ALLIS-CHALMERS

INSTRUCTION BOOK

TYPE "F" MOVABLE PORTION
FA-350A (3000 AMP)

RUPTAIR MAGNETIC POWER CIRCUIT BREAKER

AND AUXILIARY EQUIPMENT

September, 1967

Book No. BWX-6612-2

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 breakers 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 move 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, 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 line (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 stop 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 the 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 readjustment 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 trip solenoid with spacers, Item 16.

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 the contact arms to the operator mechanism.

4.2 CONTACTS (Figs. 24 and 25)

The stationary contact structure of each phase is made up of three sets of contacts; main current carrying, tertiary, 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 tertiary and 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 severity of service. Remove disconnect items as a unit by removing screw (25-5), nut (25-10) and spring (25-12). Refer to Figure 25. Carefully inspect all contact surfaces in hinge joint. Silver washer (25-6) and adjacent surfaces should be clean and free of roughness or galling. Lubricate silver washer and mating surfaces by rubbing in microfine dry graphite used sparingly. Reassemble hinge joint. Replace badly pitted or burned contacts before they are damaged to such an extent to cause improper operation of breaker.

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 (25-14) for the purpose of attaching a speed analyzer connection.

4.4 CONTACT ALIGNMENT AND STROKE

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. Check for proper contact alignment and, at the same time, for moving contact stroke by checking dimension c, View "AA," Fig. 23 between contact finger (24-3) and plate (24-10), on each side of bushing, top and bottom of each phase separately. It is not necessary that contacts touch simultaneously on all three phases.

When this dimension is found to be different than 3/64 to 5/64 at all four points in a phase, both the alignment of the contacts and the stroke of the moving contact of that phase are correct.

If this dimension is found to be different than 3/64 to 5/64 but all four in any phase measure within 1/32 of each other, it is necessary to adjust the stroke of the moving contact of that phase (see Section 4.6). If this dimension is not within tolerance, and there is a difference of over 1/32 among the four measurements in a phase, it is necessary to first adjust the contact alignment (see Section 4.5) and then the stroke of the moving contact (see Section 4.6).

4.5 ADJUSTMENT FOR CONTACT ALIGNMENT

To adjust contact alignment, close and latch breaker. Loosen two screws (24-24) and two screws (24-25). Move top block (24-8) and bottom block (24-13) sidewise until dimension c, View "AA," Figure 23, is 3/64 to 5/64. Refasten screws (24-24) and (24-25). Both the contact alignment and stroke will be in proper adjustment.

In the event that this exact dimension and tolerance cannot be obtained, move blocks (24-8) and (24-13) so that all four dimensions c in a phase are within 1/32 of each other. Contact alignment in this phase will then be in proper adjustment.

Care must be exercised in adjusting contact alignment to retain block (24-8) firmly against stop on top of stud.

4.6 ADJUSTMENT FOR STROKE

This adjustment is accomplished by lengthening or

shortening link (1-47) between operator mechanism and interrupter moving blade to bring dimension c, View "AA," Figure 23, to 3/64 to 5/64. Open breaker, remove pin (1-48), loosen checknut, and adjust the length of link (1-47) by screwing rod end in or out as required to bring this dimension to within the tolerance in all four measurements in the phase. Make up checknut, replace pin (1-48), insert and spread cotter pin. The stroke should be adjusted in each phase individually.

4.7 CONTACT LEAD (Fig. 23)

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.

In order to prepare breaker for contact lead check and adjusting, be sure that breaker is open. Disconnect the movable contact from operator link (1-47) by removing pin (1-46) and two spacers (1-45). Bring movable arcing contact (25-3) so that it just touches the stationary arcing contact (24-4) as shown in Fig. 23, View "AA," (Arcing Contacts Engaging). Measure dimension a, Figure 23, the shortest gap between the two tertiary contacts, and dimension b, View "AA," Figure 23, the shortest gap between the main contacts. Dimension a should be 1/8 to 5/32 and dimension b 9/32 to 3/8.

