SWITCHGEAR

INSTRUCTIONS

TYPE FA-350A, 5-KV AIR MAGNETIC CIRCUIT BREAKERS WITH SOLENOID OR STORED ENERGY OPERATORS

BWX-6733

18X3985-01

INDEX

ILLUSTRATIONS

INTRODUCTION

This instruction manual contains installation, operation and maintenance information for Type FA-350A 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.

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 blocked or tied to prevent tripping during shipment. REMOVE BLOCKING.
2. Push manual trip rod to open breaker.
3. Remove phase barriers and unfasten coil connections.
4. With arc chute support in place at the rear of the breaker, tilt the arc chutes to expose contact area.
5. Remove dust, foreign particles, etc., from breaker.
6. Check for simultaneous closing of arcing contacts (within 1/16 inch) by slowly closing the breaker.

   Slow Closing

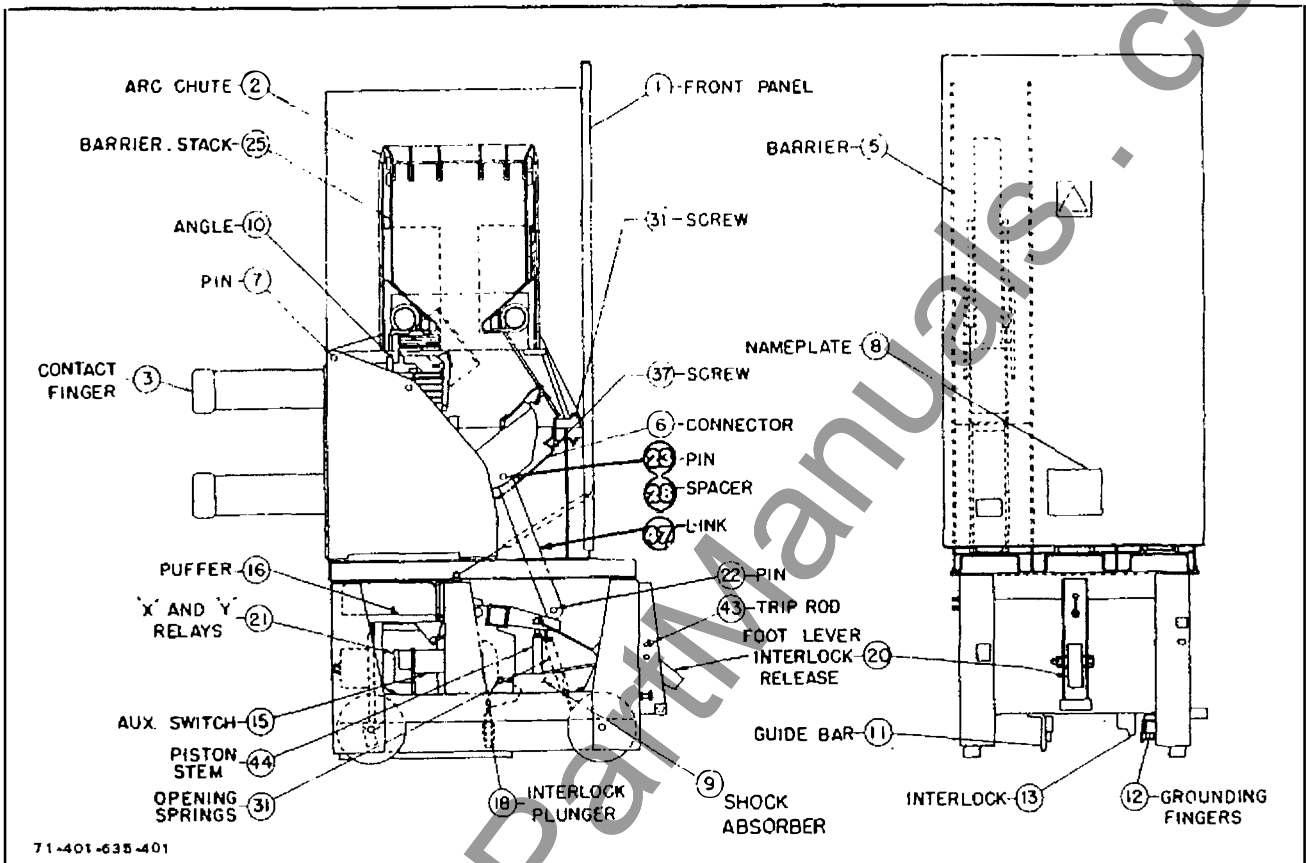
   Solenoid Operated Breaker – Insert the manual closing device into the angle bracket mounted at the rear of the breaker. With the device rolls against the solenoid armature, lever the armature in to close the breaker.

   Stored Energy Breaker – Refer to page 18.
7. Trip out breaker by depressing trip rod.
8. Return arc chutes to upright position, fasten 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 – } with control switch on cubicle panel.
12. Push depress lever and close electrically (*).
13. Release depress 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. Deenergize control power and remove plug jumper.
17. Insert breaker into its cubicle between "test" and "disconnect" positions and close manually (*).
18. Complete movement of breaker to "test" position and repeat steps 10 (#) and 11.
19. Check for proper alignment between stationary and movable secondary contacts.
20. With line and bus deenergized, 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.
21. Breaker is now ready for normal operation.

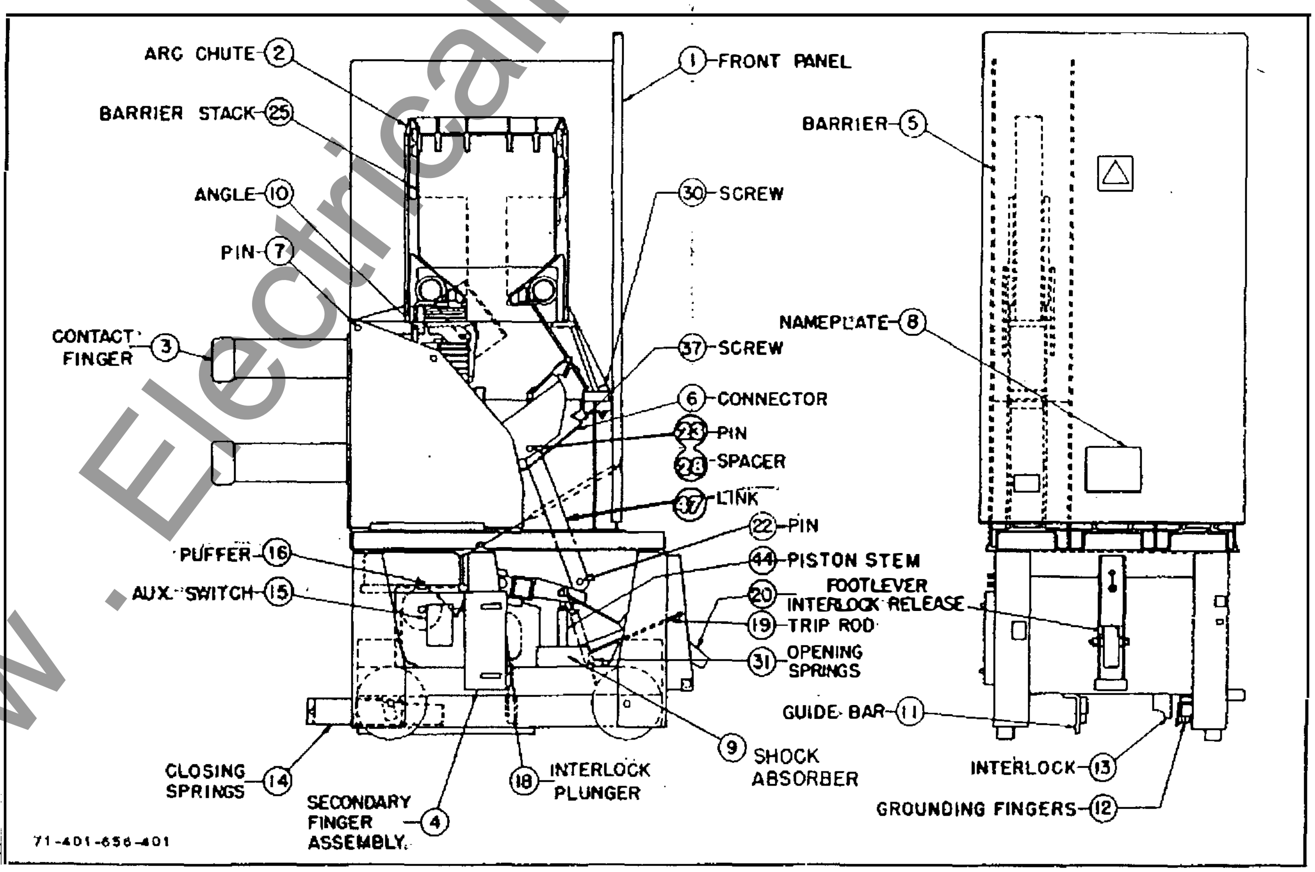
(*) Breaker is trip free.
(#) Breaker will close.

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 circuit.



With type SO-45F solenoid operator



With type SE-3 stored energy operator

Fig. 1 – Typical type FA-350A circuit breaker assemblies.

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.

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 5). The operator is powered by either a solenoid or precharged springs (stored energy).

SOLENOID OPERATOR – TYPE SO-45F

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.

DC Control Relay

The solenoid operator 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.

AC Control Relay

For alternating current applications, an ac control relay is used to switch the ac input of a silicon rectifier for control of the solenoid. The dc output of the silicon rectifier is 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.

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 destroyed 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 rectifier, 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 – TYPE SE-3

The stored energy operator 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.

Reset 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 15, Figure 16.)

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.

