CONTROLS

INSTRUCTIONS

TYPES MA-75C, MA-250C and MA-350C, 5-KV AIR MAGNETIC CIRCUIT BREAKERS with SOLENOID OR STORED ENERGY OPERATORS

BXW-6731-1 18X3087

INDEX

ILLUSTRATIONS

INTRODUCTION

This instruction manual contains installation, operation and maintenance information for Types MA-75C, MA-250C and MA-350C solenoid or stored energy operated, 5-kv air magnetic circuit breakers.

WARRANTY

The sales contract carries all information on warranty coverage.

RECEIVING

Circuit breakers are shipped from the factory completely assembled. Observe weight markings on crates and ensure that capable handling equipment is used.

Remove crating carefully with the correct tools. Check each item with the shipping manifest. If any shortage or damage is found, immediately call it to the attention of the local freight agent handling the shipment. Proper notation should be made by him on the freight bill. This prevents any controversy when claim is made and facilitates adjustment.

When handling breaker with a crane or hoist, hooks should be attached only to breaker frame. Use a spreader to prevent frame distortion. Do not attach lifting hooks, rope, etc., to bushings, insulating parts, fittings, etc. Do not slide breaker off shipping skid as interlock damage may occur.

STORAGE

Indoor - The circuit breaker should be installed as soon as possible. If storage is necessary, it should be kept in a clean dry place where it will not be exposed to dirt, corrosive atmospheres or mechanical abuse.

Outdoor - Outdoor storage of circuit breakers is not recommended. If breakers must be stored outdoors, they must be completely covered and a heat source provided to prevent condensation and subsequent corrosion.

CIRCUIT BREAKER PREPARATION

Prepare the circuit breaker for insertion into its cubicle as follows:

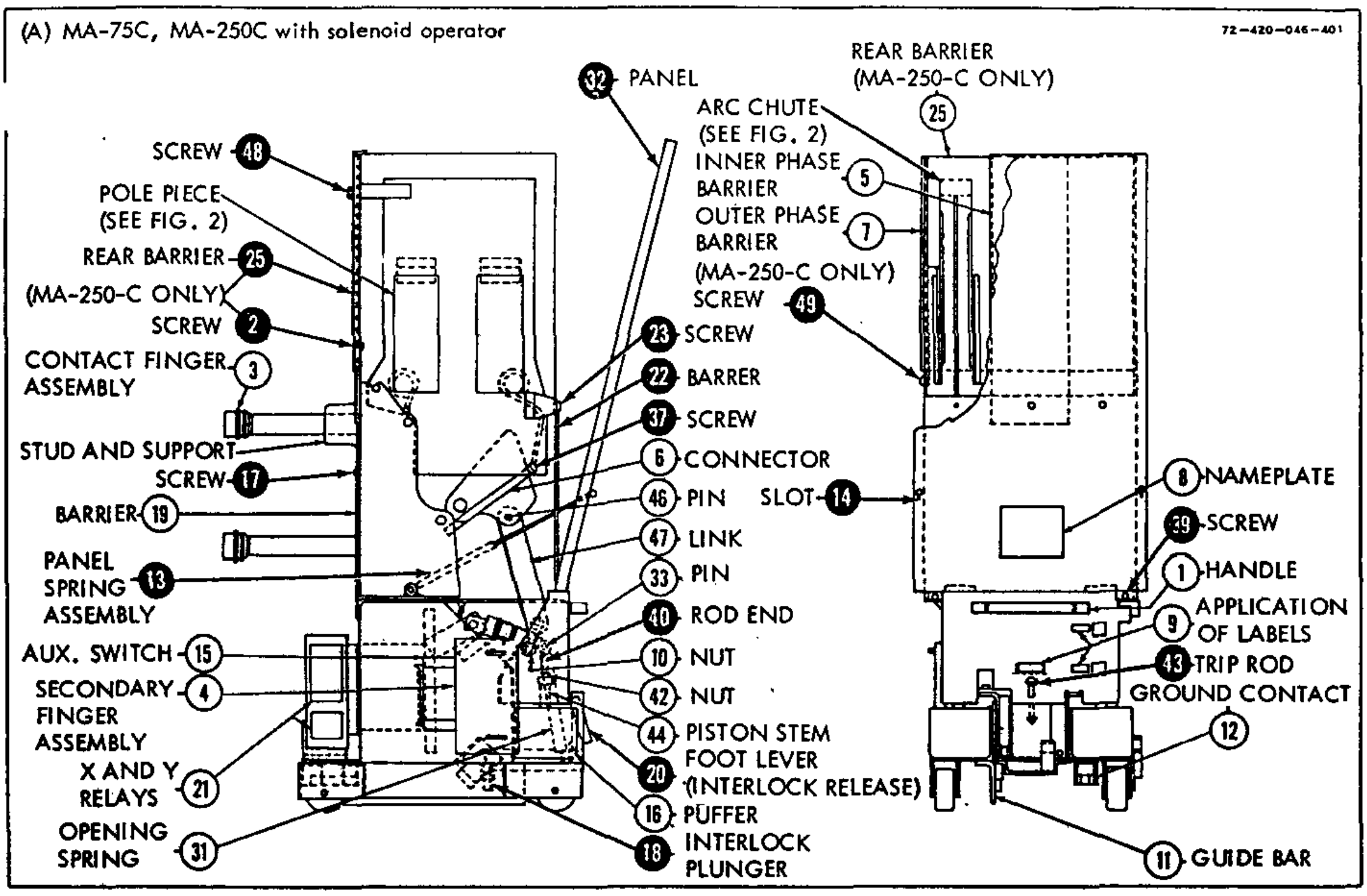
1. Free trip latch. Note: Breakers are shipped in closed position with the trip latch and foot lever blocked or tied to prevent opening during shipment. REMOVE BLOCKING.
2. Push manual trip rod to open breaker.
3. Remove phase barriers and unfasten coil connections. (See "Phase Barrier Assembly," page 14).
4. With arc chute support in place at the rear of the breaker, tilt the arc chutes (refer to page 14) to expose contact area.
5. Remove dust, foreign particles, etc., from breaker.
6. Check for mechanical freedom of disconnect arm movements by slowly closing the breaker.

   Solenoid Operated Breaker - Insert the manual closing device pin into the angle bracket mounted at the rear of the breaker. With the device rolls against the solenoid armature, lever the armature in to close the breaker.

   Stored Energy Breaker - Refer to page 17.

7. Trip out breaker by depressing trip rod.
8. Return arc chutes to upright position, fasten blowout coil connections and replace phase barriers. Be sure screws on all phases are tightened securely.
9. Install plug jumper and energize control. (Springs should charge on stored energy breakers.)
10. Close breaker - } with control switch on cubicle panel.
11. Trip breaker - }
12. Depress foot lever and close electrically (*).
13. Release foot lever and repeat steps 10 (#) and 11.
14. Lock out Kirk interlock (if provided) and repeat step 10 (*).
15. Open interlock and repeat steps 10 (#) and 11.
16. De-energize control power and remove plug jumper.
17. Coat movable primary disconnects with a light film of lubricant supplied by A-C.
18. Insert breaker into its cubicle between "test" and "disconnect" positions and close manually (*).
19. Complete movement of breaker to "test" position and repeat steps 10 (#) and 11.
20. Check for proper alignment between stationary and movable secondary contacts.
21. With line and bus de-energized, rack breaker into fully connected position. Close and trip breaker from main control panel. If bus or line are energized, get clearance before beginning this step.
22. Breaker is now ready for normal operation.

(*) Breaker is trip free.
(#) Breaker will close.



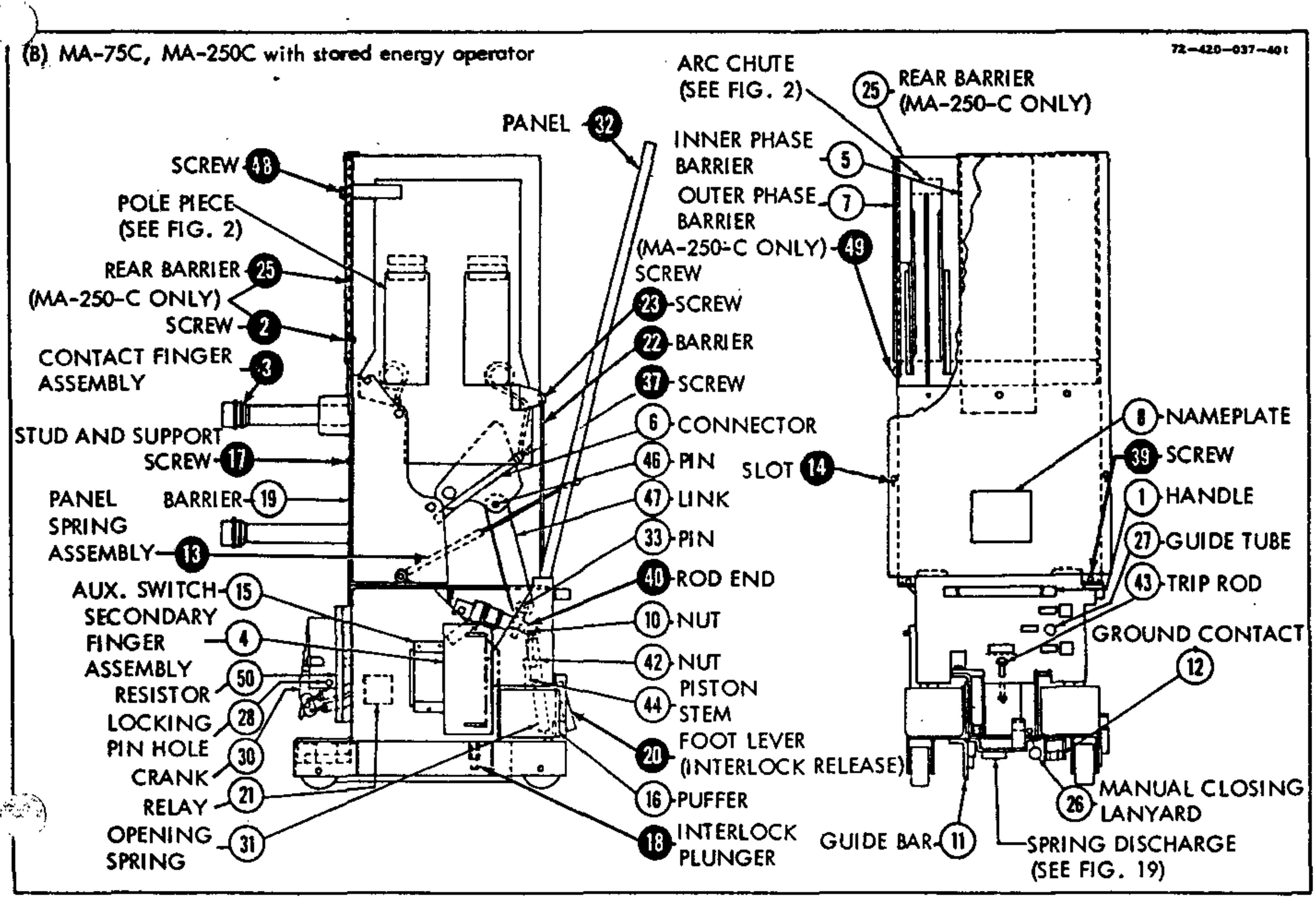
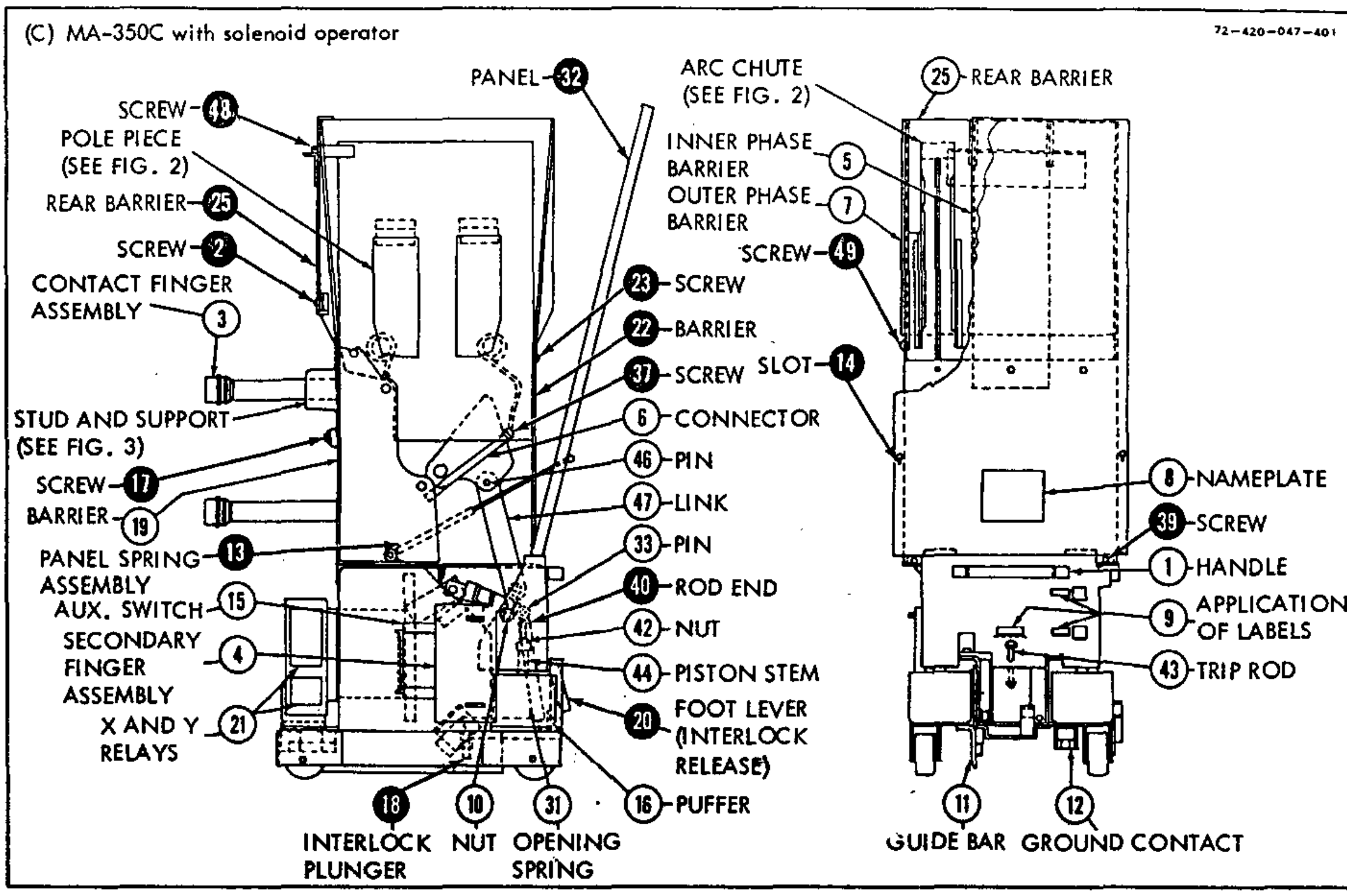


Fig. 1 – Typical circuit breaker assemblies.



