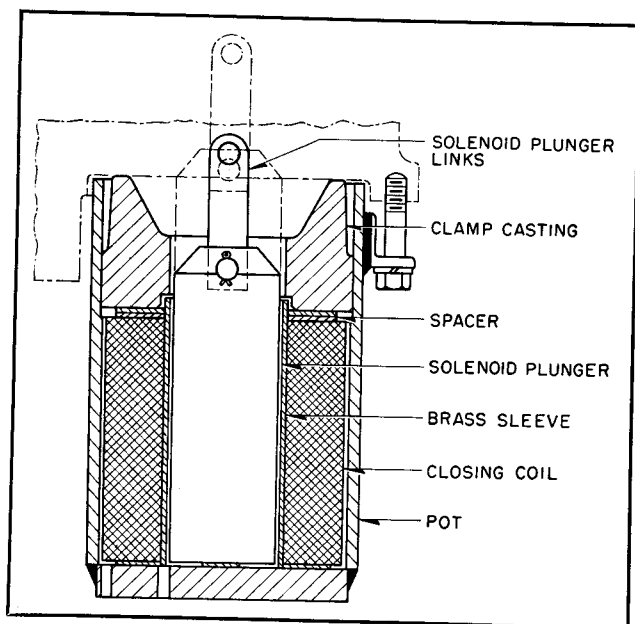


FIG. 8. Solenoid Operating Mechanism

## MECHANISM

The guide rods, Fig. 7, are used to align and guide the moving contacts for straight line motion. The crossbar must move freely on these rods. The lower end of the guide rods and part of the crossbar cooperate to form hydraulic bumpers. No adjustment is necessary, other than to be sure the moving contacts open to the full position. Do not operate the breaker excessively without oil in the tank.

When the operating shaft is rotated to the closed position, by either the solenoid or the operating handle, the operating shaft dog engages the operating lever which is connected to the trip free mechanism by an eye-bolt and an adjustable rod end and closes the breaker. The breaker is held in the closed position by the latch. The breaker is tripped manually by the hand tripping lever. When the breaker trips automatically the tripping bar strikes the tripping pin, which in turn strikes the trigger; the trigger is disengaged from the trigger lever bracket which drops and permits the latch lever to rotate upward and open the breaker. During the last part of the latch lever rotation, it strikes the latch and allows the trip free mechanism to retrieve.

The only adjustment possible on the mechanism is that for securing the proper setting of the trigger lever back-lash (distance between the trigger roller and trigger lever latching surface). This distance should be approximately  $\frac{1}{64}$  inch. Adjustment is secured by means of the trigger back-lash adjusting screw.

Care should be used to see that the operating lever does not strike the web of the top casting when in the closed position.

## D-C OPERATION

**Solenoid.** The solenoid bolts directly to the under side of the top casting and is connected to the mechanism through the mechanism levers on the operating shaft. When replacing a closing coil it is only necessary to observe that the mechanism top rests firmly on the brass tube and coil and that the housing is placed against the proper groove in the top casting. The solenoid must operate without friction.

The solenoid plunger stops against the stationary core with not over  $\frac{1}{16}$  inch back-lash between the latch and the roller in the latch lever. This adjustment is secured by lengthening or shortening the eye-bolt and adjustable rod end linkage connecting the operating shaft and the mechanism.

## SHUNT TRIP ATTACHMENT

The shunt trip attachment as shown in Fig. 9 is mounted in the right side of the top casting (facing mechanism end) by the two mounting bolts indicated.

Be sure that the set-up is rigid and agrees with the illustration.

Connect lead from the external circuit to the terminals on the shunt trip coil. The shunt trip circuit should be run through an auxiliary switch contact to interrupt the tripping current when the breaker opens. Check the control voltage on the name plate to make sure that it agrees with that on which the attachment is to be used.

When transformer trip coils are included a shunt trip coil as shown in Fig. 17 is used in place of that in Fig. 9.

## UNDervoltage RELEASE ATTACHMENT

This attachment, shown in Fig. 10, is mounted in the left side of the top casting (facing mechanism end) by means of the two mounting bolts indicated. In operation the retrieving spring brings the armature to the position shown when the breaker opens, with the holding dog keeping it there when the breaker closes. The holding dog is moved back out of position at the end of the closing stroke. The magnet drops and trips the breaker through the tripping link if voltage is not impressed on the coil. Be sure that the set-up is rigid and agrees with the illustration.