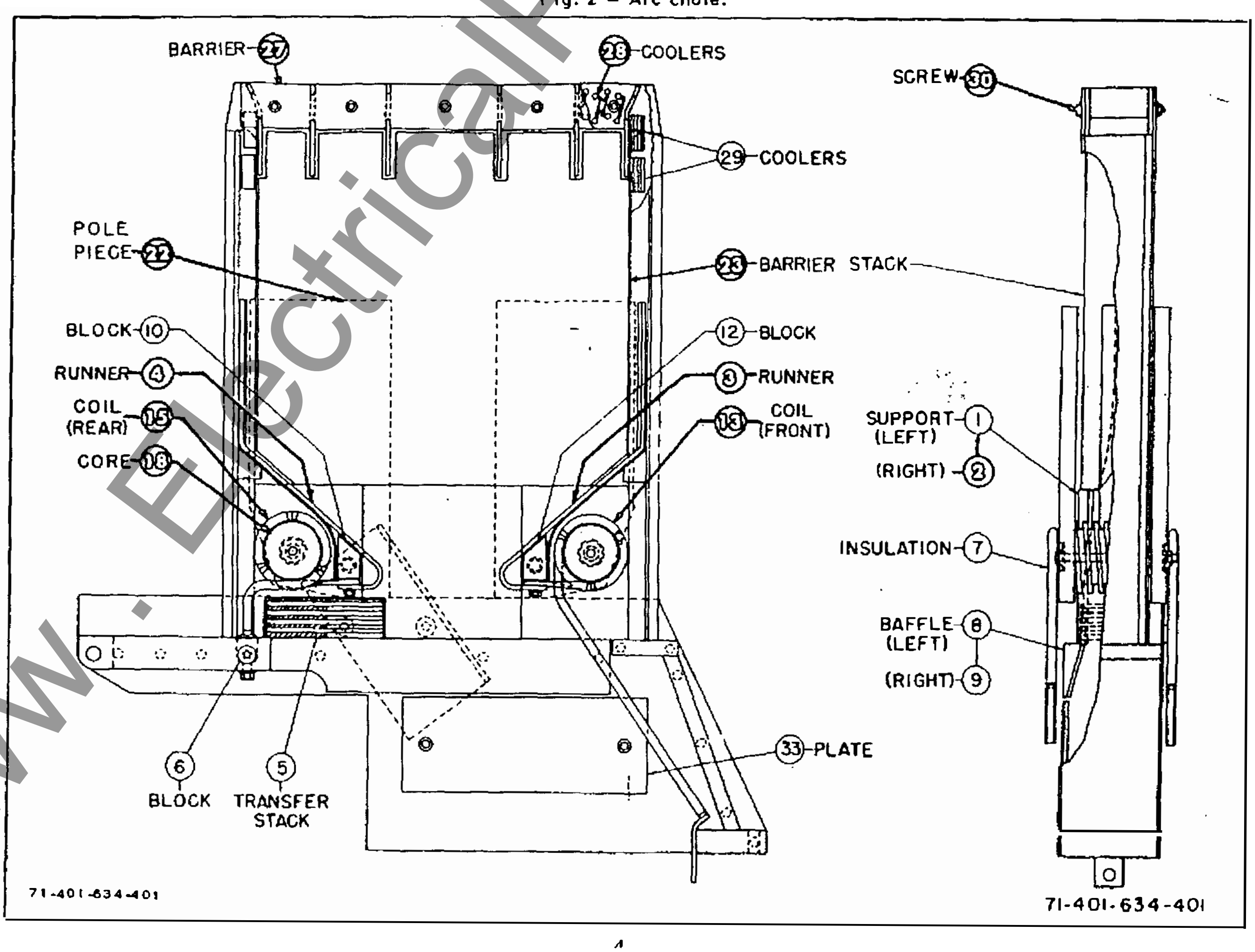
To apply the capacitor trip device to existing breakers originally shipped with dc trip coils, contact your Allis-Chalmers sales representative.

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. Transfer to the stationary end runner (4) is aided by transfer stack (5).
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 (27) containing coolers (28) through which the by-product gases of interruption pass, completes the cooling and deionizing of the arc products.

Fig. 2 – Arc chute.



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.

OPERATION

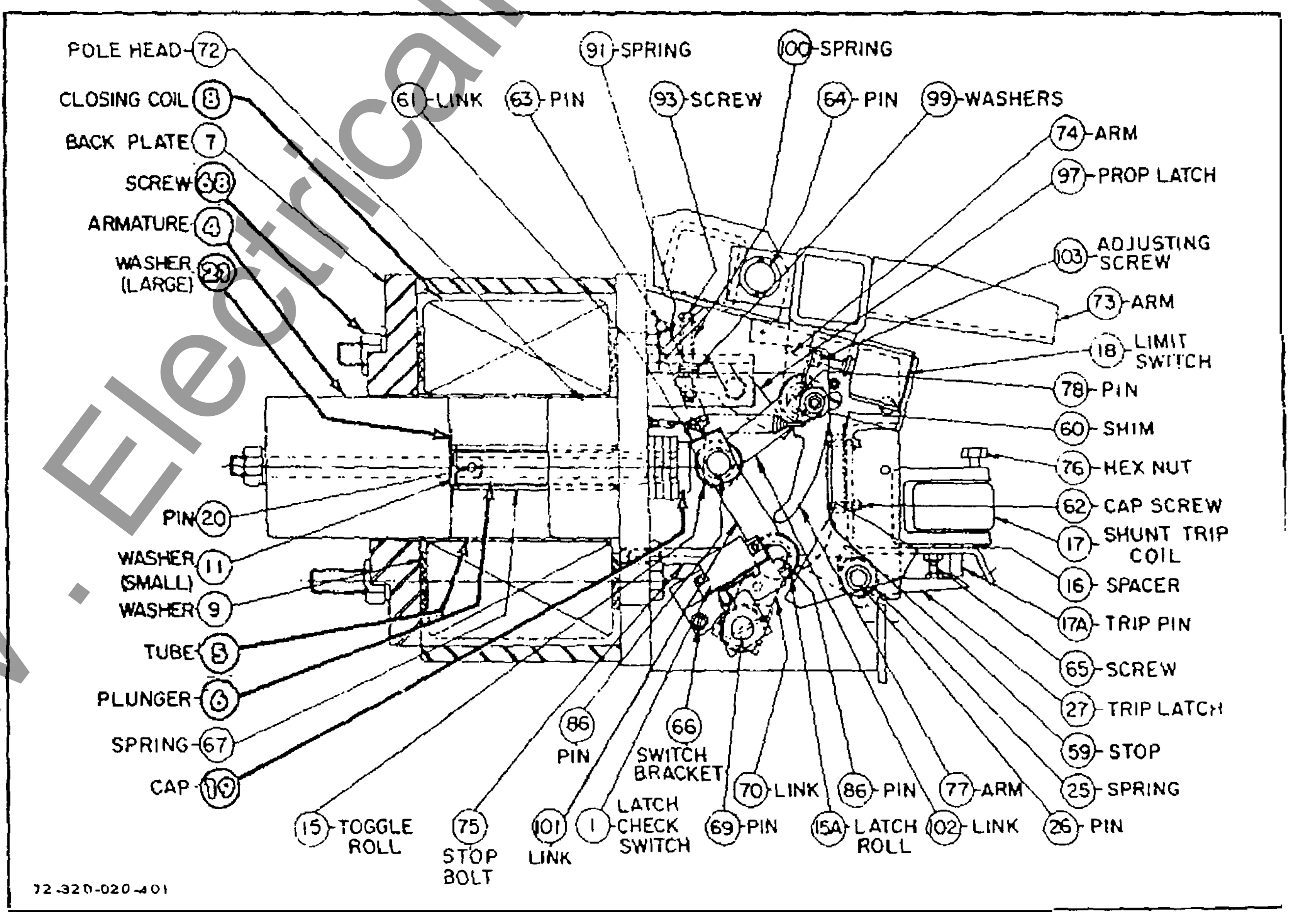
THEORY

Type SO-45F 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.

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.

Fig. 3 – Type SO-45F solenoid operator assembly.



To open the breaker, trip latch (27) is rotated about its center G either electrically – by 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.

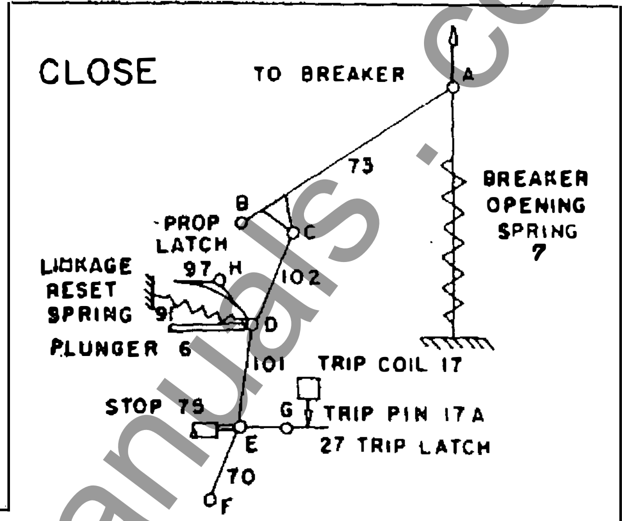


Fig. 4 – Four-bar linkage.

