

ALLIS-CHALMERS

**INSTRUCTION
BOOK**

**TYPE "F" MOVABLE PORTION
FB-250A**

**RUPTAIR MAGNETIC POWER CIRCUIT BREAKER
AND AUXILIARY EQUIPMENT (SOLENOID OPERATOR)**

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PART 1. DESCRIPTION

1.1 GENERAL

The Allis-Chalmers *Ruptair* movable portion consists of a magnetic circuit breaker for metal-clad switchgear application, with auxiliary equipment suitably arranged for best function and easy installation. As part of standard equipment, each order is furnished with one maintenance closing device for solenoid operated breaker or a charging crank for stored energy operated units.

The *Ruptair* magnetic circuit breaker differs essentially from oil breakers and air-blast breakers in that it does not depend on any stored medium such as oil or compressed air for arc interruption. The component parts of the breaker are mounted in a structural steel frame. The operator, the operating shaft, and connecting links are mounted on the lower section of the breaker frame and are well shielded. The horizontal terminal studs, which are insulated with flame retardant tubing, extend through the breaker bracket and support the other parts of the electrical circuit. Interruption occurs within the arc chute assemblies which are mounted at the top, over the contact structures.

1.2 METHOD OF ARC INTERRUPTION

Interruption is accomplished in air at atmospheric pressure, with the aid of a self-induced magnetic blowout field and air draft. At the time the trip coil is energized, current is being carried through the main contacts. As the movable contact assembly separates from the stationary contact assembly, the current transfers very quickly from the main contacts to the arcing contacts, thus keeping the main contact erosion to a minimum. (For breakers equipped with tertiary contacts, the current transfers from the mains, to the tertiary and then to the arcing contacts.) As the movable contact assembly continues its stroke, the arcing contacts part, drawing a power arc, which is transferred first to the stationary end arc runner, then to the moving end arc runner. The transfer of the arc to the arc runners establishes the full flow of current through the blowout coils, setting up the magnetic field which, in accompaniment with natural thermal effects of the heated arc, the configuration of the current carrying circuit, etc., tend to force the arc upward into the barrier stack. The cool surfaces of the barrier stack cool and deionize the arc, while the "Vee" slots in the stack reduce its cross-section and elongate it.

The arc runners are made of wide, heavy material for maximum heat dissipation and to minimize metal vaporization. To facilitate interruption of low currents, a puffer assembly provides a movement of air through the contact area to aid the magnetic field in moving the arc into the barrier stack. All of the above effects work together to increase the resistance of the arc and enable it to be extinguished at an early current zero.

PART 2. ADJUSTMENTS

2.1 GENERAL

The Breaker has been completely set up, adjusted and tested at the factory.

Adjustments should not have to be made nor fastenings tightened when the breaker is received. If there is visible damage or breakage due to shipment, storage or installation, the adjustments should be checked and corrected, if necessary, before breaker is operated electrically.

Manual operation (use maintenance closing device) of breaker should be used for preliminary operation to see that all parts are free and work smoothly. The bushings and other insulating parts should be clean and dry. All contact surfaces should be inspected to see that they are clean and smooth. (Do not dress silver surfaces.) Removal of all phase barriers and removal or raising of arc chute assemblies gives access to breaker for checking adjustments.

CAUTION: Before removing any part, make sure that the breaker and its operating mechanism is disconnected from all electric power and that this breaker is in the open position.

PART 3. SOLENOID OPERATOR

3.1 SOLENOID OPERATOR (Fig. 4)

A solenoid operator is an integral part of this type of breaker unit. (For breakers equipped with the stored energy closer, see separate instruction book.) It is mounted in the lower section of breaker and is contained within the breaker frame. The operator is furnished with a mechanically trip-free mechanism consisting of a 4-bar toggle linkage so designed as to provide quick and positive tripping at any position of the closing stroke. The operator mechanism is of low inertia, capable of quick acceleration, and it is equipped with a low energy trip device and opening coil designed to provide high speed release of the trip mechanism upon energization of the trip coil.

3.2 CLOSING (Figs. 4 and 13)

Figure 13 shows the mechanism of the operator in the open position. Points "B", "F", "G" and "H" are fixed centers about which crank arms (2) and (3), link (6), trip latch (9), and prop latch (10) rotate respectively. Center "E" is a temporarily fixed center, being restrained by stop (11) and latch (9) as long as latch (9) is in position.

The closing force is applied by armature (4-4, 13-12) to toggle roll (4-15, 13-D). The toggle roll moves toward the right, forcing the toggle linkage (4-101, 13-5) and (4-102, 13-4) to an on-center or in-line position, thus rotating crank arms (4-73, 13-2) and (4-74,

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13-3) counterclockwise about pin (4-64, 13-B). Movement of crank arm (4-73, 13-2) upward forces link (1-47, 13-1) to move upward, thus rotating the disconnect arm counterclockwise, closing the breaker and charging the breaker opening springs (1-31, 13-7) and the reset spring (4-91, 13-8).

When toggle links (4-101, 13-5) and (4-102, 13-4) reach their final positions, prop latch (4-97, 13-10) drops behind toggle roll (4-15, 13-D) to lock the mechanism in the closed position as shown in Figure 14. After closing the breaker, armature (4-4, 14-12) returns to its normal position. Manual closing is as described except that armature (4-4, 13-12) is activated manually through the manual closing device.