If the dimensions a and b are found to be different, remove one roll pin from each plate (24-10), loosen eight screws (24-22). Insert a spacer as thick as correct dimension a between the tertiary contacts, and apply a C-clamp bearing on rear of block (24-8) and front of movable contact (25-3). Tighten C-clamp to obtain dimension b. With contacts held in this position, move two plates (24-10) back so that pins (24-16) are touching leading end of plate slots. Tighten eight screws (24-22), drill and insert pin to retain adjustment. Remove spacer, remove C-clamp, and reconnect movable contact to link (1-47).

PART 5. ARC CHUTE ASSEMBLY

5.1 ARC CHUTE ASSEMBLY (Fig. 26)

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:

a) The transfer stack consisting of refractory plates. It aids the transfer of the arc terminal from the stationary end arcing contact (24-4) to the stationary end runner (26-4).

b) The stationary end arc runner (26-4) and moving end arc runner (26-3) 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.

c) The stationary end blowout coil (26-15) and moving end blowout coil (26-13) 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 (26-18), pole pieces (26-22), and the space between the pole pieces. The action of this flux on the arc forces the arc up the barrier stack.

d) The barrier stack (26-23) 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.

e) The barrier (26-27) containing coolers (26-28) 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 breaker and/or to replace parts such as barrier stacks (26-23). The arc chutes may also be removed from the breaker if necessary to replace parts not exposed when tilted by removal of pivot pins (1-7) in addition to removing fastenings per Photo A, Section 5.3 and 5.4.

5.2 PHASE BARRIERS

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

To remove the phase barriers pull front panel (1-1) forward and then withdraw phase barriers (1-5). On replacing the barriers, make certain that they are fully seated in their respective locating slots.

5.3 TILTING ARC CHUTES (Fig. 1)

Remove phase barriers (see Section 5.2). Remove screw (1-37) and (1-38) on each phase. With the arc chute support in place, at the rear of the breaker, tilt back the arc chutes. After tilting arc chutes upright, be sure screws (1-37) and (1-38) are tightened securely on all three phases.

CAUTION: Avoid having more than two arc chutes in the tilted position. Breaker could tend to tip under weight of more than two tilted arc chutes.

5.4 BARRIER STACKS

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.