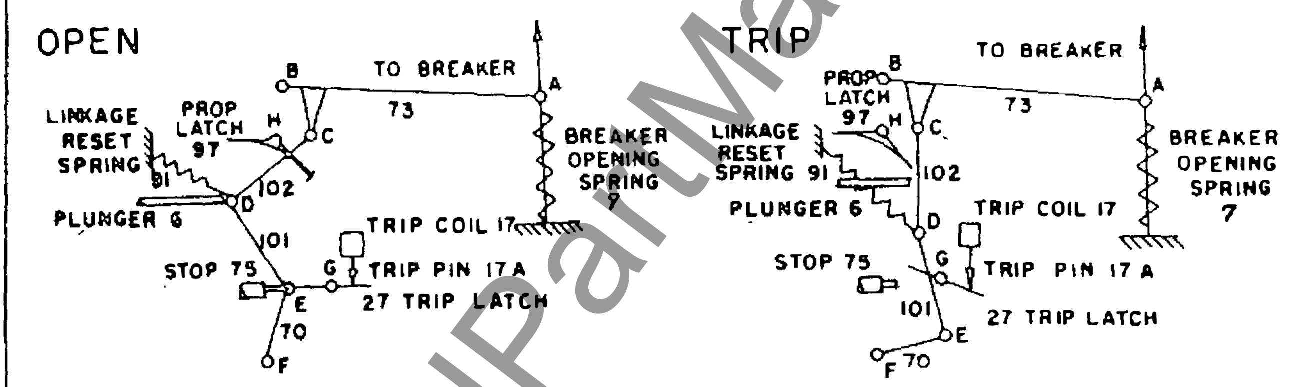
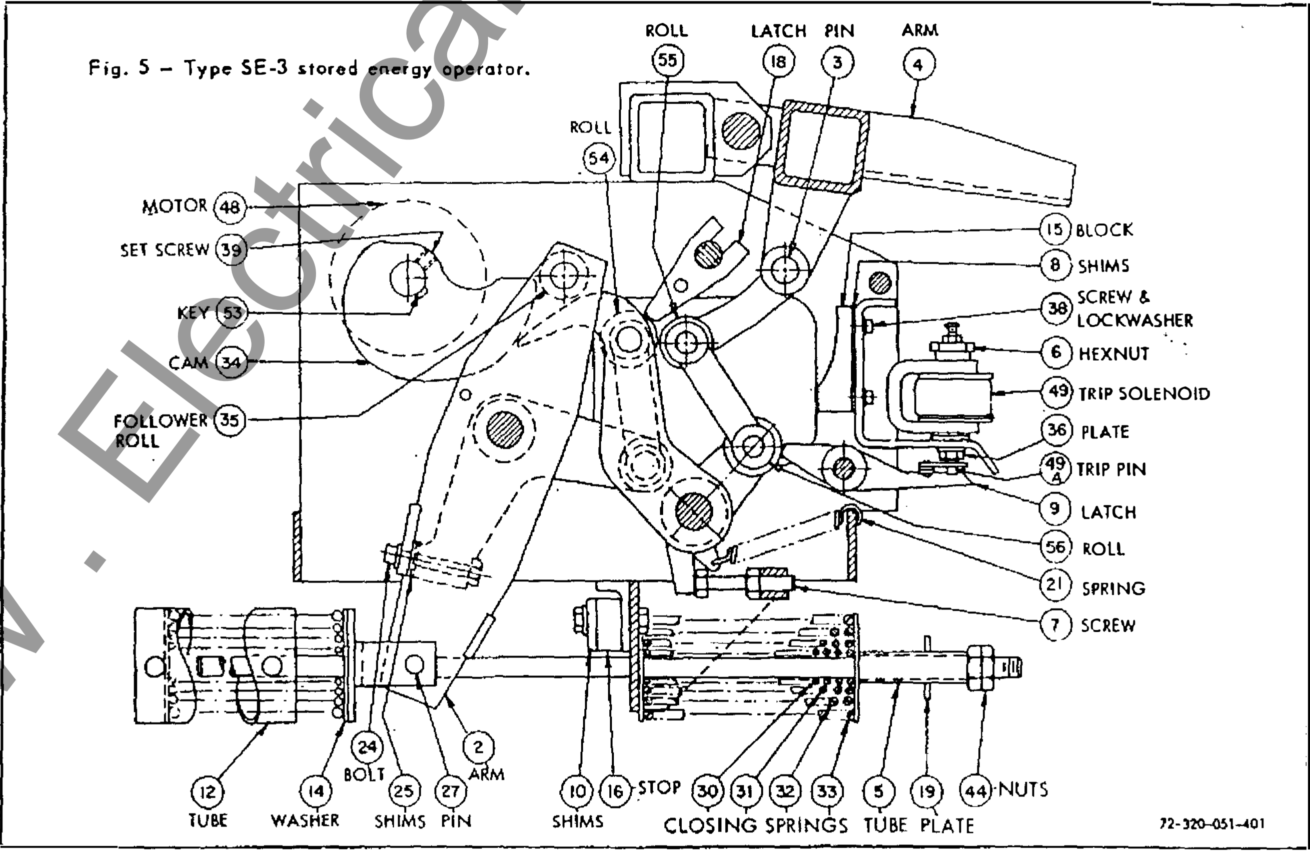


Fig. 5 – Type SE-3 stored energy operator.



Type SE-3-Stored Energy Operator – (Figure 5 A-H)

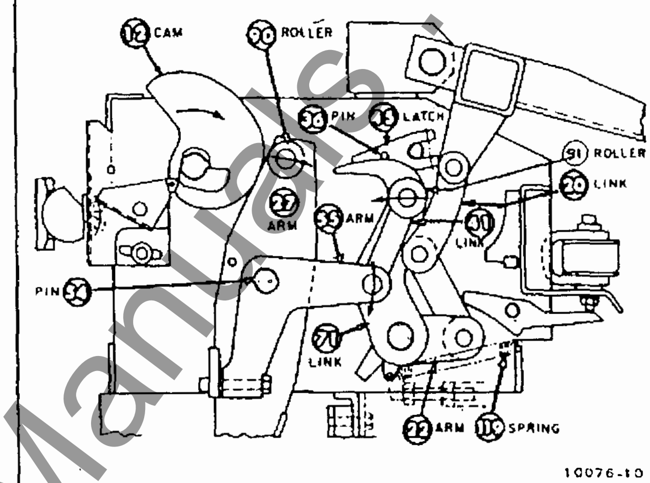
Fig. A – Breaker open, springs discharged. Switches (32) released as arm (3) has been released by cam (35). Switch (32) closes motor circuit and cam (12) rotates clockwise.

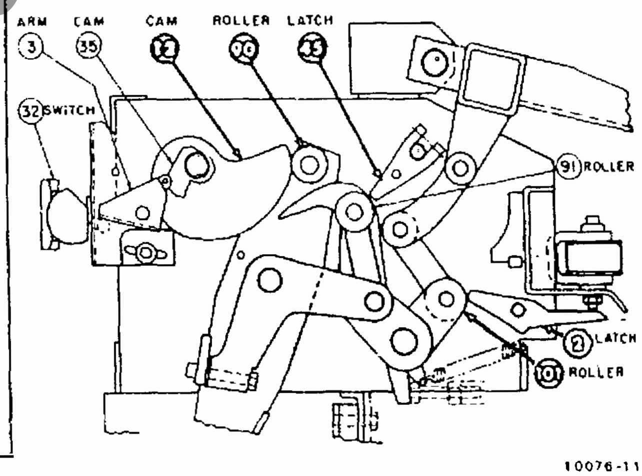
Fig. B – Cam (12) has rotated against roller (90) forcing arm (27) and (55), which are fastened together, to rotate clockwise about pin (54). This compresses the closing springs which are fastened to the lower end of arm (27). The rotation of arm (55) pulls link (71) to the left thru link (41). Spring (119) rotates arm (22), attempting to recouple the 4-bar linkage but is retarded by link (20) riding on roll (91) until link (71) moves to the left. Note: Latch (45) is held from resetting by pin (36), riding on crown of horn of link (71).

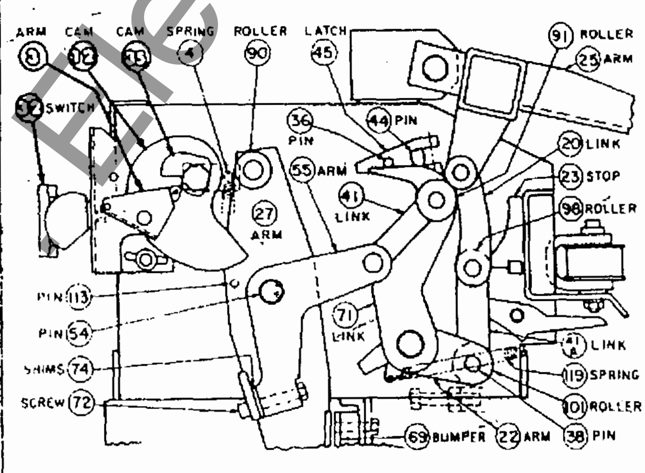
Fig. C – Roller (90) is at crown of cam (12) latch roll (91) is past latch (45), allowing latch to drop in place and the 4-bar linkage has reset with trip latch (2) reset back of roll (101).

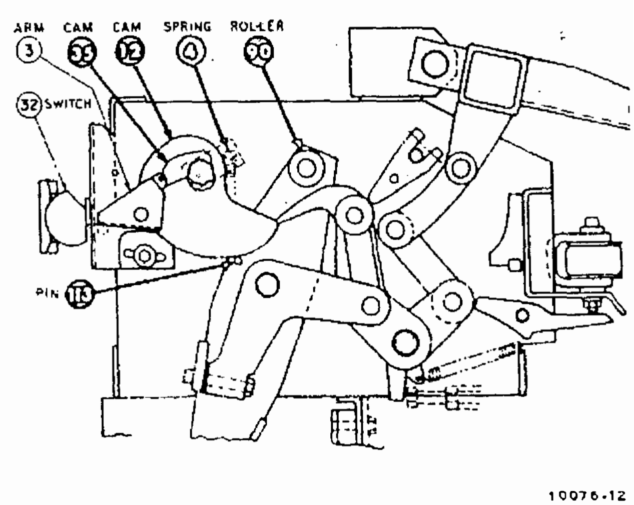
Fig. D – There are teeth cut from the driving gear train so that when cam (12) clears roller (90), the motor drive is disconnected and cam (12) is free. Reset spring (4) continues the rotation of cam (12) until it rests against pin (113), Cam (35) rotates with cam (12). When cam (12) rests against pin (113), cam (35) holds the switches (32) in thrown position.

Fig. 5 (A–D) – Type SE-3 stored energy operator assembly.