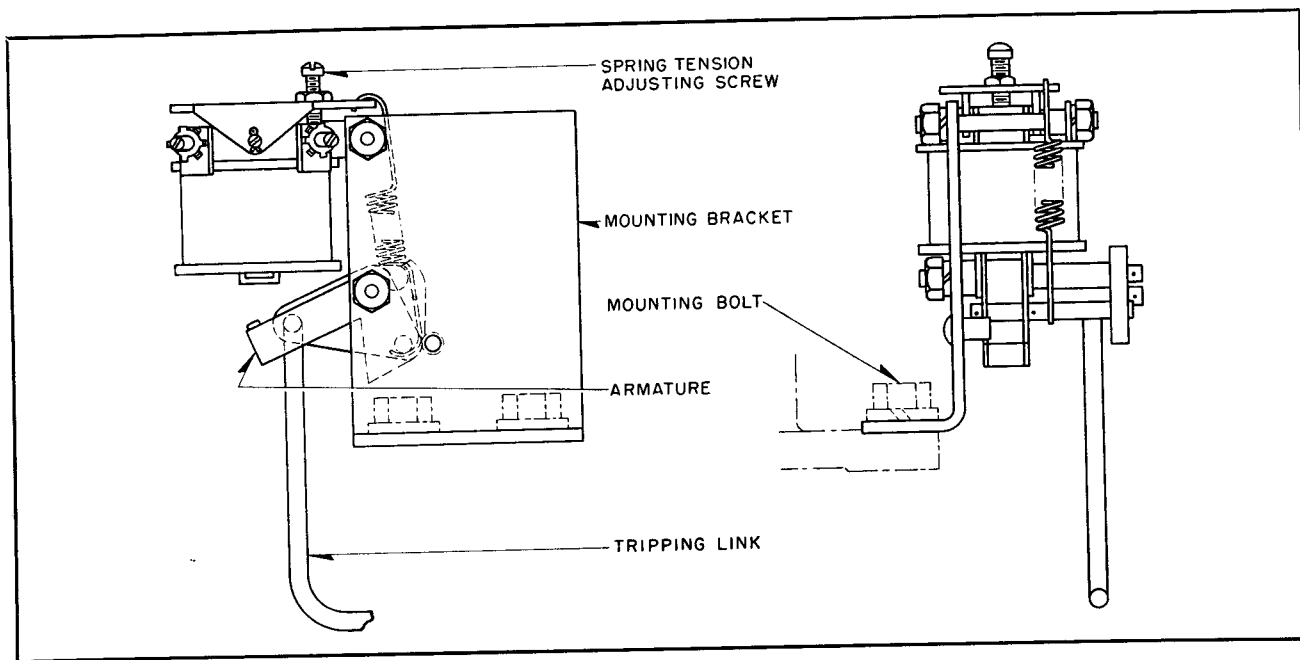


FIG. 9. Shunt Trip Assembly

Connect the leads from the external circuit to the terminals on the undervoltage coil. The undervoltage coil should be connected directly across the line, but should be protected by fuses. The undervoltage coils should be connected to the line side of the breaker. Check the control voltage stamped on the name plate to make sure that it agrees with that on which the attachment is to be used.

Make sure that the retrieving spring retrieves the armature to within  $\frac{1}{16}$  inch of the stationary core

with the breaker in the open position. If this dimension is exceeded and normal voltage is applied, the coil will burn out. Check to see that armature is pulled up against stationary core when coil is energized.

If noise develops, the faces of the armature and stationary core should be examined to see that a good clean seat is obtained when they are together. If necessary to clean these faces, be sure to leave them bearing over their entire area.

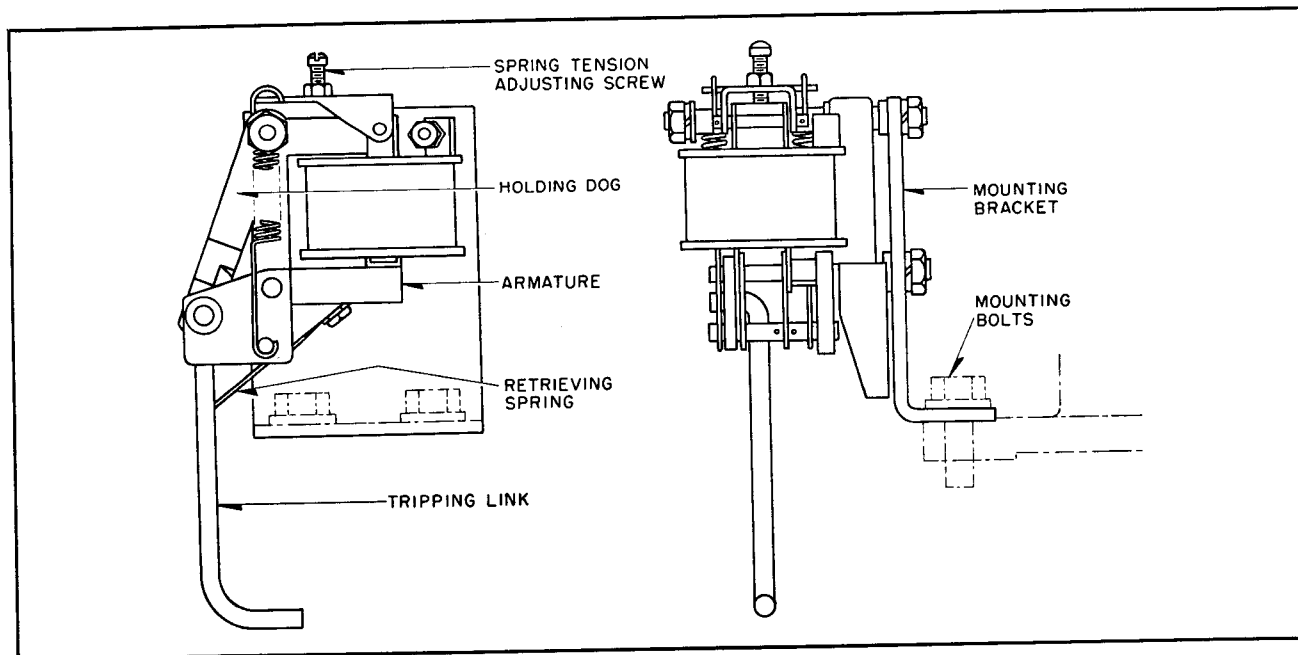


FIG. 10. Undervoltage Trip Assembly

## ADJUSTMENT

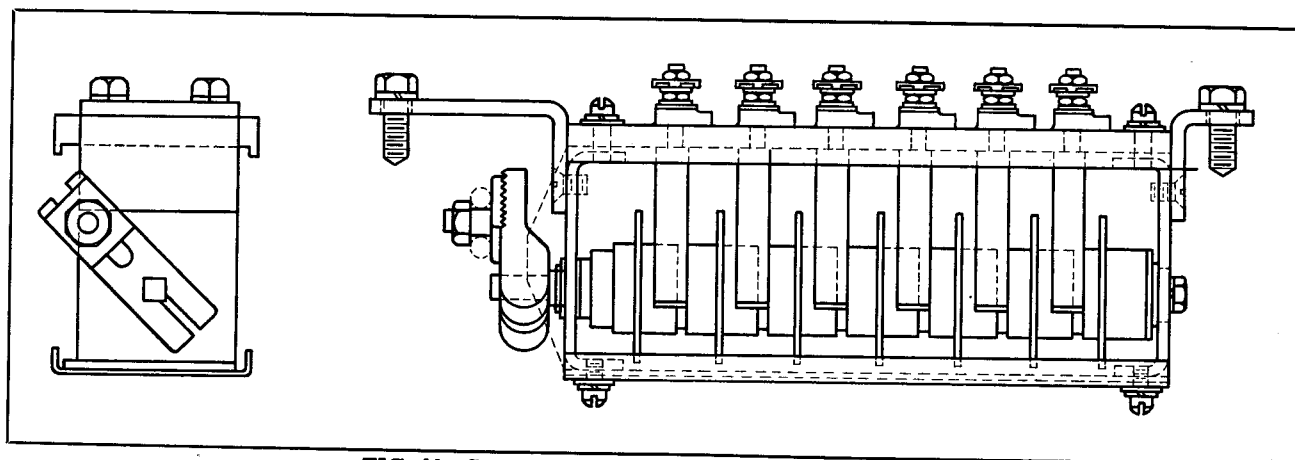


FIG. 11. Six-Pole Rotary Auxiliary Switch Assembly

### AUXILIARY SWITCH

The auxiliary switch is mounted in the top casting and connected to the switch lever on the operating shaft as indicated in Figures 7 and 11. The contacts should be inspected from time to time to insure that burning has not proceeded to a point where stubbing is eminent, particularly on contacts carrying shunt trip circuit.

