SIEMENS-ALLIS

Switchgear

INSTRUCTIONS

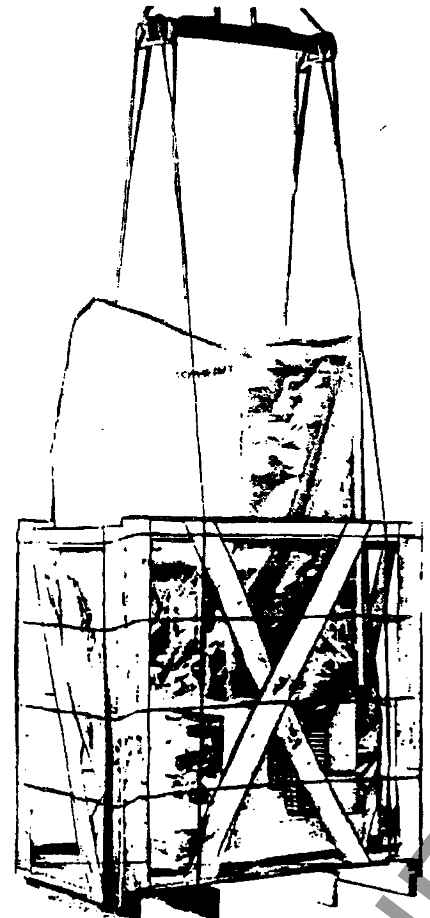
TYPE FC-1000B 15 kV
1200 - 2000 - 3000 AMP
AIR MAGNETIC CIRCUIT BREAKER
WITH
STORED ENERGY OPERATOR
TYPE 515-3

Supplement to
18X 10700

18X10695
October, 1979

INDEX

ILLUSTRATIONS



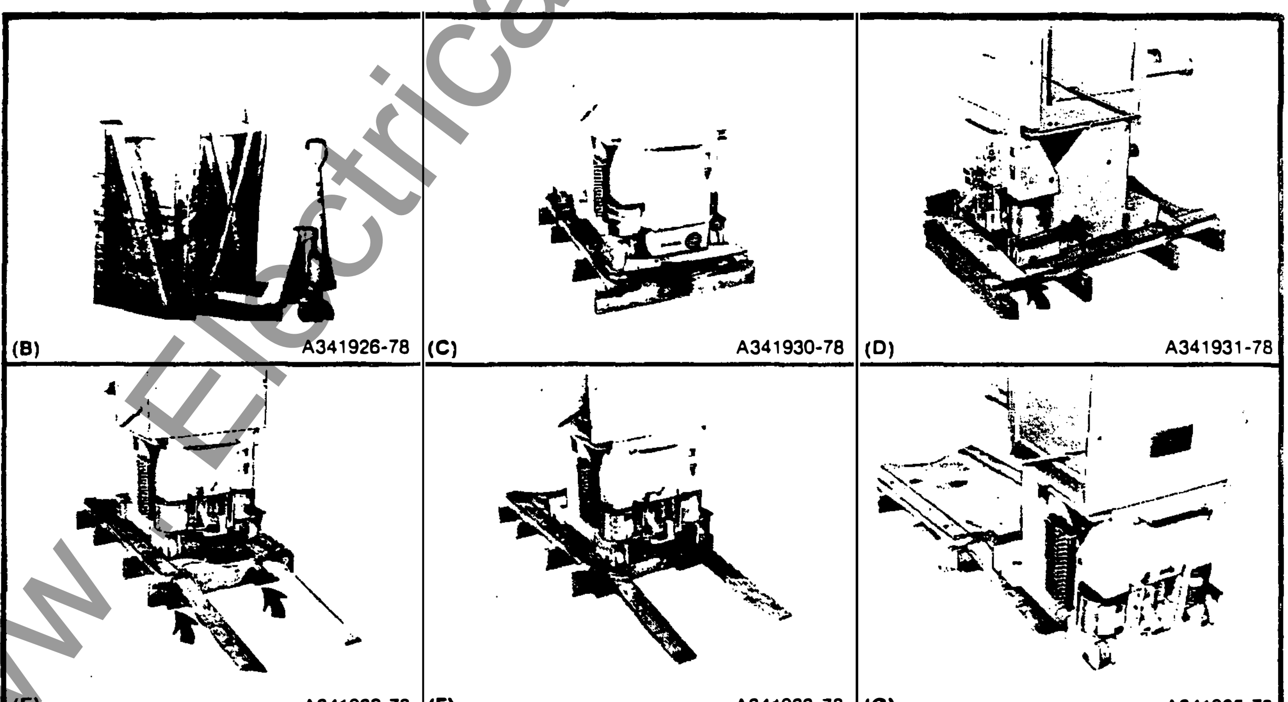
(A) A341928-78

PRELIMINARY HANDLING INSTRUCTIONS

- Move breaker to installation location with fork lift or crane (A).
- Carefully remove protective plastic cover or crate.
- Remove ramp pieces nailed to the pallet at the front of the breaker (B).
- Remove hold down bolts located on each side of breaker (C).
- Place ramp pieces in front of the pallet in line with breaker wheels and nail to pallet as shown by arrows in (D).
- Slowly roll breaker off pallet (E & F).

CAUTION

Remove packaging. Breakers are shipped in closed position with the trip rod and foot lever enclosed by packaging to prevent opening during shipment.



(B) A341926-78 (C) A341930-78 (D) A341931-78

(E) A341932-78 (F) A341933-78 (G) A341925-78

18X10492

Figure 1. Circuit Breaker Handling Instructions

INTRODUCTION

This instruction manual contains installation, operation and maintenance information for Type FC-1000B 15 kV stored energy operated 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 correct 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 do not attach lifting hooks, rope, etc., to bushings, insulating parts, fittings, etc. Do not slide breaker off shipping skid without using ramp blocks provided as interlock plunger and linkage may be damaged.

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 covered completely and a heat source provided to prevent condensation and subsequent corrosion.

If the circuit breaker must be stored for some time, "As Found" tests are desirable (see page 31).

CIRCUIT BREAKER PREPARATION

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

1. Remove packaging.

NOTE

Breakers are shipped in closed position with the trip rod and foot lever enclosed by packaging to prevent opening during shipment (refer to Figure 1).

2. Push manual trip rod to open breaker.

3. Remove phase barriers (see "Phase Barrier Assembly", page 15) and unfasten both front and rear blowout coil connections (see "Tilting Arc Chutes", page 17).

4. With arc chute support in place at the rear of the breaker, tilt the arc chutes (refer to page 17 for details) to expose contact area.

5. Remove dust, foreign particles, ect., from breaker.

   a. Inspect ceramics for possible shipping damage.

6. Check for mechanical freedom of disconnect arm movements by slowly closing the breaker. Reference page 24 for Slow Close Procedure.

7. Trip breaker by depressing trip rod (Figure 2, Item 15).

8. Return arc chutes to upright position, **fasten both front arc runner and rear 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).