- E -

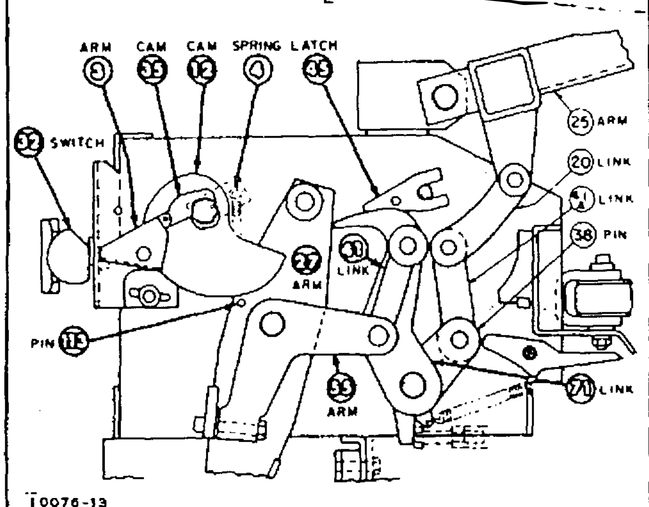


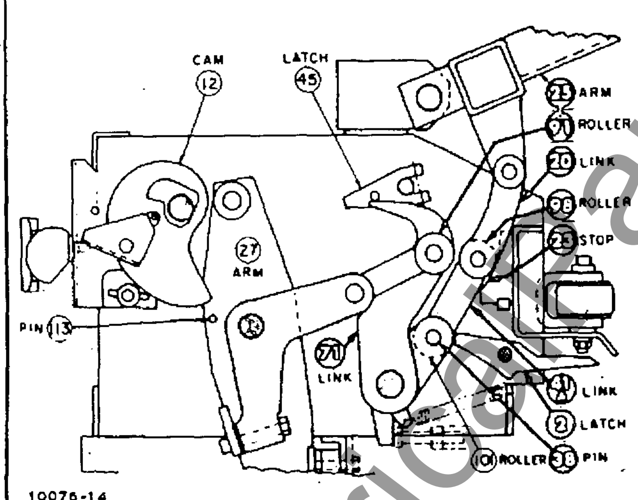
Fig. E – Latch (45) has been rotated to close the breaker. This releases link (71). Arm (27) rotates counterclockwise as the closing springs force its lower end to the right. Arm (55) thru link (41) forces link (71) to the right. As arm (27) rotates, pin (113) drops away, freeing cam (12) which is rotated by spring (4) allowing cam (35) to release arm (3) and switches (32) which throw over closing motor circuit to recharge springs.

Fig. F – Roller (91), by the swing of link (71), forces roller (98) ahead of it. Link (41A) rotates about pin (38) held by latch (2). Straightening of the toggle framed by links (41A) and (20) raises (25), closing the breaker. Links (41A) and (20) go over toggle against stop (23).

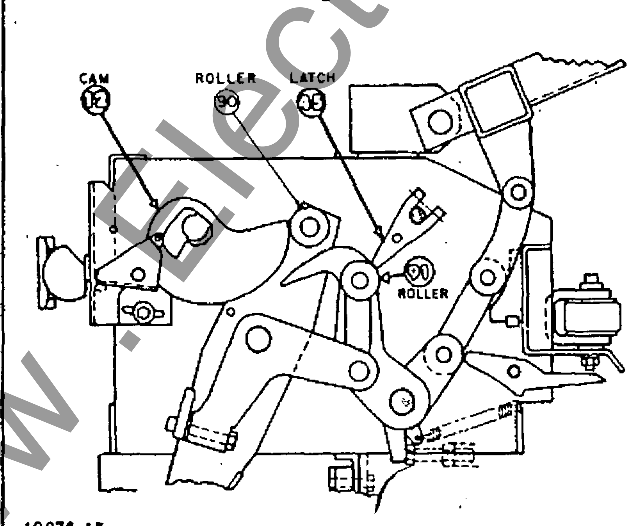
Fig. G – Shows the breaker closed and the springs almost charged. The cam (12) has gone by its crown and is easing roller (91) onto latch (45).

Fig. H – Trip latch (2) has been rotated to release roller (101). Arm (22) rotates about its fixed center, allowing links (41A) and (20) to drop. Shape of stop (23) forces roller (98) back to break the overtoggle between links (41A) and (20), allowing the 4-bar linkage to reset.

- F -



- G -



- H -

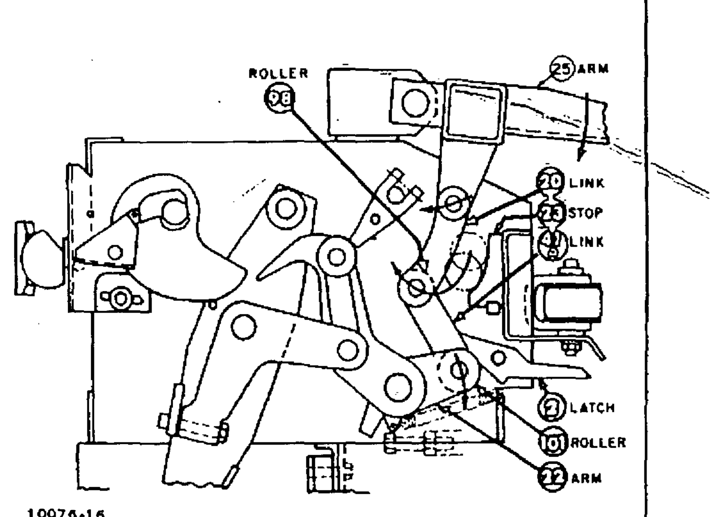
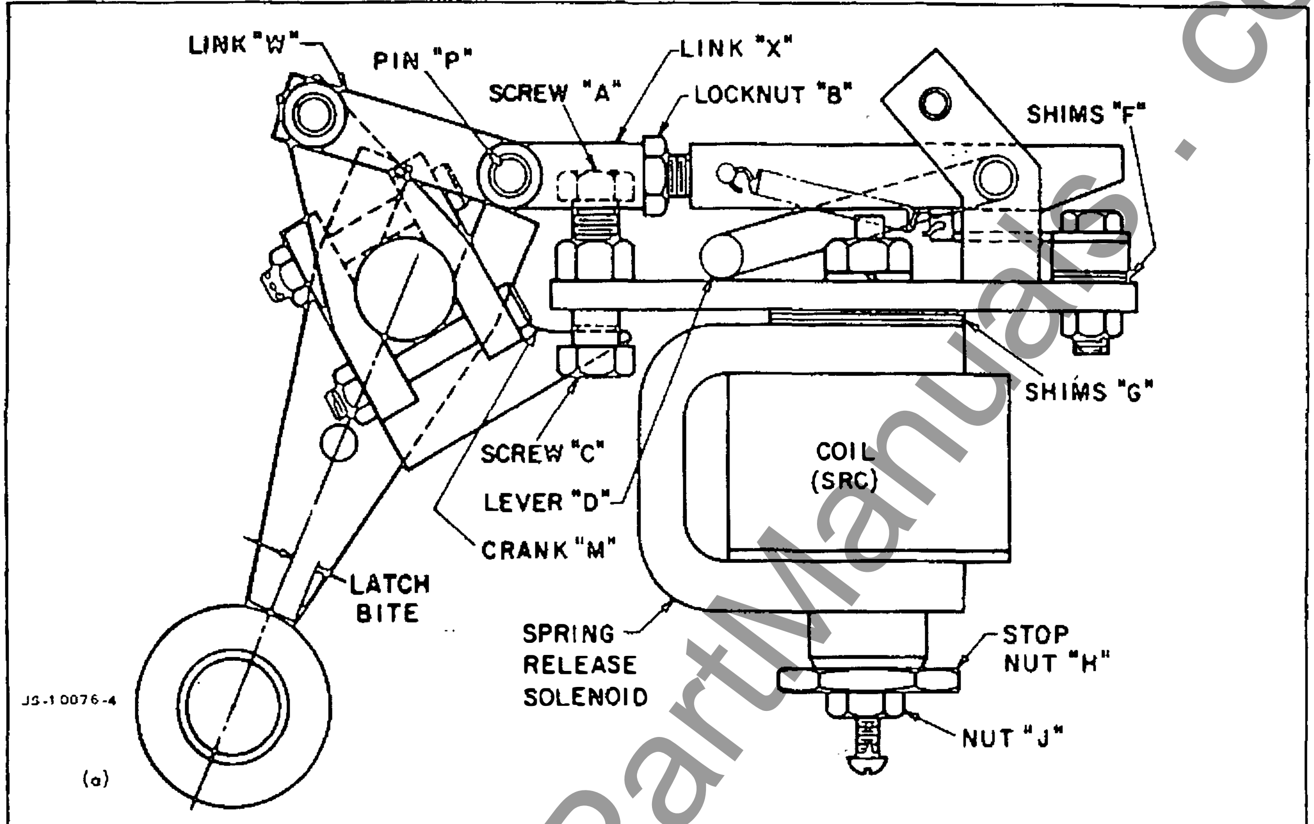


Fig. 5 (E–H) – Type SE-3 stored energy operator assembly.