The individual contact fingers and the rotor segments are replaceable.

The rotor should travel approximately 90 degrees. Adjustment is obtained by changing the length of the operating arm. The fingers should be approximately centered on the rotor cam. Adjustment is obtained by lengthening or shortening adjustable link connecting to mechanism.

### CUTOFF SWITCH

A plunger type switch (Fig. 12) mounted in line with rotary auxiliary switch closes its contacts when the breaker closes, and is connected in control relay panel circuit so as to open the relay and de-energize solenoid when breaker reaches closed position. A second, similar switch except with contacts normally closed is added when reclosing equipment is added.

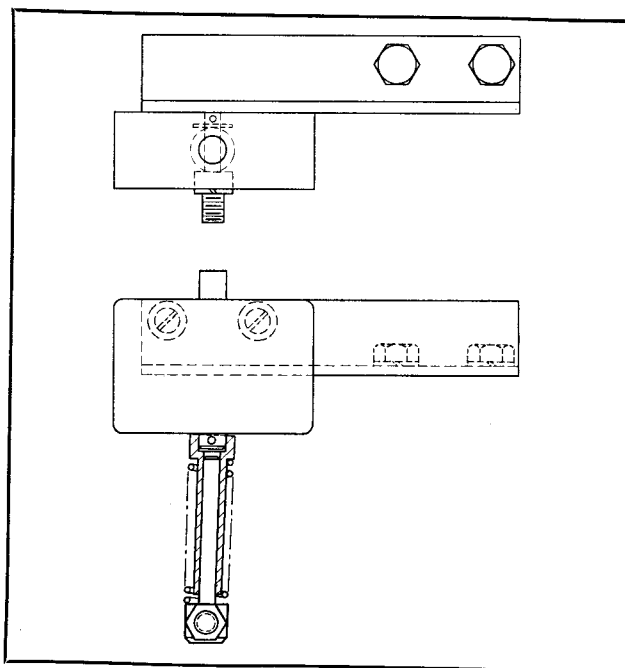


FIG. 12. Single Pole Plunger Switch

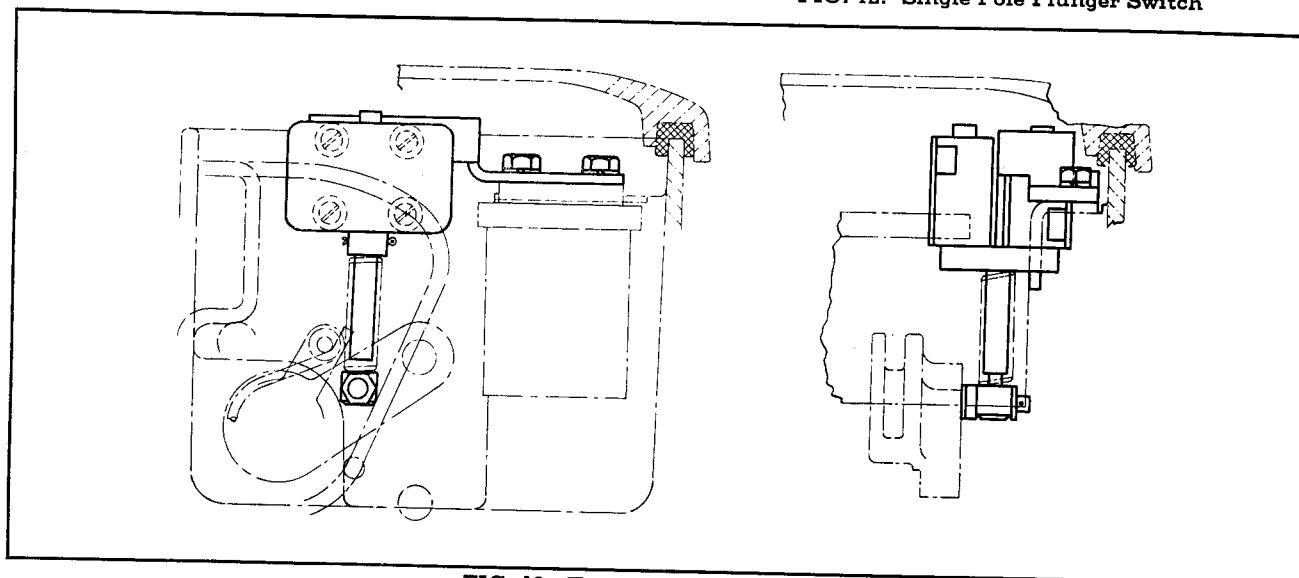


FIG. 13. Two-Pole Plunger Switch

**SERIES TRIP ATTACHMENT**

The series trip attachment mounts on the series trip coil mounting plate and is connected to the series trip mechanism as indicated in Figures 14 and 15.

The push rod adjusting nut is used to adjust the distance between the moving and stationary cores so that the various coils will pick up and trip the breaker at the same current. It is sometimes necessary to file the tops of the push rod so that the trigger is released, tripping the breaker, during the last  $\frac{1}{16}$  inch of the moving core travel. The greatest tripping power is developed when the moving and stationary cores are close together.

The calibration for the series trip coils can be changed by removing the calibration rod cap, loosening the calibration rod clamp and screwing the calibration rod up or down until the proper marking is flush with the top of the calibration rod clamp. Be sure to tighten the clamp after adjustment. If a setting in between the actual markings is required, the actual markings can be interpolated with reasonable accuracy.