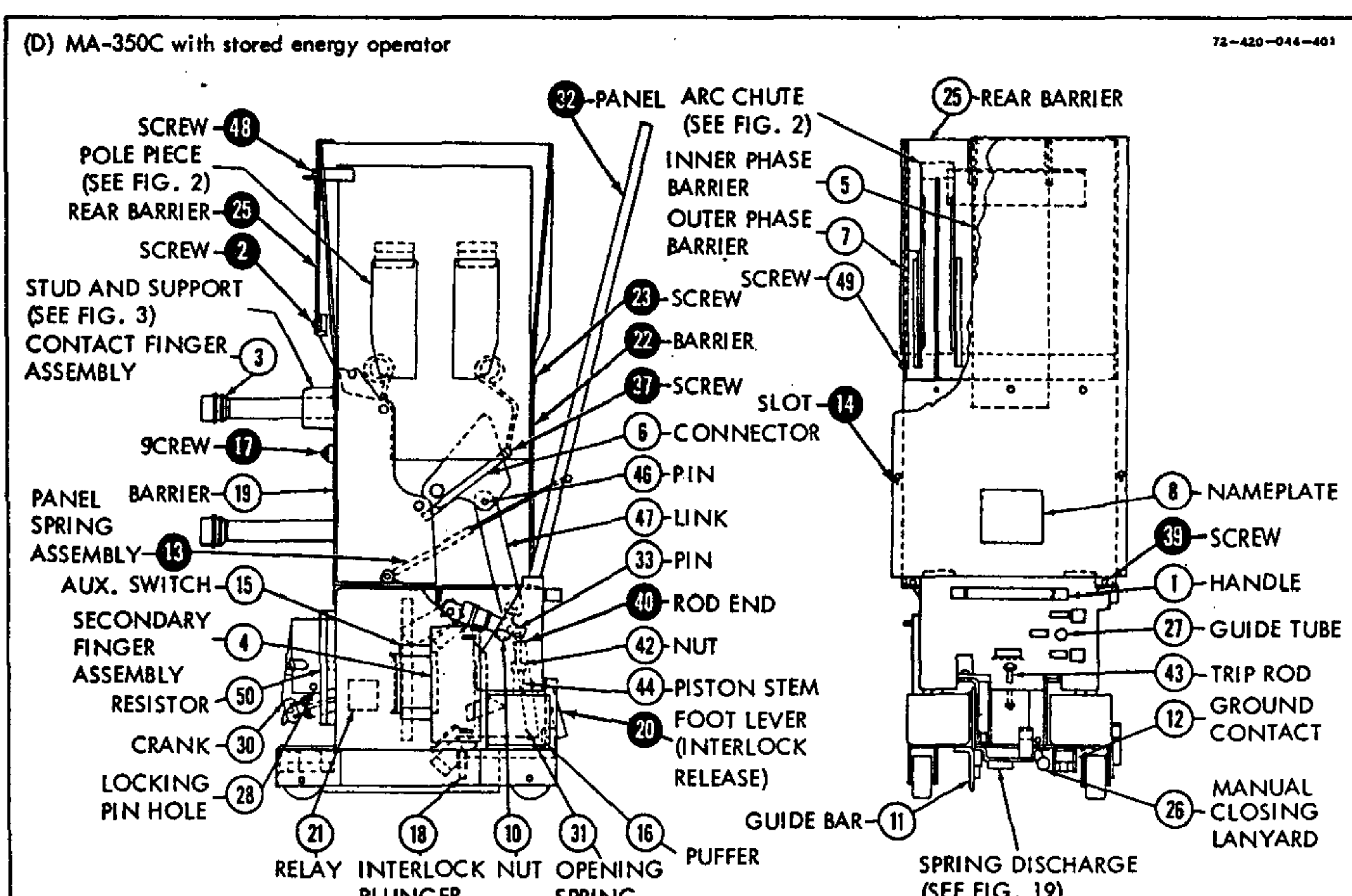


Fig. 1 – Typical circuit breaker assemblies.

DESCRIPTION

A typical circuit breaker consists of primary disconnect, arc chute, and operator sections. The primary disconnect section contains the main contacts, which supply power to the load. The arc chute section dissipates the power arc drawn during the opening of the main contacts. The operator section contains the mechanism used to close and open the main contacts. This mechanism consists of either a solenoid or a stored energy operator with its associated control circuitry.

ARC INTERRUPTION

Arc interruption is accomplished in free air at atmospheric pressure with the aid of a self-induced, magnetic blowout field and forced air draft. When the trip solenoid is energized, load current is being carried by the main contacts. As the contacts open, the main contacts part first and the current is carried by the arcing contacts. When the arcing contacts part, an arc is established between them.

The arc between the arcing contacts is transferred to the arc runners as the arcing contacts open. The transfer of the arc to the arc runner establishes full current flow through the blowout coils, setting up a strong magnetic field. The magnetic field, accompanied by the natural thermal effects of the heated arc, tends to force the arc upward into the barrier stack. The cool surfaces of the barrier stack cool and de-ionize the arc, while the V-shaped slots in the stack reduce its cross-section and elongate it, leading to rapid extinction. The arc runners are made of wide, heavy material for maximum heat dissipation and to minimize metal vaporization.

A puffer mechanism provides a forced air draft through the main contact area. This aids the magnetic blowout field and natural thermal effect in forcing the arc into the barrier stack for easy extinction.

OPERATORS

The breaker is closed by the operator straightening a toggle in the four-bar linkage (page 8). The operator is powered by either a solenoid or precharged springs (stored energy).

SOLENOID OPERATOR

A large dc solenoid is used to drive two links of the four-bar linkage to an in-line position, allowing a prop latch to drop behind a toggle roll in the linkage system to hold the breaker closed. (Fig. 4.)

DC Control Relay

The solenoid operator (Fig. 3) is designed to operate on dc current only. The control relay consists of two relays which may be mounted on a common base. Solenoid current is handled by the main control, or X relay, while the second relay, or Y relay, provides auxiliary control and anti-pump protection.

AC Control Relay

For alternating current applications, the ac input is rectified by a silicon rectifier connected directly to the solenoid. The control relay consists of two relays which may be mounted on a common base. Alternating current to the rectifier is handled by the main control, or X relay, while the second relay, or Y relay, provides auxiliary control and anti-pump protection. (Fig. 6.)

Silicon Rectifier

A full wave rectifier is used to convert alternating current to direct current for the dc solenoid in the solenoid operator. This rectifier is designed for intermittent duty and should not be used for any other purpose.

The four rectifiers (diodes) are mounted on heat sinks which are assembled together with a terminal block on a chassis. The diodes are connected to form a full wave, single-phase, bridge. Direction of current flow does not affect solenoid operation. Nominal operating voltage for the rectifier is up to 300 volts ac.

The junctions of these rectifiers can be damaged by overvoltage or heating due to excessive current flowing through them. Protection against switching transients is provided by a suppressor.

Rectifier junctions will be distroyed if the full E/R closing current flows for more than a second or two as might occur if the breaker fails to close normally due to mechanical difficulty. To protect the recifier, a fuse is provided in the closing circuit capable of blowing under such conditions. The blown fuse must be replaced only with another of the same type and rating. As a safety measure, the fuse should always be in series with the rectifier during any test operations. Limit such operations to not more than two a minute.

STORED ENERGY OPERATOR

The stored energy operator (Fig. 5) uses charged springs to power the closing operation. Opening is spring-powered also, but not with the same springs used for closing. A stored energy operator consists of three systems: driving, spring linkage and four-bar toggle linkage. These systems are disengaged from each other except while performing their specific functions. For example - the driving and spring linkage systems are completely free of each other except when the spring linkage is being charged. Similarly, the spring linkage and four-bar toggle linkage systems are free of each other except during a closing operation.

Stored energy operated breakers normally require a single commercial relay for control. This relay is furnished to match the control voltage.

Rest Relay

The reset relay is used for instantaneous reclosure service on stored energy operated breakers instead of a latch check switch. The relay is a solid state device that operates an electro-mechanical relay. Closing time is not affected by voltage or current variances well beyond the standard circuit breaker control limits. The voltage regulator and timing circuits are mounted on a printed circuit board and encapsulated in a resilient material for shock resistance.

AUXILIARY EQUIPMENT

Auxiliary Switch

Mounted on the breaker, the auxiliary switch is normally used to open the trip circuit when the circuit breaker is opened. As this multi-stage switch operates from the breaker disconnect blades, circuitry dependent on the position of the breaker, such as indicator lights, etc., is wired through this switch. The individual stages are easily converted to "a" or "b" without disassembling the switch. (See page 16, Figure 14.)

Capacitor Trip Device

A capacitor trip device is commonly used with circuit breakers having an ac control supply installed in remote locations or unattached substations where battery cost and maintenance are undesirable.

In these cases, the capacitor trip device may be charged from the same stepdown transformer that is used to energize the breaker control. This stepdown transformer should be connected to the line side of the breaker.

To apply the capacitor trip device to existing breakers originally shipped with dc trip coils, contact your Allis-Chalmers sales representative.

ARC CHUTE ASSEMBLY

Each arc chute (Fig. 2) 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 -

1. The stationary end arc runner (4) and moving end arc runner (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.

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

3. The barrier stack (23) consisting of a number of refractory plates, with "v-shaped" slots, cemented together. The barrier stack cools, squeezes and stretches the arc to force a quick interruption.

4. The barrier (1) containing coolers (28) through which the by-product gases of interruption pass, completes the cooling and deionizing of the arc products.

Arc chutes are tilted to expose contact area for inspection of barrier stack (23). The arc chutes may also be lifted and removed from the breaker. Unfasten coil connections before tilting or removing arc chutes.

OPERATION

CIRCUIT BREAKERS

Normal -- Normal circuit breaker operation is controlled by cubicle mounted controls or other control devices. The closing springs of stored energy operated breakers will charge as soon as the breaker control bus is energized. Check the motor cutoff adjustment (page 18) if springs do not charge.

Opening Breaker -- Solenoid or stored energy operated breakers can be tripped manually by depressing the trip rod (43), Fig. 1, or electrically by energizing the trip circuit. This rotates the latch that allows the closing linkage to collapse and reset.

Closing Breaker -- When the springs of a stored energy operated breaker are fully charged, it can be closed manually by pulling lanyard (26), Fig. 1, or electrically by energizing the closing circuit. This rotates the latch that allows the springs to close the breaker.

OPERATORS

Solenoid Operator - The primary closing force of this operator (Fig. 3) is supplied by a dc solenoid. The iron circuit housing the solenoid consists of the main operator frame - to which the pole head is welded - a helically wound tube and a back plate held in place by four bolts (68). The armature (4), with plunger (6) and cap (19) attached, slides in a non-magnetic tube (5). When the coil (8) is energized, the armature moves toward the pole head. The non-magnetic washer (21) keeps the armature from actual contact with the pole head so that the armature will release rapidly when the coil is de-energized by reducing the effect of the residual magnetism. The armature is returned by a spring around the plunger.

The operator, through the use of a 4-bar linkage, may be electrically and mechanically trip-free by the release of the trip latch mechanically or by energizing the trip solenoid electrically at any time during the closing stroke or after the breaker is closed.

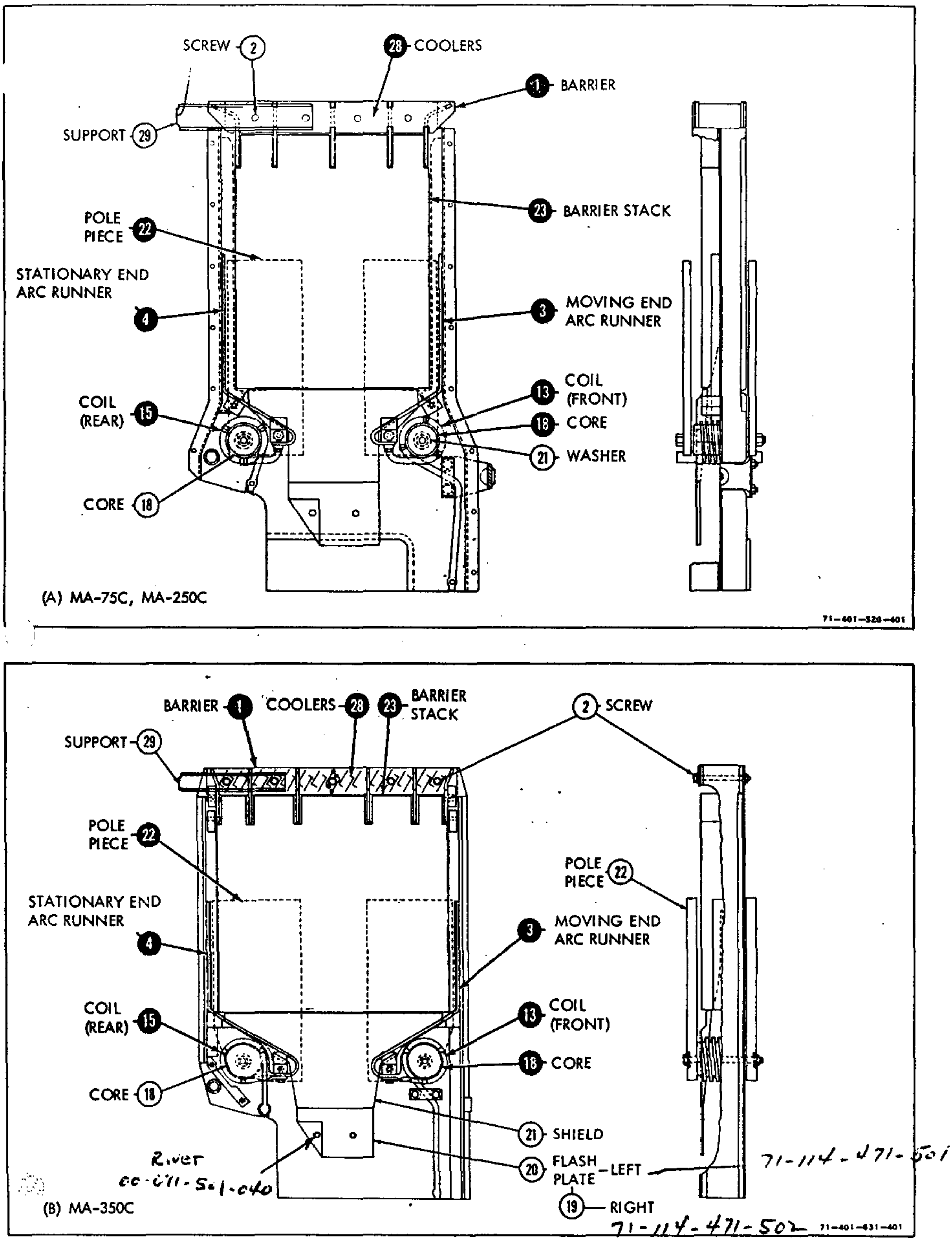


Fig. 2 – Arc chutes.