10. Close breaker with control switch on cubicle panel.

11. Trip breaker with control switch on cubicle panel.

12. Depress foot lever and close electrically*.

13. Release foot lever and repeat steps 10** and 11.

14. De-energize control power and remove plug jumper.

15. Coat movable primary and secondary disconnects with a film of Siemens-Allis contact lubricant, 15-171-370-002.

16. Insert breaker into its cubicle to "disconnect" position and close manually*.

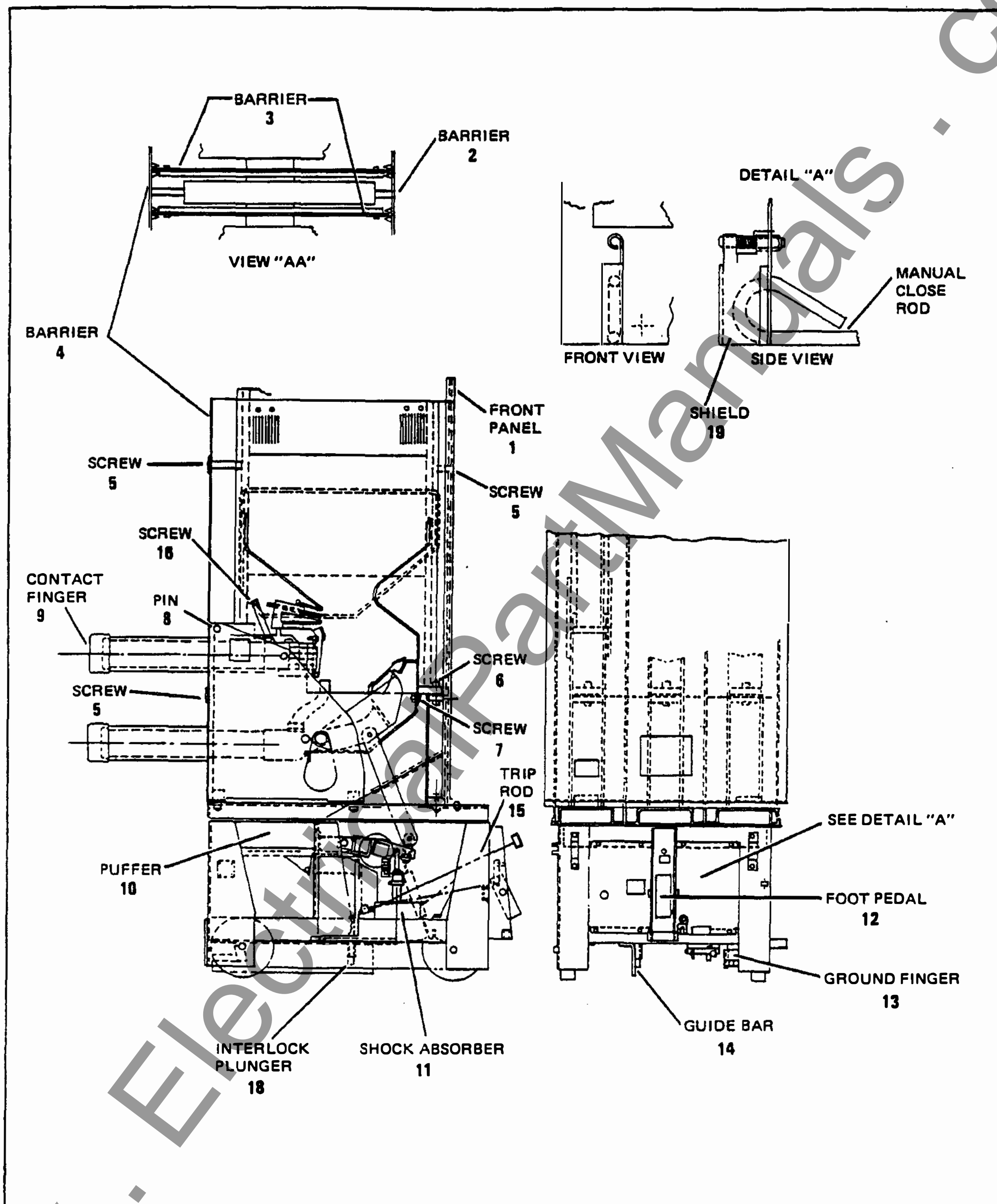


Figure 2. Typical Circuit Breaker Assembly FC-1000B

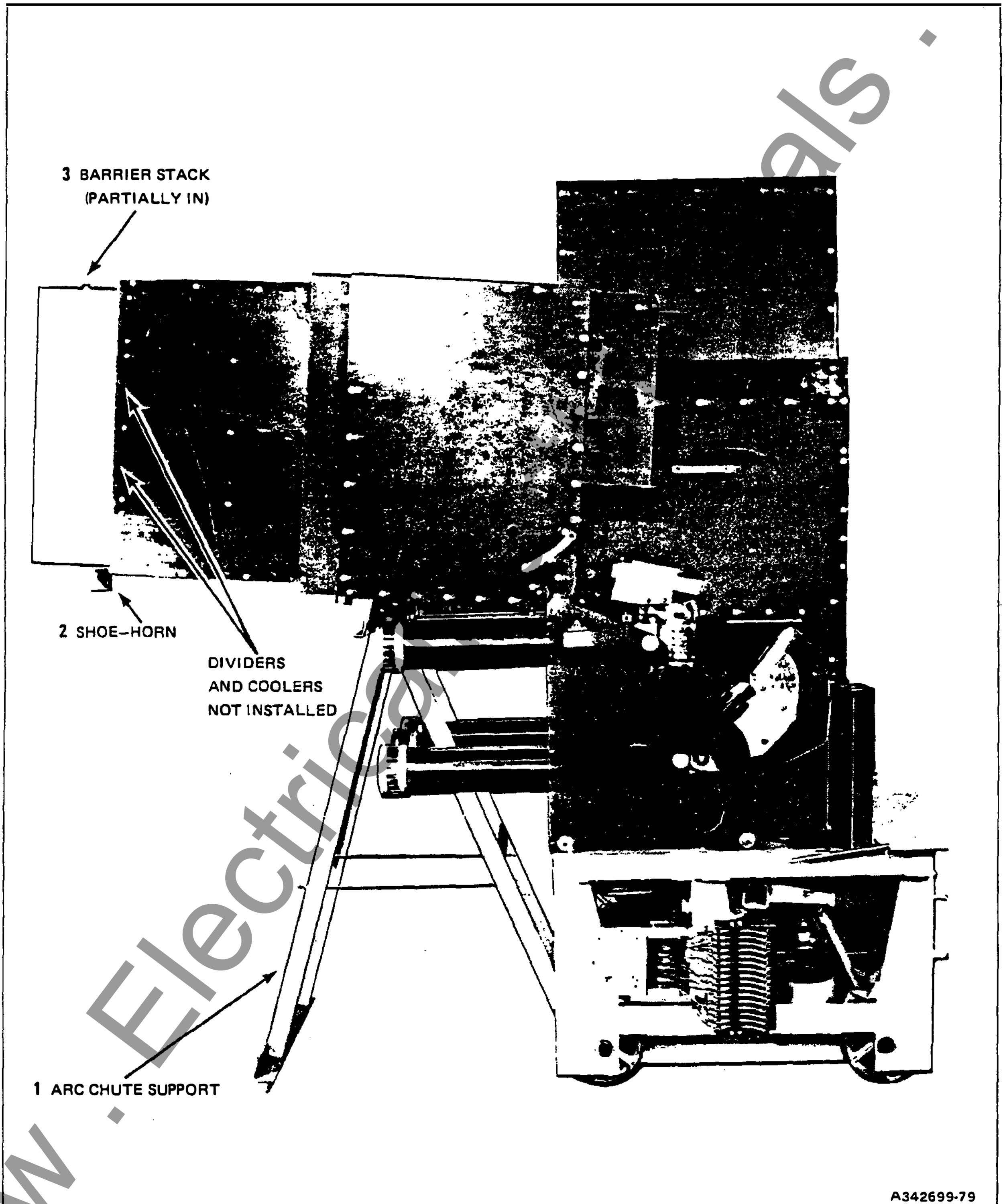


Figure 2A. Arc Chute Support in Position

17. Complete movement of breaker to "test" position and repeat steps 10** and 11.

18. Check for proper alignment between stationary and movable secondary contacts. Check for proper alignment between auxiliary switch bayonet on cubicle wall and operating fork on breaker.

19. 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.

20. Lock out Key interlock (if provided) and repeat step 10* again.

21. Open interlock and repeat steps 10** and 11.

22. Breaker is now ready for normal operation.

* — Breaker is trip free and should not close.
** — Breaker will close.

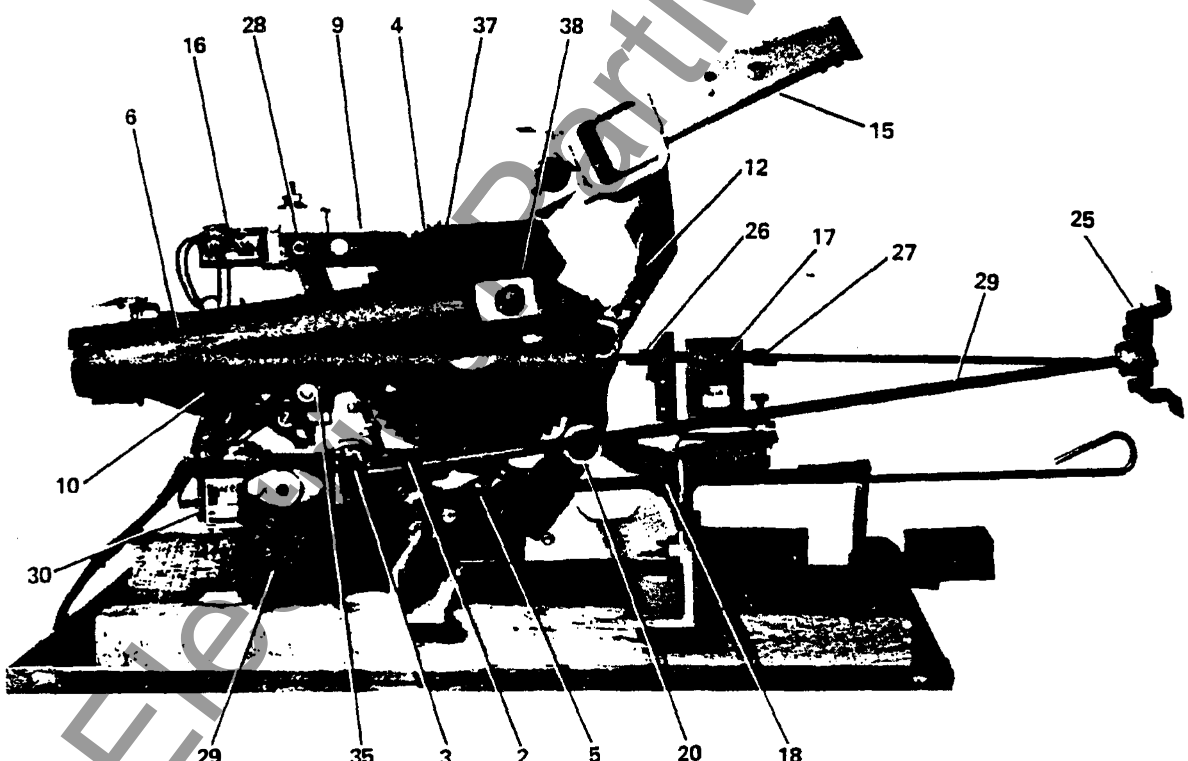


Figure 3. 515-3 Operator L.H. View

CIRCUIT BREAKER DESCRIPTION

A typical circuit breaker consists of primary disconnect, arc chute and operator sections. The primary disconnect section contains the main contact which supplies power to the load. The arc chute section dissipates the power arc energy 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 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 transferred to 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 through a transfer stack 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 large 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 for minimum metal vaporization.

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

OPERATOR

The breaker is closed by the stored energy operator straightening a toggle in the four-bar linkage (Figure 7, Item 12). The operator is powered by precharged springs (stored energy).

Stored Energy Operator

The stored energy operator (Figure 3) 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: spring charging drive, cam and ratchet assembly, and the four bar toggle linkage (Figure 4, A-D). These systems are disengaged from each other except while performing their specific functions. For example, the spring charging drive and cam-ratchet assembly are disengaged except when the cam-ratchet arrangement is being charged. Similarly, the cam-ratchet and four bar linkage are free of each other except during closing.

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

Reclosing Control (Optional - For Reclosing Applications Only)

The trip latch check system provides the necessary control to perform the reclosing function when the switchgear is equipped with reclosing relays.

The system is comprised of three elements: A magnetic actuator, a non-contacting magnetically operated Hall effect switch (sensor) and a timer module. The system performs two distinct functions prior to enabling the reclosing operation.

1. It senses that the trip latch has returned to its reset position and is ready to receive a reclosing operation.

2. Imposes a delay following latch reset to insure the linkage assembly has fully reset and then applies power to the spring release coil.

The non-contacting magnetically operated Hall effect switch and magnet actuator combine to perform proximity detection of the trip latch tail. The speed of operation and life expectancy of this proximity sensor system is not limited by mechanical actuation as no physical contact between the actuating magnet and Hall switch exist. The switch consists of a Hall sensor, trigger and amplifier integrated on a silicon chip. Its complete encapsulation isolates the device from environmental effects.

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 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 Figure 5).

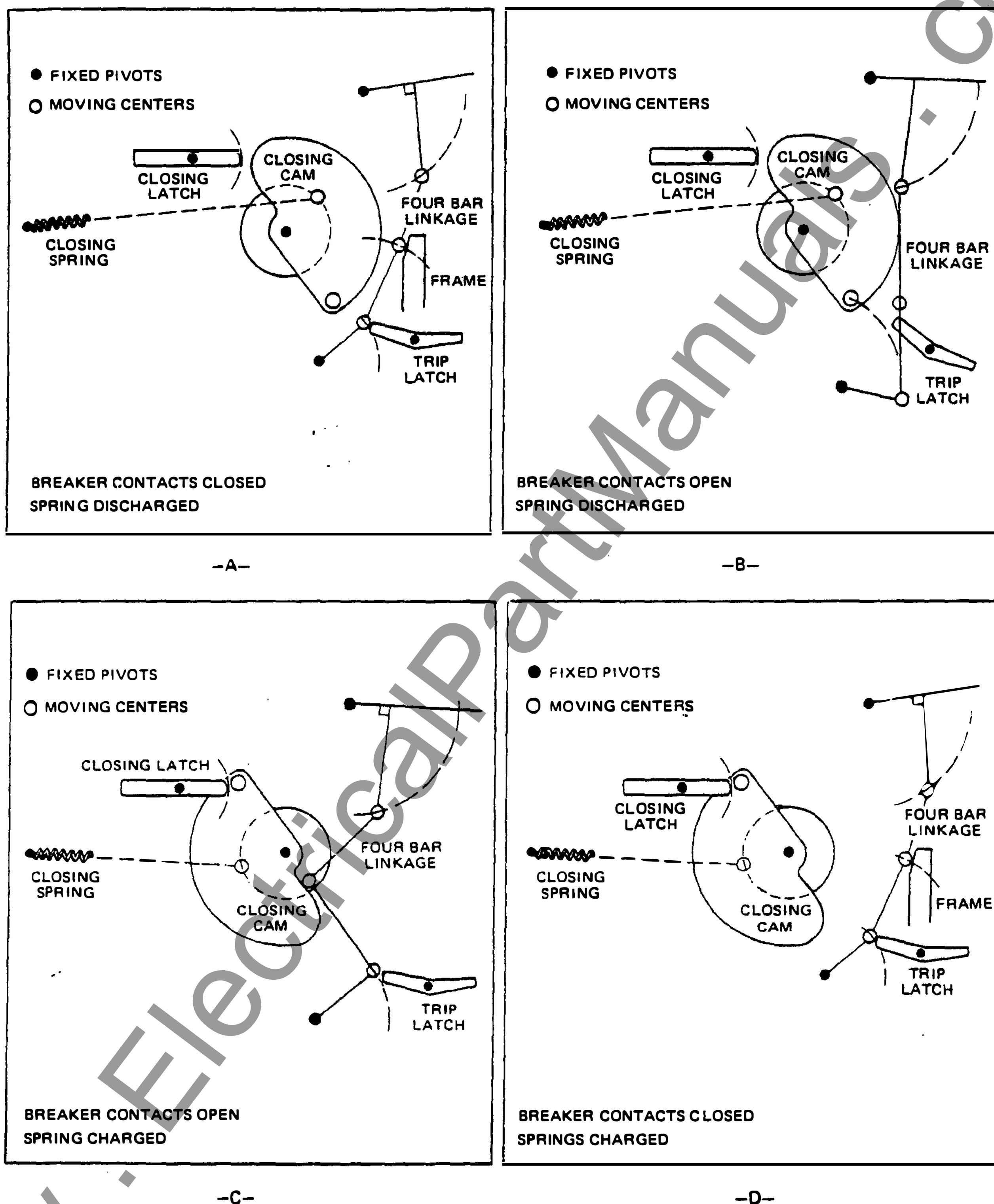
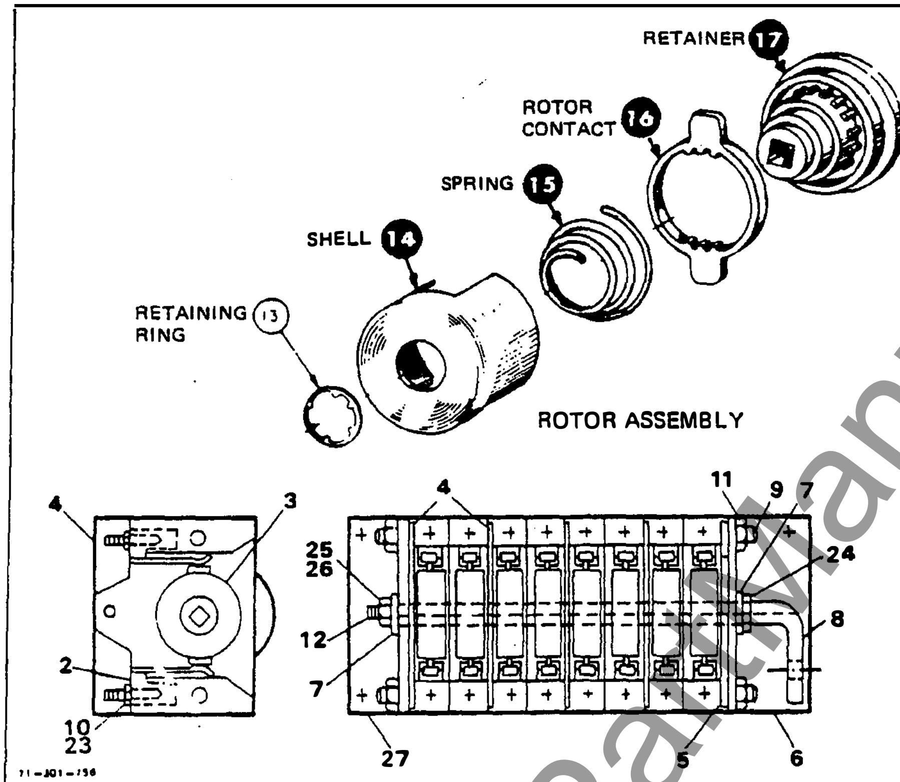