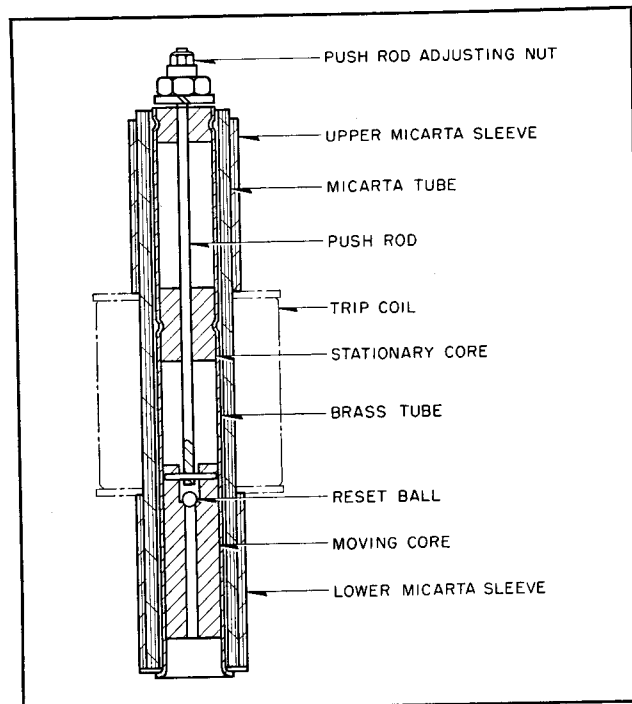


FIG. 14. Series Trip Attachment

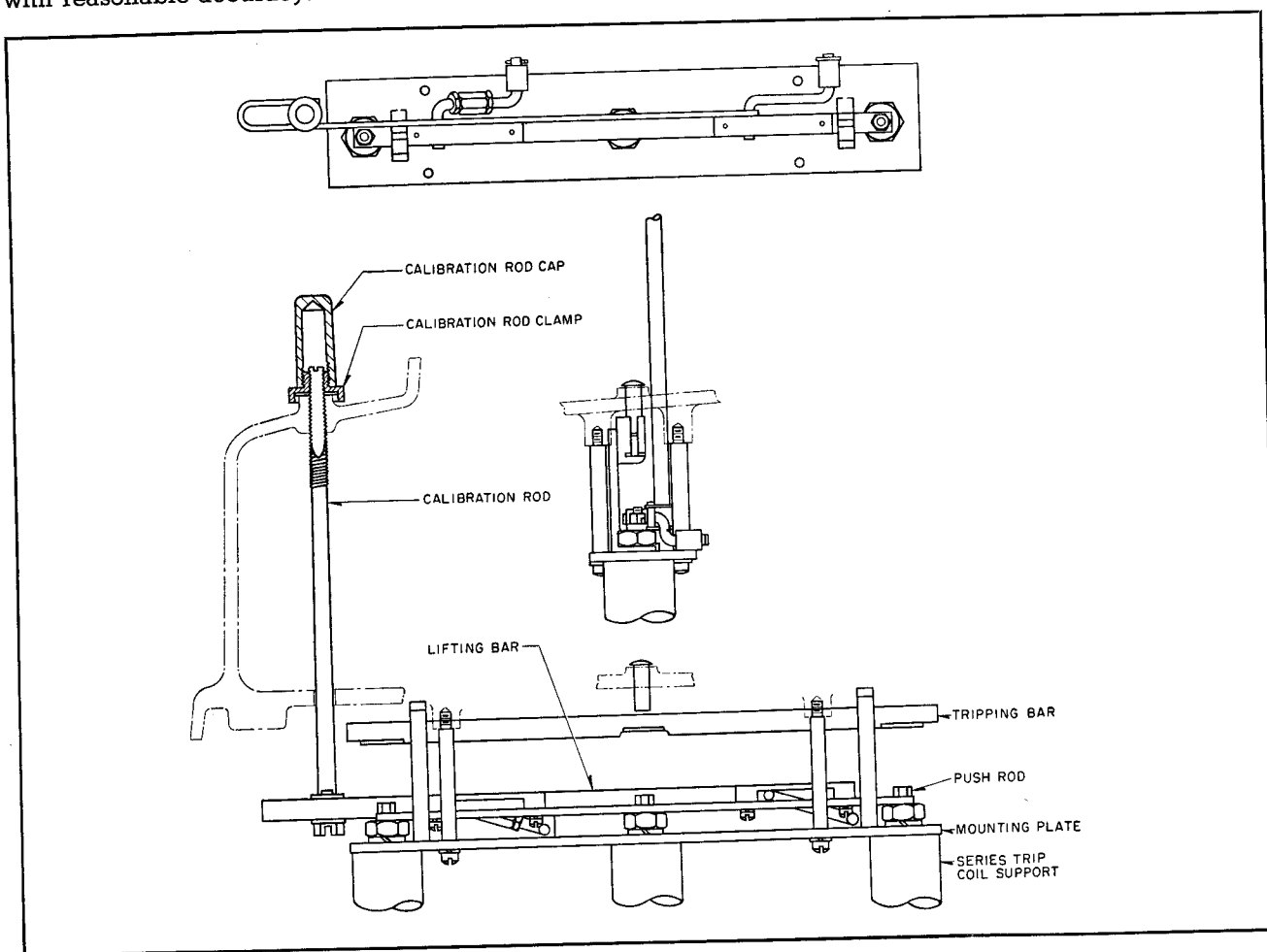


FIG. 15. Series Trip Assembly

## ADJUSTMENT

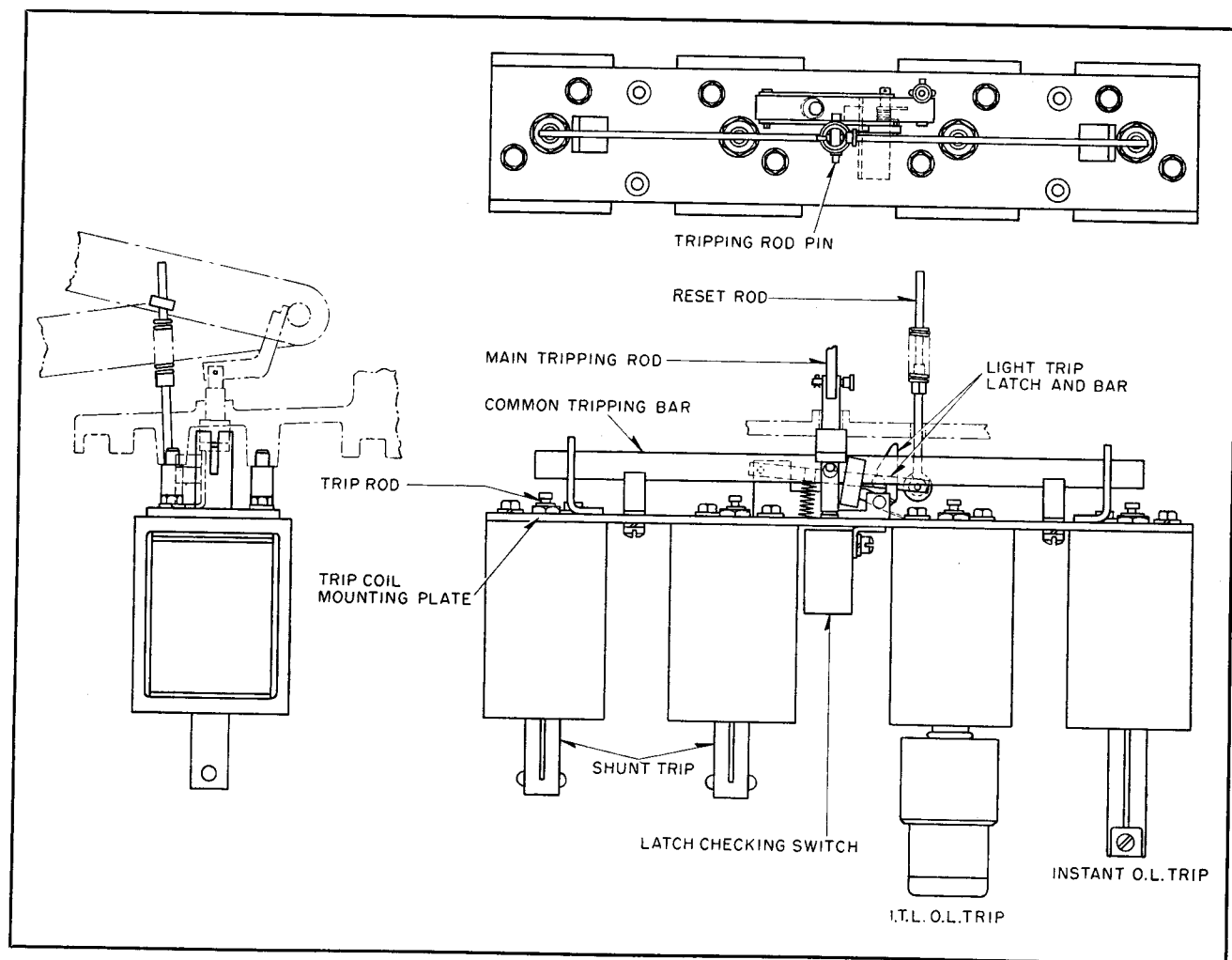


FIG. 16. Transformer Trip Assembly

### MINIMUM PRIMARY TRIPPING CURRENT OF FO-22-A BREAKERS WITH BUSHING TYPE, SINGLE RATIO TRANSFORMERS

TRANSFORMER RATING IN AMPS. (5-AMP. SECONDARY)	SECONDARY TURNS	WITHOUT RELAYS INST. TRIP AND I. T. L. (5 AMPS.)	WITH CIRCUIT CLOSING RELAY AND SHUNT TRIP COIL *	WITH CIRCUIT OPENING RELAY AND INST. TRIP ATTACHMENT (4 AMPS.)	WITH CIRCUIT CLOSING RELAY AND DIRECT TRIP ATTACHMENT (5 AMPS.)	PRIMARY CURRENT FOR FULL SCALE DEFLECTION ON SECONDARY AMMETER†
50	7	...	40†	...	...	50
75	11	...	65†	...	...	75
100	17	...	80	...	...	100
125	19	...	100	...	...	125
150	26	150†	120	150†	...	150
200	37	200	160	200	...	200
250	48	250	200	240	...	250
300	58	300	240	275	300†	300
400	78	400	320	370	400†	400
500	98	500	400	450	500†	500
600	118	600	480	525	600†	600

† Two transformers in series.

\* 4-ampere tap. Breaker will trip at 125% of these values on 5-ampere tap.

‡ Requires special calibration.