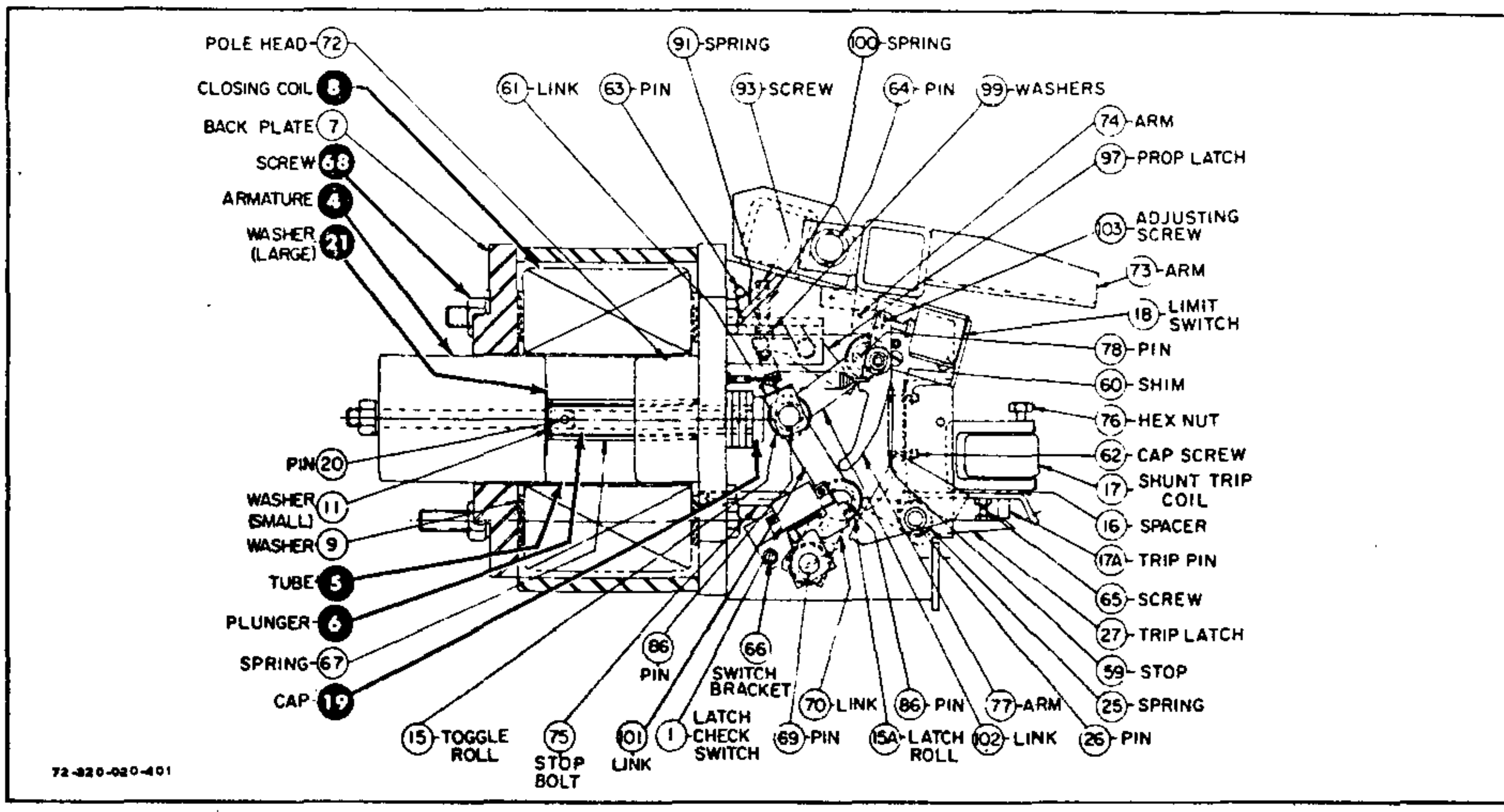
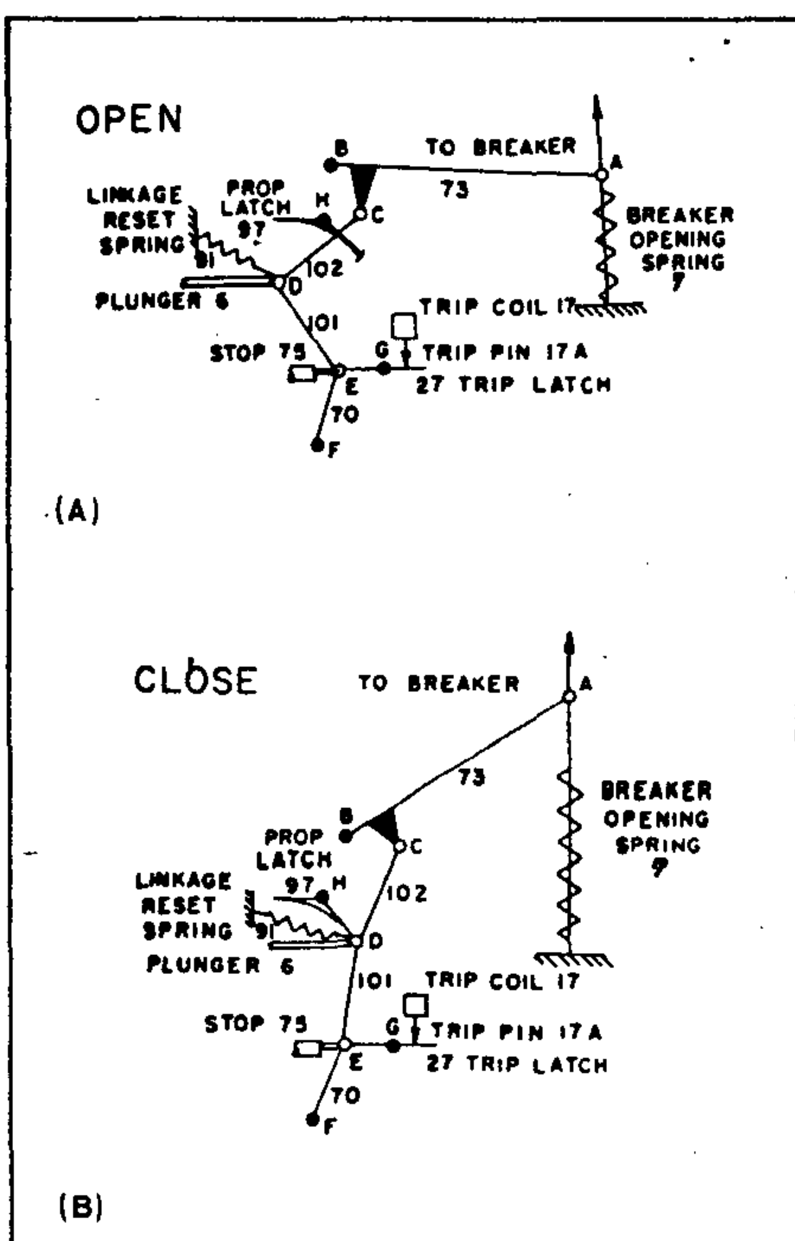


Fig. 3 – Solenoid operator assembly.



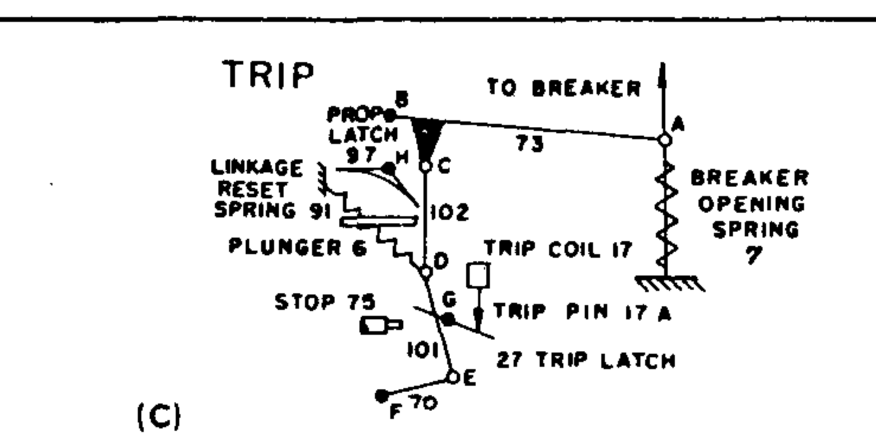


Fig. 4 – Four-bar linkage.

The 4-bar linkage (Fig. 4) consists of links (70, 101, 102 and 73). In normal closing operation, point E is held fixed between stop bolt (75) and trip latch (27). When the closing solenoid is energized, plunger (6) moves forward to rotate link (101) about center E. This forces link (102) to move, rotating arm (73) about its fixed center B. The forward travel of point D carries it past prop latch (97) which holds point D as plunger (6) retracts. The rotation of arm (73) closes the breaker blades and extends the opening springs.

To open the breaker, trip latch (27) is rotated about its center G either electrically - bv energizing the trip solenoid coil which moves the trip pin down to strike and rotate the latch - or mechanically - by depressing the tail of the latch. This releases point E, allowing link (70) to rotate about its fixed center F. Links (101 and 102) drop allowing arm (73) to rotate, pulled down by spring (7). As point D drops, it is freed from the prop latch (97). Reset spring (91) pulls D back, lifting point E back of trip latch (27) and resetting the linkage. If the trip latch (27) is rotated at any time during the closing stroke, the linkage will collapse.

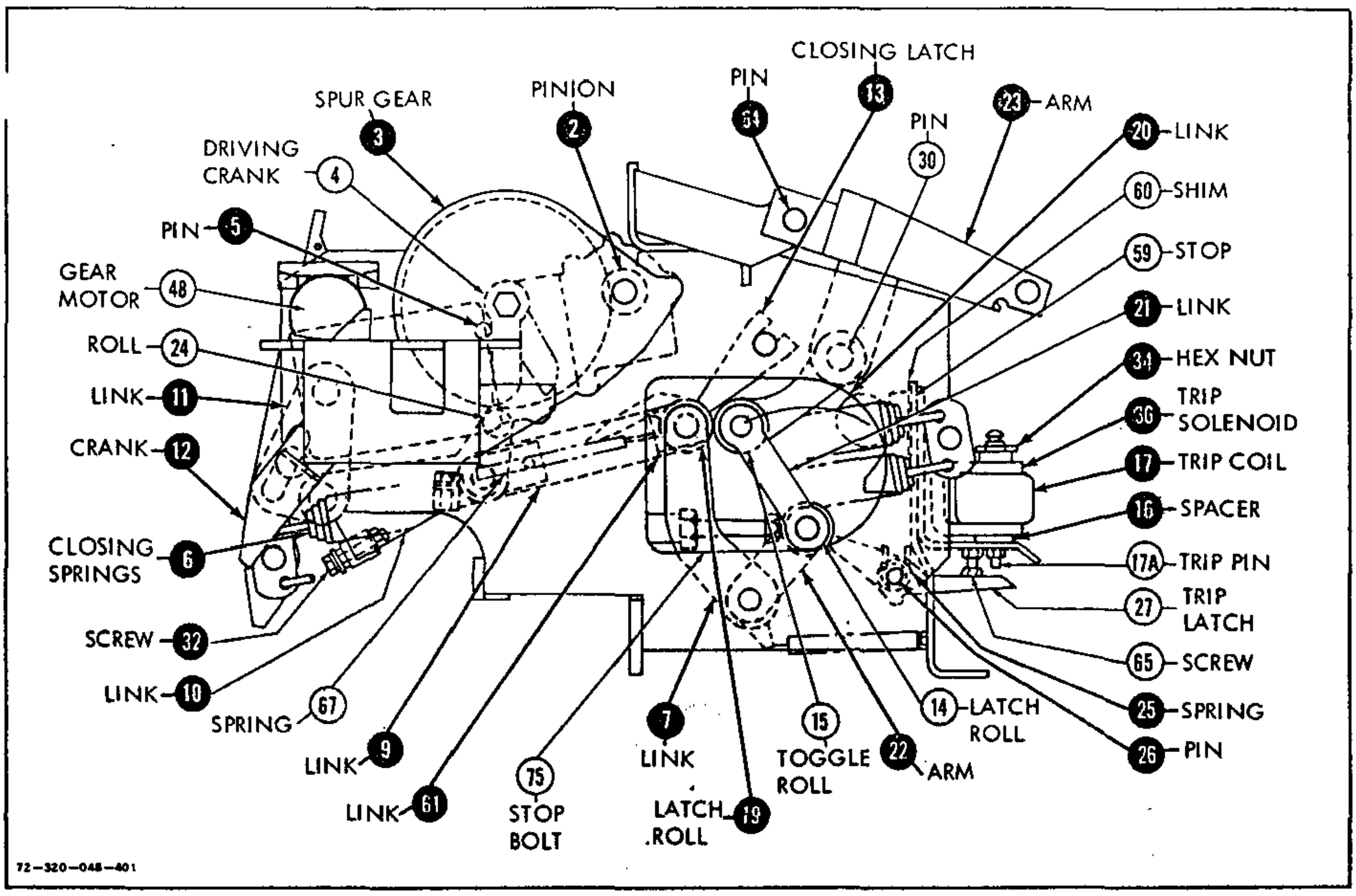
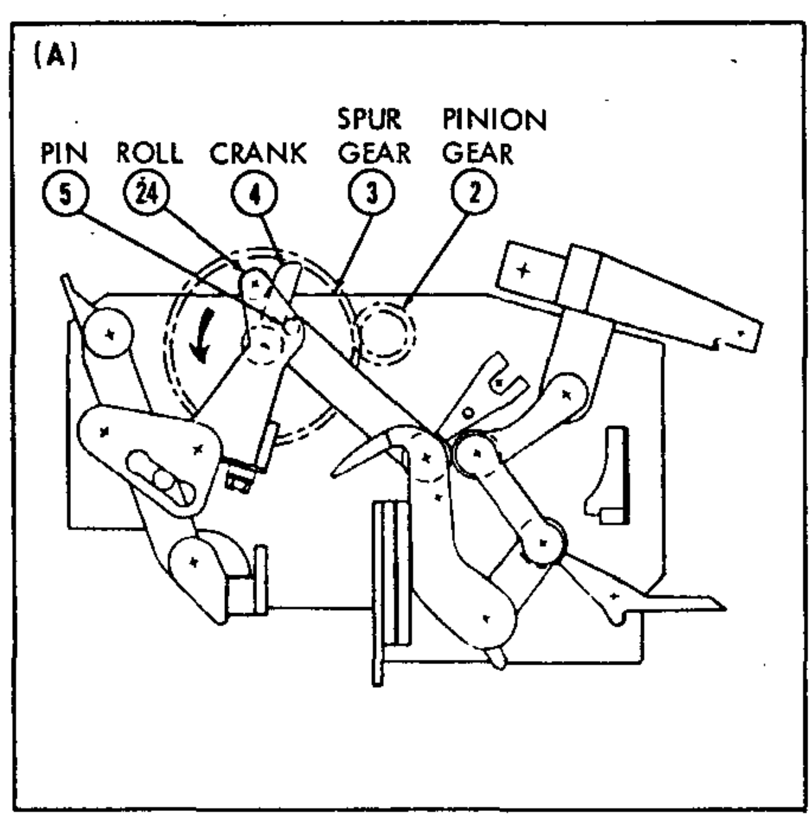


Fig. 5 - Stored energy operator.

STORED ENERGY OPERATOR - (Figures 5A-G)

Fig. A -- Breaker Open, Springs Discharged, Motor Running Ready to Charge. The charging motor drives pinion gear (2) which rotates spur gears (3). Pin (5), on the face of the spur gears, engages the free-swinging driving cranks (4) which are rotated into engagement with roll (24).