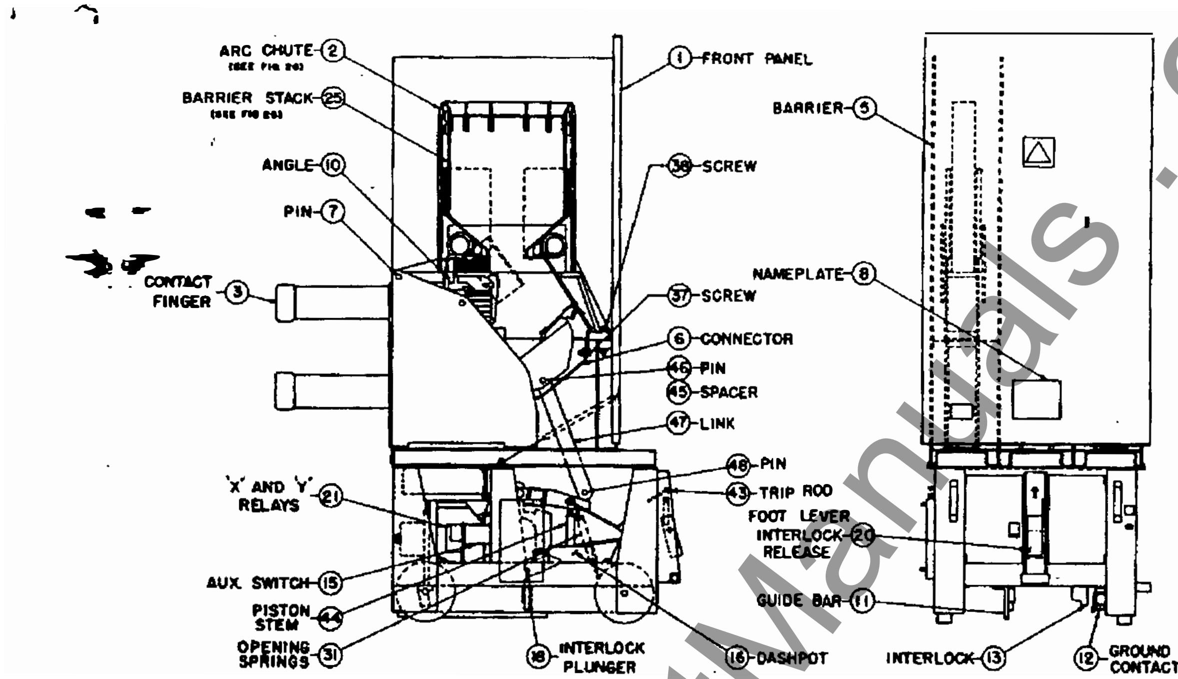


FIG. 1

TYPICAL MAGNETIC BREAKER ASSEMBLY

APRIL 20, 1967 72-420-048-401