Figure 4. Sequence of Operation



2	Contract Finger
3	Rotor Assembly
4	Barrier
5	Barrier
6	Bracket
7	Bushing
8	Shaft
9	Stud
10	Hex Nut (10-32) Brass
11	Stv. Locknut
12	Cotter Pin
23	#10 Lockwasher
24	Washer
25	Hex Nut (.250)
26	.25 Lockwasher
27	Bracket

Figure 5. Type Q-10 Auxiliary Switch

Capacitor Trip Device

A capacitor trip device is commonly used with circuit breakers having an ac control supply installed in remote locations or unattended 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 Siemens-Allis sales representative.

Trip Solenoid

Normal electrical tripping (opening) is caused by the trip solenoid (Figure 8, 17) which is designated 52TC on the schematic of Figure 9. The trip solenoid is energized by operation of the circuit breaker control switch and the protective relays which are mounted on the switchgear.

ARC CHUTE ASSEMBLY

Each arc chute (Figure 6) 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 (1) and moving end arc runner (2) 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 left hand blowout coil (4) is connected to the stationary end arc runner (1) and the right hand blowout coil (5) is connected to the upper main conductor (upper stud). The two coils are connected in series and the current in these coils generates a magnetic field that forces the arc up into the barrier stack (3).

3. The barrier stack (3) consists 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 coolers (6) through which the by-product gases of interruption pass, completes the cooling and de-ionizes of the arc products.

Arc chutes can be tilted to expose contact area and for inspection of barrier stack (3). The arc chutes may also be lifted and removed from the breaker. Unfasten front screws (6, 7) and rear screw (16, Figure 2) before tilting or removing arc chutes.

NOTE

After arc chutes have been tilted back to their normal position, make sure that all screws have been replaced and tightened securely on all phases before phase barriers are replaced. Also ensure that blowout coils have been reconnected.

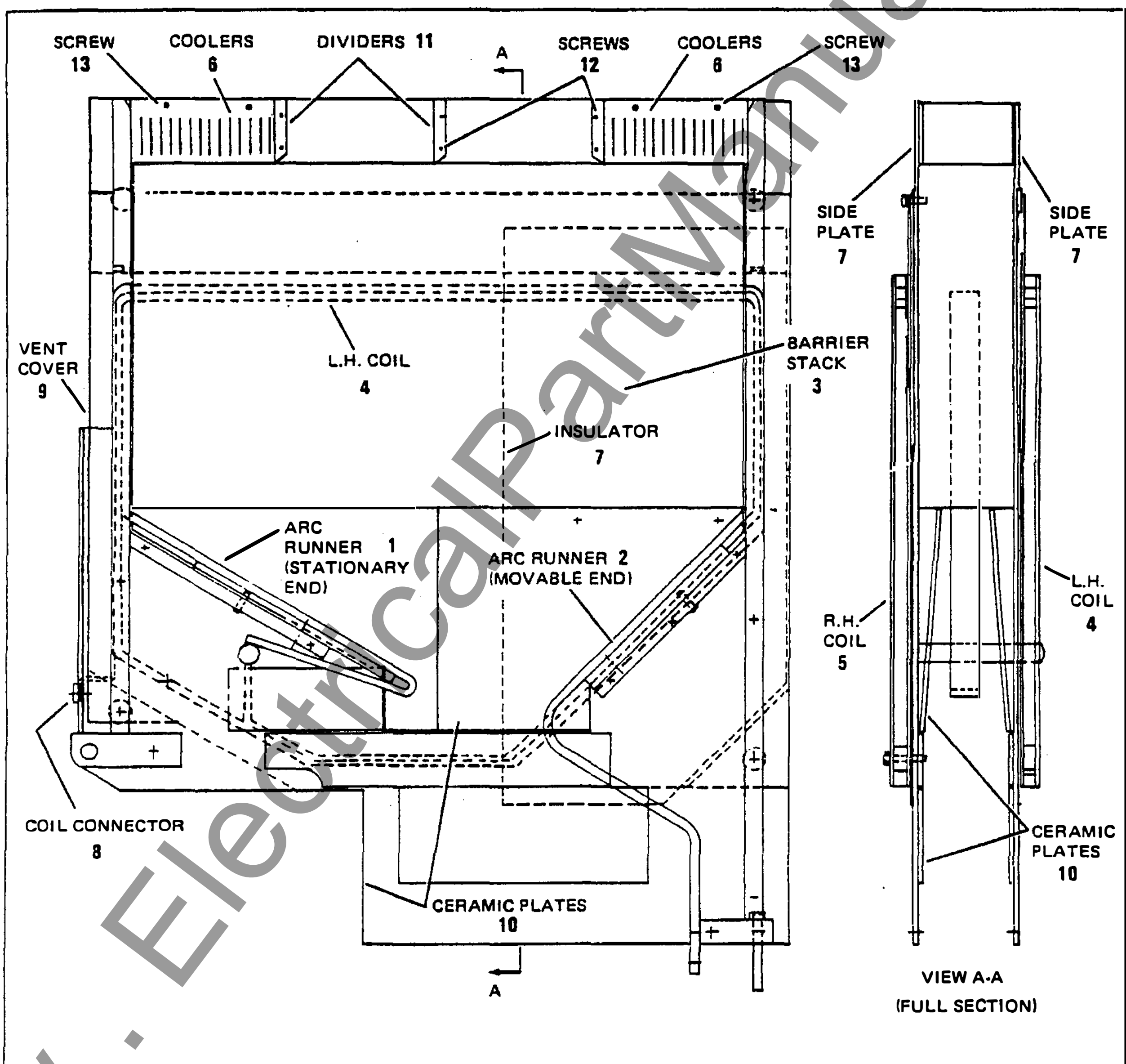


Figure 6. Arc Chute Section View

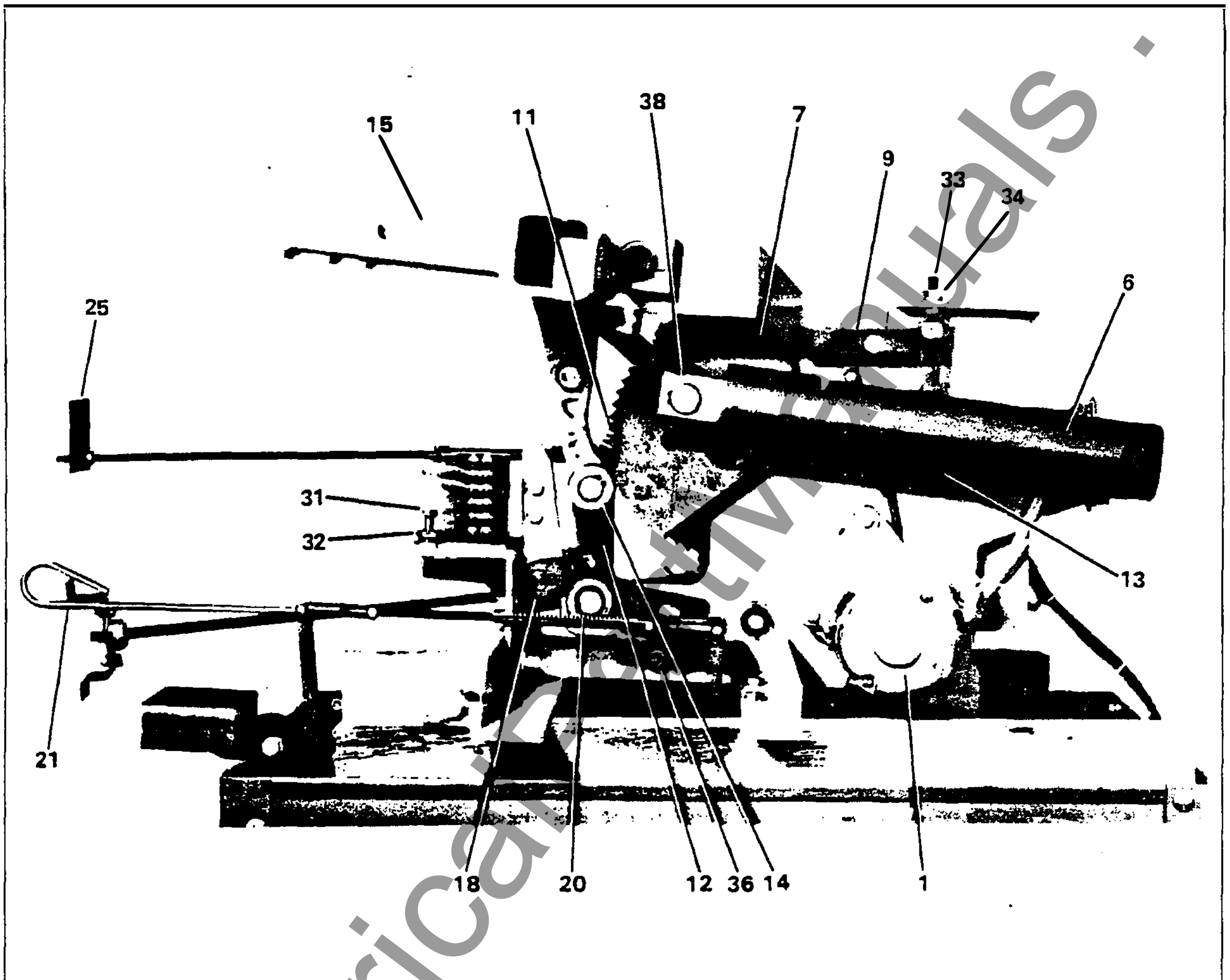


Figure 7. 515-3 Operator R.H. View

CIRCUIT BREAKER OPERATION

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 is energized.

Opening Breaker — Stored energy operated breakers can be tripped manually by depressing the trip rod (15) Figure 2), 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 by pulling the manual close pull rod (21, Figure 7), or electrically by energizing the closing circuit. This rotates the latch that allows the springs to close the breaker.

STORED ENERGY OPERATOR DESCRIPTION OF OPERATION

SPRING CHARGING CYCLE

Energization of the Breaker Control Circuit will cause the spring charging motor (1, Figure 7) to start charging the closing springs (6, Figure 3). The spring charging motor (1) will drive the driving pawl (2, Figure 3) through an eccentric drive shaft (3, Figure 3). The driving pawl (2) will turn the ratchet wheel (4, Figure 3) counterclockwise one tooth at a time. The holding pawl (5, Figure 3) will hold the ratchet in position between driving strokes of driving pawl (2). This charging operation will continue turning the ratchet wheel (4) counterclockwise a tooth at a time until the closing springs (6) are fully charged (dead center). The motor will drive the ratchet wheel past this dead center position and the closing springs (6) will aid rotation driving the ratchet wheel and cams counterclockwise until spring release rollers (8, Figure 8) on the inside surfaces of cams (7, Figure 7) engage the close latch (9, Figure 7). This arrests the motion of the ratchet wheel (4) and the cams (7) and holds the operator in a fully charged position. As the cams and ratchet wheel go over center, the motor cutoff switch (10, Figure 3) is actuated to de-energize the spring charging motor (1). The spring charging motor then coasts to a stop, driving pawl (2) oscillating freely in the smooth toothless section of the ratchet wheel.