3.3 OPENING (Figs. 4 and 15)

Opening of the breaker is accomplished either manually or electrically. Manually the breaker is tripped by pushing on the trip button (1-43) which rotates the trip latch (4-27, 15-9) in a clockwise direction. Latch roll (4-15A, 15-E) is released, enabling link (4-70, 15-6) to rotate clockwise about pin (4-69, 15-F). Since the restraining force on opening spring (1-31, 15-7) is now released they act to rapidly open the breaker contacts. Reset spring (4-91, 15-8) then acts to return the mechanism to the normal open position shown in Figures 4 and 13.

Electrical tripping is as previously described except that trip latch (4-27, 15-9) is rotated by the trip pin (4-17A, 15-13) which is actuated by the shunt trip coil (4-17, 15-14).

The tripping action previously described can take place at any time during a closing operation, either manual or electrical, and regardless of whether or not the armature is energized. Thus, the mechanism is electrically and mechanically trip-free in any position.

3.4 AUXILIARY EQUIPMENT

The auxiliary equipment consists of a secondary transfer device, control relay, auxiliary switch and closing rectifier as required. These are mounted on the lower portion of the breaker. The secondary finger contacts are wired such that when movable portion is moved into test or operating position in the cubicle the finger contacts engage the stationary contacts to complete the control circuit for operation of the breaker.

3.5 AUXILIARY SWITCH (Fig. 11)

The auxiliary switch (1-15) has been adjusted at the factory and should normally not require further adjustment. Each rotor (11-3) can be adjusted individually in steps of 15 degrees merely by pressing the contact to one side against the spring and rotating it within its insulated rotor housing until it snaps into the desired position.

3.6 LIMIT SWITCH (Fig. 4)

The limit switch (4-18) is located on the front of the operator frame and contains both the "a-a" and "b-b" stages of limit switch contacts. The switch has been adjusted before leaving the factory and should require no further adjustment.

If adjustment is required, the adjusting screw (4-103) should be adjusted so that with the breaker open and the arm (4-77) against the top pin, the "b-b" contact is closed with 1/32 to 1/64 overtravel left in the limit switch.

3.7 LATCH CHECK SWITCH (Fig. 4)

The latch check switch (4-1) is mounted on the bottom of the operator frame. The switch makes contact near the end of the reset travel of the lower link (4-70). Adjustment is made by moving switch bracket (4-66).

NOTE : The latch check switch may be jumped out or omitted except when the unit is used with a recloser relay.

3.8 INTERLOCK PLUNGER (Fig. 1)

The foot lever (1-20) operates the interlock plunger (1-18) as well as the trip latch. Depressing the lever trips the breaker and raises plunger (1-18) sufficiently to release the breaker, allowing it to be moved in the cubicle. The interlock is in proper adjustment when the plunger (1-18) is positioned to 1-11/16 to 1-13/16 above the floor line, and causes tripping of breaker contacts when it is raised to a level not more than 2-1/16 above the floor line. The latch tripping rod associated with the foot lever should be clear of the trip latch (4-27) by 1/32 to 1/16.

3.9 TRIP LATCH (Fig. 4)

The trip latch (4-27) is in proper adjustment when the latch roll (4-15A) engages it at a point 1/8 to 3/16 from the bottom edge of the latch face (4-27). Changes in adjustment are made by positioning stop screw (4-65). Note that this adjustment affects the clearance between the trip pin (4-17A) and the trip latch (4-27) (see Section 3.10). The latch roll stop screw (4-75) should be positioned such that the latch roll will have a clearance of 1/64 to 3/64 between the latch roll and latch face with breaker in open position.

3.10 TRIPPING SOLENOID

The tripping solenoid (4-17) has been adjusted in the factory and should require no further adjustment. If re-adjustment is required it should be made only when the trip latch bite is in correct adjustment (see Section 3.9).

The travel of the trip armature should be such that slow manual actuation will trip the breaker and have 1/16 to 3/32 after travel. Adjustment is made by shim-ming the tripsolenoid with spacers, Item 16.

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With the coil de-energized there should be 3/32 to 5/32 clearance between the trip pin (4-17A) and the trip latch (4-27). Adjustment is made by raising or lowering the hex nut (4-76).

3.11 PROP LATCH (Fig. 4)

The prop latch (4-97) is normally adjusted such that it engages the toggle roll (4-15) at a point 1/8 to 3/16 from the bottom edge of the latch. Adjustment is made by using spacers (4-99).

With the breaker closed and armature (4-4) held with maintenance closing device against pole head (4-72), the armature must push the toggle roll (4-15) to a point which will provide a clearance of 1/64 to 3/64 with the prop latch (4-97), and 1/32 to 3/32 clearance to stop (4-59). These settings have been made at the factory and should not require readjustment. Adjustment is made by changing the effective plunger length with washers (small) (4-11) between the plunger (4-6) and the armature (4-4).

PART 4. DISCONNECT SECTION

4.1 BREAKER MECHANISM

The breaker mechanism consists essentially of movable contact arms and insulating links which connect arms to the operator mechanism.

4.2 CONTACTS (Fig. 3)

The stationary contact structure of each phase is made up of two sets of contacts; main current carrying, and arcing, which are mounted on the upper bushing stud. The movable contacts are attached to contact arms that pivot from the end of the lower bushing stud. Transfer areas of current carrying contacts are silver plated and contact surfaces are of silver-tungsten alloy. The main current carrying contacts are finger type and engage with a wiping action. The arcing contacts are butt type. All contacts are backed by steel springs giving positive contact pressure when engaged.