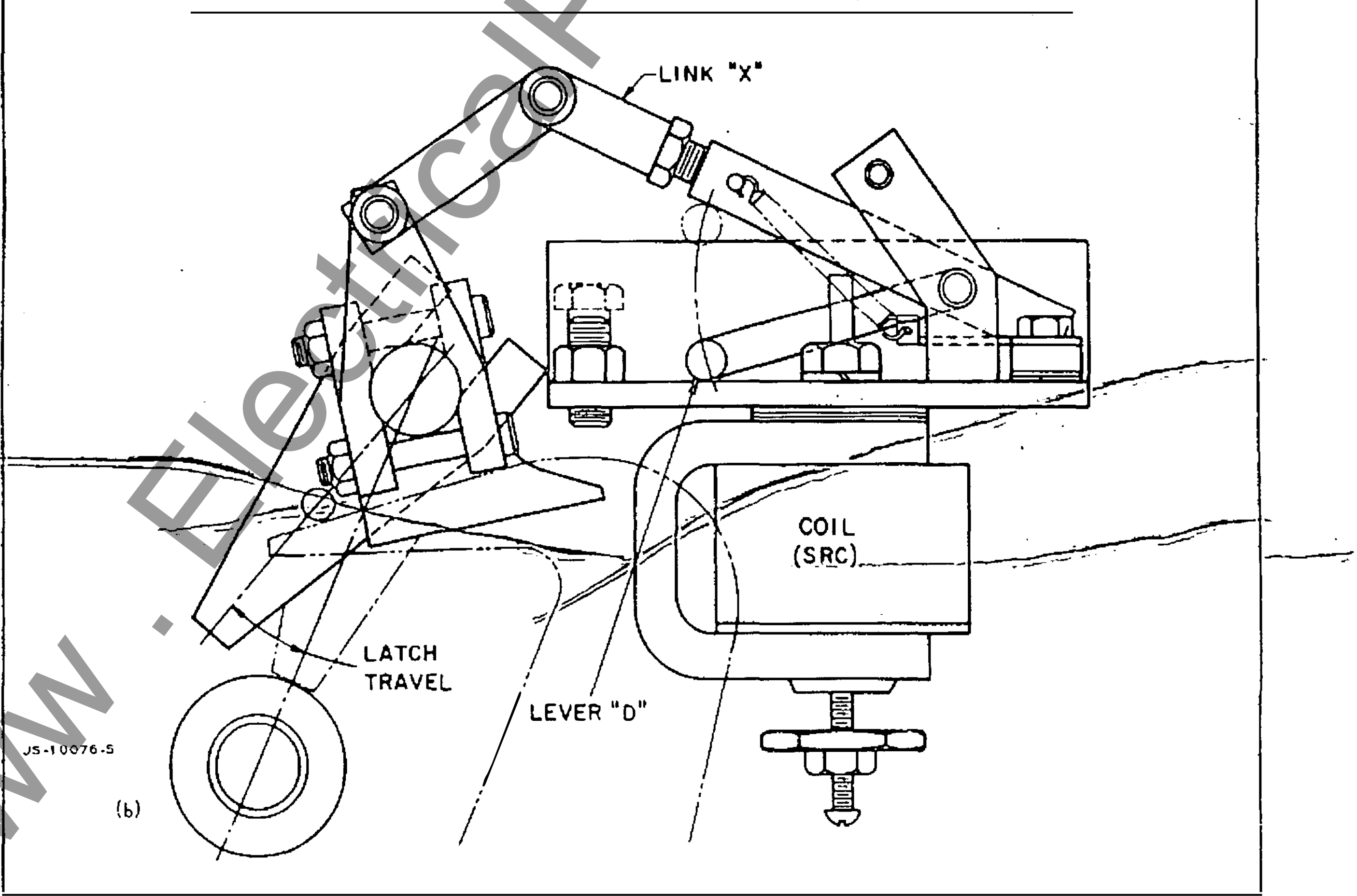


Fig. 12 – Spring release latch – type SE-3 stored energy operator.

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.

SERVICING CONTACTS

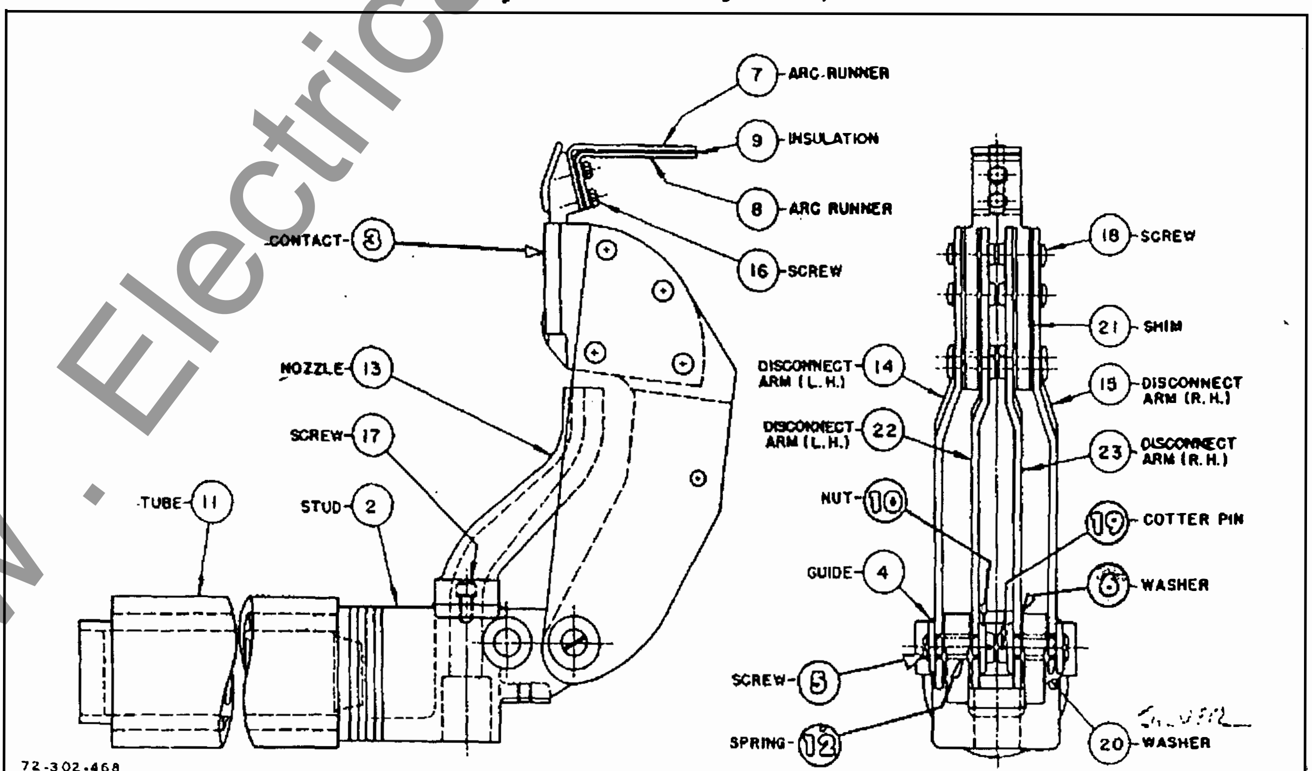
The frequency of contact inspection depends on severity of service. Refer to Fig. 13. Remove disconnect arms as a unit by removing screw (5), nut (10) and spring (12). Carefully inspect all contact surfaces in hinge joint. Silver washer (6) and adjacent surfaces should be clean and free of roughness or galling. Lubricate silver washer and mating surfaces by rubbing in microfine dry graphite sparingly. Reassemble hinge joint. Tighten screw (5) and nut (10) so that cotter pin (19) can be re-installed. Spring (12) and washer (6) 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 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. Normally, no further adjustment is necessary. Check for proper contact alignment and, at the same time, for moving contact stroke by checking dimensions "c" (view "AA," Fig. 14) between contact finger (8) and plate (7), Fig. 14, on each side of bushing top and bottom of each phase separately. It is not necessary that contacts touch simultaneously on all three phases.

If this dimension is 3/64 to 5/64 of an inch 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 not 3/64 to 5/64 of an inch, but all four points in any phase measure within 1/32 inch of each other, the moving contact stroke of that phase must be adjusted (see "Adjustment for Stroke" page 14). If this dimension is not within tolerance and there is a difference of over 1/32 of an inch among the four measurements in a phase, it is necessary to first adjust the contact alignment (see "Adjustment for Contact Alignment," page 14) and then the stroke of the moving contact.

Fig. 13 – Lower bushing assembly.



ADJUSTMENT FOR CONTACT ALIGNMENT

To adjust contact alignment, close breaker and measure dimension 'C' (see Fig. 14). If Dim. 'C' is not between 3/64" to 5/64" on each side and within 1/32" of each other, adjustment is made by opening the breaker, scribing the position of blocks 8 & 13 (Fig. 15), loosening screws 24 & 25 and moving blocks 8 & 13 sideways to equalize (within 1/32") dimension 'C' between each side. Using the scribed lines for reference. Refasten screws 24 & 25. Close breaker and check alignment. Repeat procedure if necessary until 'C' dimensions are equal or within 1/32" of each other.

When making this adjustment be sure that block (8) is held firmly against stop on top of stud.

ADJUSTMENT FOR STROKE

This adjustment is accomplished by lengthening or shortening link (47), Fig. 1, between operator mechanism and interrupter moving blade to bring dimension "c" (view "AA," Fig. 14) to 3/64 to 5/64 of an inch. Open breaker. Adjust length of link (47) by turning checknut (10) and locknut (12) that hold tee casting (9) to radius arm (73). Make sure this adjustment brings dimensions "c" within tolerance in each phase. After reaching correct contact engagement, make sure that checknut (10) and locknut (12) are tightened securely (a compound, such as Locktite, may be used to insure against slipping). The stroke should be adjusted in each phase individually.