The motor cutoff switch (10) has four functions:

1. It de-energizes the spring charging motor (1);

2. It opens a contact in the anti-pump relay circuit;

3. It sets up the closing coil circuit;

4. It can be used to energize an indicating light to indicate that the closing springs (6) are fully charged.

NOTE

The close latch check switch (16, Figure 3) is in the motor circuit. The close latch check switch monitors the position of the close latch (9) and will prevent charging of the closing springs (6) electrically unless the close latch (9) is in the correct position.

As energy is stored in the closing springs, the four bar linkage (12, Figure 7) will be positioned by the linkage reset spring (11, Figure 7) which acts to cause cam follower rollers (14, Figure 7) to follow the surface of cam (7, Figure 7) until the links are in a reset position, and allowing latch rollers (20, Figure 7) to be positioned in front of trip latch (18, Figure 7).

See Figure 4 for sequence of operation.

RECLOSING CONTROL (Optional - For Reclosing Applications Only)

The electronic solid state time delay module works in concert with the trip latch sensor system. The time delay module consists of an electronic timer and an electromagnetic relay. The diagram (Figure 9), shows the timer module receiving power between terminals 1 and 3. Terminal 3 is connected to the common side of the closing control source. Terminal 1 is connected to the high side of the closing control source through auxiliary contact (52B) and the closing source contact "CSC". The trip latch sensor system consists of the magnetic actuator and the Hall effect switch.

The time delay module is not energized until the breaker is charged, open and the closing source switch "CSC" is closed. With the latch reset at the instant "CSC" closes, the timer modules internal relay with normally open contact operates with no intentional delay (40ms electro-mechanical delay) to connect the spring release solenoid through timer module terminal 2 to the high side of the closing source initiating the breakers closing sequence.

If at the time the closing source is applied, the trip latch is not reset, the timer module will assume a delaying mode of operation. Upon latch reset a predetermined delay will be imposed before the timer's relay closes energizing the spring release solenoid. The complete trip latch check system is not affected by broad variation of closing source voltage. The time delay error caused by temperature extremes of -40^{o} to 65^{o}C is a minus 3% to plus 5%.

BREAKER CLOSING CYCLE

Energizing the spring release solenoid (13, Figure 7) will drive the close latch (9, Figure 7) away from the spring release rollers (8, Figure 8) on the cams (7, Figure 7) releasing the stored energy in the closing springs (6, Figure 7). The closing springs (6) will drive the ratchet wheel (4, Figure 3) and the cams (7, Figure 7) counter-clockwise at a high rate of speed. The cams (7) will engage the cam follower rollers (14, Figure 7) of the four bar linkage (12, Figure 7) and drive them forward causing the four bar linkage to become straight. As the four bar linkage (12)

becomes straight, it drives the radius arm (15, Figure 7) upward causing the breaker contacts to close and the opening springs to be charged. The cams (7) drive the four bar linkage (12) over toggle and against the frame thereby latching the breaker contacts in the closed position.

SPRING RECHARGE AFTER CLOSING

When the closing cycle has been initiated and the cams (7, Figure 7) begin to turn, the motor cutoff switch (10, Figure 3) resets itself. A "b" auxiliary switch of the breaker opens de-energizing the closing solenoid (13, Figure 7). The close latch (9, Figure 7) returns to its reset position and the close latch check switch (16, Figure 3) closes and energizes the spring charging motor (1). The closing springs (6) are then recharged as described earlier.

TRIPPING CYCLE

Energizing the trip solenoid (17, Figure 3) will drive the trip latch (18, Figure 3) away from latch roller (20, Figure 3) on the four bar linkage (12, Figure 3). This allows the four bar linkage to collapse and the breaker contacts will open. If the closing springs (6) are in the charged position, the linkage reset spring (11, Figure 7) will immediately reset the four bar linkage (12). If the closing springs (6) are not charged, the linkage reset spring (11) will not reset the four bar linkage (12) until just before the closing springs (6) are completely charged.

ELECTRICAL CONTROL

The normal control for this operator is contained in a control panel mounted at the rear of the unit. It consists of motor cutoff switch (10, Figure 3), anti-pumping relay (30, Figure 3), and the close latch check switch (16). The typical control arrangement's elementary diagram is shown in Figure 9. (Check schematic furnished with switchgear as wiring arrangements may vary.)

Spring Charging

The spring charging motor power is supplied through terminals 3 and 4 (Figure 9). The mechanical interlock is a switch operated by the breaker release lever (foot lever) which opens the motor circuit when the lever is depressed. The close latch check switch is closed when the close latch (9, Figure 3) is in the reset position. The 88 switches are shown with the closing springs discharged. When the control is energized, the motor starts to charge the springs. The 88 switch is operated by a roll pin striker (37, Figure 3) mounted in the ratchet wheel (4, Figures 3 and 16). As the ratchet wheel and drive blocks charge the springs, the ratchet wheel revolves to the position of full compression. dead center. Beyond dead center position, the springs aid rotation and cause the motor cutoff switch striker to depress the actuator (35, Figure 3) of the 88-1 switch, opening the motor circuit and the 88-3 contact in the anti-pumping relay circuit. The spring charging motor coasts to a stop with the driving pawl (2, Figure 3) oscillating freely on the smooth portion of the ratchet wheel.

STORED ENERGY OPERATOR-COMPONENTS NOMENCLATURE

To be used with "Description of Operation", Figures 3, 7 and 8.

1. Spring Charging Motor
2. Driving Pawl
3. Eccentric Drive Shaft
4. Ratchet Wheel
5. Holding Pawl
6. Closing Springs
7. Cams
8. Spring Release Rollers
9. Close Latch
10. Motor Cutoff Switch
11. Linkage Reset Spring
12. Four Bar Linkage
13. Close Solenoid
14. Cam Follower Rollers (Main Toggle Roll)
15. Radius Arm
16. Close Latch Check Switch
17. Trip Solenoid
18. Trip Latch
20. Latch Roller
21. Manual Close Pull Rod
22. Spring Discharge Roller Free Height Adjustment
23. Spring Discharge Close Latch Yoke End Adjustment
24. Spring Discharge Roller
25. Charge Discharge Indicator
26. Discharge Indication Adjustment
27. Charge Indication Adjustment
28. Mechanical Charging Interlock Adjustment
29. Manual Charging Shaft and Gear Box
30. Anti-Pumping Relay
31. Trip Latch Bite Adjusting Screw
32. Trip Latch Bite Adjusting Screw Locking Nut
33. Close Latch Bite Adjusting Screw
34. Close Latch Bite Adjusting Screw Locking Nut
35. Motor Cutoff Switch Actuator
36. Lower Link Stop
37. Roll Pin Striker
38. Aluminum Spring Drive Blocks
39. Spring Discharge Connecting Rod

*See Figures 9 and 13 for Trip Latch Check System

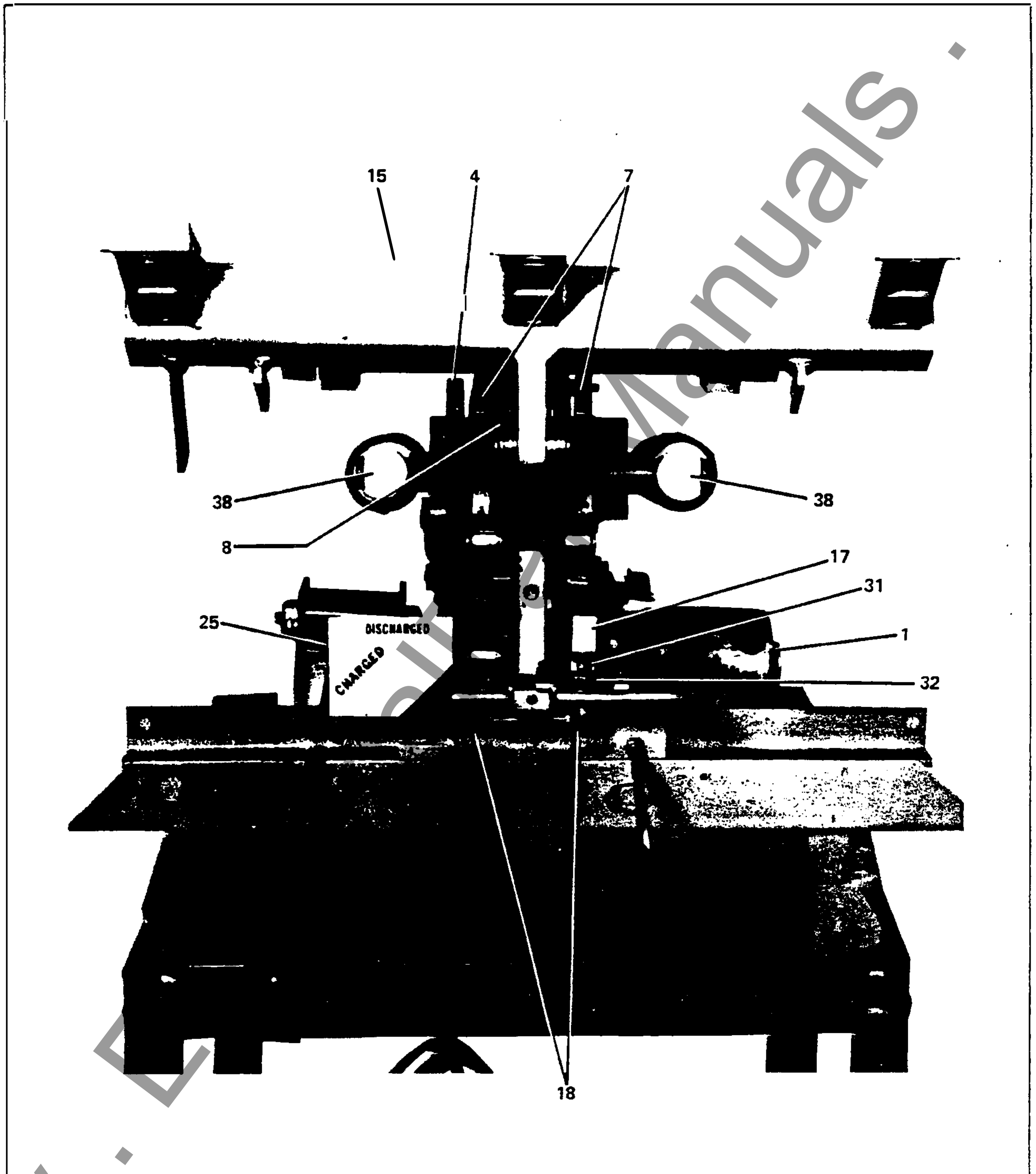
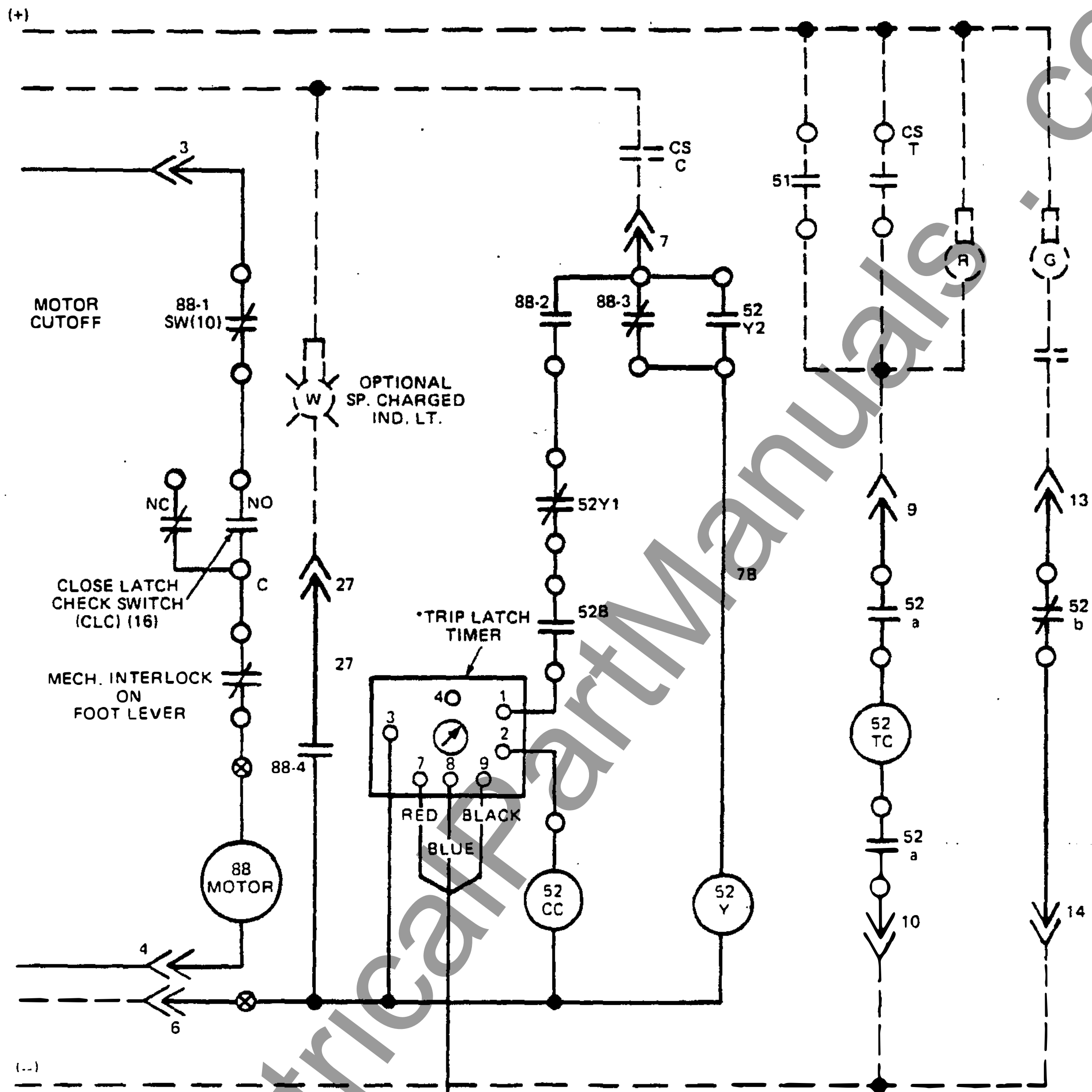
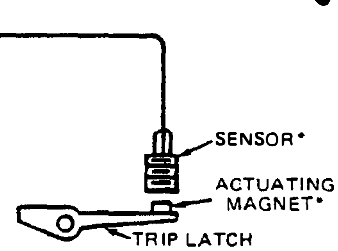