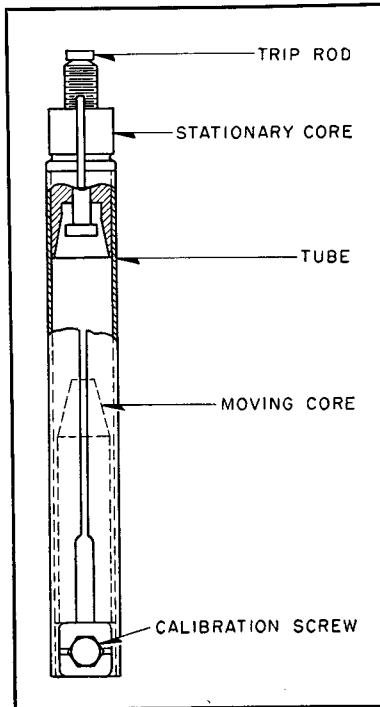


FIG. 17. Overload Attachment

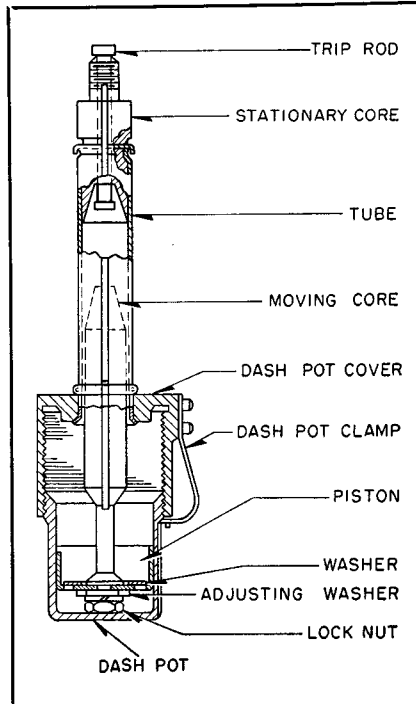


FIG. 18. Inverse Time Limit Attachment

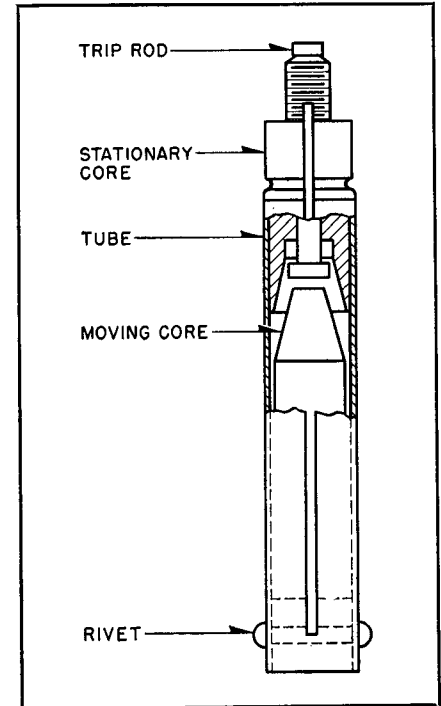


FIG. 19. Shunt Trip Attachment

## BUSHING TYPE CURRENT TRANSFORMERS

The breaker may be equipped with a maximum of six multi-tap type current transformers. The table on page 12 indicates the minimum primary tripping currents for the various attachments.

## TRANSFORMER TRIP ATTACHMENTS

Space is provided for a maximum of three trip coils to operate from the bushing current transformers. They may be instantaneous in action or have a dashpot to give delayed action. They are assembled as shown in Fig. 16. They are calibrated 5 to 9 amperes. Calibration is changed on the instantaneous type by loosening the clamping screw and shifting the calibration plate as desired. This changes the air gap between the stationary and tripping cores.

On time delay type the pot is screwed in or out of the stationary member so as to vary the air gap. Variation in the time delay is obtained by shifting the disk inside the dashpot so as to uncover more or fewer holes. The loose washer acts as a check valve to permit rapid resetting.

The time delay is proportional to the viscosity of the oil used in the dashpot and to the amount of overload. When extremes of heat or cold are encountered special oils may be required. The curves in Fig. 20 show some of the variations that can be expected.

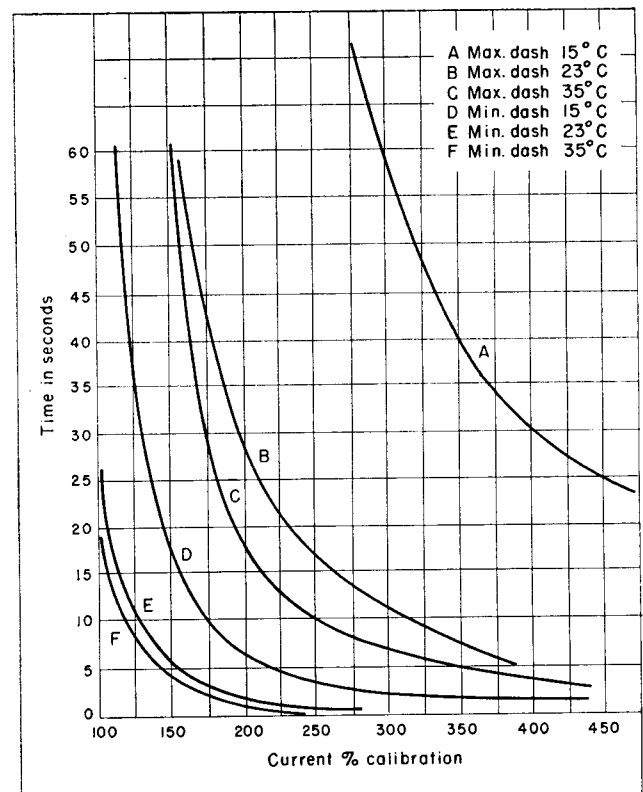


FIG. 20 Approximate Time Overload Characteristics of the Inverse Time Limit Attachment Used with Standard Dashpot Oil as Supplied