4.2A SERVICING CONTACTS

The frequency of contact inspection depends on the severity of service to which the breaker is subjected. There are two areas which normally require service inspection:

- a) Stationary and moving main and arcing contacts. Badly pitted or burned contacts should be replaced.
- b) Hinge joints. Remove the disconnect arms as a unit by removing screw (3-24), nut (3-14) and spring washers (3-23). Carefully inspect all contact surfaces. Silver washers (3-25) and adjacent surfaces should be clean and free of roughness or galling. Lubricate washers (3-25) and mating surfaces by rubbing in microfine dry graphite, used sparingly. Remove excess graphite. Reassemble, adjusting hinge joint pressure as described in Section 4.5.

4.3 BREAKER TIMING

Check the contact adjustment and breaker timing, also check adjustments of auxiliary equipment and see that it functions properly. A comparison of breaker timing at any period of maintenance with that taken when the breaker was new will immediately indicate a condition of maladjustment or friction should the timing vary more than 1/2 cycle on opening or 2 cycles on closing with the same coils. A hole is provided in the movable contact arm for the purpose of attaching a speed analyzer connection.

4.4 ARCING CONTACT HINGE JOINT (Fig. 3)

The arcing contact hinge joint is in proper adjustment when each spring washer (3-15) is deflected approximately 0.015 inches.

This adjustment is obtained by tightening nut (3-4) until all parts just touch, then tighten the nut 3/4 to 1 turn more.

4.5 CONTACT PRESSURE OF HINGE JOINT (Fig. 3)

The hinge joint contact pressure is in proper adjustment when a pull of from 5 to 7 pounds is required to move the disconnect toward the open position. The measurement is obtained as follows:

Remove pin (1-46) and detach link (1-47) from the disconnect arms (3-18) and (3-19). Move the disconnect to a position just short of "contact make." Attach a spring scale to the disconnect 10 1/2 inches above screw (3-24), and in a direction perpendicular to the longest edge of the disconnect arm. Measure the pull to move the disconnect toward the open position.

Adjustment is made by tightening (or loosening) nut (3-14).

Before attaching link (1-47) to disconnect arms (3-18) and (3-19), check contact alignment (Section 4.6) and contact lead (Section 4.7).

4.6 CONTACT ALIGNMENT (Fig. 3)

The contacts are an integral part of the bushing assemblies and are carefully aligned with the upper and lower bushings before shipment and no further adjustment should normally be necessary.

The horizontal pairs of main contact fingers in each phase should "make" with the moving contact simultaneously. (Note: Contacts on different phases should not necessarily "make" simultaneously, they can vary as much as 1/32 inches.)

If not already detached, remove pin (1-46) and detach link (1-47) from disconnect arms (3-18) and (3-19).

Remove pin (1-46) and detach link (1-47) from disconnect arms (3-18) and (3-19) of two phases only. With the maintenance closing device, move the disconnects of the remaining phase toward the closed position until

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a main contact finger (3-11) is touched. Dimension c should then be no greater than .020 inches, with one contact touching.

Adjustment is made by loosening two nuts (3-22) and rotating the contact assembly. Alignment (dimension c) should be checked after tightening nuts (3-22).

Alignment is checked and adjusted on each phase separately. Be sure there are no binds between contacts (3-11), preventing proper wiping action with the disconnect arms.

Attach arcing contact (3-10) to yoke (3-2), if detached, but check contact lead (Section 4.7), before attaching link (1-47) to disconnect arms (3-18) and (3-19).

4.7 CONTACT LEAD (Fig. 3)

Contact lead is adjusted on breakers in the factory and should normally not require further adjustment. It should, however, be checked on each phase separately and only with contact alignment on the phase in correct adjustment (see Section 4.6).

The arcing contacts (3-9, 10, 27, 28) should "make" before the main contacts. Measure and adjust each phase separately as follows:

4.8 CONTACT STROKE (Fig. 3)

Contact stroke should be checked and adjusted only when the contacts are in proper alignment (see Section 4.6).

In order to ensure proper wiping action and contact pressure, the stroke of the disconnect must be maintained in proper adjustment. Check and adjust as follows:

With the breaker latched, the spread of the contacts (2a in view A-A, Figure 3), on the top pair of fingers should be 1/8 to 3/16". Adjustment is made with the breaker in the open position by increasing or decreasing the effective link (1-47) by means of nuts (1-10). Each phase is adjusted individually.

Trip the breaker open and check to see that dimension d is $6 \pm 1/8$ inches on all three phases. (On breakers with more than four contacts per phase, dimension d is still measured to the second from top contact.)

If not already detached, remove pin (1-46) to detach link (1-47) from disconnect arms (3-18) and (3-19). Move the disconnect toward the closed position until the arcing contacts just touch (see Fig. 3, View A-A, arcing contact engaging).

The shortest gap between the bottom contact fingers (3-11) and the contact on the disconnect arms (3-18) and (3-19) should be 7/32 to 1/4 inches. (Dimension b in View A-A of Fig. 3.) Adjustment is made by opening or closing the gap with nut (3-1).

Reconnect link (1-47) to disconnect arms (3-18) and (3-19) using pin (1-46).

Adjustment for dimension d is made by first removing pin (1-33) on each puffer. After loosening nut (1-42), increase (or decrease) effective length of rod end (1-40) by screwing (or unscrewing) it into piston stem (1-44). Adjust rod ends (1-40) on both puffers the same amount. Tighten nuts (1-42), replace pin (1-33), and check dimension d .