Figure 8. 515-3 Operator Front View





52 TC – CIRCUIT BREAKER TRIP COIL
52 CC – CIRCUIT BREAKER CLOSING COIL
52 Y – AUX. CLOSING RELAY ANTI PUMP
MCO – MOTOR CUTOFF SWITCH
88 – SPRING CHARGING MOTOR
CLC – CLOSE LATCH CHECK SWITCH
TLC – TRIP LATCH CHECK SWITCH
CSC – CONTROL SWITCH – CLOSE CONTACT
CST – CONTROL SWITCH – TRIP CONTACT
R – RED INDICATING LAMP
G – GREEN INDICATING LAMP
a – AUX. SWITCH – OPEN WHEN BR'KR. IS OPEN
b – AUX. SWITCH – CLOSED WHEN BR.KR. IS OPEN
* – OPTIONAL ITEMS FOR RECLOSING APPLICATIONS ONLY

Figure 9. Control Scheme for Stored Energy Operator

Closing Circuit

The standard control circuit for a stored energy operator is shown in Figure 9. When the close control switch is closed, the circuit from terminal 7 through 88-2 and 52Y1 to 52B through trip latch timer, Figure 14 (when furnished), to terminal 6 energizes the closing coil, closing the breaker. As soon as the closing springs are discharged, and 88-3 switch contact closes to energize the 52Y relay. If the close control switch remains closed, the 52Y relay remains picked up through contact 52Y2. Control switch has to be released to reset control for another closing operation. This forms the anti-pumping relay circuit which prevents the circuit breaker from reclosing immediately after a trip free operation. If control power is momentarily lost during closing, upon re-energization, the 52Y relay picks up instantaneously through contact 88-3 maintaining the anti-pumping relay circuit prior to complete spring charging.

Close Latch – Mechanical and Electrical Interlocks

The close latch (9, Figure 3) must be fully reset to receive the cam mounted spring release rollers at the end of the charging cycle. To insure the close latch is in this fully reset position, an electrical and mechanical interlock is provided.

The close latch check switch (16, Figures 3 and 17) consists of snap-action type switch mounted in close proximity to the close latch. A striker plate at the tail of the close latch engages the switch's acuator slightly before the fully reset position is achieved and actuates the switch prior to the latches reaching the fully reset position. At the time of actuation, a contact closes initiating the charging sequence. The switch operates with very small differential, and this sensitivity coupled with the close latch biased engagement of the spring release rollers provides a positive sensitive interlock.

The mechanical interlock (Figures 19) prevents manual charging of the breaker if the close latch is not adequately reset. A linkage attached by a clevis to the close latch, extends down the side of the breaker frame to the driving pawl mechanism. An extension of the interlock linkage passes above the driving pawl constant force return spring. If the close latch fails to return to a fully reset position, the linkage extension thrusts the driving pawl's return spring downward preventing the driving pawl's engagement of the ratchet wheel, thus mechanically inhibiting either manual or electrical spring charging.

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 make 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 (8.3 ms) on opening and 2 cycles (33.3 ms) on closing indicates a maladjustment or friction buildup. A speed analyzer may be connected to the movable contact arm by removing one button head socket screw in the movable contact arm (Item 29, Figure 11A).

PHASE BARRIER ASSEMBLY

Barriers of high dielectric flame retardant material isolate each phase (Figure 10). To remove interphase barriers (1) and flux shunts (2), remove screws (6), lateral supports (5), front barrier (7), rear barrier (4) and outer barrier (3). Flux shunts (2) should be pulled out first towards the rear of the breaker before interphase barriers (1) can be removed.

CAUTION

Each flux shunt (2) weighs about 90 pounds and should be handled accordingly.

Hand holes are provided in the flux shunt packages (2) for lifting advantage when sliding them in and out of the breaker.

To install the flux shunts (2) and interphase barriers (1), follow the reverse order of the dismantling procedure above. Interphase barriers (1) should be mounted first with their flat surfaces facing the center phase (ribs facing the outer phases inside the pedestal walls). Then flux shunts (2) are mounted alongside the interphase barriers (1) facing the center phase. Install front barrier (7) and rear barrier (4) starting at the bottom and work up to the top to insure interphase barriers (1) are in slots. Bolt down loosely the lateral supports (5) with screws (6). Insert outer barriers (3) from the top of the front (7) and rear (4) barriers and drop in the slot with their ribs facing the breaker. Tighten screws (6) of lateral supports (5).

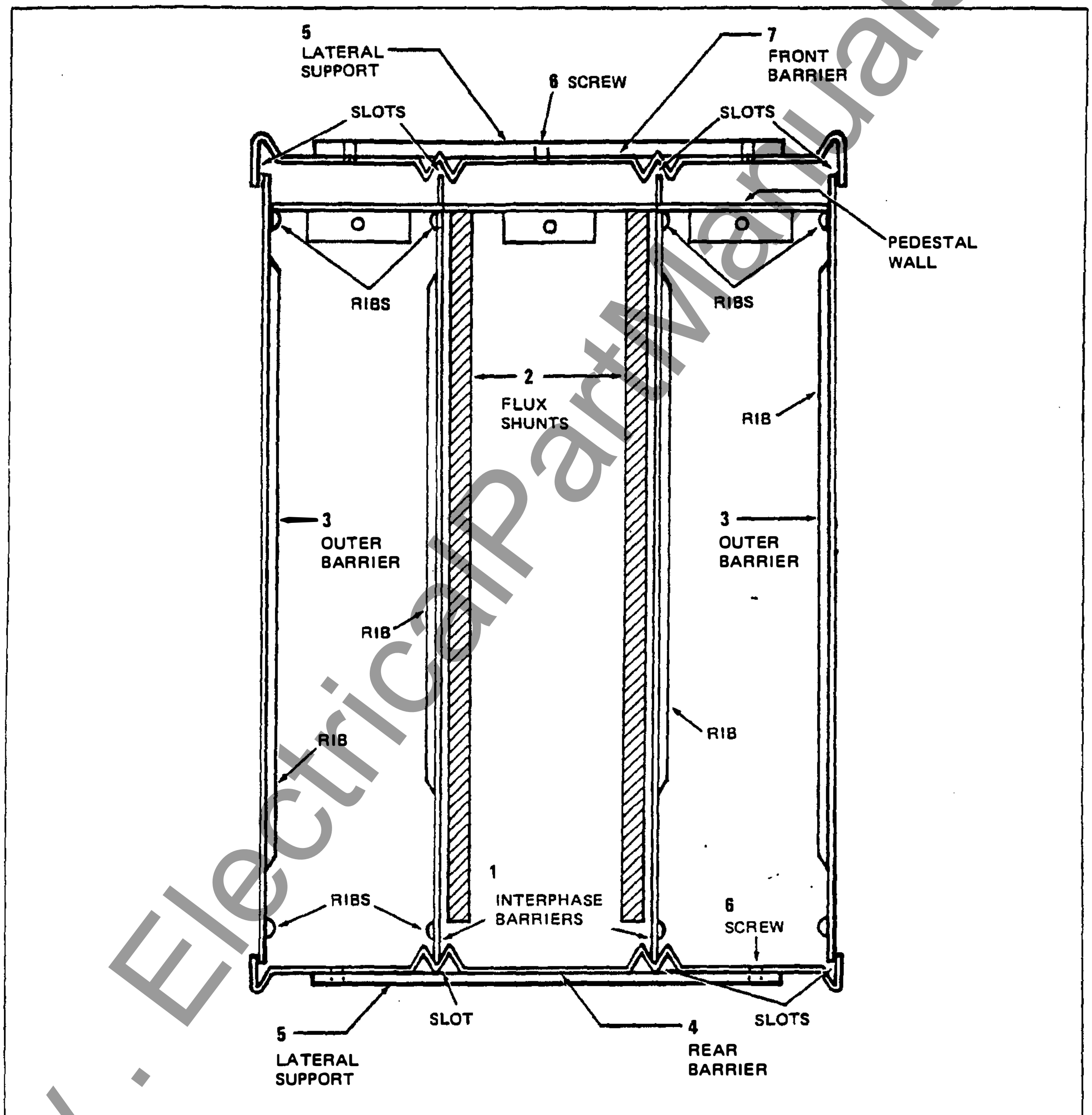


Figure 10. Phase Barrier Assembly Top View

TILTING ARC CHUTES

Remove phase barriers as described under "Phase Barriers Assembly" (refer to Figure 10).

Remove screw (16) of the blowout coil, screw (7) of the front arc runner and front screw (6) of the arc chute of each phase (see Figure 2).

Position arc chute support at the rear of the breaker and tilt back the arc chutes as shown in Figure 2A.

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.

NOTE

Make sure that blowout coils are reconnected with front screw (7) and rear screw (16) (Figure 2).

BARRIER STACKS

The barrier stacks (3, Figures 2A and 6) are fragile and must be handled carefully. Inspect the barrier stacks (3) for erosion of the plates in the areas of the slots. The barrier stacks (3) 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 stack (3), tilt back the arc chutes one at a time as in Figure 2A, remove screws (13) (see Figure 6), coolers (6), screws (12), dividers (11) and slide barrier stack (3) through the top of the arc chute. When replacing barrier stack (3), lay the "shoe-horn" guide (2, Figure 2A) in position on the bottom endplate of the tilted arc chute to avoid upsetting and destroying the endplate seal that could result in difficult insertion of the barrier stack and breakage of its plates. Slide in the barrier stack (3) making sure V-shaped slots go in first. Install coolers (6) with screws (13) and dividers (11) with screws (12). Tilt the arc chute back to its upright position and pull out "shoe horn" guide (2, Figure 2A) from the top of the arc chute.

TRANSFER STACK

Transfer stack (34) shown in Figure 11C are as fragile as the barrier stacks and likewise, should be handled carefully. Transfer stacks (34) should be replaced if milky glaze appears on the edges of the slots or if plates are broken or cracked. To remove the transfer stack (34), remove one of the two sideplate supports (33). Hold the transfer stack (34) with one hand to prevent it from falling down while the sideplate support (33) is being taken out. To install the transfer stack (34), follow the reverse order of above.

CONTACT ALIGNMENT AND REPLACEMENT

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

The procedures which follow are to be used if it becomes necessary to change contacts, adjust penetration, or restore contact alignment (refer to Figures 11A, 11B and 11C).