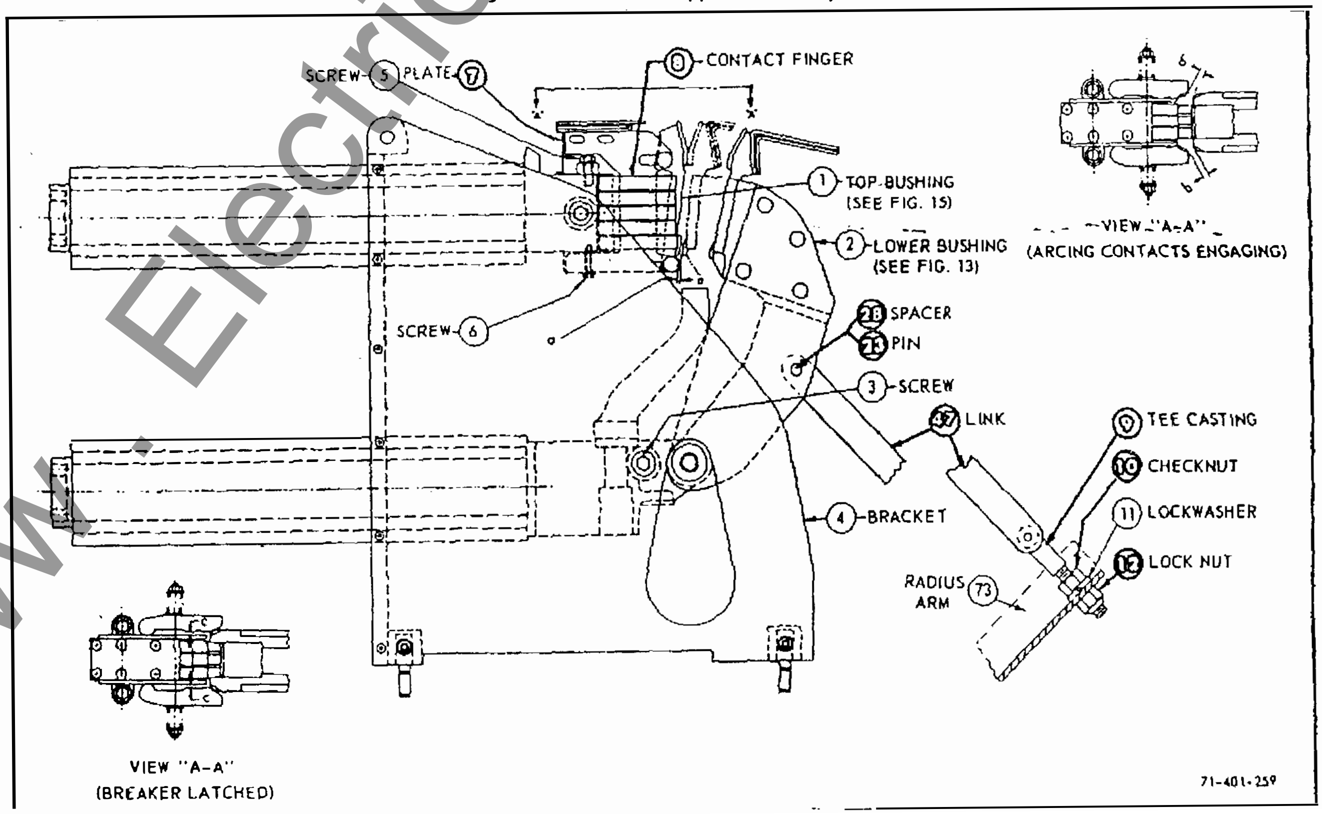
CONTACT LEAD

Contact lead is adjusted at the factory and, normally, no further adjustment is necessary. However, it should be checked on each phase separately and only with contact alignment on the phase in correct adjustment.

Make sure breaker is open before checking for contact lead adjusting. Disconnect the movable contact from operator link (47) Fig. 1 by removing pin (23) and two spacers (28). Bring movable arcing contact (3), Fig. 13, so that it just touches the stationary arcing contact (4), Fig. 15, as shown in view "AA" – Arcing Contacts Engaging, Fig. 14. Measure dimension "a," Fig. 14, the shortest gap between the two tertiary contacts, and dimension "b" (view "AA," Fig. 14), the shortest gap between the main contacts. Dimension "a" should be 1/8 to 5/32 of an inch and dimension "b" 9/32 to 3/8 of an inch.

If dimensions "a" and "b" are incorrect, remove one roll pin from each plate (10) and loosen eight screws (22), Fig. 15. Insert a spacer as thick as correct dimension "a" between the tertiary contacts, and apply a C-clamp bearing on rear of block (8), Fig. 15, and front of movable contact (3), Fig. 13. Tighten C-clamp to dimension "b." With contacts held in this position, move two plates (10), Fig. 15, back so that pins (16) are touching leading end of plate slots. Tighten eight screws (22), drill and insert pin to retain adjustment. Remove spacer, remove C-clamp and reconnect movable contact to link (47), Fig. 1.

Fig. 14 – Stud and support assembly.



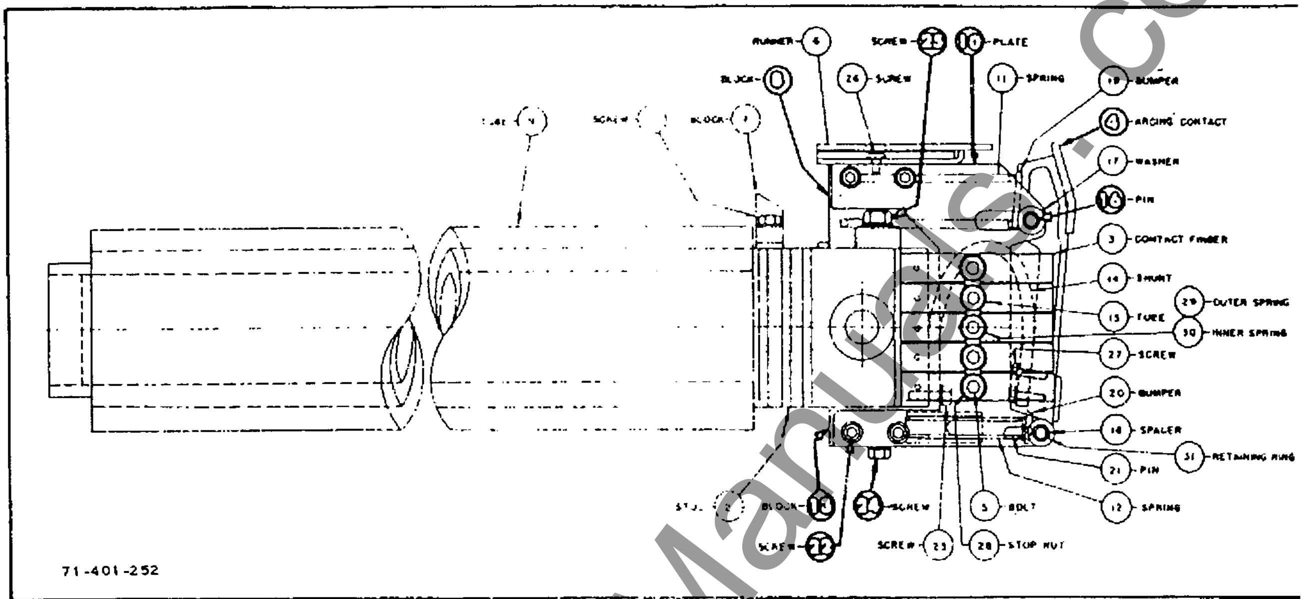


Fig. 15 – Top bushing assembly

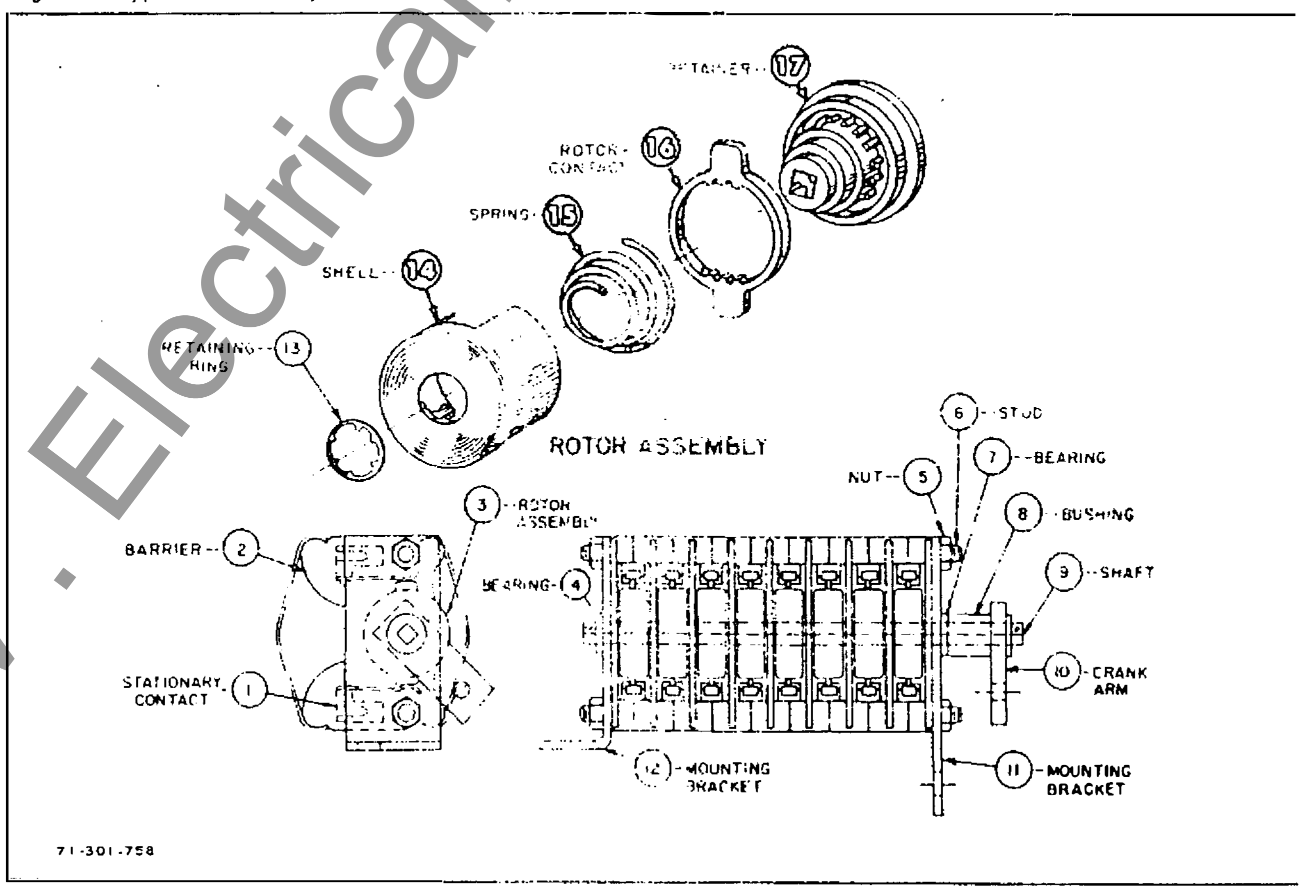
AUXILIARY SWITCH

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. 16) 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). Rotat the rotor to the desired position and release. Be su the rotor springs solidly back against the retainer t fully engage the rotor and retainer teeth.