## ADJUSTMENT

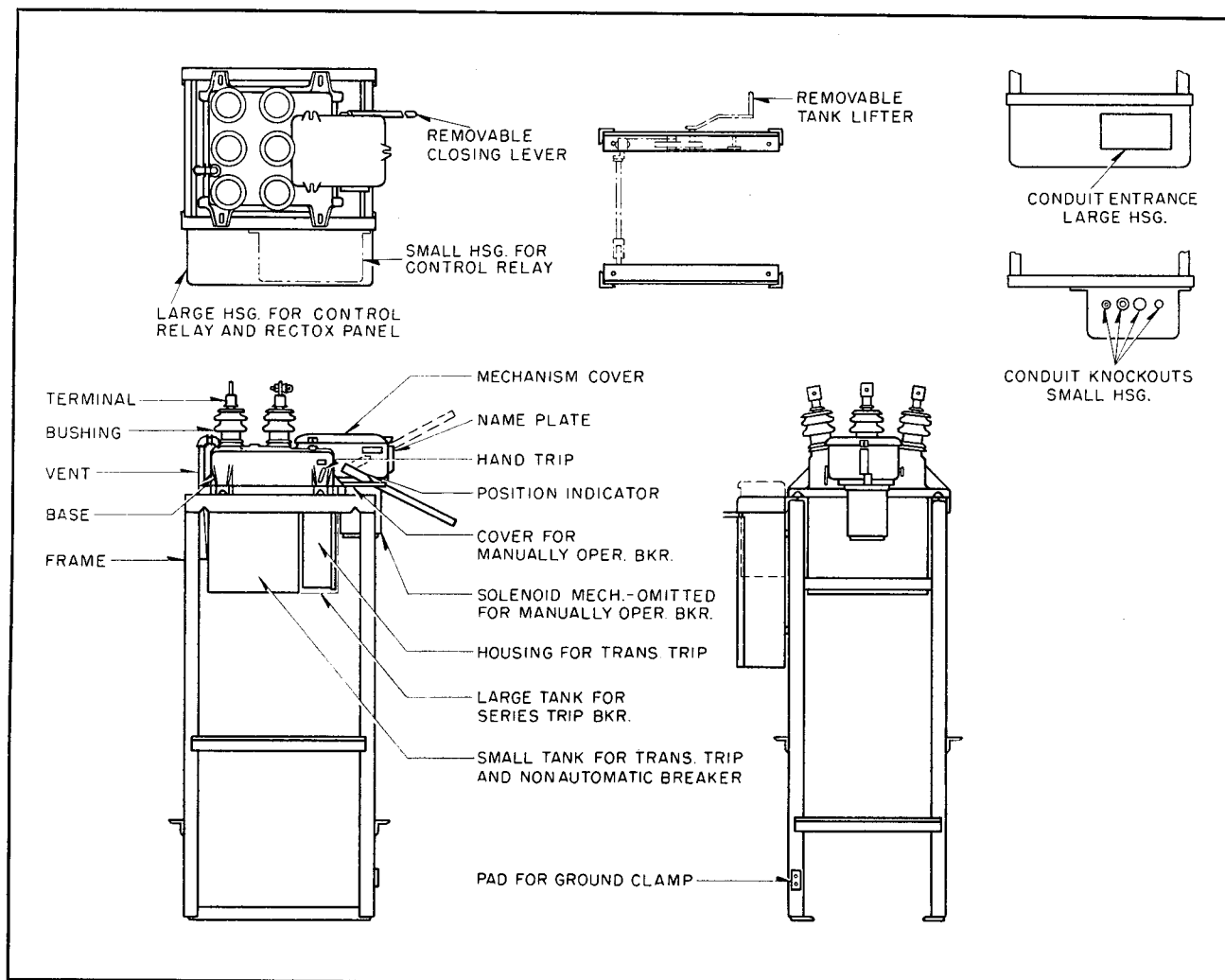


FIG. 21. Side Mounted Housings

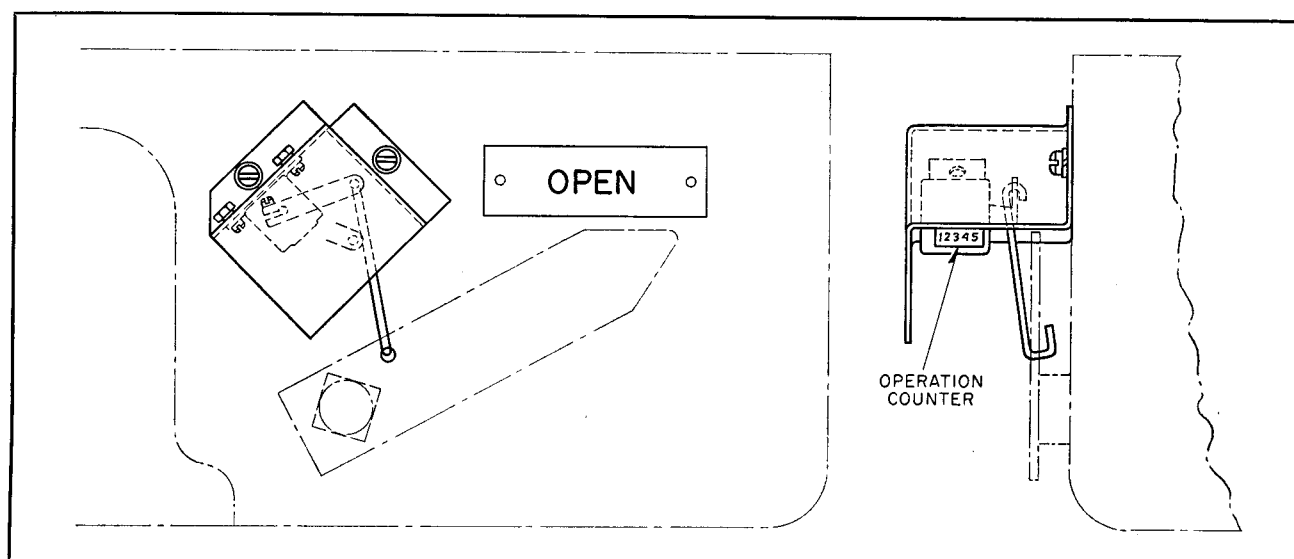


FIG. 22. Operation Counter Assembly

Note: Operation counter is supplied on special order. Standard with reclosing equipment.