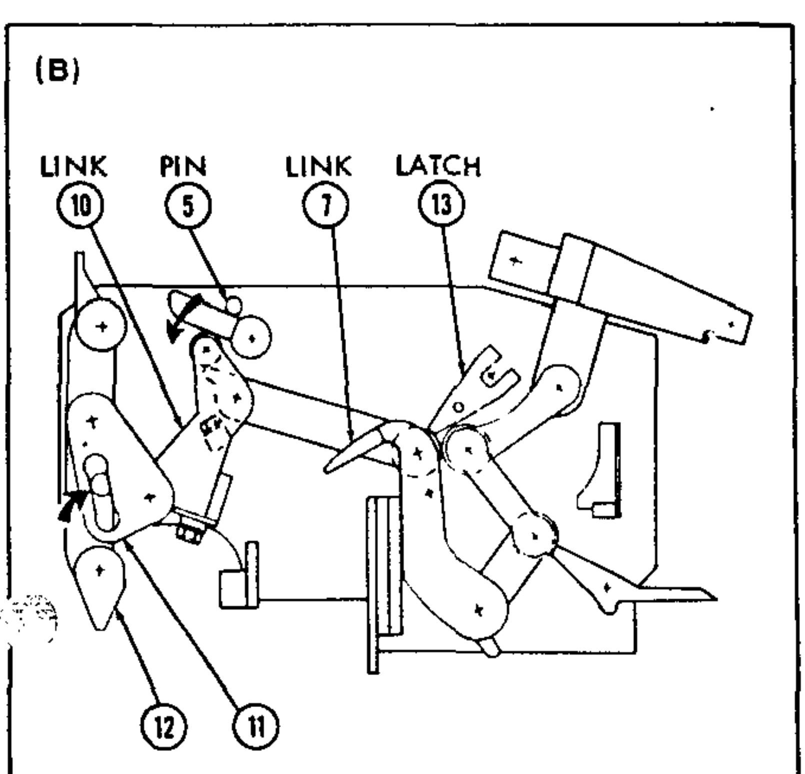


Fig. B -- Breaker Open, Springs Partially Charged. Continued rotation of cranks forces link (10) down because link (7) is held in place by latch (13). Link (11) rotates about its fixed center. Link (11), through pin (31), drives crank (12) back, extending the closing springs attached to the lower end of crank (12).

Fig. C -- Breaker Open, Springs Charged. As the closing springs become fully extended, cranks (4) push links (9, 10) over toggle and cranks (4) disengage roll (24) and rotate out of the way. The closing springs are fully charged and held by spring release latch (13).

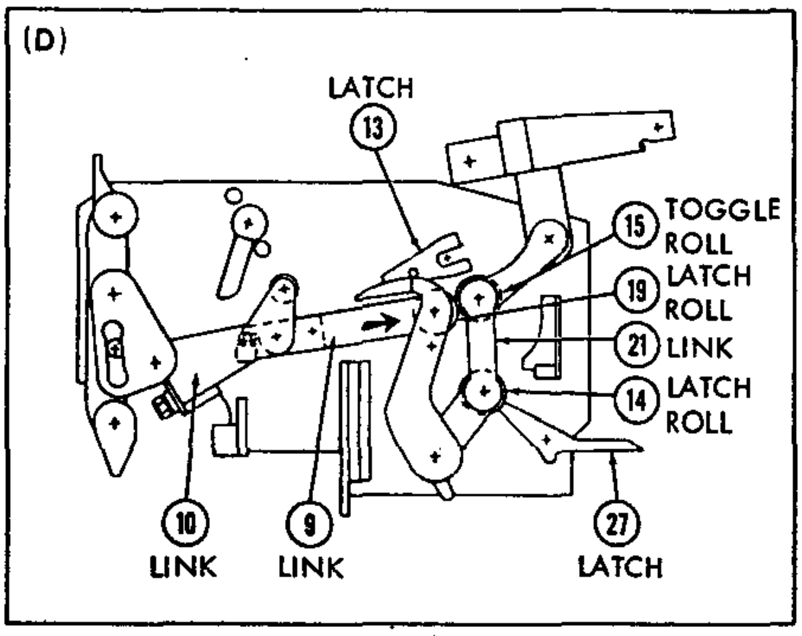


Fig. E -- Breaker Closed, Linkage Starts to Collapse. The rotation of link (21) rotates arm (23), through link (20), closing the disconnect blades. Links (20, 21) go over toggle against stop (59), locking the breaker closed. Screw (32) and crank (12) come in contact and force link (10) to rotate, breaking the over toggle between links (9, 10).

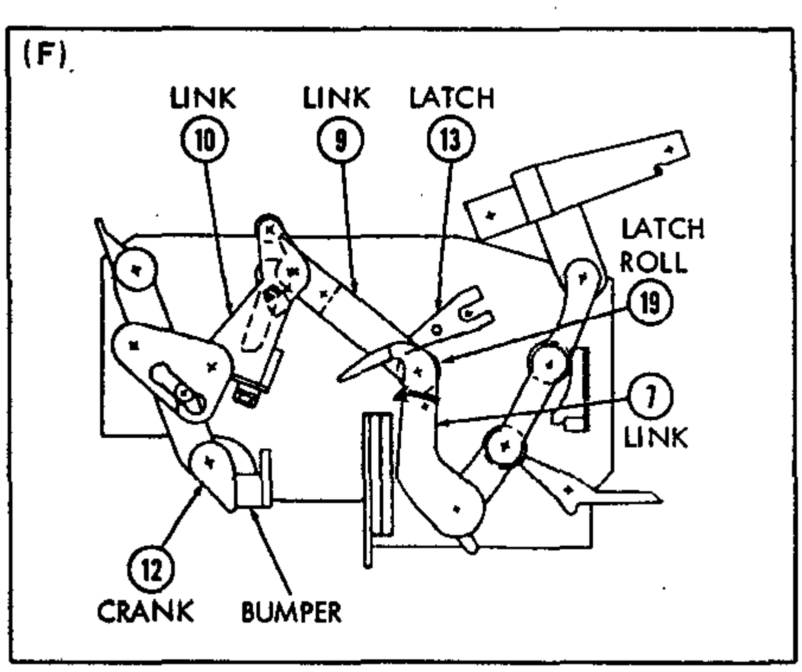


Fig. G -- Breaker Opening, Springs Charged. To open the breaker, trip latch (27) is rotated by depressing latch, releasing latch roll (14). Arm (22) rotates about its center, allowing links (20, 21) to drop. This rotates arm (23) about its center, opening the breaker. Toggle roll (15) is forced back by the curve of stop (59), breaking the over toggle of links (20, 21) and allowing them to reset. This rotates arm (22) back into reset position with latch roll (14) back of latch (27).

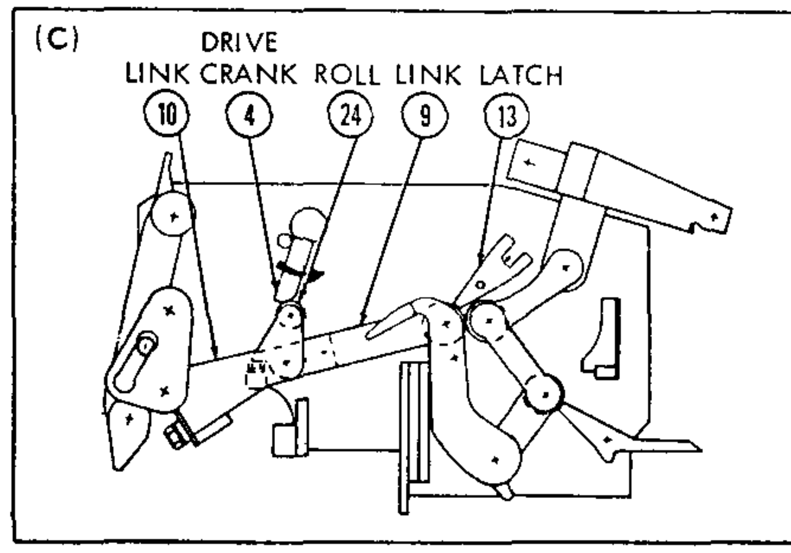


Fig. D -- Start of Closing. To close the breaker, the spring release latch (13) is moved up to release latch roll (19). Links (9, 10) drive forward as a unit. Latch roll (19) forces toggle roll (15) forward. This rotates link (21) about latch roll (14) which is held fixed by latch (27).

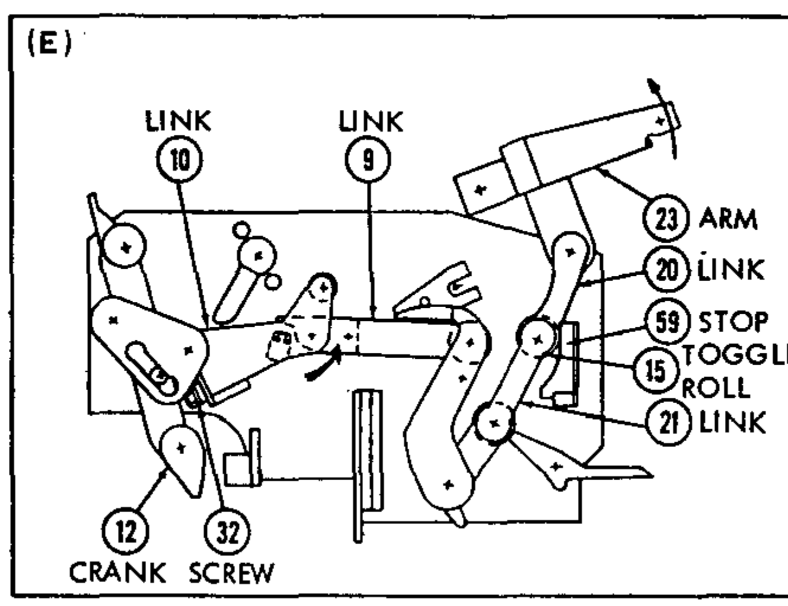
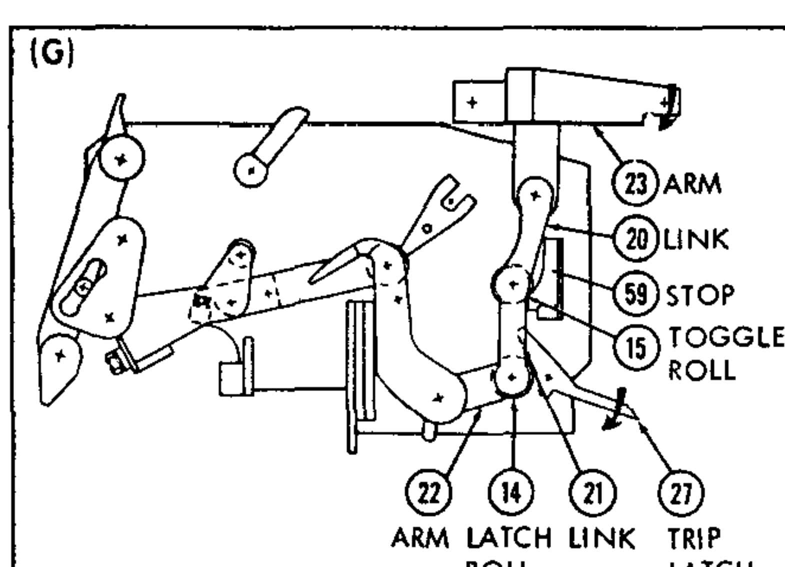


Fig. F -- Breaker Closed, Springs Discharged, Mechanism Practically Reset. Crank (12) is stopped by the bumper. Links (9, 10) collapse upward, allowing link (7) to reset. Latch (13) drops ahead of latch roll (19). Unit is set to recharge springs.



OPERATOR CONTROL

SOLENOID OPERATOR

The normal control (Fig. 6) for this operator has the close and control power from a common source. The solenoid has dc coils designed to give maximum efficiency over the desired control voltage range.

For dc control the normal method is as shown in Fig. 6A. When the close contact (CS-C) is closed, current flow through 52LC and 52Y1 energizes the 52X relay coil. This closes contacts (52X3 and 52X4) to energize the closing coil (52cc). Contact (52X1) closes to lock in the 52X relay coil. Late in the solenoid stroke, the limit switch contact (52aa) closes, energizing the 52Y relay. The closing of the 52Y2 relay and the opening of the 52Y1 contacts cuts off the 52X3 and 52X4 contacts and the lock-in circuit (X1) of the 52X relay. If the close control remains closed, the 52Y relay is still locked in through contact 52Y2 and must be opened to reset the control for another close. This forms the anti-pump circuit so that on a trip-free operation the close control has to be opened before the breaker will attempt another close action.

For ac control, a full-wave, bridge rectifier is used to supply dc to the closing coil. An ac control similar to the dc control scheme is shown in Fig. 6B. The control function is the same as for the dc control. A surge suppressor is furnished across the rectifier to protect against high voltage surges which ...y destroy the rectifier elements.

The more commonly used ac control method (Fig. 6C) requires a close control with a normally closed contact and a normally open contact. When the supply is energized, relay (52Y) is energized and locks in through contact (52Y2) to terminal (5). Contact (52Y4) also closes so that when the close control switch operates, current flow through terminal (7) and 52Y4 energizes the 52X relay which locks in through 52X1 and terminal (5). Relay (52X) energizes the close coil circuit through 52X2 and 52X3. Late in the solenoid stroke, limit switch contacts (52bb) open de-energizing the 52Y relay. Opening of contacts (52Y2 and 52Y4) de-energizes the 52X relay, opening contacts (52X1, 52X2 and 52X3) and de-energizes the entire circuit. To re-energize the circuit, relay (52Y) must be energized by releasing the close control to re-energize terminal (19). If the breaker is closed, contact (52b) will be open and relay (52Y) will energize when the breaker is tripped open.

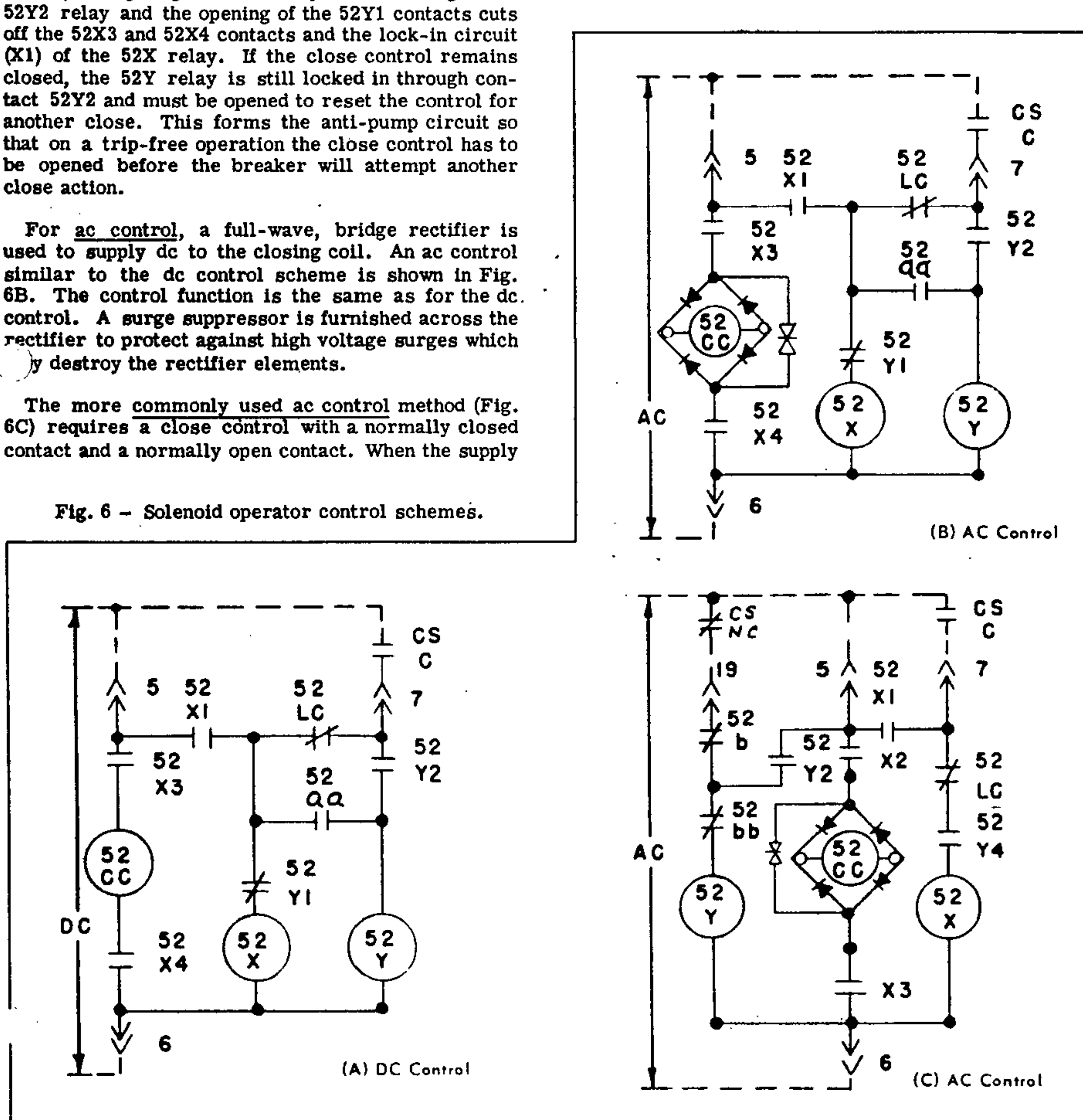


Fig. 6 – Solenoid operator control schemes.