PROCEDURE A Contact Alignment and Penetration (Stroke)

1. The check for proper contact alignment and penetration can be made at the same time by measuring dimensions "C", view "A-A", Figure 11A.

2. Using power closing procedures, close and latch breaker. The main contacts will have spread apart leaving gaps between the stationary main fingers (8, Figure 11A) and plates (7). Penetration is determined by measuring these gaps, dimensions "C", with feeler gages.

3. Alignment and penetration are satisfactory if the sum of left and right hand "C" dimensions total 0.090 to 0.120 inches (2.29-3.05 mm). The minimum "C" dimension on either side is 0.040 inches (1.02 mm).

4. If either a left or right hand "C" dimension is less than 0.040 (1.02 mm) contact alignment will require adjustment. This adjustment is made by opening the breaker, scribing the position of blocks (8 and 13, Figure 11C). loosening screws (24 and 25) and moving blocks (8 and 13) sideways to equalize the dimensions "C" between each side. The scribed lines serve as a reference. Refasten screws (24 and 25). Close breaker and check alignment. When making this adjustment be sure block (8) is firmly seated against ridge on top of stud.

5. If the total of "C" dimensions are less than 0.090 inches (2.29 mm) penetration will require adjustment. This adjustment is made by lengthening or shortening link (47, Figure 11A). Adjust length of link (47) by removing or inserting washers between the base of "T" casting (9) and checknut (10). Use a 0.625 ID by 1.25 OD by 0.03 thick (15.9 ID by 31.800 by 0.8 mm thick) brass washer, Siemens-Allis part number 71-018-451-001. Adding washers will increase penetration, "C" dimensions will increase. The adjustment should proceed by adding or removing a single washer at a time. Make sure this adjustment brings

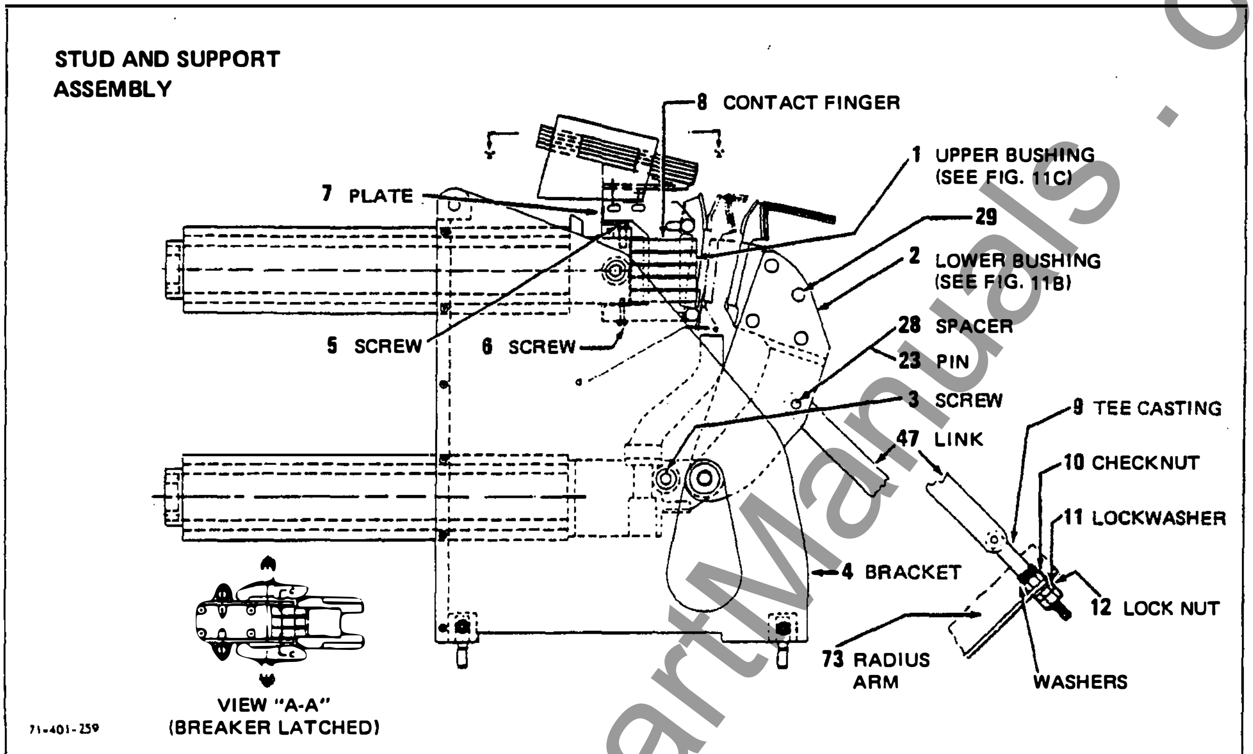


Figure 11A.

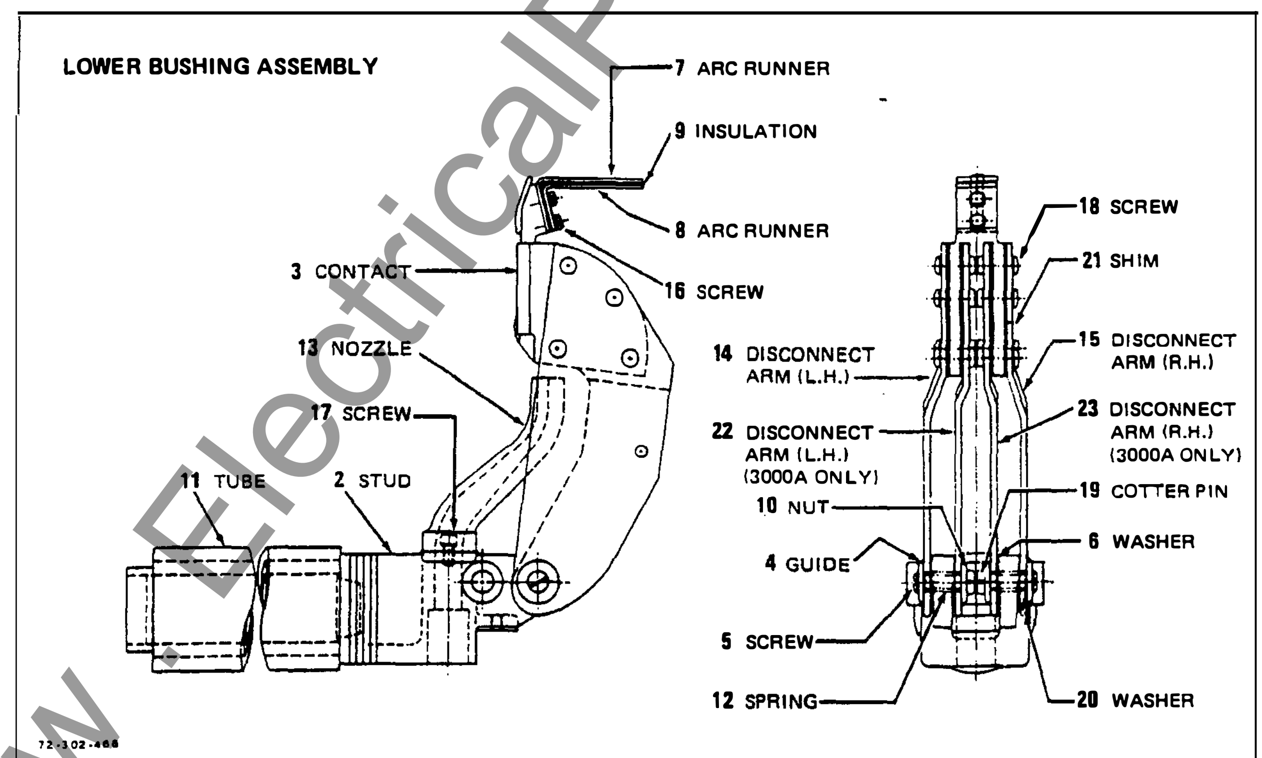


Figure 11B.

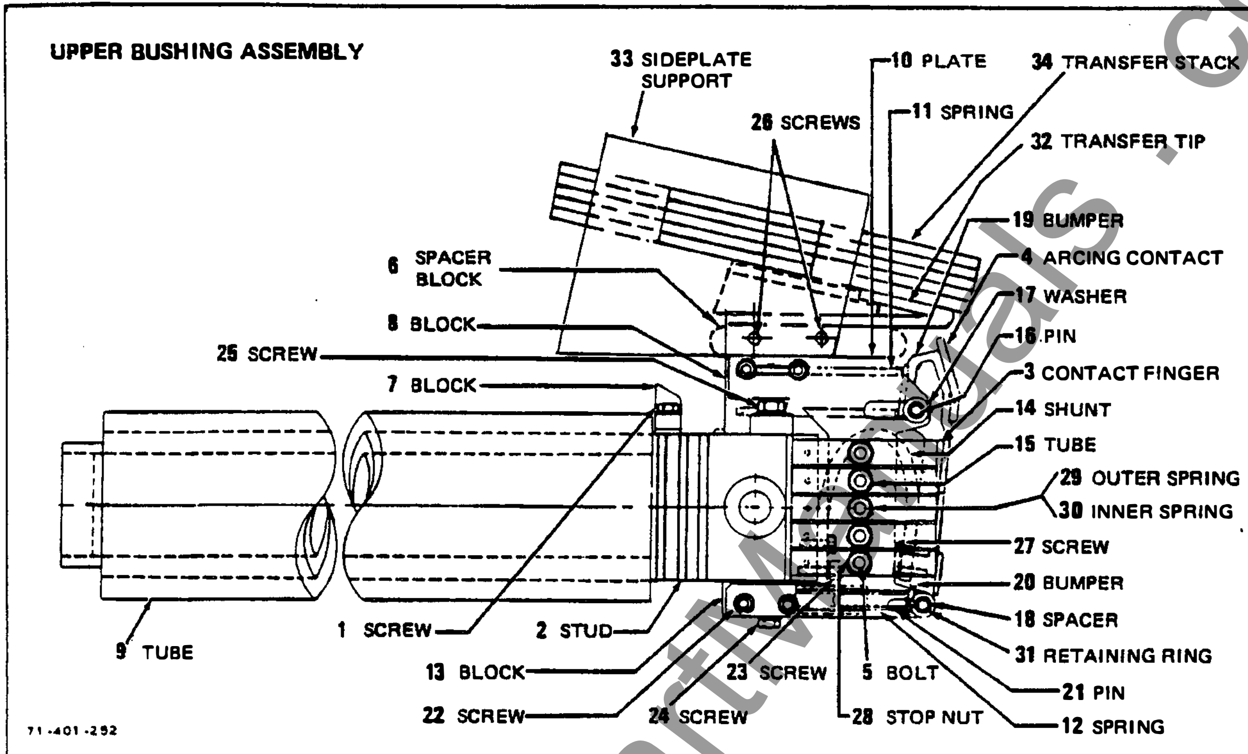


Figure 11C.

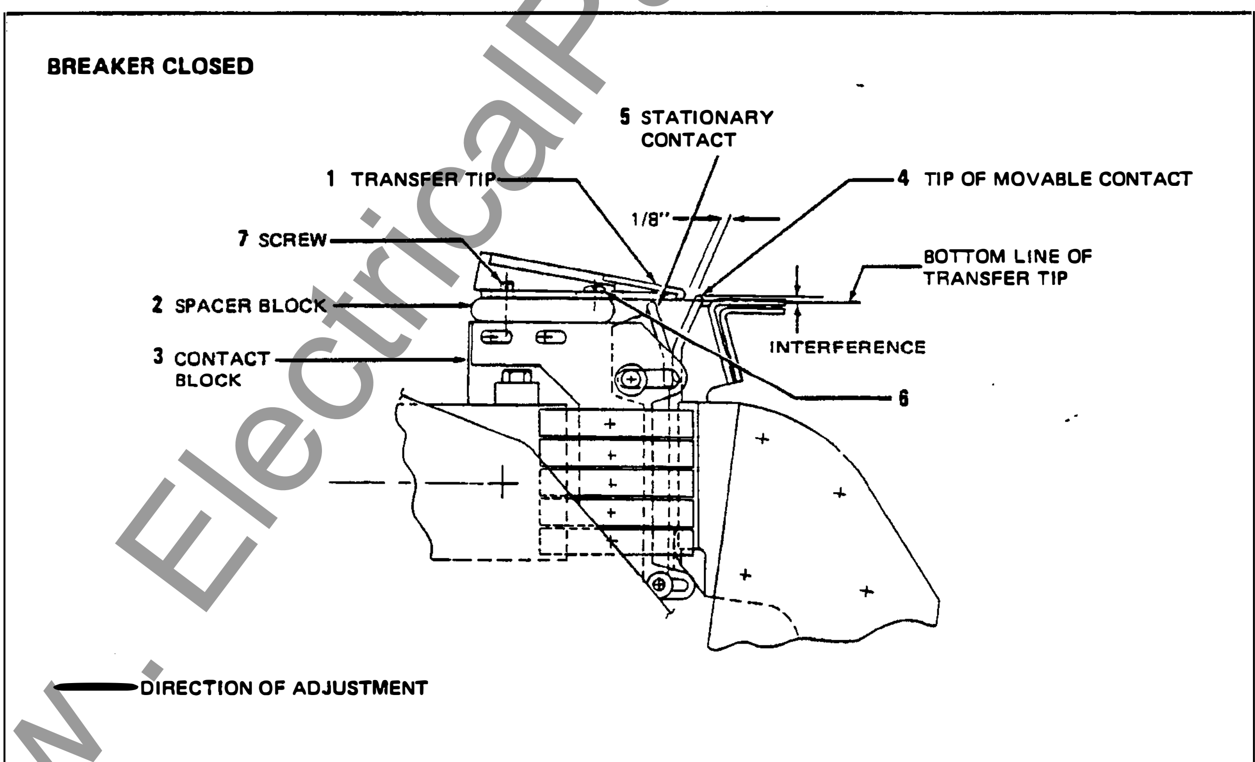


Figure 11D.