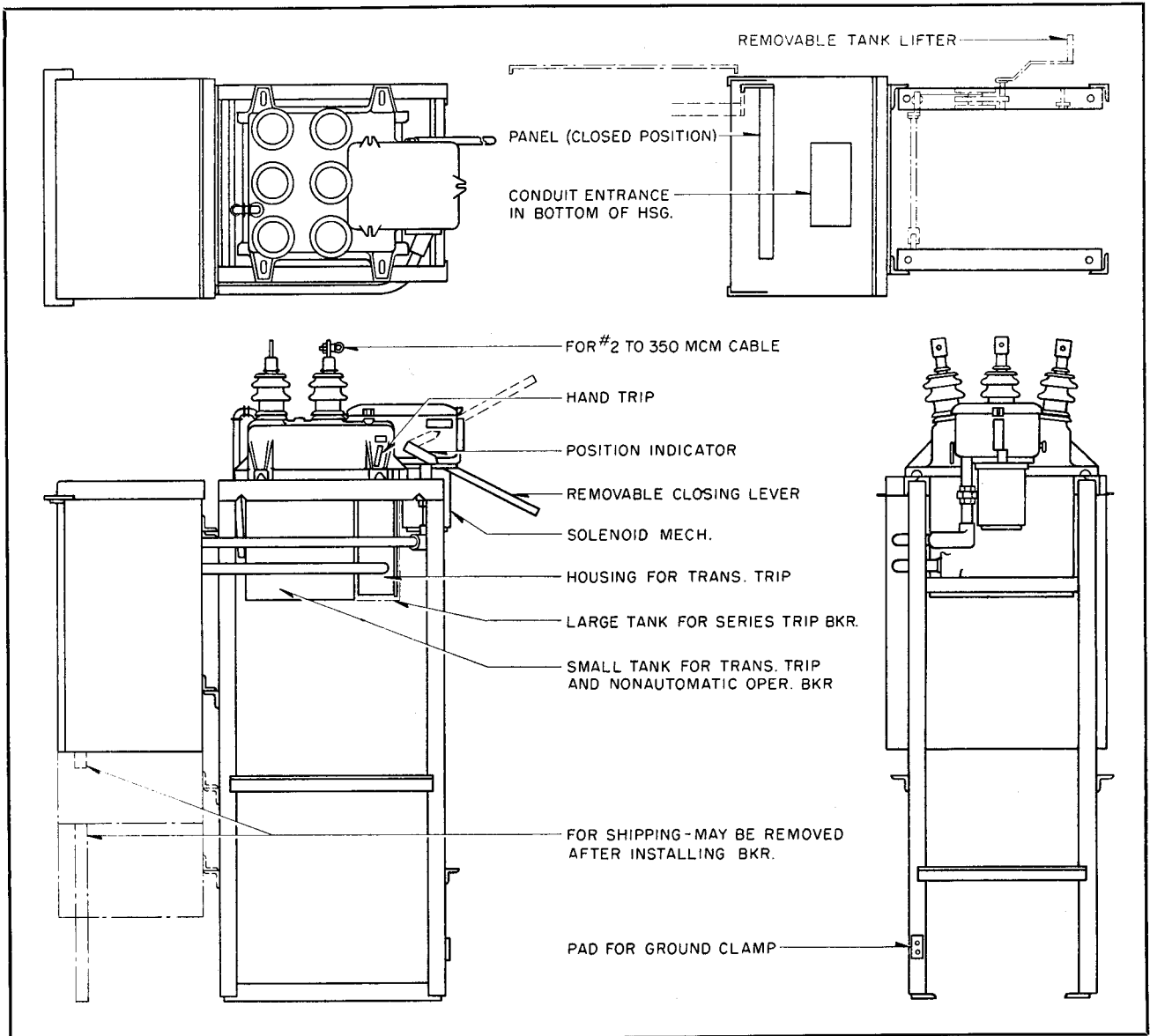


FIG. 23. Outline—Rear Mounted Relay Housings

# MAINTENANCE

## INSULATING OIL

Dielectric test of the oil should be made after particularly frequent or heavy duty or at approximately 6-month intervals. Moisture or sludge developed during operation tends to settle in the bottom of the tank. To obtain an average operate the breaker several times before taking the test sample.

## CARE OF INSULATING OIL

The care of insulating oil in circuit breakers is of the utmost importance in successful operation. Contamination by dirt, moisture, metallic particles, lint, etc. reduces the dielectric strength upon which the operation and current interrupting ability largely depend. Consequently, the most careful attention should be given to keeping the oil clean,

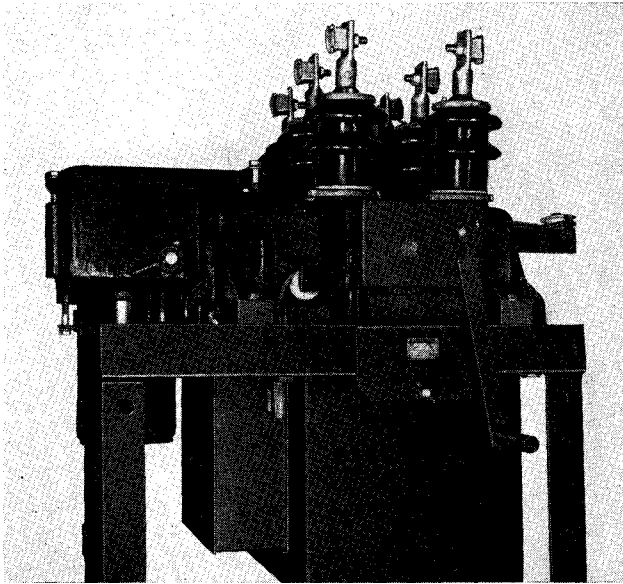


FIG. 24. Tank Lifter Assembly

not only in filling the tanks originally, but in later maintenance or other work on the breakers which might involve opening the tanks.

Only the highest grade oil such as Wemco "C" or other approved oil, should be used in the breakers. The oil should be new or thoroughly reconditioned by means of a filter press or centrifuge. In any case, before using, it should be given a dielectric test which should show a minimum of 22,000 volts (preferably 25,000 to 30,000) measured in a standard test cup between 1-inch diameter discs spaced 0.1 inch apart.

Before filling, the tanks should be thoroughly cleaned and flushed out with insulating oil. In doing this, rags which will leave lint should not be used as this absorbs and holds moisture.

Care should be used during inspection or maintenance work on the breaker, which should preferably be done under favorable weather conditions. If the oil is to be reconditioned following operation of the breaker under short-circuit, the tank, and entire inside of the breaker should be cleaned before the oil is returned to the tank. If the work merely involves lowering or removal of the tank, care should be taken to keep the tank covered until it is replaced so that dirt, dust, metallic particles, etc., cannot fall into the oil.

For instructions as to the care and testing of insulating oil, see Instruction Book 44-820-1A.

### **TANK LIFTER**

When preparing to lower the tank mount the tank lifter on the frame on the right side and clamp in place. Remove the left rear and right front tank bolts, loosen the other two tank bolts. Hook the cable ends into the bolt loops in the tank and take up a slight tension on the lifter cable. Remove the other two bolts and lower tank. In replacing tank do not attempt to pull tank home into final position with the lifter. Use the bolts, tightening them evenly, to put the tank into final position.

### **TERMINAL BUSHING**

The surface of the condenser-bushing insulation should be smooth and well varnished. If the varnished surface is damaged it should be smoothed with fine sandpaper and revarnished with three coats of good quality, clear, air-drying varnish. Each coat should be allowed to dry 24 hours.

### **MAINTENANCE PROCEDURE**

The following points should be observed in maintenance.

1. Before touching the breaker make sure that all lines are electrically dead.
2. Be sure the breaker frame is grounded.
3. Do not operate the breaker excessively when the tank is removed.
4. Examine all contacts occasionally and especially after short-circuit interruption. See that the contacts are properly aligned. Smooth off any roughness with a file. Replace arcing contacts when burns penetrate  $\frac{1}{16}$  inch or more.
5. After making any adjustments, operate the apparatus carefully by hand to make sure that it operates smoothly and correctly.
6. Inspect the oil and check with standard test cup. If test is below 17 kv replace the oil.
7. When replacing oil thoroughly clean the tanks, tank liners, lift rods, and terminal bushings. Use only washed rags so as to avoid lint.
8. Whenever breaker is opened inspect all spring cotters and bolts to see that they are in place.
9. Keep the bearing surfaces of the mechanism and breaker adequately oiled.