PART 5. ARC CHUTE ASSEMBLY

5.1 ARC CHUTE ASSEMBLY (Figs. 2 and 3)

Each arc chute consists of a flame retardant envelope which provides phase isolation for interruption and venting of the by-product gases of interruption. The arc chute contains:

- The transfer stack consisting of refractory plates. It aids the transfer of the arc terminal from the stationary end arcing contact (3-9) to the stationary end runner (2-4).
- The stationary end arc runner (2-4) and moving end arc runner (2-3) to which the arc terminals transfer from the arcing contacts. The arc runners form paths for the arc terminals to travel up the arc chute.
- The stationary end blowout coil (2-15) and moving end blowout coil (2-13) which connect their respective arc runners to the top and bottom bushings. The current in these coils creates the magnetic flux which passes through cores (2-18), pole pieces (2-22) and the space between the pole pieces. The action of this flux on the arc forces the arc up the barrier stack.
- The barrier stack (2-23) consisting of a number of refractory plates with "Vee-Shaped" slots cemented together. The barrier stack cools, squeezes and stretches the arc to force a quick interruption.
- The barrier (2-1) containing coolers (2-28) through which the by-product gases of interruption pass. The barrier completes the cooling and deionizing of the arc products.

Arc chutes are normally tilted (see Section 5.3) to expose contact area of the breaker and/or to replace parts such as barrier stacks (2-23). The arc chutes may also be removed from the breaker, if necessary, to replace parts not exposed when tilted by removing fastenings per Section 5.3.

5.2 PHASE BARRIERS (Fig. 1)

Full size barriers of high dielectric flame retardant material isolate each phase.

Remove screws (1-13) and channels (1-9) on rear of breaker. Lower panel (1-32) and loosen three screws (1-23); remove three screws (1-24) and panel (1-22) on front of breaker. The phase barrier assemblies (1-5) can now be removed from the front of the breaker.

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Replace the above parts in reverse order, taking care that barriers are seated properly and that channels (1-9) are located inside of washers (1-8).

5.3 TILTING ARC CHUTES

Remove phase barriers (see Section 5.2).

Remove screws (1-1 and 1-37) on each phase. Loosen screws (1-23) and remove screws (1-24) and (1-39) to remove panel (1-22).

With arc chute support in place at the rear of the breaker, tilt back the arc chutes.

After tilting arc chutes upright, and replacing barriers, be sure all screws are tightened securely on all three phases.

5.4 BARRIER STACKS (Fig. 2)

The barrier stacks are fragile and should be handled carefully. The barrier stacks should be inspected for

erosion of the plates in the areas of the slots. The stacks should be replaced when a milky glaze is observed on the full length of the edges of most of the slots. They should likewise be replaced if plates are broken or cracked. When cleaning the breaker and cubicle, inspect for pieces of barrier stack refractory material which would obviously indicate breakage.

To remove the barrier stacks, tilt back the arc chutes (see Section 5.3).

Remove four screws (1-26), two barriers (2-1) and, if applicable, two screws (2-6) and two tubes (2-5) from each arc chute. Slide barrier stack (2-23) through top of arc chute.

When sliding a barrier stack into the arc chute, care should be taken to see that the end containing the "Vee-shaped" slots goes in first.