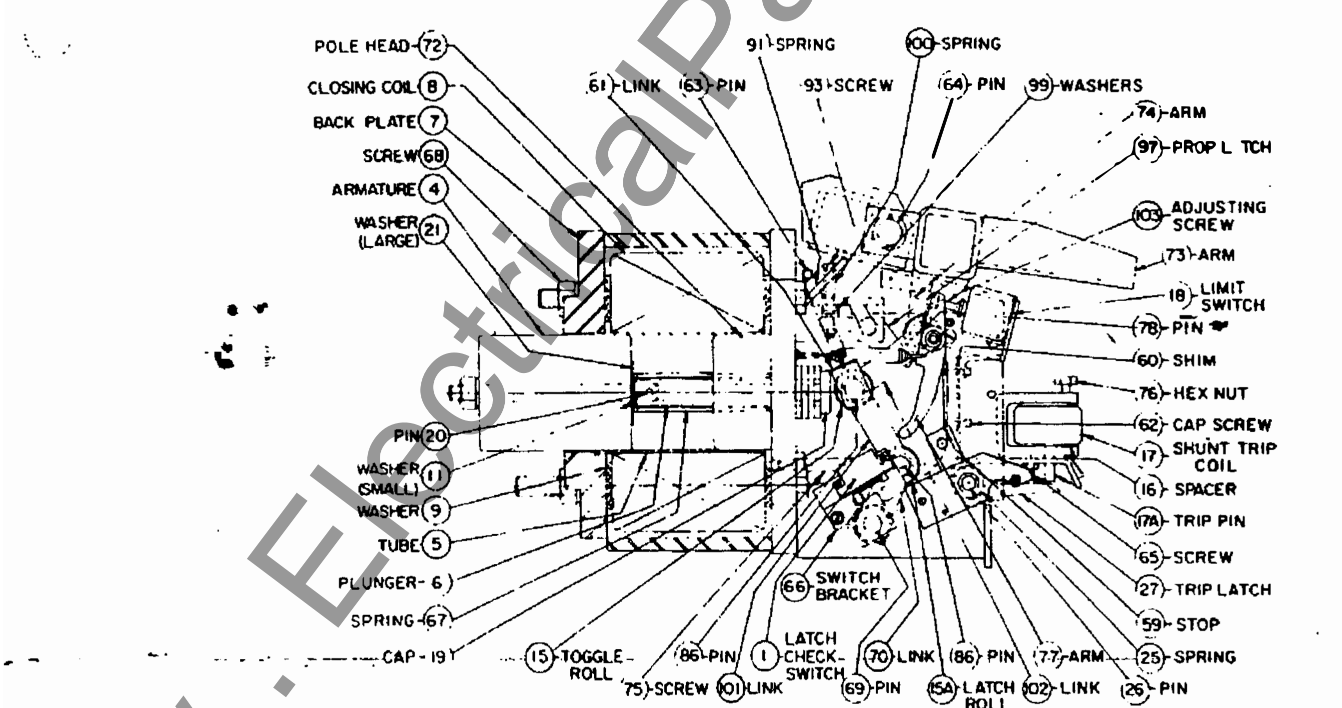


FIG. 4

TYPICAL OPERATOR ASSEMBLY