STORED ENERGY OPERATOR

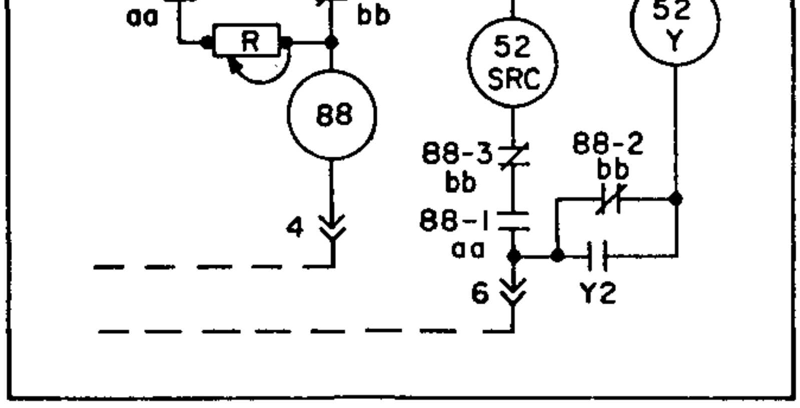
The normal control (Fig. 7) for this operator has been incorporated in one switch assembly located at the rear of the unit. It consists of two heavy-duty toggle switches (6) operated by common linkage (1) from the main closing springs and one heavy-duty toggle switch (6) operated by a cam (2) driven by the main gear (Fig. 11).

The main spring charging motor power is supplied through terminals 3 and 4, Fig. 7. The mechanical interlock is a switch operated by the breaker release lever which opens the motor circuit when the lever is depressed. The prop latch check switch is closed when the spring release latch is in reset position. The 88-1 and 88-2 switches are shown with the main closing springs discharged. When the control is energized, the motor starts to charge the springs. The 88-3 switch is operated by cam (2), Fig. 11, on the main gear. As the charging linkage charges the main closing springs, the motor switch cam rotates with the left-hand large gear. When the control is energized the motor starts to charge the springs. Just before the springs are fully charged, the 88-1 and 88-2 switches are thrown by lever (1) which is operated by pin (5), Fig. 11. The 88-1bb switch opens when the springs are fully charged. However, before this switch opens, the 88-3aa switch closes and connects the dropping resistor into the motor circuit. The motor continues to drive the gears until the free swinging cranks on the main gears are almost to the top of the greas. The motor then shuts off (cutoff by the cam operating the 88-3aa switch) and coasts until the cranks go over center and drop out of the way.

Closing Circuit

The standard control circuit for a stored energy operator is shown in Figure 7. When the close control switch (CS) is closed, the circuit from terminal

Fig. 7 – Control scheme for stored energy operator.



7 through 52B and Y1 to 52SRC, through 88-3 and 88-1 to terminal 6 energizes the spring release coil, closing the breaker. As soon as the closing springs are discharged, 88-2 (bb) closes to energize 52Y relay. If the close control switch remains closed, the 52Y relay remains locked in through contact 52T2. Control switch (CS) has to be released to reset control for another closing operation. This forms the anti-pump circuit which prevents the circuit breaker from reclosing immediately after a trip free operation.

Reset Relay (Reclosing Control)

The reset relay (Fig. 8) designed for use in circuit breaker control is an electronic solid state time delay which operates an electro-mechanical relay (R). The relay, in turn, energizes the spring release coil (SRC) to close the breaker. The relay contacts are rated 15 amperes.

The relay closing time is not affected by board variance of voltage and current well beyond the standard circuit breaker control limits. The time delay error caused by temperature is minor, being less than 3% from -20 to +80 C and not over 5% to -40 C.

The voltage regulator and timing circuits are mounted on a printed circuit board and encapsulated in a resilient material for shock resistance.

The controlled supply voltage charges the capacitor (C1) through the time rate determining resistor (R1) to the triggering voltage of the unijunction transistor (UJT) which activates the SCR, energizing the relay coil.

Variable resistor (R) is preset at the factory for a delay of ten cycles and locked in place by the stem locking nut. A 5-degree change in resistor setting would mean a change in delay of approximately 1/2 cycle. The unit is adjustable from an approximately instantaneous to a 60-cycle delay. Any readjustment should be made using a cycle counter or equivalent for timing.

The delay circuit in the reset relay is a closely controlled capacitor relaxation circuit, direct current operated. Figure 9 shows a circuit used on a breaker with dc control. When the close control switch is closed, the circuit from 7 through 52B and Y1 to terminal T4 and from terminal T3 to 6 energizes the time delay circuit. After the specified delay, normally ten cycles, the relay coil is energized, closing the relay contact (R_2), tieing terminal T1 to terminal T2, completing the circuit to the spring release coil and closing the breaker.

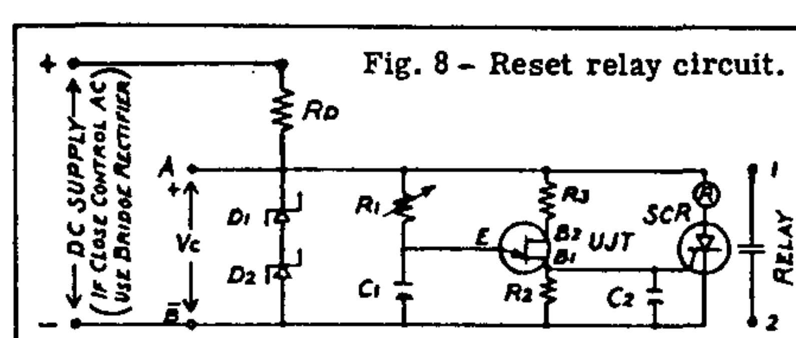


Fig. 8 – Reset relay circuit.

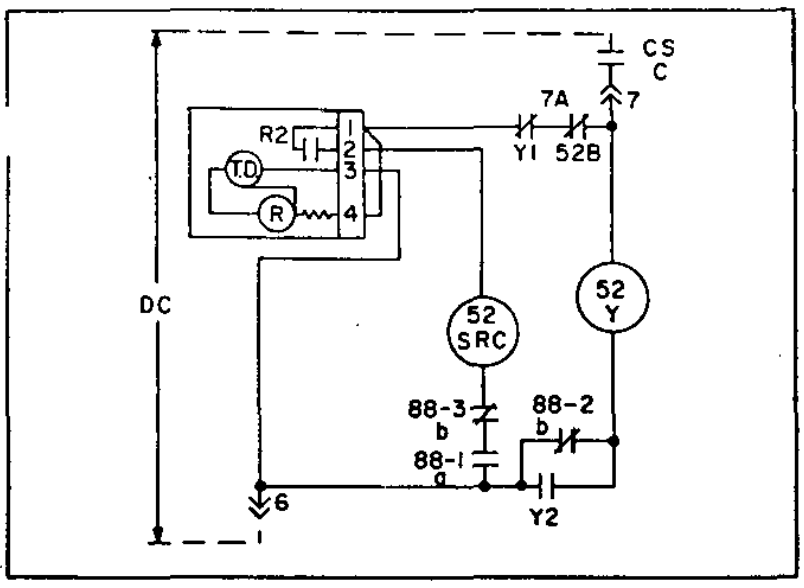


Fig. 9 – DC control scheme.

When used with an ac closing circuit, a full-wave, bridge rectifier is used to supply dc to the delay circuit (Fig. 10). The input to the rectifier is T1 and T2. The dc output through terminals T3 and T4 supply the time delay circuit of the reset relay.

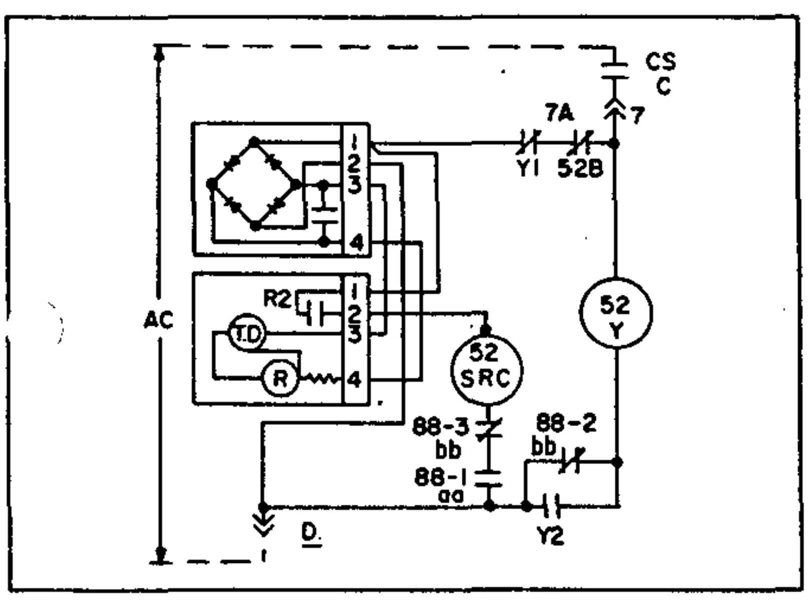


Fig. 10 – AC control scheme.

Motor Control Switch

Normal control for stored energy operated breakers is incorporated into one switch assembly (Fig. 11) located at the rear of the breaker. This switch assembly consists of two heavy duty toggle switches (6) operated by common linkage (1) from the main closing springs and one heavy duty toggle switch (6) operated by a cam (2) driven by the main gear.

The 88-1bb contact is in the drive motor circuit and is used to start the motor when the springs are discharged and stop the motor when the springs are fully charged. The 88-1aa and 88-3bb contacts are in series with the close control circuit and keep the circuit open until the springs have been fully charged and the charging motor de-energized.

The 88-2bb contact is in the close control lockout circuit. The 88-2aa is used to energize an indicating light which shows that the springs are fully charged.

The 88-3aa contact introduces a resistor into the drive motor circuit to coast the drive cranks out of the way with a reduced voltage on the motor.

As the charging linkage charges the main closing springs, the motor switch cam rotates with the left-hand large gear. Just before the springs are fully charged, the cam (2) throws the 88-3 switch. A split second later, when the springs are fully changed, the 88-1 and 88-2 switches are thrown by lever (1) which is operated by pin (5). Thus, before the 88-1bb switch opens, the 88-3aa switch has closed connecting the resistor into the motor circuit. The motor continues to drive the gears until the free swinging cranks on the main gears are almost to the top of the gears. The motor then shuts off (cut by the cam operating the 88-3aa switch), allowing the cranks to go over center and drop out of the way.

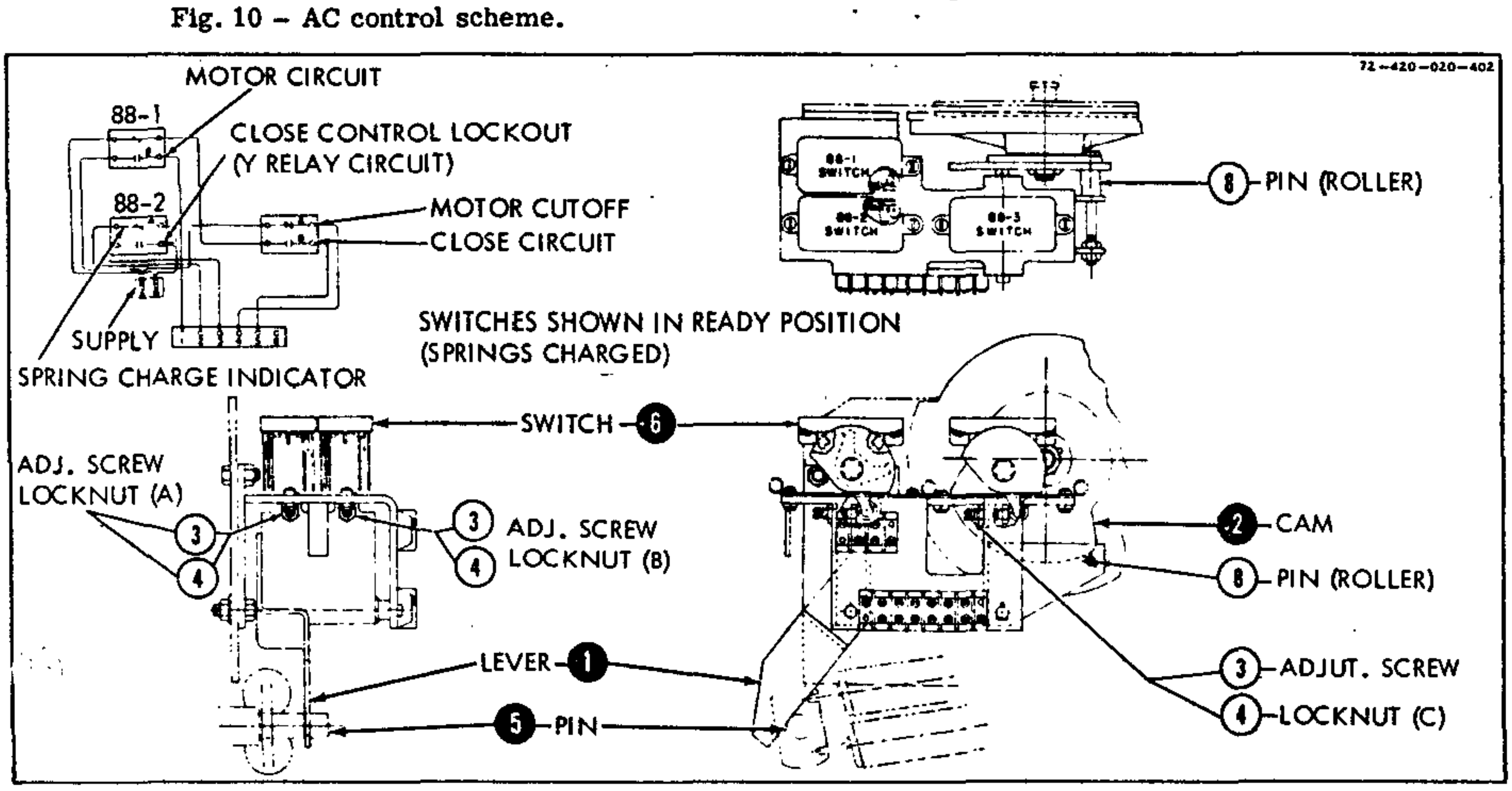


Fig. 11 – Motor control switch assembly for stored energy operator.