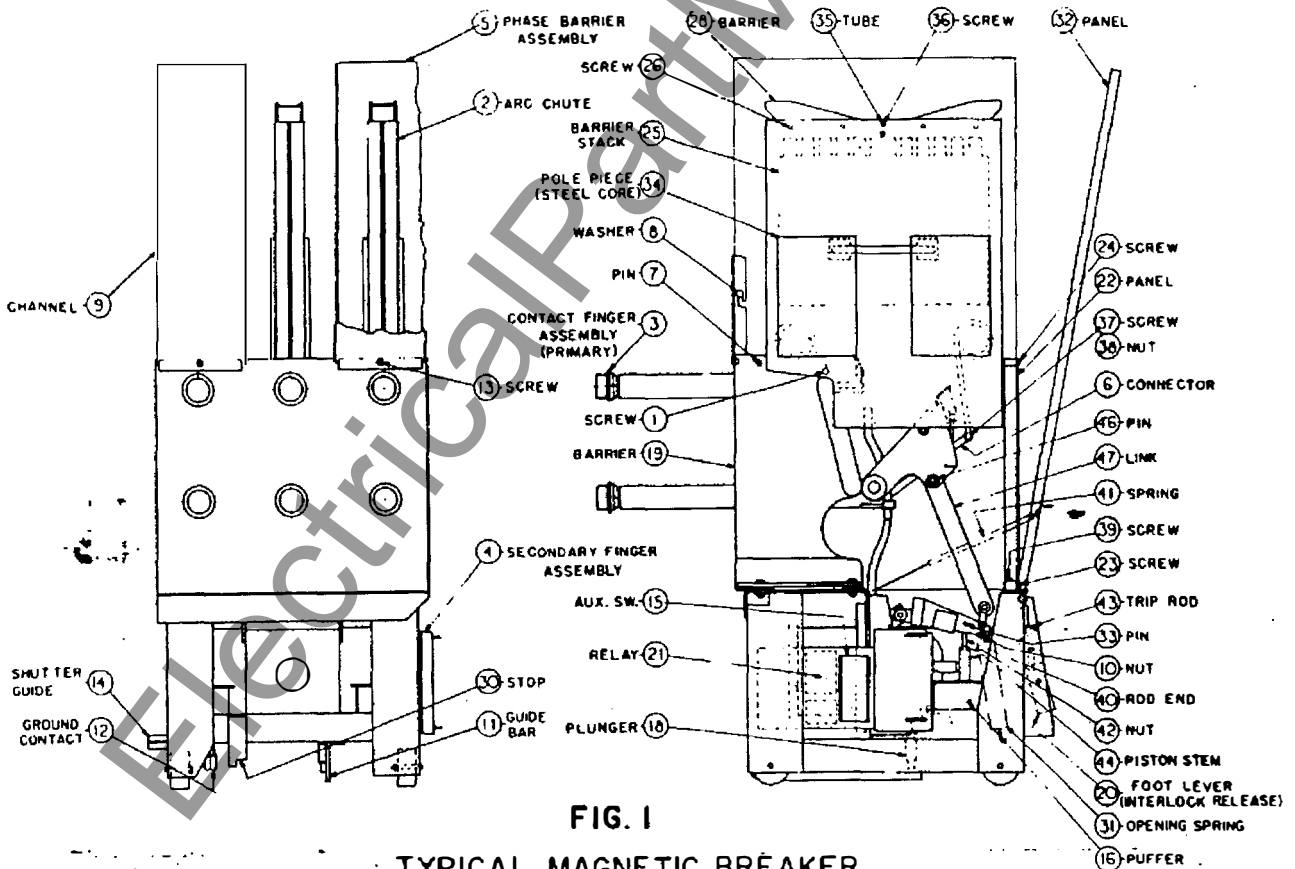


FIG. 1

TYPICAL MAGNETIC BREAKER

APRIL 20, 1967

72-420-056-401

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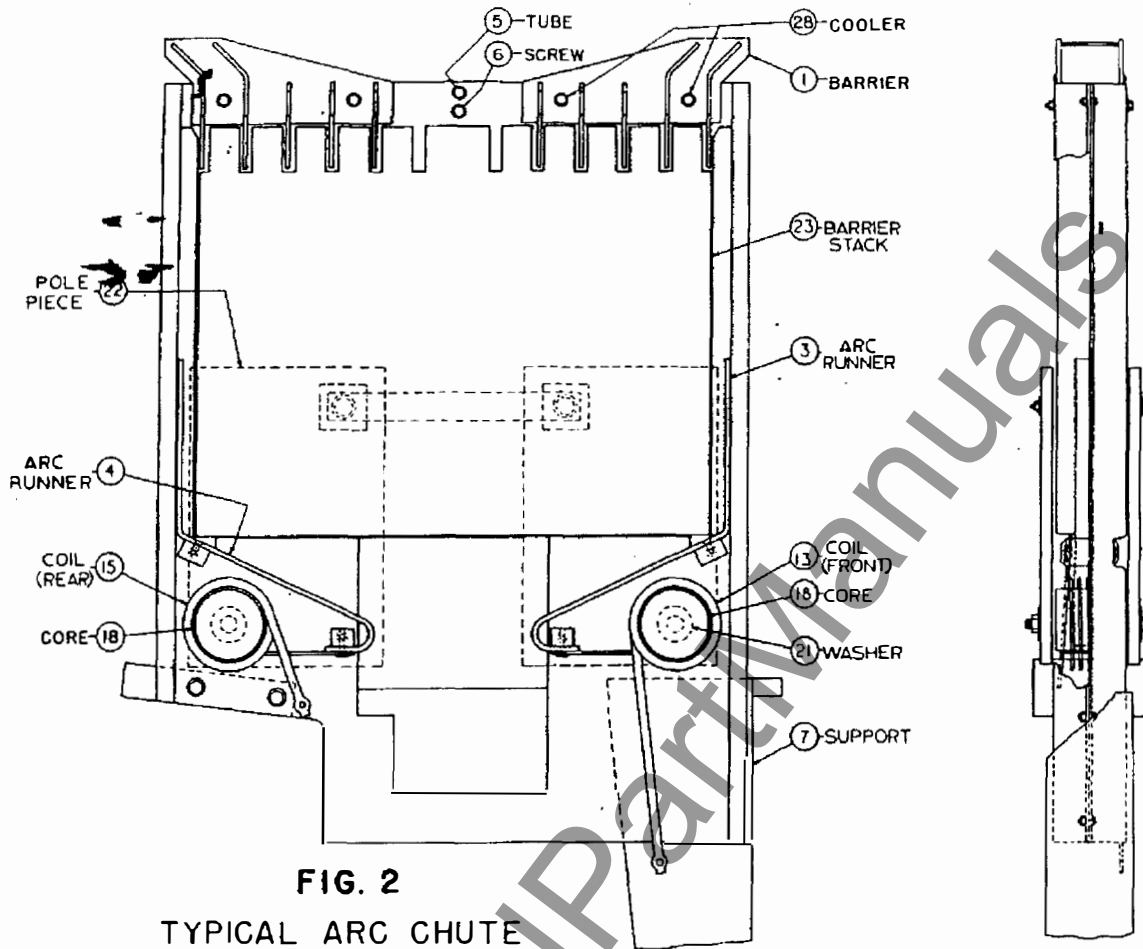