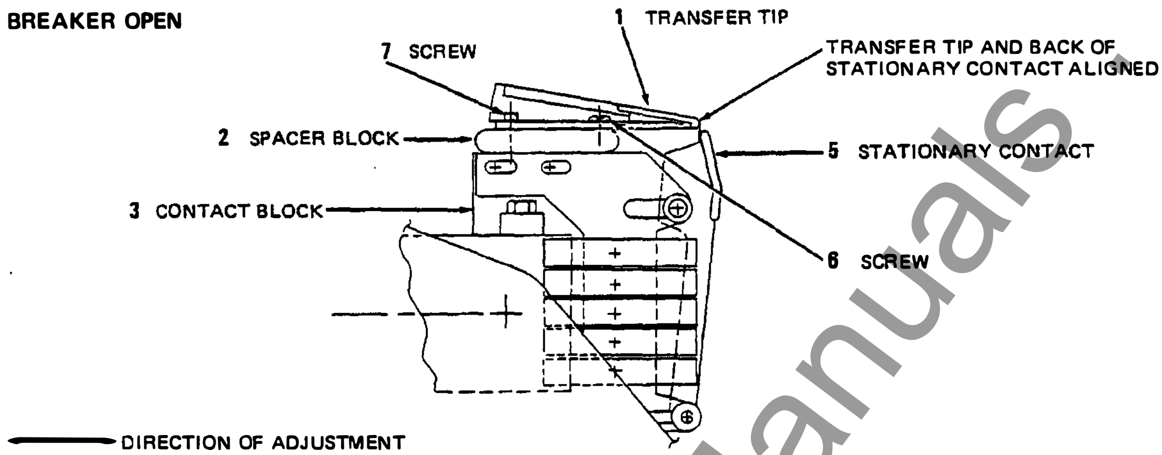


Figure 11E.

dimensions "C" (totalized) within tolerance. Repeat on each phase if necessary. After reaching correct engagement, make certain that checknut (10) and locknut (12) are tightened securely.

PROCEDURE B Contact Lead

1. Each movable contact structure is to be checked separately for contact lead. Remove pin (23, Figure 11A) from each of three phases. This frees the individual phases for independent checks and adjustment. Raise each phases movable contact until the arcing contact just touches. Refer to Figure 11A and measure.

1.1 Shortest gap between main and stationary contacts, dimension "b". This measurement should be 0.375 to .281 inches (9.5-7.1 mm).

1.2 Shortest gap between tertiary contacts, dimension "a". This measurement should be 0.156 to .125 inches (4.0-3.2 mm).

2. If dimensions "a" and "b" are incorrect, remove one roll pin from each plate (10) and loosen eight screws (22, Figure 11C). Insert a spacer as thick as dimension "a" between the tertiary contacts, and apply a C-clamp bearing on rear of block (8, Figure 11C) and front movable contact (3, Figure 11B). Adjust clamp to dimension "b". With contacts held in this position move two plates (10, Figure 11C) 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, clamp and reconnect contact link (47, Figure 11A).

NOTE

Do not attempt to obtain simultaneous touch of arcing contacts on all 3 phases as it is not required.

TRANSFER TIP ADJUSTMENT

Transfer tip adjustment (Figures 11D and 11E) is required if any of the following is performed.

a. Transfer tip (1) is disturbed or removed (replaced) from its present position on spacer block (2).

b. Contact penetration is adjusted.

c. Movable contact (4) is replaced.

Transfer tip adjustment is necessary to prevent the tip of movable contact (4) from hitting the transfer tip (1) when closing the breaker if there is interference:

1. With the breaker open, loosen screws (6 and 7) and slide the transfer tip (1) along its slotted holes all the way to the back away from the stationary contact (5).

2. Close the breaker.

3. Move the transfer tip (1) forward towards the movable contact (4, Figure 11D). If the tip of the movable contact (4) is above the bottom line of the transfer tip (with interference), adjust the transfer tip (1) so that there is 1/8 inch (3.2 mm) clearance between transfer tip (1) and tip of movable contact (4).

4. If the tip of the movable contact (4) is below the bottom line of the transfer tip (1) (no interference), open the breaker and adjust transfer tip (1) so that it is just behind the stationary contact (5, Figure 11E). Tighten screws (6 and 7).

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 (Figure 5) 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 breaker release (12, Figure 2) operates the interlock plunger (18, Figure 2) 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 (42.9-46.0 mm) above the floor line, and causes tripping of breaker contacts when it is raised to a level not more than 1-1/16 inch (52.4 mm) above the floor line. The latch tripping rod associated with the foot lever should be clear of the trip latch by 1/32 to 1/16 inch (0.8-1.6 mm) in the relaxed position (18, Figure 3).

The foot lever can be 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 (50.8-57.2 mm) from the floor line and will hold the breaker in any of the three positions within the cubicle.

TRIP LATCH ADJUSTMENTS

Trip Latch Clearance Adjustment (Figure 13) — is to be performed after completing the arcing contact touch and main contact penetration adjustments referenced above.

This adjustment is necessary to insure proper clearance between the trip latch and trip latch rollers. The puffer (or snubber) height adjustment will accomplish this purpose, and in no way will affect the penetration adjustment.

Adjust shock absorber (11, Figure 2) height to rotate radius arm and four bar linkage until a .030" to .060" (0.76-1.52 mm) gap appears between the latch and latch roller. Lock in place. Each shock absorber must be adjusted equally.

If the .030" to .060" (0.76-1.52 mm) gap can not be obtained, loosen lower link stop (36, Figure 13) and rotate to permit maximum lower trip link movement. Adjust shock absorbers as described above and lock in place. Rotate lower link stop until it touches lower link and lock in place.

PUFFER STROKE ADJUSTMENT

After completing trip latch clearance adjustment, adjust puffer linkage (Figure 12) to provide 1/8 inch (3.2 mm) clearance from the extreme end of stroke of the disk diaphragm (that is, bellows solidly compressed) to prevent disk from bottoming against manifold.

Clevis pin connecting the crank and puffer linkage is not installed during the adjustment of the disk diaphragm. After the 1/8 inch (3.2 mm) clearance is achieved by holding the disk diaphragm from the manifold, puffer linkage is adjusted to match the hole of the crank and then the clevis pin is installed.

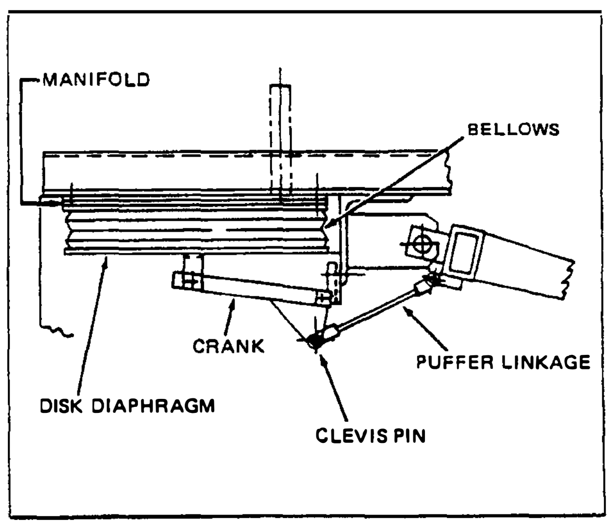


Figure 12. Puffer Adjustment Breaker — Open

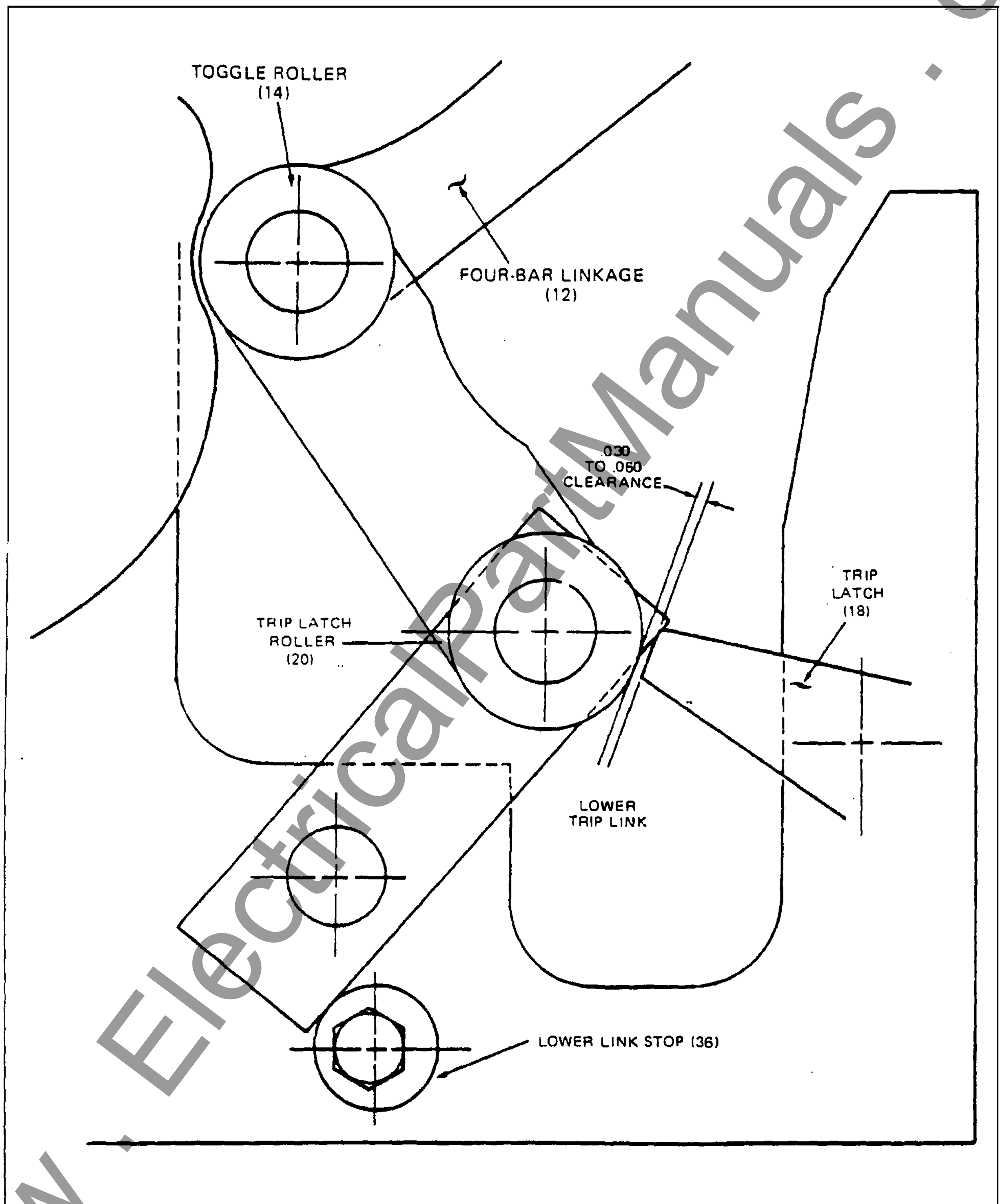


Figure 13. Trip Latch Clearance Adjustment

Trip Latch Bite Adjustment — trip latch bite is established by setting the latch tail top surface 5/16" (7.9 mm) below surface of self clinching nut as shown in Figure 14-(A). Lock securely with jam nut. One turn of adjusting screw will alter the gap 0.062 inches (1.57 mm). This adjustment will produce a latch bite of approximately 1/8" to 1/4" (3.2-6.4 mm) as shown in Figure 14-(C).