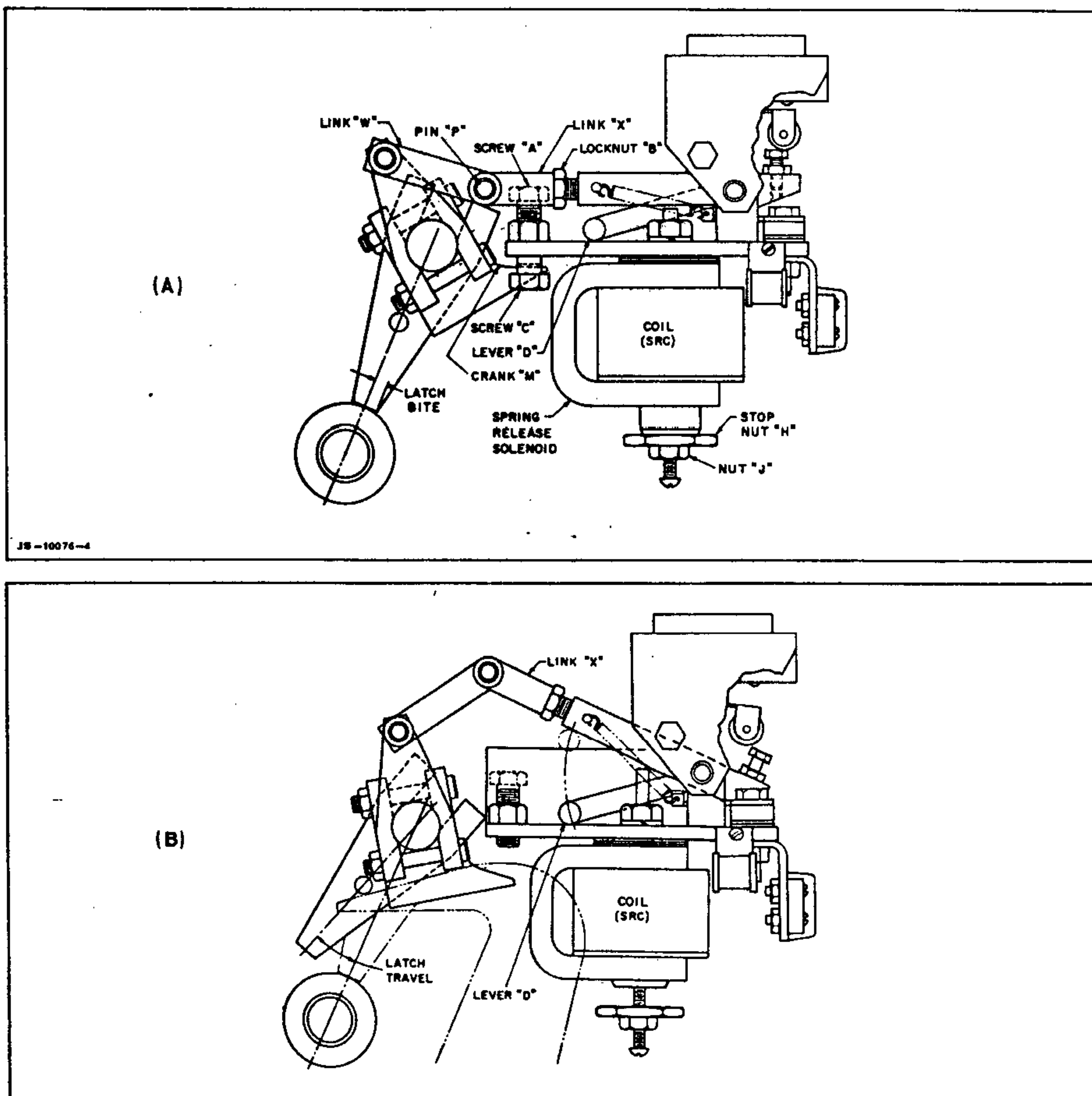
The resistor is adjusted to limit the speed of the unloaded motor. It is factory set to operate the motor at rated and minimum voltage and limit the coast of the motor so that the pin on the gear coasts past top center by not beyond 10 o'clock. With too much resistance the motor will stall. With too little resistance, the motor will coast too far and the cam will reclose the 88-3aa switch and the motor will continue to run.

Spring Release Latch

Fig. 12a shows the spring release latch in the hold position and locked in place by links (W and X) which are over toggle against screw (A). To release the latch, link (X) must be moved upward to invert the toggle. The switch is in the drive motor circuit and is closed when link (X) is against screw (A). Vertical movement of link (X) opens the switch.

When the spring release solenoid is energized (Fig. 12b), the armature moves up with the ram, forcing link (X) up, to break the over toggle condition of links (W and X). Link (X) is rotated to the right, removing the latch from the latch roll to release the closing mechanism. The upward movement of link (X) opens the switch in the drive motor circuit, preventing the springs from charging until link (X) resets to lock switch in position.

Fig. 12 – Spring release latch for stored energy operator.



ADJUSTMENTS

Adjustments are factory set and checked before and after numerous mechanical operations on every breaker to insure correctness. No adjustment checking should be necessary on new breakers. If a malfunction occurs, check for hidden shipping damage.

The following will help you get the correct adjustments when replacing a broken or worn part.

CIRCUIT BREAKER TIMING

A comparison of circuit breaker timing at any period of maintenance with that taken when the breaker was new will indicate the operational condition of the breaker mechanism. A time variance of more than 1/2 cycle on opening and 2 cycles on closing indicates a maladjustment or friction buildup. A hole in the movable contact arm is provided for connection of a speed analyzer.

PHASE BARRIER ASSEMBLY

Full size barriers of high dielectric flame retardant material isolate each phase (Fig. 1).

To remove phase barriers, lift panel spring assembly (13) out of slots (14) to release panel (32). Lift and remove panel (32). Remove screws (23, 30) from barrier (22). Remove screws (2, 48, 49). Remove rear barrier (25).

TILTING ARC CHUTES

Remove phase barriers as described under "Phase Barriers," above. Refer to Fig. 1. Remove screw (37) on each phase.

Position arc chute support at the rear of the breaker and tilt back the arc chutes.

After arc chutes are tilted back to their normal position, make sure all screws are tightened securely on all phases before phase barriers are replaced.

BARRIER STACKS

The barrier stacks (Fig. 2) are fragile and must be handled carefully. Inspect the barrier stacks for erosion of the plates in the areas of the slots. The stacks should be replaced when a milky glaze appears on the full length of the edges of most of the slots. They should also 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, remove screws (30) and barrier (27) from each arc chute. Slide barrier stack (23) through top of arc chute. When replacing barrier stack be sure the v-shaped slots go in first.

SERVICING CONTACTS

The frequency of contact inspection depends on severity of service. Refer to Fig. 13. Remove disconnect arms as a unit by removing screw (24), nut (14) and spring (23). Carefully inspect all contact surface in hinge joint. Silver washer (25) and adjacent surfaces should be clean and free of roughness or galling. Lubricate silver washer and mating surfaces by rubbing in microfine dry graphite sparingly. Reassemble hinge hoint. Tighten screw (24) and nut (14) so that cotter pin can be re-installed. Spring (23) and washer (25) must be assembled in their original position to assure proper adjustment. Replace badly pitted or burned contacts before they are damaged to such an extent to cause improper operation of breaker.

CONTACT PRESSURE OF HINGE JOINT

The hinge joint contact pressure is in proper adjustment when a pull of 5 to 7 pounds is required to move the disconnect toward the open position. This measurement is obtained as follows: (Fig. 13)

Remove pin (12) and detach link (8) from the disconnect arms (18) and (19). Move the disconnect to a position just short of "contact make." Attach a spring scale to the disconnect 8-1/2 inches above screw (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 (14).

Before attaching link (8) to disconnect arms (18) and (19), check contact alignment and contact lead (Page 15).

ARCING CONTACT HINGE JOINT

The arcing contact hinge joint (Fig. 13) is in proper adjustment when each spring washer (15) is deflected approximately 0.015 inches.

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

CONTACT ALIGNMENT

The main and arcing contacts are an integral part of the bushing assemblies and are carefully alignment with the upper and lower bushings before shipment. Normally, no further adjustment is necessary.

Use these procedures if it becomes necessary to change contacts or reset contact alignment (refer to Fig. 13).

Procedure A. Horizontal Alignment

1. If not already detached, remove pin (12) and detach link (8) from disconnect arms (18, 19).

2. Detach arcing contact (10) from yoke (2) by removing pin (26) and loosening nut (1) until assembly is free. Move main contacts as far back as they will go on stud.

3. Move the disconnect towards the closed position until it touches a main contact finger (view A-A, Main Contacts Engaging). Dimension "c" should be no greater than .020 with one contact touching.

4. Adjustment is made by loosening two nuts (22) and rotating the entire contact assembly. Check alignment (dimension "c") after nuts (22) are tightened.

5. Alignment is checked and adjusted on each phase separately. Be sure there are no binds between contacts (11) that could prevent wiping action with the disconnect arm.

Procedure B. Contact Penetration (Stroke)

1. Contact penetration should be checked and adjusted only when the contacts are properly aligned.

2. Attach link (8) with pin (12).

3. Using electrical closing procedures, close and latch breaker. Teh spread of the contacts (view A-A, Breaker Latched) should be 1/8 to 3/16 inch. This is the total of the two gap dimensions "a" measured on each side of the contact centering tube between the brass tube and the flat stop surface on the contact. Each "a" dimension is normally 1/16 to 3/32 inch.

4. With the breaker open, adjust by increasing or decreasing length of link (8) by turning nut (16). Adjust each phase separately.

Procedure C. Arcing Contact Lead

Arcing contacts are adjusted only after the main contacts have the proper alignment and penetration. The arcing contacts should "make" before the main contacts. To measure and adjust each phase:

1. Attach the arcing contacts to the yoke and spring assembly (reverse of Procedure A, step 2).

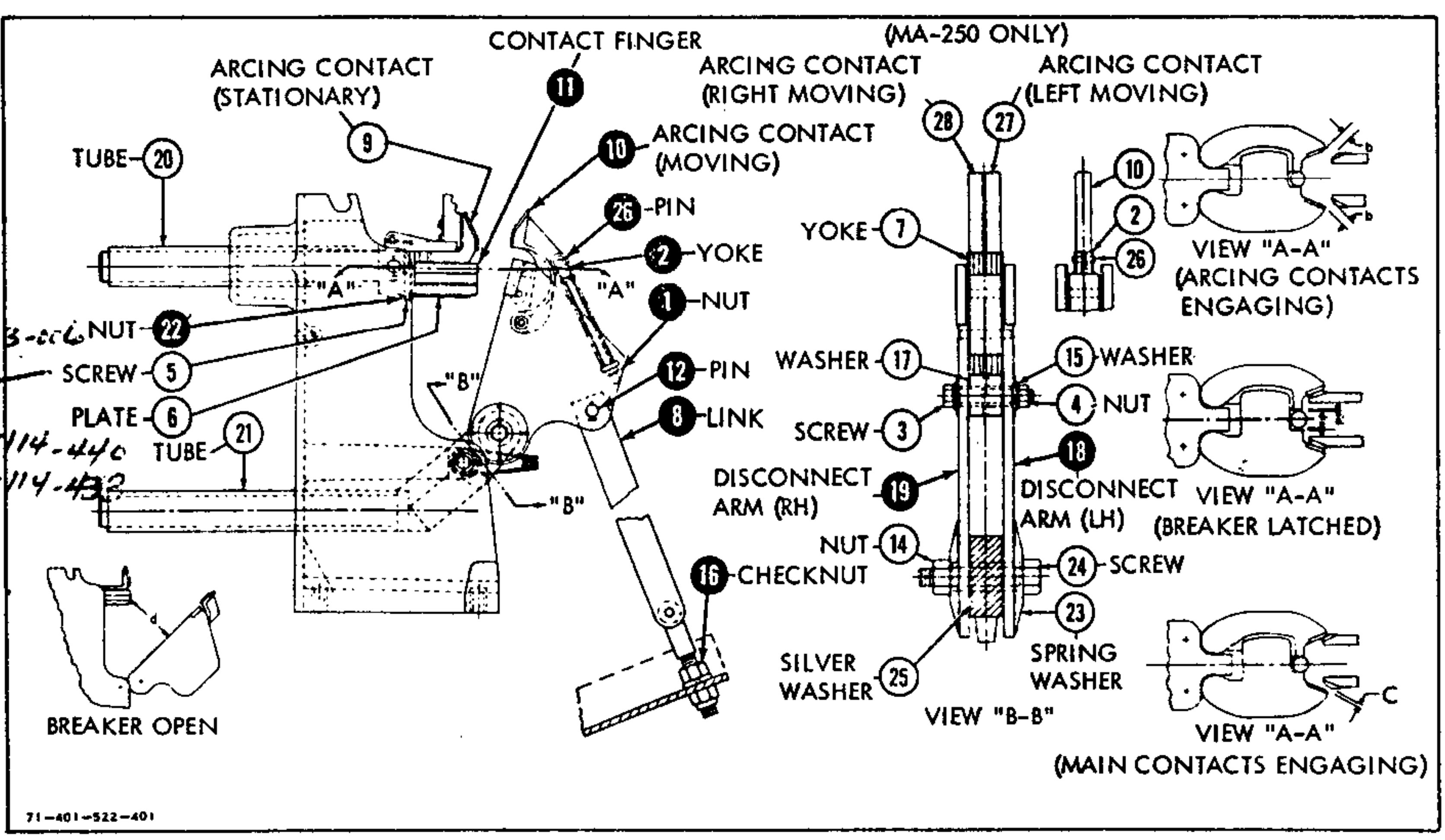
2. Using the maintenance closing procedure, slowly move all three phases toward the closed position until a dimension between 7/32 to 9/32 (dimension "b" view A-A, Arcing Contacts Engaging) can be measured simultaneously between main contacts on all three phases.

3. Set the arcing contacts to touch simultaneously at this point by adjusting nut (1) on the individual phases.

Procedure D. Check Breaker Open Position

Dimension "d" (Breaker Open of Fig. 13) is 4 inches plus or minus 1/8. Following the setting and adjustment of the contacts (Procedures A, B and C) open the breaker and measure dimension "d" between the disconnect arm and the bottom of the second finger in the main contact assembly. Adjustment is made with the breaker in the open position by positioning rod end (40), Fig. 1 at the top of the puffer piston rod.

Fig. 13 – Stud and support assembly.