FIG. 2
TYPICAL ARC CHUTE
 JANUARY 18, 1962 71-401-442-401

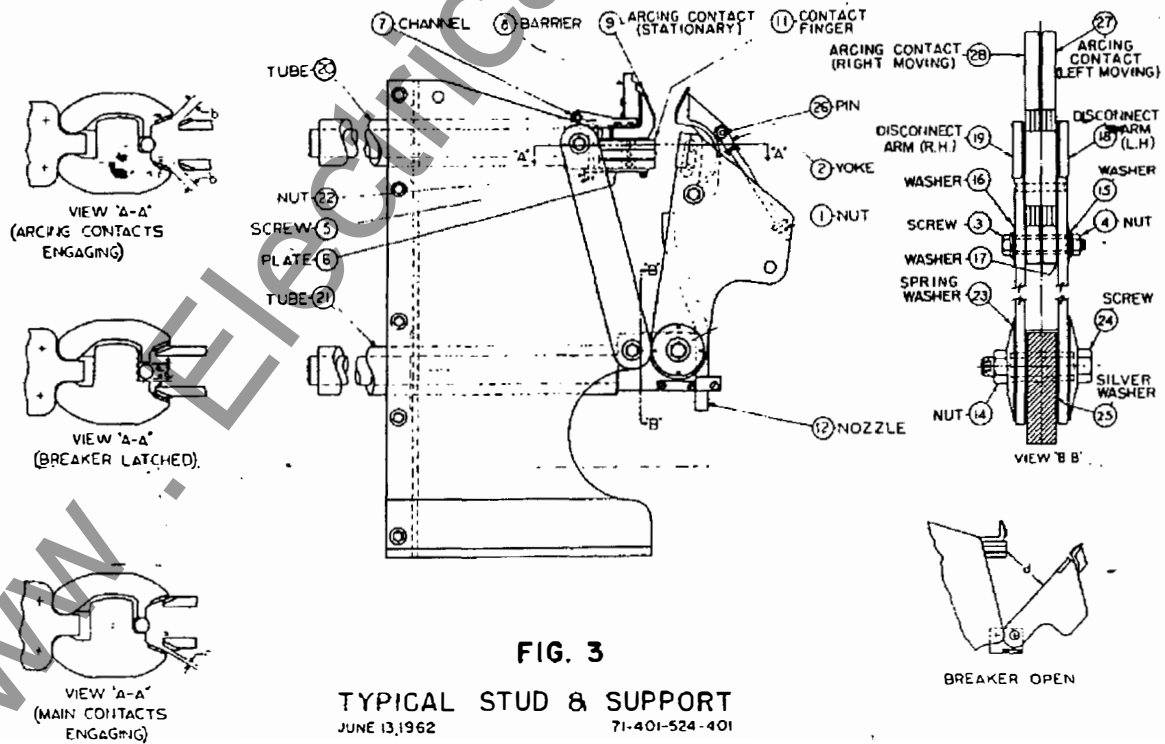


FIG. 3
TYPICAL STUD & SUPPORT
 JUNE 13, 1962 71-401-524-401

BREAKER OPEN

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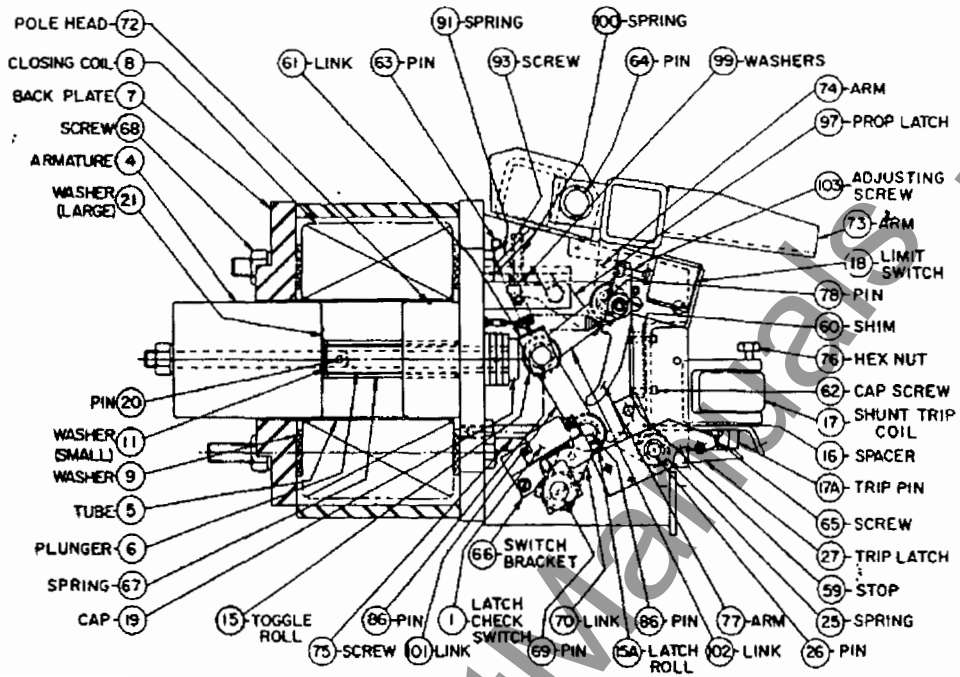