FEBUARY 16, 1967 72-320-041-401

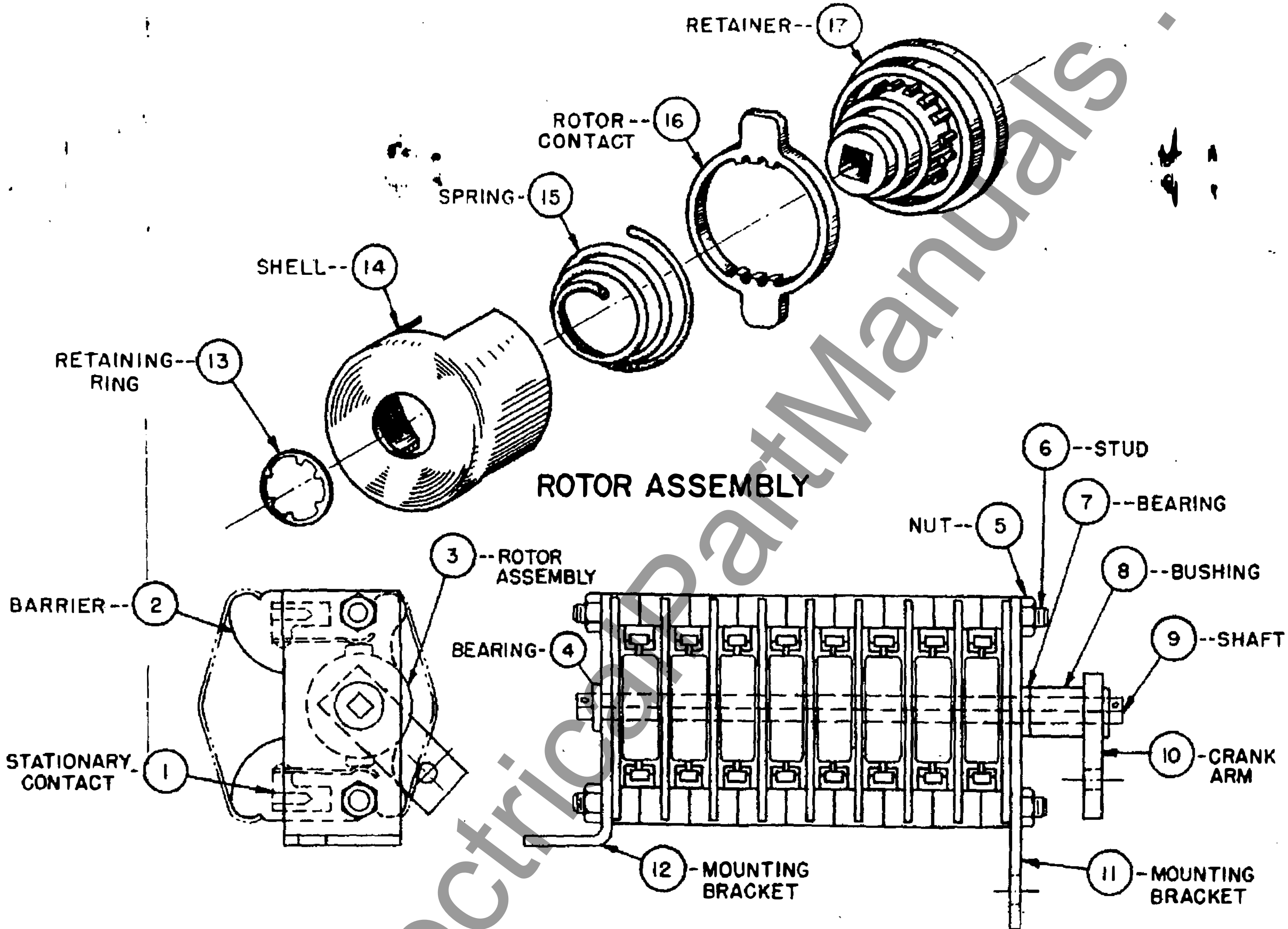
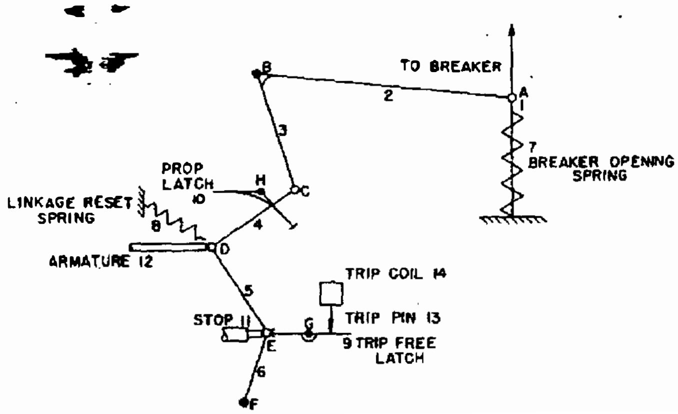