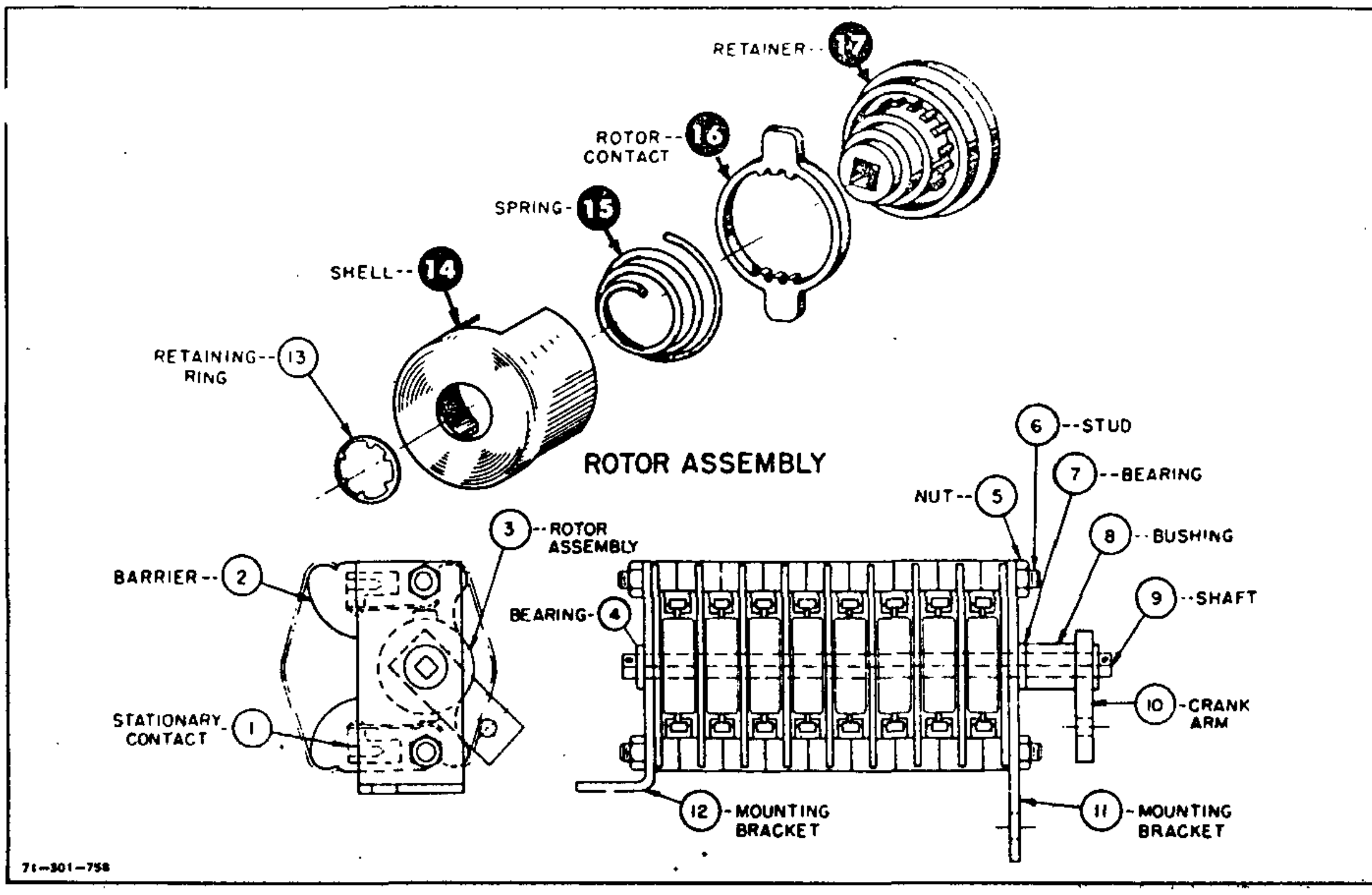


Fig. 14 – Type Q-10 auxiliary switch.

AUXILIARY SWITCH

The type Q-10 auxiliary switch has been tested and adjusted at the factory. Contacts used in the breaker control circuit should not require further adjustment.

The switch (Fig. 14) is designed so that the individual contacts may be repositioned in fifteen degree steps without disassembling the switch.

Using long-nosed pliers, move the rotor contact (16) in the slot of the shell (14), compressing spring (15). This will free the rotor from the retainer (17). Rotate the rotor to the desired position and release. Be sure the rotor springs solidly back against the retainer to fully engage the rotor and retainer teeth.

INTERLOCK PLUNGER

The foot lever (20, Fig. 1) operates the interlock plunger (18, Fig. 1) as well as the trip latch. Depressing the lever trips the breaker and raises the plunger. This frees the breaker so that it can be moved in its cubicle. The interlock system is in proper adjustment when the plunger is positioned 1-11/16 to 1-13/16 inch above the floor line, and causes tripping of breaker contacts when it is raised to a level not more than 2-1/16 inch above the floor line. The latch tripping rod associated with the [illegible] lever should be clear of the trip latch (27, Figs. 1[illegible] & 16) by 1/32 to 1/16 inch.

The foot lever is padlocked by matching holes in the breaker frame with those in the lever arm. In the padlocked position, the foot lever will be halfway down, the breaker will be trip-free, the interlock plunger will be between 2 and 2-1/4 inches from the floor line and will hold the breaker in any of the three positions within the cubicle.

SOLENOID OPERATOR (Fig. 15)

Latch Roll Clearance - With the breaker open and latch roll (15A) resting against stop bolt (75), the latch roll should clear the trip latch (27) by 1/64 to 3/64 of an inch. Adjustment is made by stop bolt (75).

Trip Latch - The trip latch (27) should engage the latch roll (15A) 1/8 to 3/16 of an inch above the lower edge of the latch face with the breaker closed. This adjustment affects the clearance between the trip pin and trip latch. Refer to tripping solenoid adjustment.

Trip Solenoid - The trip solenoid is adjusted by shims so that when the armature (4) is against the pole head (72) there is 1/32 to 3/32 of an inch travel after the breaker trips.

The trip pin (17A) clears the trip latch (27) when relaxed by 3/32 to 5/32 of an inch. Adjustment is by hex nut (76).

Prop Latch - The prop latch (97) is adjusted by shims so that it engages the toggle roll (15) 1/8 to 3/16 of an inch above the lower face of the latch.

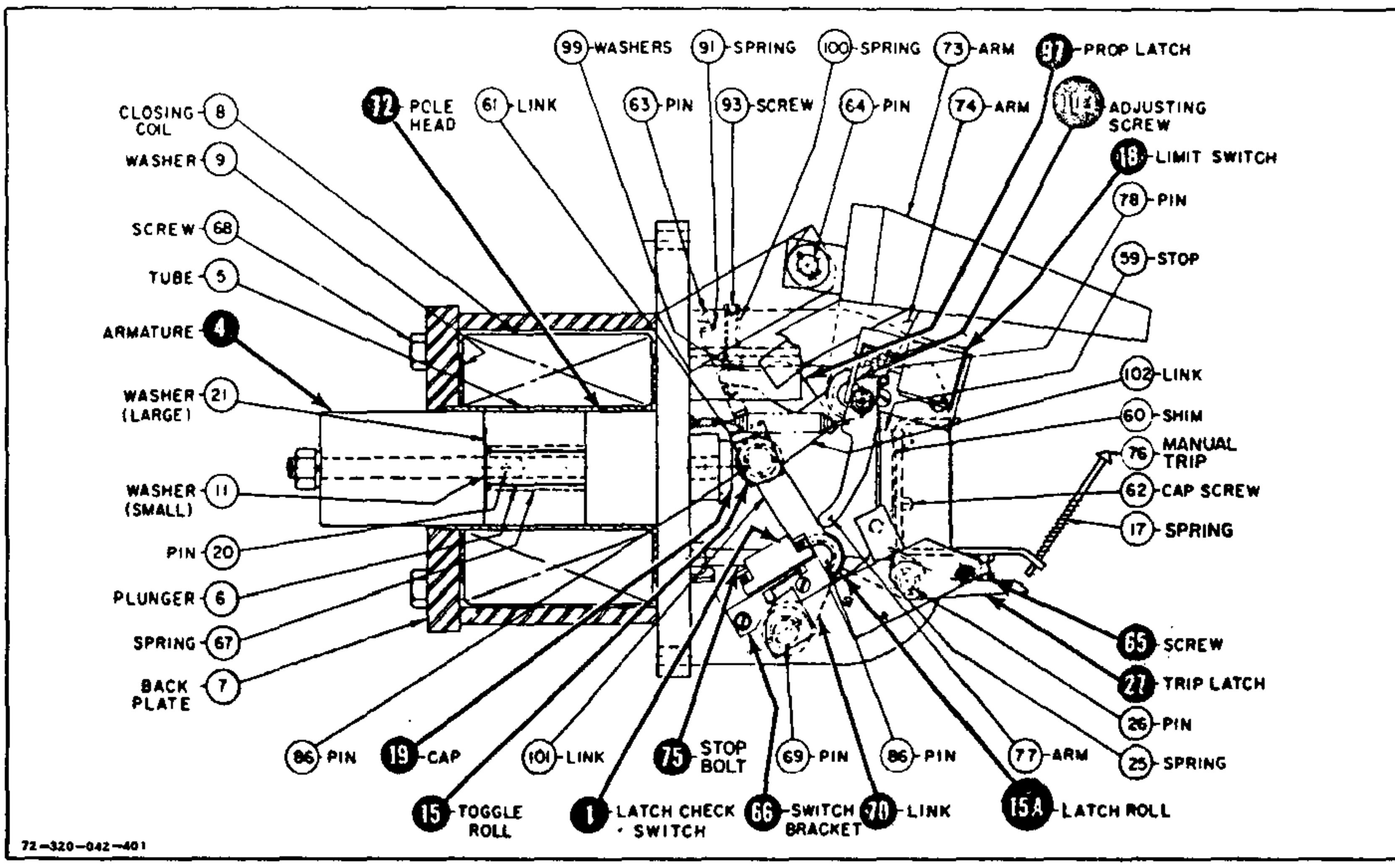


Fig. 15 - Solenoid operator assembly.

Limit Switch - The limit switch (18) is located on the front of the operator frame and is contacted by an extension of the toggle roll (15) pin within the 4-bar toggle linkage.

Adjust by screw (103). Contact action required by circuit breaker should be at 3/4 to 7/8 inch of the stroke of ram cap (19).

Latch Check Switch - The latch check switch (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 (70) of the 4-bar toggle linkage.

Adjust by moving switch bracket (66). The latch check switch may be jumper wired out or omitted if not used for instantaneous reclose.

STORED ENERGY OPERATOR (Fig. 16)

Main Toggle Roll -- When the breaker is in closed position with roll (15) against block (59), center of main toggle roll (15) should be 3/16 to 5/16 of an inch beyond line of centers of latch roll (14) and pin (30). Adjustment is made by adding or removing shims (60) behind stop (59).

Trip Latch -- The trip latch should engage its roll (14) 1/8 to 3/16 of an inch above the lower edge of the latch face. Adjustment is made with screw (65). This adjustment affects the clearance between the trip pin (17A) and the trip latch (27). With the springs charged and the breaker open, the trip latch (27) should clear its latch roll (14) by 1/64 to 3/64 of an inch. Adjustment is made by stop bolt (75).

Trip Solenoid -- The trip solenoid is adjusted by shims so that when the armature is against the pole head there is 1/32 to 3/32 of an inch of travel after the breaker trips. The trip pin (17A) clears the trip latch (27) when relaxed by 3/32 to 5/32 of an inch. Adjustment is made by hex nut (34).

Manual Charging of Closing Springs -- The springs are manually charged by inserting the charging handle into the guide tube to engage the gear motor (48). Turn the handle in the direction shown until the spring linkage is heard to go over toggle. This audible snap indicates that the springs are fully compressed (changed). Continue turning handle (about 95 more turns) to bring driving cranks (4) to their reset position (just past dead center). This removes the cranks from the danger of being hit by roll (24) as the breaker closes. It also correctly positions the cam controlling the 88-3 switch for electrical operation.

Manually Slow Closing the Breaker -- Thisbreaker can be partially closed slowly and mechanically held in any position of the closing stroke to make or check adjustments. Insert spring charging handle into guide tube and engage with gear motor (48). Turn handle counterclockwise until resistance is felt. Pull closing lanyard and hold out, continue turning handle. Contacts will close to main contact touch position but not fully closed.

CAUTION

As the contacts approach the closed position, check position of cranks (4) on rolls (24). Do not allow cranks to pass by the rolls, causing the contacts to snap open.

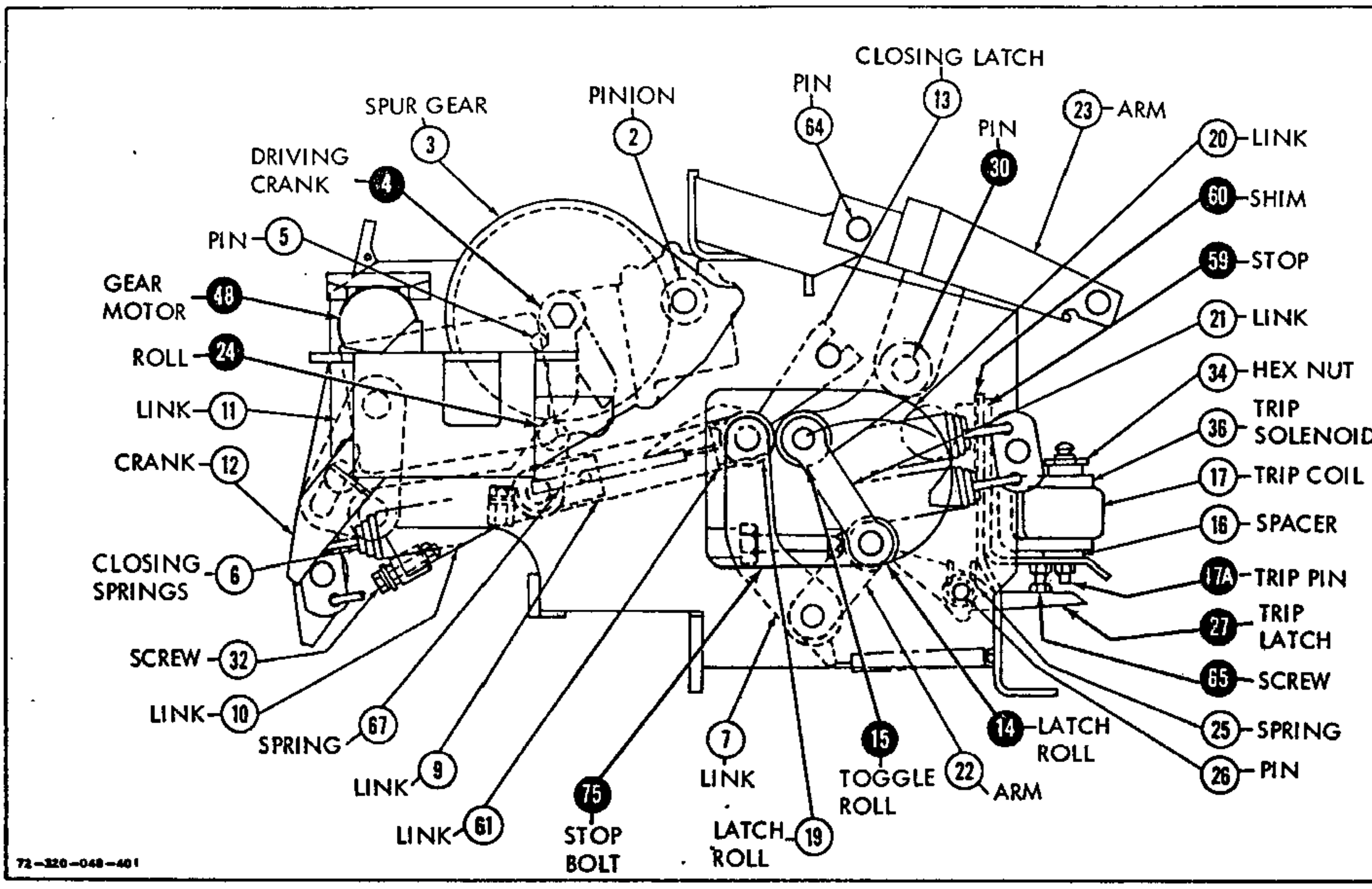


Fig. 16 – Stored energy operator assembly.