FIG. 4

TYPICAL OPERATOR ASSEMBLY
 FEBRUARY 16, 1967 72-320-041-401

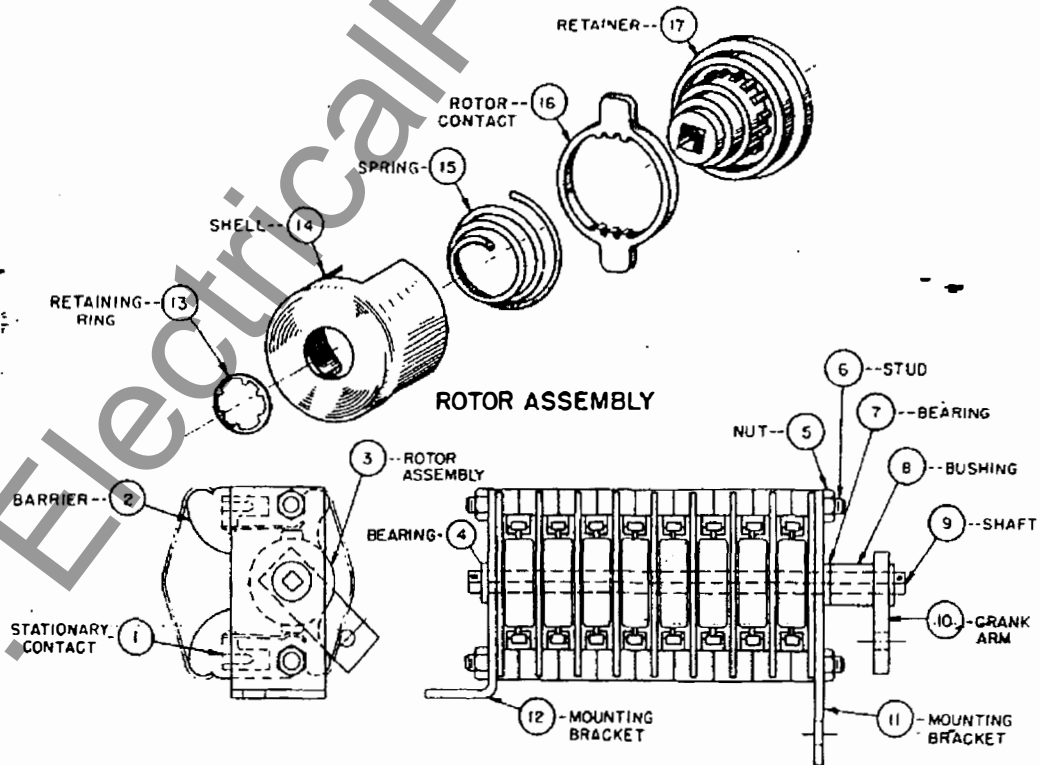
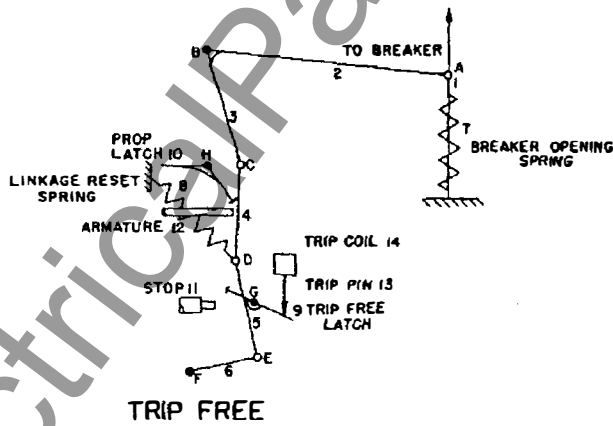
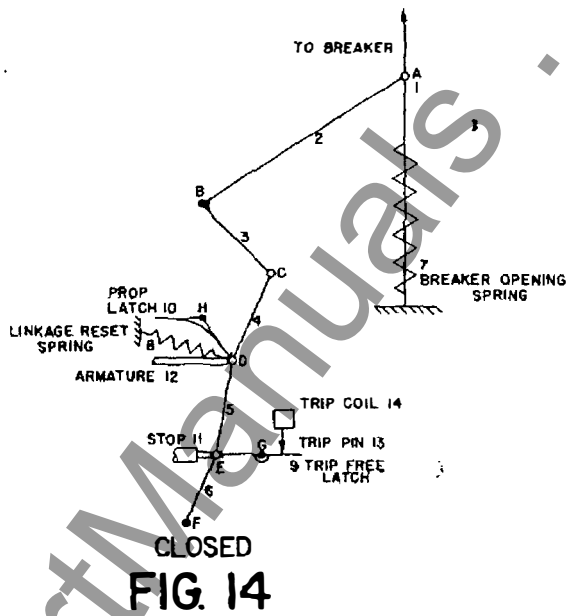
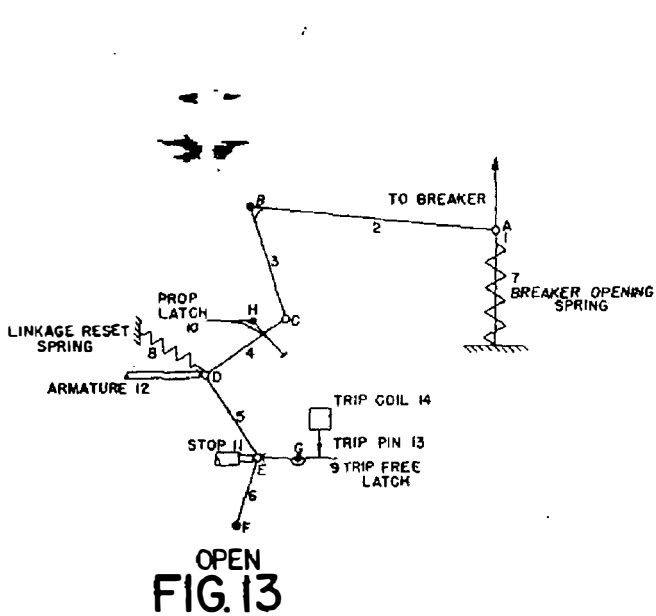