FIG. 11

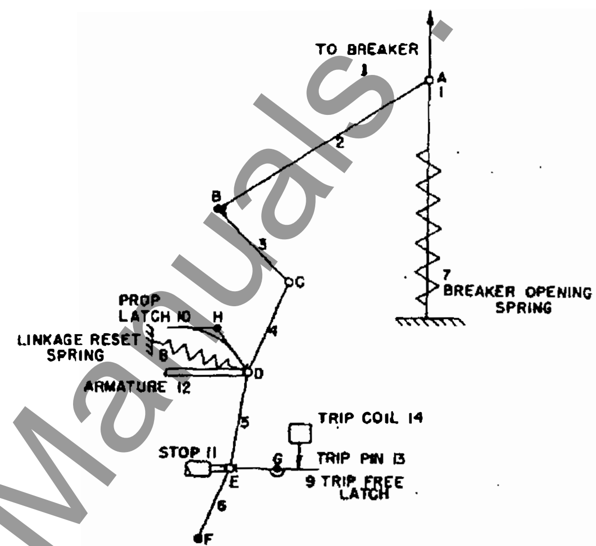
TYPICAL AUXILIARY SWITCH

JULY 16, 1958 71-301-758



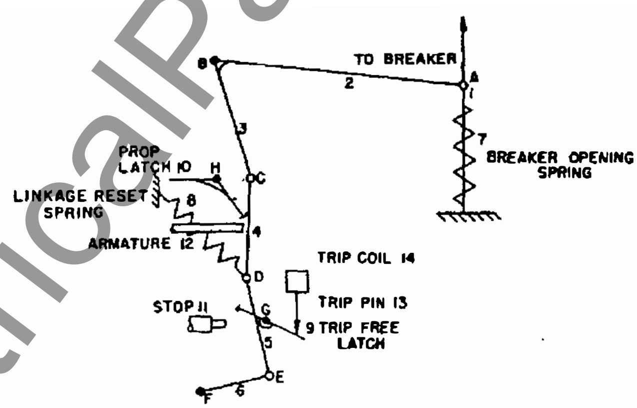
OPEN

FIG. 13



CLOSED

FIG. 14

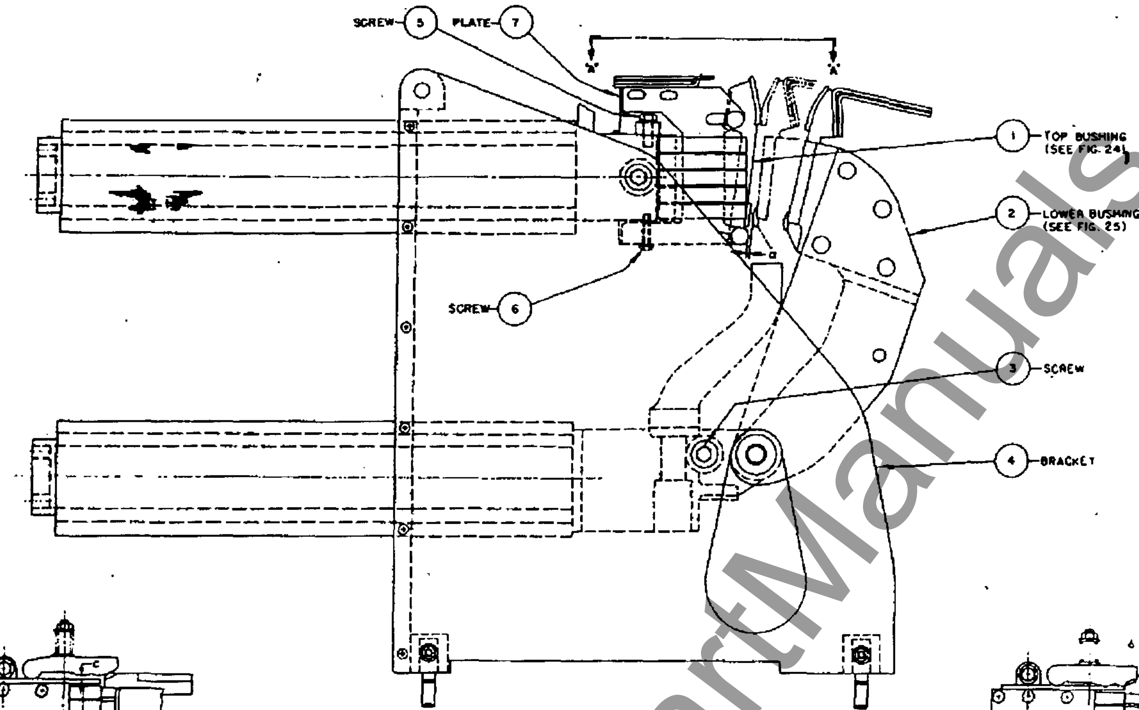


TRIP FREE

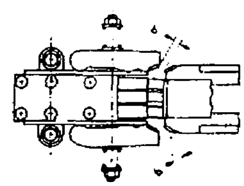
FIG. 15

TYPICAL OPERATOR LINKAGE DIAGRAM

SEPTEMBER 9, 1953 71-400-246-40(



VIEW "A-A"
(BREAKER LATCHED)



VIEW "A-A"
(ARCING CONTACTS ENGAGING)