Motor Control Switch -- The 88 motor control switch assembly (Fig. 17) is factory adjusted and pinned in position. If it should become inoperative, clean contact areas with an electrical cleaning solvent and spray dry silicon lubricant lightly between contact surfaces and pivot points.

If adjustment becomes necessary, follow this procedure:

1. Loosen lock nuts (4).

2. Back off adjusting screws on all three switches.

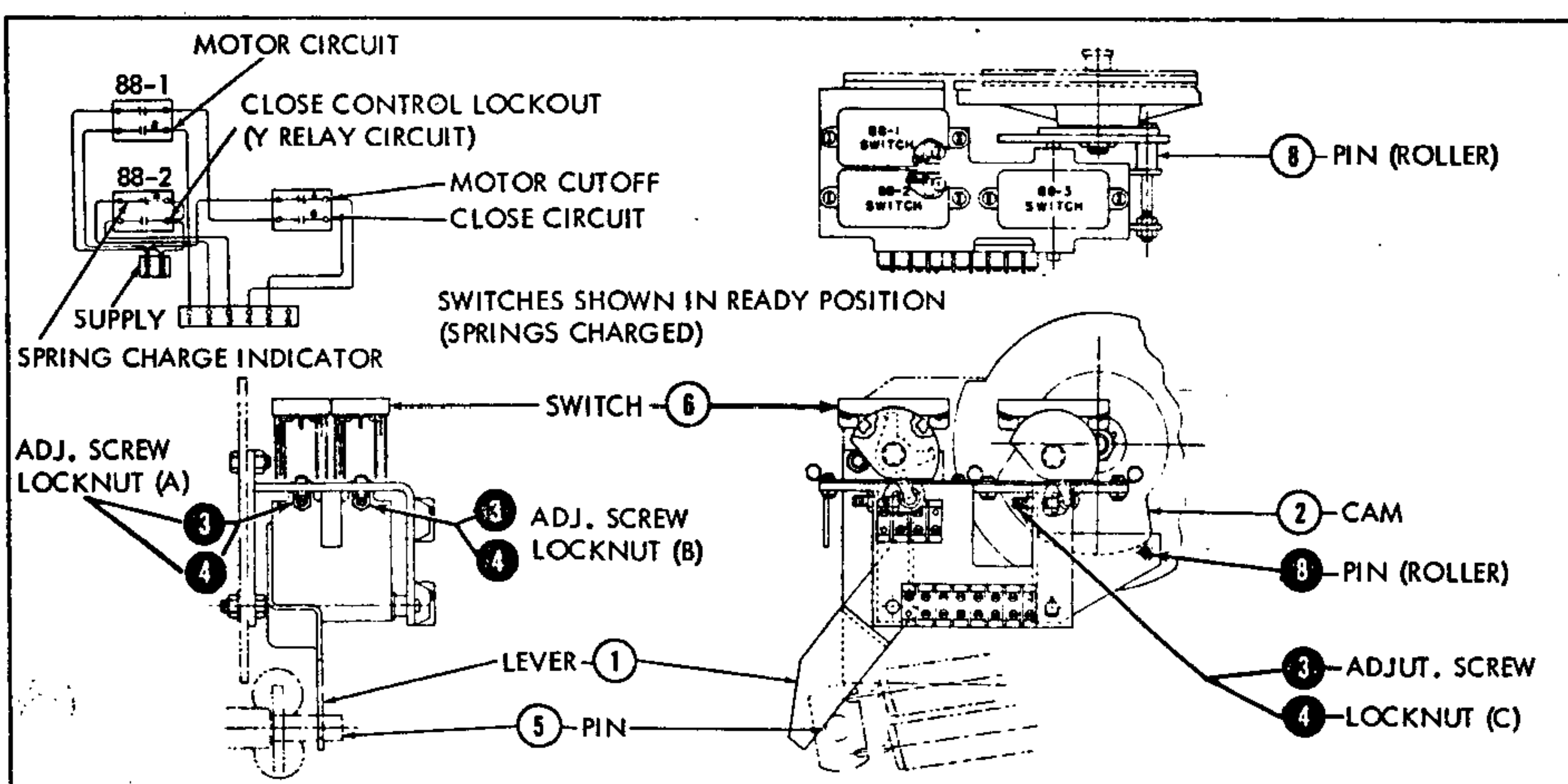


Fig. 17 – Motor control switch.

3. Hand crank unit until pin (8) rests on crown of cam (2) (before springs begin to charge).

4. Turn adjusting screw (3) on 88-3 switch until there is only 1/32 to 1/64 inch travel left. Lock with locknut (4C).

5. Hand crank unit until springs charge and 88-3 switch snaps over just before springs reach the full charged position.

6. Turn adjusting screws (3) on 88-1 and 88-2 switches until they snap over. Lock with locknuts (4A, 4B).

7. Crank unit until 88-3 switch is reset and drive pawls drop over center.

8. Discharge springs.

9. Recharge springs and readjust 88-1 and 88-2 switches, if necessary, to snap over with--or after--88-3 switch.

Spring Release Latch and Over Toggle Linkage - To change bite of spring release latch (Fig. 18), disconnect links (W and X) by removing pin (P) and turning screw (A) against crank (M). Check visually to see that bite is 3/16-in., or point of contact at about the center of the latch (18). Lock screw (A) with locknut (C). Adjust link (X), if necessary, so that pin (P) can be easily inserted. To adjust link (X), loosen locknut (B) and rotate the link end to increase or decrease its length.

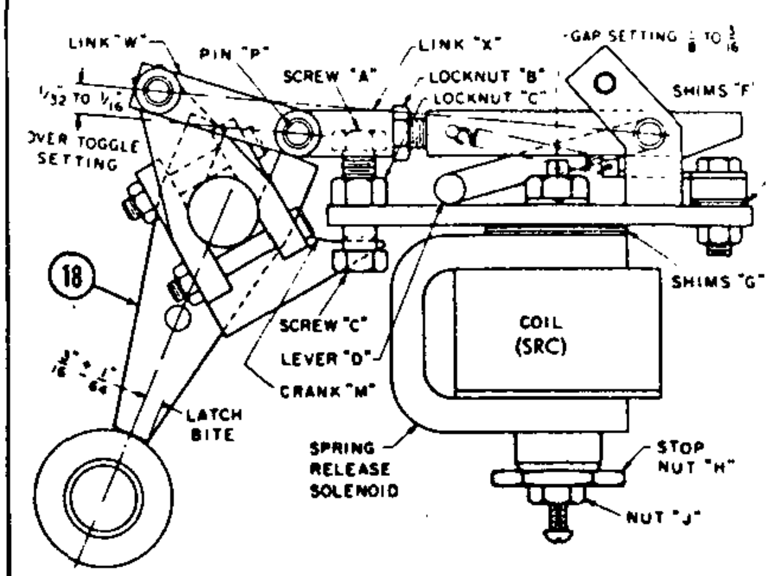


Fig. 18 - Spring release latch.

The over toggle linkage (links W and X) functions to stabilize the position of the spring release latch (18). It is in proper adjustment when the center of pin (P) is 1/32 to 1/16-in. below a line drawn between the pivot points of links W and X. This adjustment is made with screw (C) which acts to position link (X).

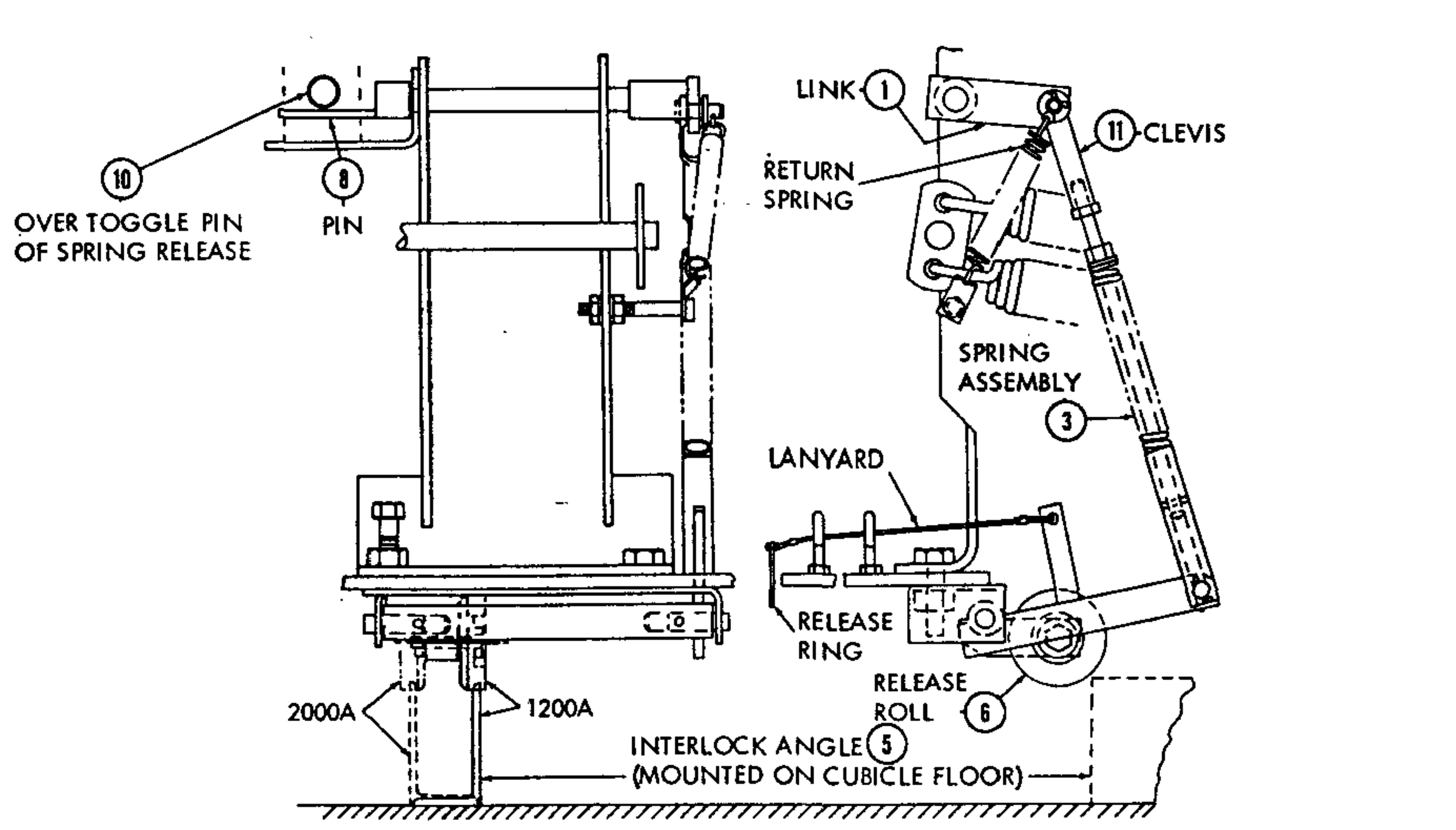


Fig. 19 - Spring release arrangement for stored energy operator.

CAUTION

Over toggle linkage (W, X and Pin P) must be free to move through the toggle position with crank (M) against screw (A) without moving latch (18). Otherwise, excessive load may exceed the output of the spring release coil (50), preventing the breaker from closing.

Spring Discharge - During insertion or removal of the breaker from its cubicle, the closing springs of the operator will discharge automatically. This is done by release roll (6) (Fig. 19) passing over interlock angle (5), mounted on the cubicle floor. As the release roll passes over the interlock angle, it rises and pushes up on the spring assembly (3). This causes link (1) to rotate pin (8) which raises lever (D) and link (X) (Fig. 18), releasing the closing springs.

The length of the spring assembly can be increased, or decreased, if necessary, by adjusting clevis (11).

MAINTENANCE

The lubricant supplied with the cubicle accessories is intended to be used only on the cubicle's disconnect contacts and must not be used on any part of the circuit breaker.

Thorough, periodic inspection is important to satisfactory operation. Inspection and maintenance frequency depends on installation site, weather and atmospheric conditions, experience of operating personnel and special operation requirements. Because of this, a well-planned and effective maintenance program depends largely on experience and practice.

When lubrication is necessary, all purely mechanical joints should be given a light film of Beacon P-290 grease. All current carrying joints should be inspected to be sure all contact surfaces are free of protrusions or sharp plane changes. Rub microfine graphite well into contact surfaces and remove any excess. Do not get graphite on insulation. Insulation contaminated by graphite must be replaced.

Needle bearings are packed with a special lubricant and should require no further attention. Bearing pins and other sliding or rotating areas should be wiped with a thin film of Beacon P-290 grease. Greasing should be done carefully because excess grease tends to collect foreign matter which, in time, may make operation sluggish and affect the dielectric strength of insulating members.

Beacon P-290 grease may be purchased through Humble sales offices in Los Angeles, Calif.; Oak Brook, Ill.; Baltimore, Md.; Pelham, N.Y.; Charlotte, N.C.; Memphis, Tenn.; Dallas and Houston, Texas.

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INST. BOOK NUMBER	REF. NO.	DESCRIPTION	DRAWING NO.	RECOMMENDED FOR STOCK 1-5 BRK'RS	5 OR MORE BR'K'RS
BWX-6657-4	3-9	ARCING CONTACT (STATIONARY)	71-112-966-502	1	3
	3-28	ARCING CONTACT (RH MOVING)	71-112-913-502	1	3
	3-27	ARCING CONTACT (LH MOVING)	71-112-913-503	1	3
	3-11	MAIN CONTACT (ONE FINGER)	71-112-903-501	6	15
1200 A	3-19	MAIN CONTACT (RH MOVING)	71-208-255-509	1	3
2000 A	3-19	MAIN CONTACT (RH MOVING)	71-208-255-511	1	3
1200 A	3-18	MAIN CONTACT (LH MOVING)	71-208-255-510	1	3
2000 A	3-18	MAIN CONTACT (LH MOVING)	71-208-255-512	1	3
	2-23	BARRIER STACK	71-208-818-502	1	3
	3-25	HINGE CONTACT WASHER (MAIN)	71-177-196-003	2	6
	3-17	HINGE CONTACT WASHER (ARCING)	71-114-701-001	3	12
1200 A	1-3	PRIMARY CONTACT ASSEMBLY	71-201-738-502	1	6
2000 A	1-3	PRIMARY CONTACT ASSEMBLY	71-201-458-502	1	6
	1-21	"Y" RELAY (GIVE VOLTAGE)		1	2
	4-8	CLOSING SOLENOID COIL (GIVE VOLTAGE)	71-200-745	1	2
	4-17	TRIP SOLENOID COIL (GIVE VOLTAGE)	71-209-234	1	2
	8-6	83 SWITCH	72-220-005-001	1	2
	4-48	MOTOR (GIVE VOLTAGE)	71-210-046	1	2
		RESET RELAY (GIVE VOLTAGE)	72-200-053		1
		POWER SUPPLY (FOR RESET RELAY IF A-C CLOSE)	72-200-051-501		1

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