Fig. 16 -- Type Q-10 auxiliary switch.



TYPE SO-45F SOLENOID OPERATOR (Fig. 17)

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 offsets 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.

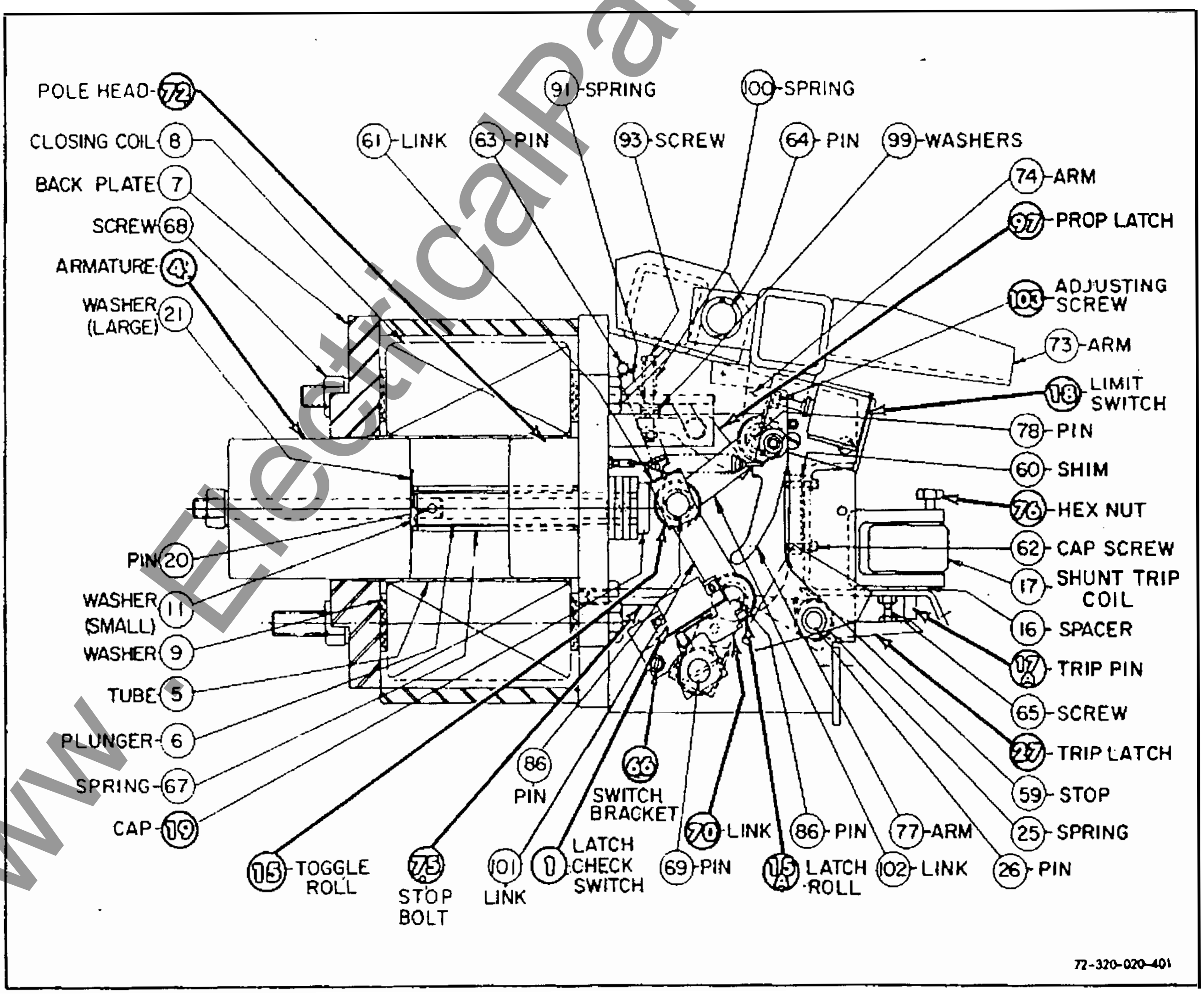
Limit Switch – The limit switch (18) is located on the front of the operator frame and is contacted by an extension of the toggle roll (15) pin within the 4-bar toggle linkage.

Adjust by screw (103). Contact action required by circuit breaker should be at 3/4 to 7/8 of an inch 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.

Fig. 17 – Type SO-45F solenoid operator assembly.



TYPE SE-3 STORED ENERGY OPERATOR
(Figs. 18 and 19)

Main Toggle Roll – When the breaker is in closed position with roll (55) against block (15), center of main toggle roll (55) should be 3/16 to 5/16 of an inch beyond line of centers of latch roll (56) and pin (3). Adjustment is made by adding or removing shims (8).

Trip Latch – The trip latch (9) should engage its roll (56) 1/8 to 3/16 of an inch above the lower edge of the latch face. Adjustment is made by shimming plate (36). This adjustment affects the clearance between the trip pin (49A) and the trip latch (9). With the springs charged and the breaker open, the trip latch (9) should clear its latch roll (56) by 1/64 to 3/64 of an inch. Adjustment is made by screw (7).

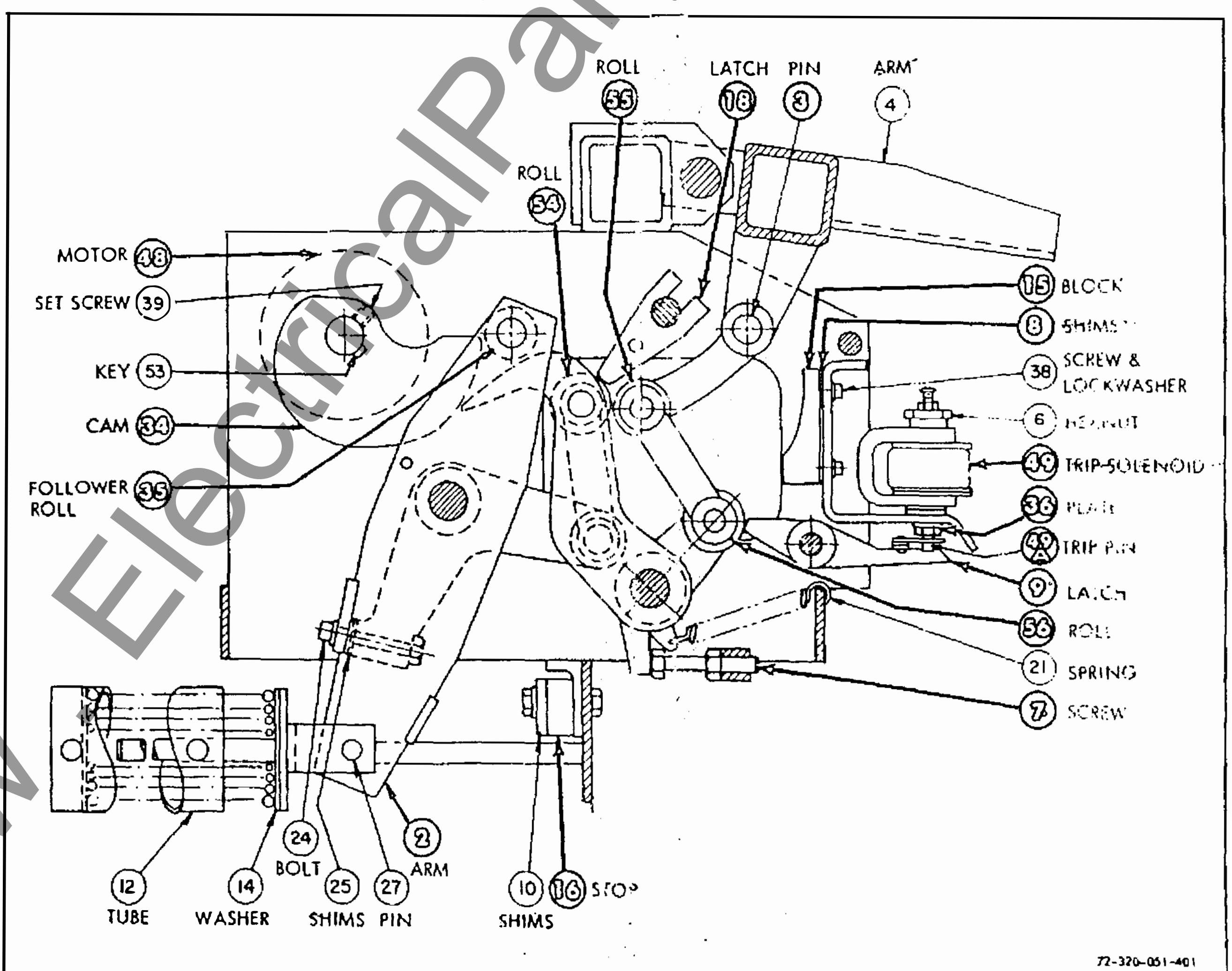
Closing Latch – The closing latch (18) should engage its roll (54) 3/16 of an inch above the lower edge of the latch face. See over-toggle latch for adjustment.

Tripping and Closing solenoid – The trip (49) and closing (50) solenoids action and adjustments are identical. Each solenoid has been adjusted at the factory and should require no further adjustment. If readjustment is required it should be made only when the trip and closing latch bites are in correct adjustment.

The armature should move freely and have no binds. The travel of the armature should be such that slow manual actuation will trip the latch and have 1/32 to 1/16 of an inch overtravel. Adjustment is made by shimming the solenoid with washers on the mounting screws.