FIG. 23

TYPICAL STUD & SUPPORT ASSEMBLY

MAY 9, 1960 71-401-259

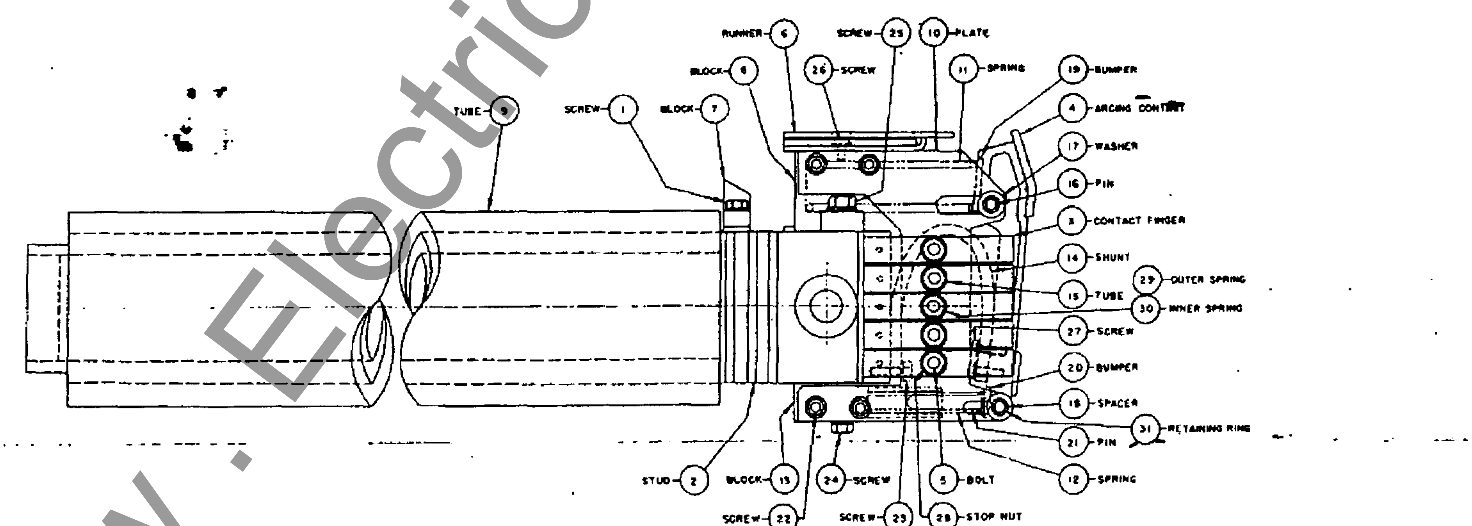


FIG. 24

TYPICAL TOP BUSHING ASSEMBLY

APRIL 28, 1960 71-401-252