FIG. 11

TYPICAL AUXILIARY SWITCH
 JULY 16, 1968 71-301-758

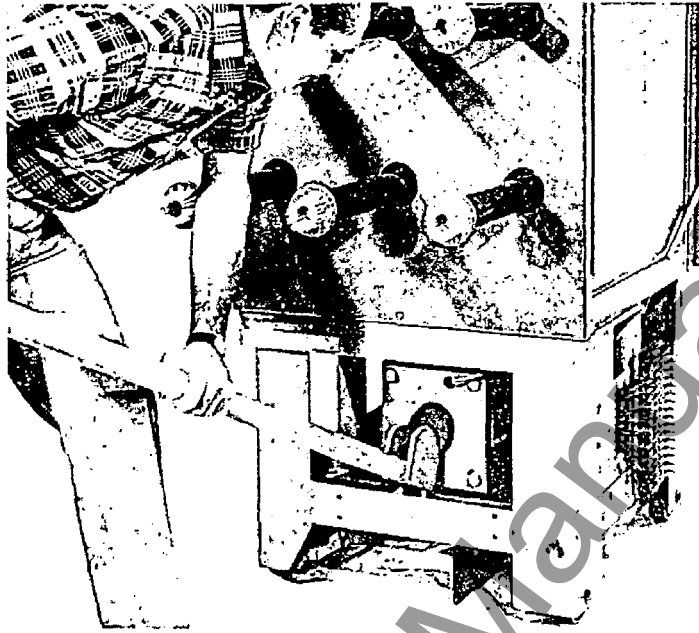
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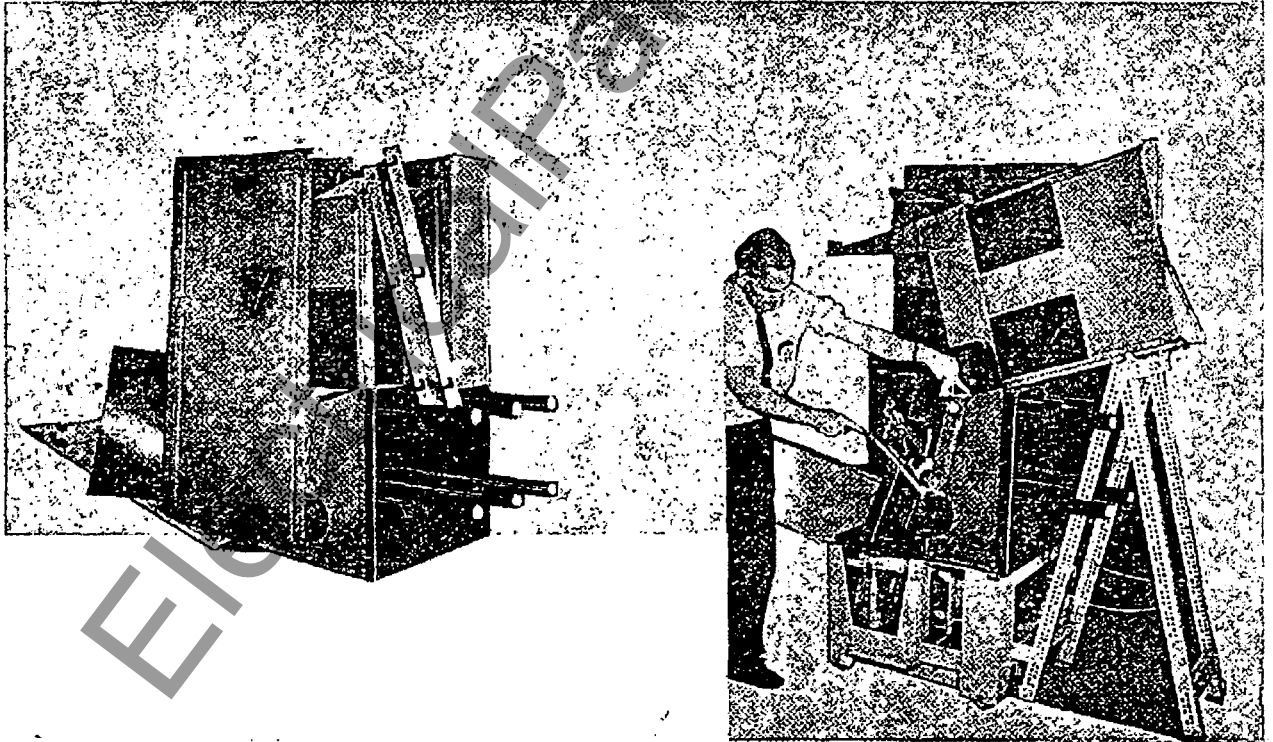
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FIG. 15
 TYPICAL OPERATOR LINKAGE DIAGRAM
 SEPTEMBER 9, 1953 71-400-246-401

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205397 Manual Closing Device



205129 Removing Phase Barriers.
Remove Channels (1), Panel (2), and slide
Phase Barrier Assemblies (3) off front of
breaker.

205130 Tilting Arc Chutes.
Position arc chute support; unfasten
blowout coil connections and lower
end of arc chute; tilt arc chutes back
on supports.

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