Manual Charging of Closing Springs – A charging handle is provided to charge the closing springs manually. Open the control power circuit and engage the charging handle with the coupling on the front of the motor (48). The springs are charged by a counterclockwise rotation of the handle. Full spring compression will be realized by an audible snap as roll (54) drops back on latch (18) when cam (34) clears follower roll (35). Continue to rotate handle until motor coupling rotates freely without load.

Fig. 18 – Type SE-3 stored energy operator assembly.



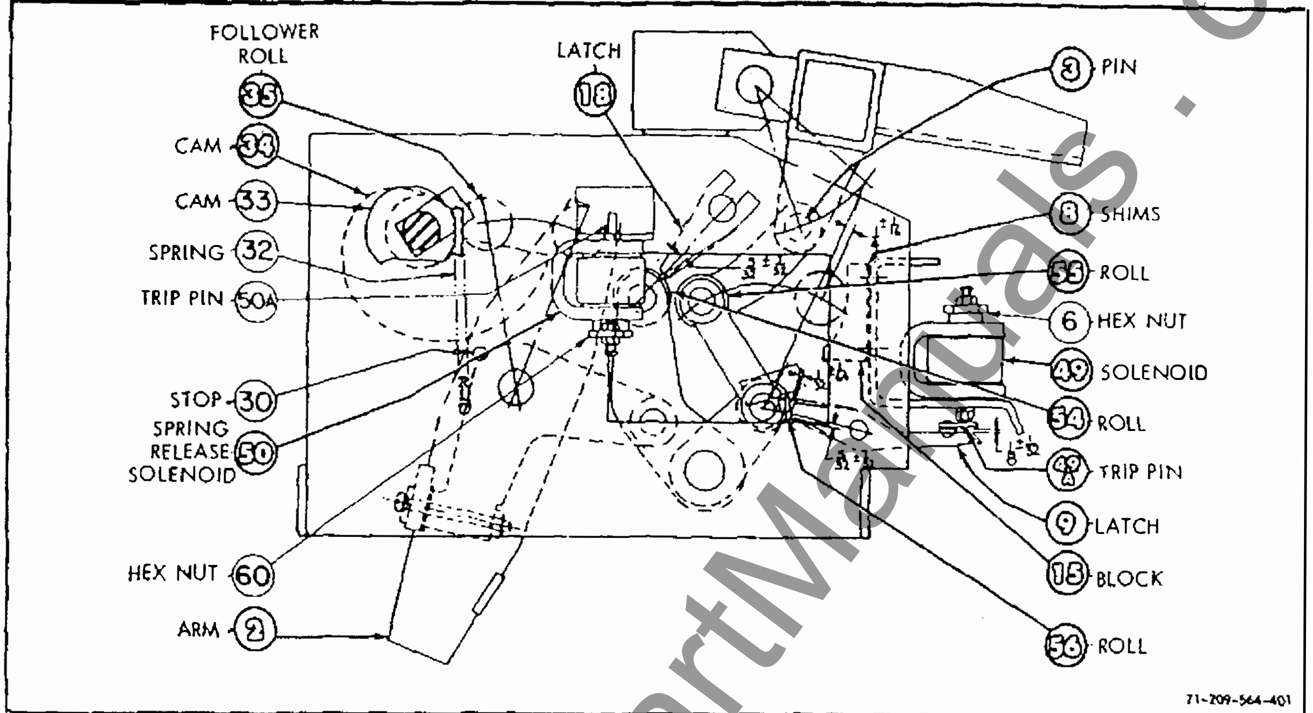


Fig. 19 – Type SE-3 stored energy operator assembly.

Manually Slow Closing the Breaker – Manual slow closing the breaker is done with a counterclockwise rotation of the charging handle. Rotate handle only to the point where latch (9) drops in front of roll (56). **Do Not Proceed Until You Are Sure That:**

1. Cam (34) is engaged with following roll (35).
2. Latch (18) is not engaged with roll (54).

Breaker can now be closed to contact touch portion by slowly turning charging handle clockwise. The breaker will close to point where arm 2 is against stop 16 fig. 18.

The breaker mechanism can be cranked to any position and held because the motor gears are self-locking.

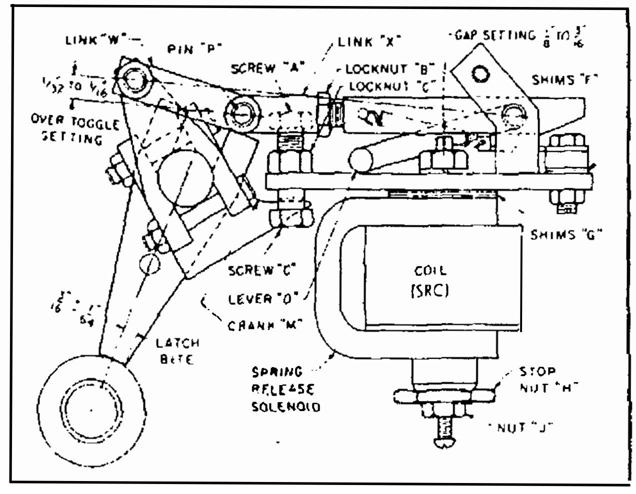
Control Switch – The 88 control switch assembly (Fig. 11) is factory adjusted and pinned in position. If it should become inoperative, clean contact areas with an electrical cleaning solvent and spray dry silicone lubricant lightly between contact surfaces and pivot points. If readjustment is required, remove roll pin (2), loosen nut (3) and rotate the switch assembly clockwise as far as it will travel.

Manually charge the closing springs fully as described under "Manual Charging of Closing Springs," above. Place a 1/32-inch shim between one of the switch rolls (5) and arm (4). Slowly rotate the switch assembly counterclockwise until the switch roll reaches its extreme travel. Tighten nut (3). Relocate and drill .190 diameter hole (at a convenient location) and drive in roll pin (2). Remove 1/32-inch shim.

Spring Release Latch and Over Toggle Linkage – To change bite of spring release latch (Fig. 20), 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.

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. 20 – Spring release latch.



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 do[ne] by release roll (6) (Fig. 21) passing over interlo[ck] angle (5), mounted on the cubicle floor. As the relea[se] roll passes over the interlock angle, it rises and push[es] up on the spring assembly (3). This causes link (1) [to] rotate pin (8) which raises lever (D) and link (X) (Fi[g.] 20), releasing the closing springs.

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

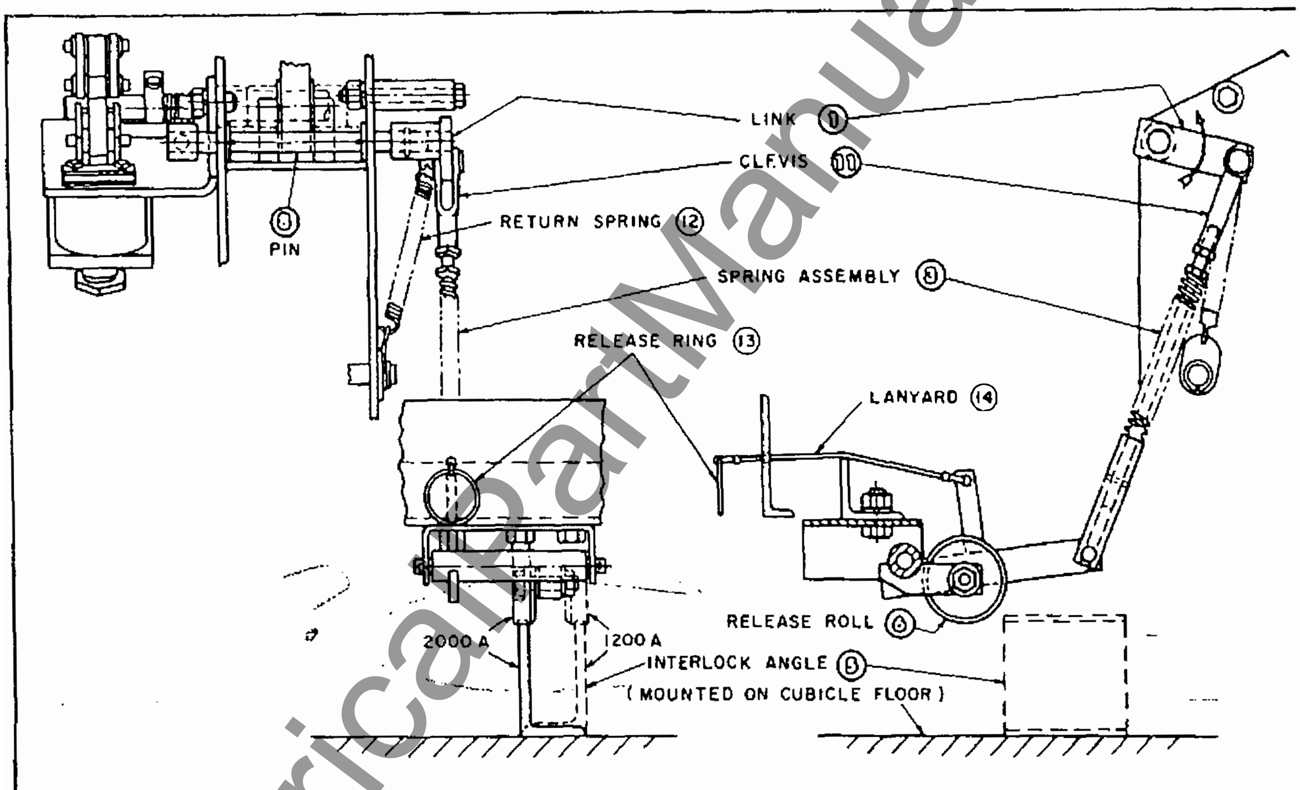


Fig. 21 – Spring release arrangement for type SE-3 stored energy operator.

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.~~

LUBRICATE CURRENT CARRYING JOINTS WITH A [illegible] LUBE AND REMOVE ANY EXCESS WHEN SQUEEZED OUT [illegible]

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.