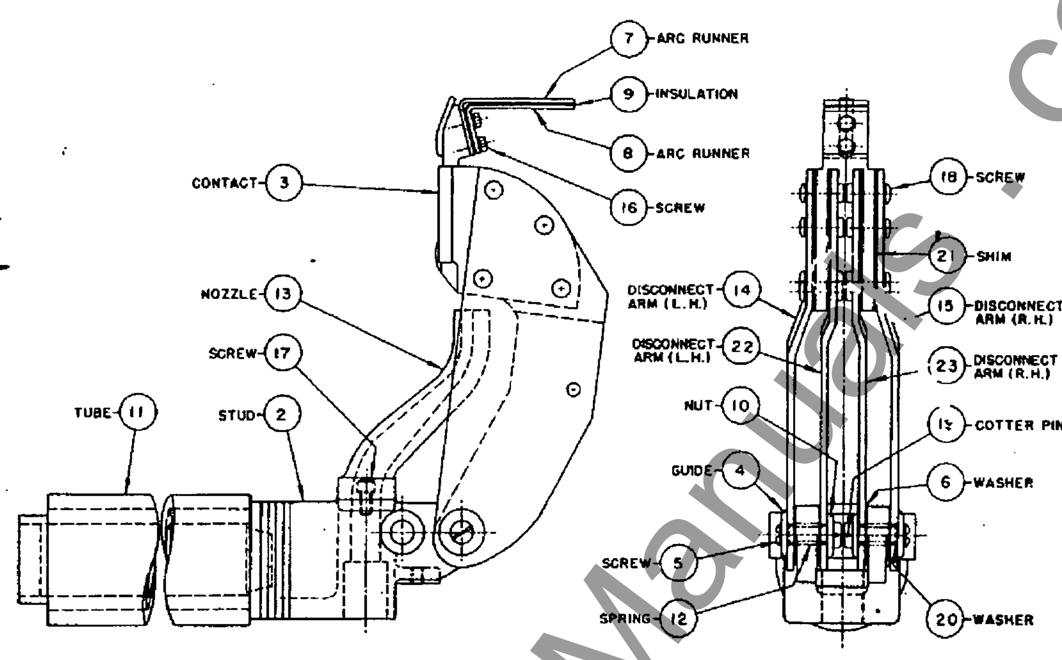


FIG. 25

TYPICAL LOWER BUSHING ASSEMBLY

APRIL 29, 1960 71-302-468

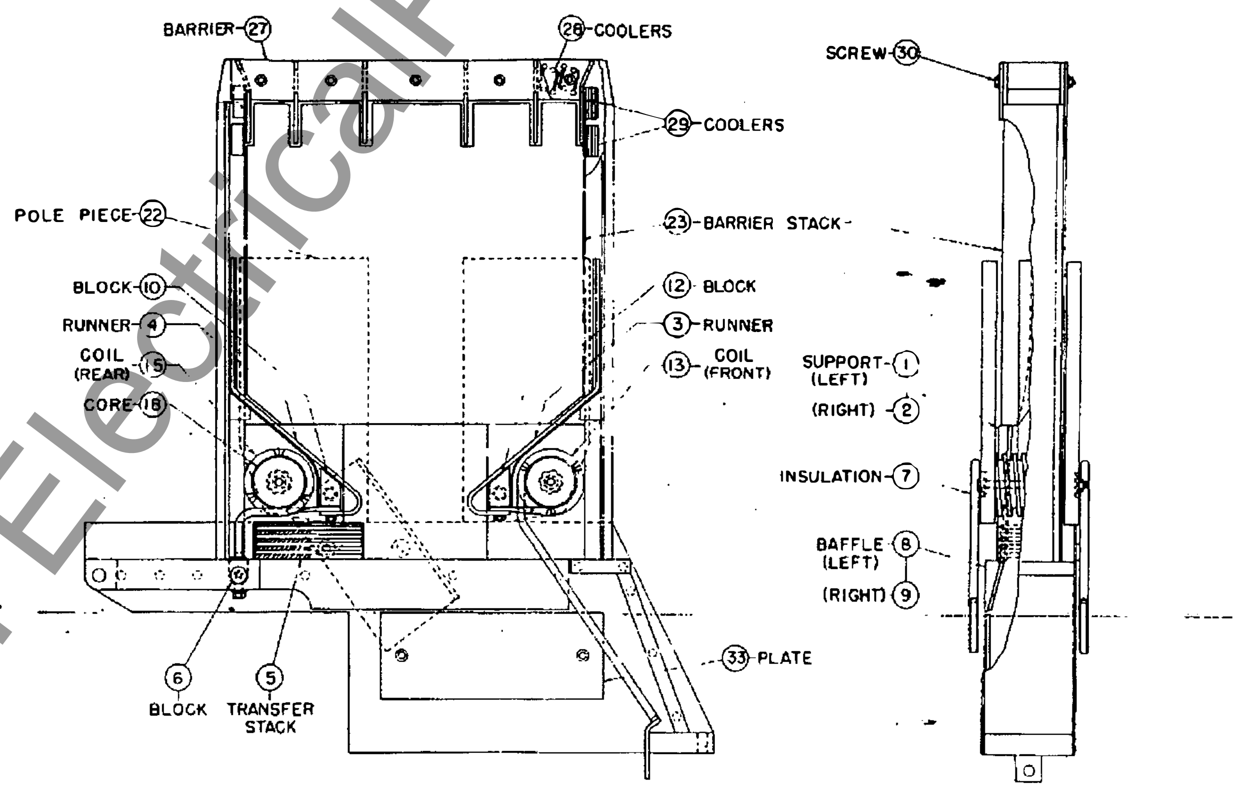


FIG. 26

TYPICAL ARC CHUTE

MAY, 1963 71-401-634-401