TRIP LATCH CHECK SENSOR ADJUSTMENTS [FIGURES 14(B) AND 14(D)]

This adjustment is to be completed only after establishing the "bite" adjustment described above.

The magnetically operated Hall effect switch (sensor) and actuating magnet are to be preassembled to the operator. The unit can be adjusted by advancing the threaded bushing through the tapped hole in shaft until a gap of .040 to .000 + .015 inches (1.02-.00/+.38 mm) is achieved between the surface of the switch and the top of the shrink tubing holding the magnet actuator assembly to the trip latch. With this gap achieved, the sensor may be locked in place.

Functional electrical test on breaker may be made to confirm sensors operation. The timing modules nameplate and rated voltage should be checked to insure it matches breaker closing control voltage. The timer's delay adjust-

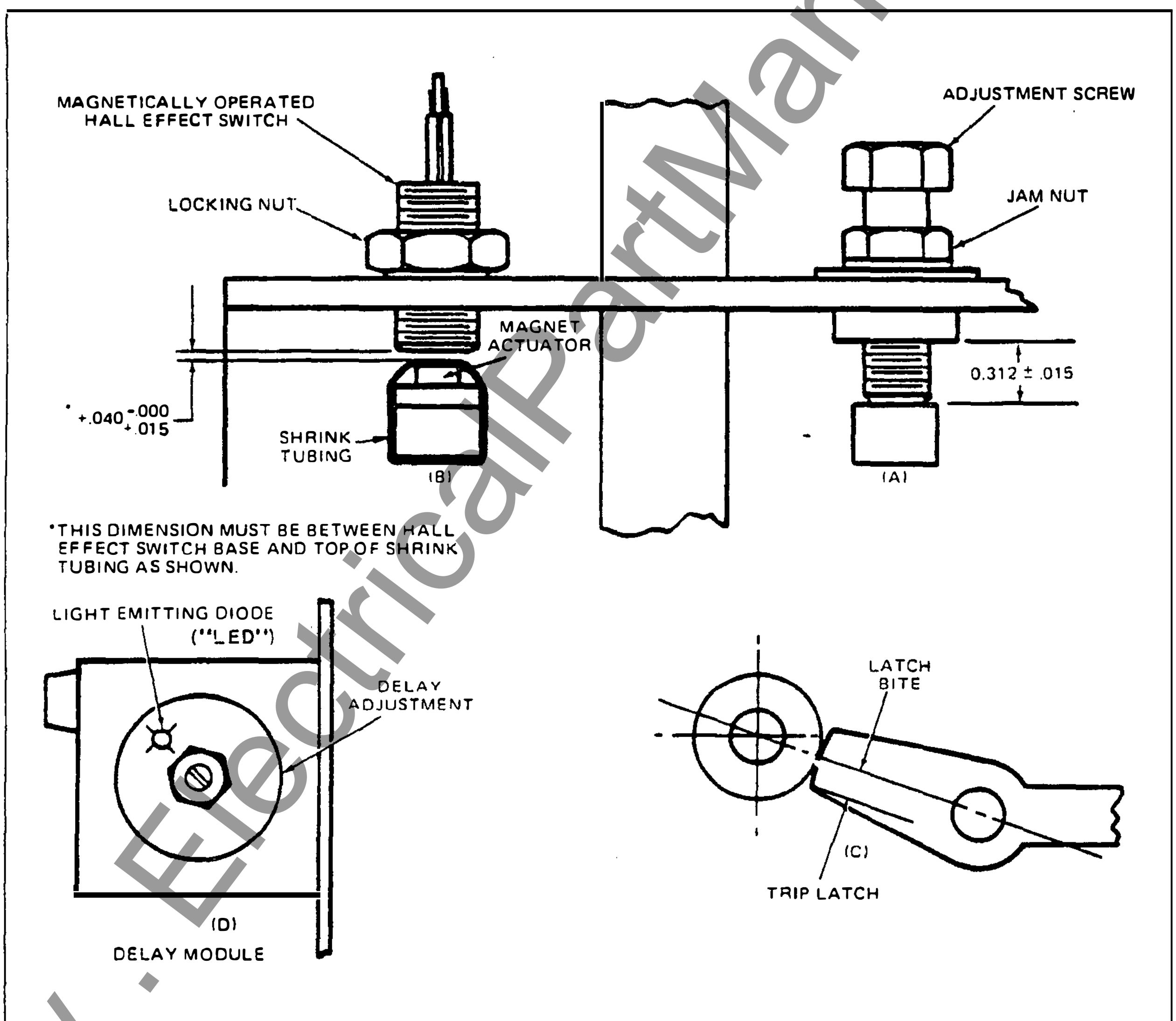


Figure 14. Trip Latch Bite and Check Switch Adjustments

ment has been previously set and **should not be altered.** Remove wire from terminal 2 on timer module and insulate. Open breaker and charge opening springs.

Apply closing voltage and observe light emitting diode (LED) adjacent to delay adjustment. The "LED" should be brightly illuminated when the trip latch is fully reset. Depress latch with manual trip lever and observe the "LED" goes out. Release trip lever and the "LED" should come on. This sequence confirms sensors operation. Do not apply closing control voltage for longer than two minutes while performing this test.

MANUAL CHARGING OF CLOSING SPRINGS

To charge the closing springs manually, disconnect control power before inserting the manual spring charging crank in the socket located in the center of the left hand operator panel. Turn the crank in a counter-clockwise direction to charge the springs. The effort to charge the closing springs will fluctuate and will increase to a peak and then decrease. At the point of least effort an audible click will be heard and the effort to turn the crank will drop to near zero. The mechanism is now fully charged. Remove manual charging crank. The breaker may be closed by pulling the manual close pull rod.

> **CAUTION**
>
> **MAINTAIN A FIRM GRIP ON CRANK. The closing springs are charged through the driving pawl and ratchet wheel and are thereby indexed by the holding pawl. Some springback can occur between tooth positions on the ratchet wheel.**

MAINTENANCE SLOW CLOSE

With the breaker removed from the cubicle, manually charge the closing springs as previously described and remove charging handle. Then, from the rear or stud side of the breaker, attach the spring blocking device (Figure 15), by fastening it in the slots in the closing spring tubes. Insert the spring blocking device into operator area before setting up arc chute support.

Stay clear of the breaker contacts and pull the manual close pull rod at the front of the breaker. This will discharge the closing springs against the spring blocking device during which the breaker contacts will move slightly toward the closed position.

Place the manual spring charging crank back in the socket. By turning the crank counterclockwise, the breaker contacts may be slowly closed for checking contact alignment.

> **CAUTION**
>
> **MAINTAIN A FIRM GRIP ON CRANK. As the contacts will close in increments determined by the teeth on the ratchet wheel, springback will occur between tooth positions.**

REMOVAL OF SPRING BLOCKING DEVICE

To remove the closing spring blocking device (Figure 15), the closing spring must be fully charged. The spring may be charged manually by inserting the charging crank and continuing counterclockwise rotation. The main contacts will go fully closed as the four bar linkage toggles. Upon continued rotation, the closing springs will be picked-up as noted by increased effort in cranking. Continue rotation until the springs are fully charged. A sharp click will be heard as the spring release rollers engage the close latch indicating full spring charge has been achieved. The spring blocking device may now be easily removed by pulling the blocking portion from the slots in the spring tubes.

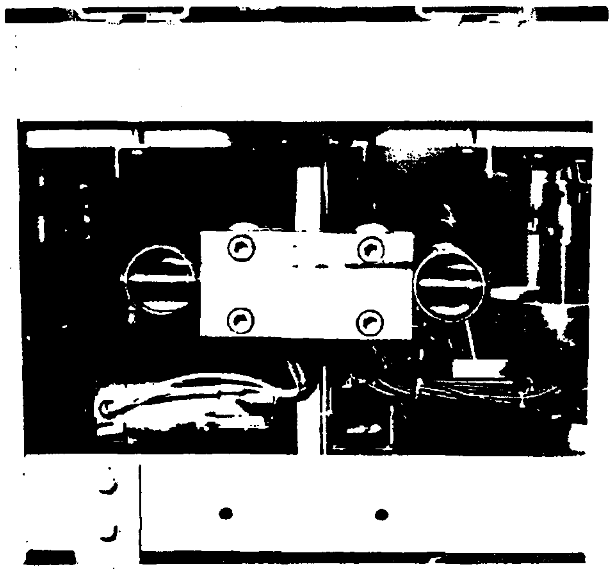
REMOVAL OF CLOSING SPRINGS (SPRINGS MUST BE DISCHARGED)

The closing springs may be quickly and safely removed from the breaker. Remove two of the four bolts holding the spring beating block at the rear of the breaker. These bolts should be diagonally opposite each other. Insert studs approximately 6" (150 mm) long in place of bolts. Remove the remaining two bolts by shifting the spring load to the 6" (150 mm) long studs. The spring bearing block can then be backed off by alternating backing off the studs. To install the closing springs the reverse procedure should be used. The spring bearing block top surface should be even with the bracket of the frame. The four bolts should be torqued to 50 ft. lbs. (67.8 N-m).

If the charging ratchet and cams are to be revolved with springs removed, it is advisable to remove the two aluminum spring drive blocks (Item 38, Figure 8) secured to the ratchet and cam crankpins by retaining rings. These pins if not rem ved or held essentially in a horizontal position may jam while revolving the cam and ratchet assembly.

Motor Cutoff Switch — The 88 motor cutoff switch assembly (Figure 16) is factory adjusted. If it should become inoperative, entire unit must be removed and inspected for contact wear. Replacement may be necessary.

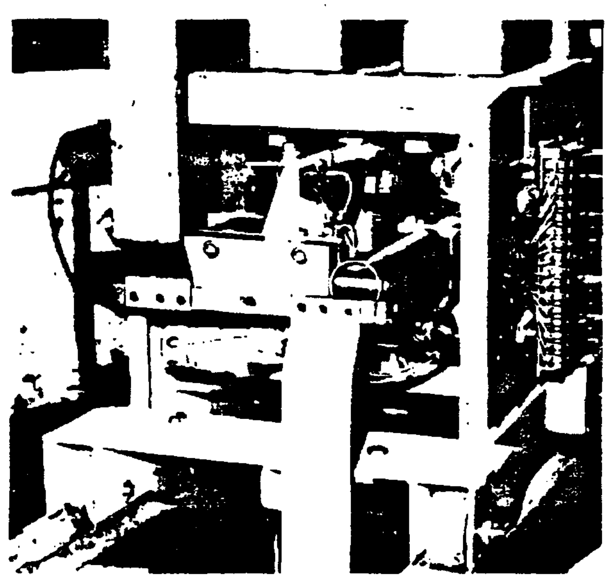
Motor Cutoff Switch Adjustment — is most conveniently performed before installing the charging springs.



BREAKER CHARGED AND READY TO RECEIVE SPRING BLOCKING DEVICE.

SPRING BLOCKING DEVICE IN CORRECT POSITION FOR INSERTION

INSERTION OF THE SPRING BLOCKING DEVICE. NOTE: SPRING BLOCKING DEVICE MUST BE DIAGONALLY INSERTED TO CLEAR BREAKER FRAME.



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SPRING BLOCKING DEVICE IN PLACE READY FOR CLOSING SPRING RELEASE.

Figure 15. Maintenance Close Spring Blocking Device Insertion

Advance ratchet and cam assemblies to position shown (Figure 16). The holding pawl must rest behind the ninth (9) tooth position on the ratchet as counted counterclockwise from area on ratchet periphery which lacks two teeth.

With ratchet in the position described above, adjust the motor cutoff switch vertically until its actuator makes positive contact with the rollpin striker. Lock switch assembly in this position.

Check lateral movement of actuator. Lateral play at end of actuator (tip) should be no more than 1/16" (1.6 mm) maximum. If adjustment is necessary, snug pivot screw to just bind actuator, and then back off 1/16 to 1/8 turn. Rotate ratchet and cam assembly to insure actuator rides in gap between ratchet and cam without striking or binding.

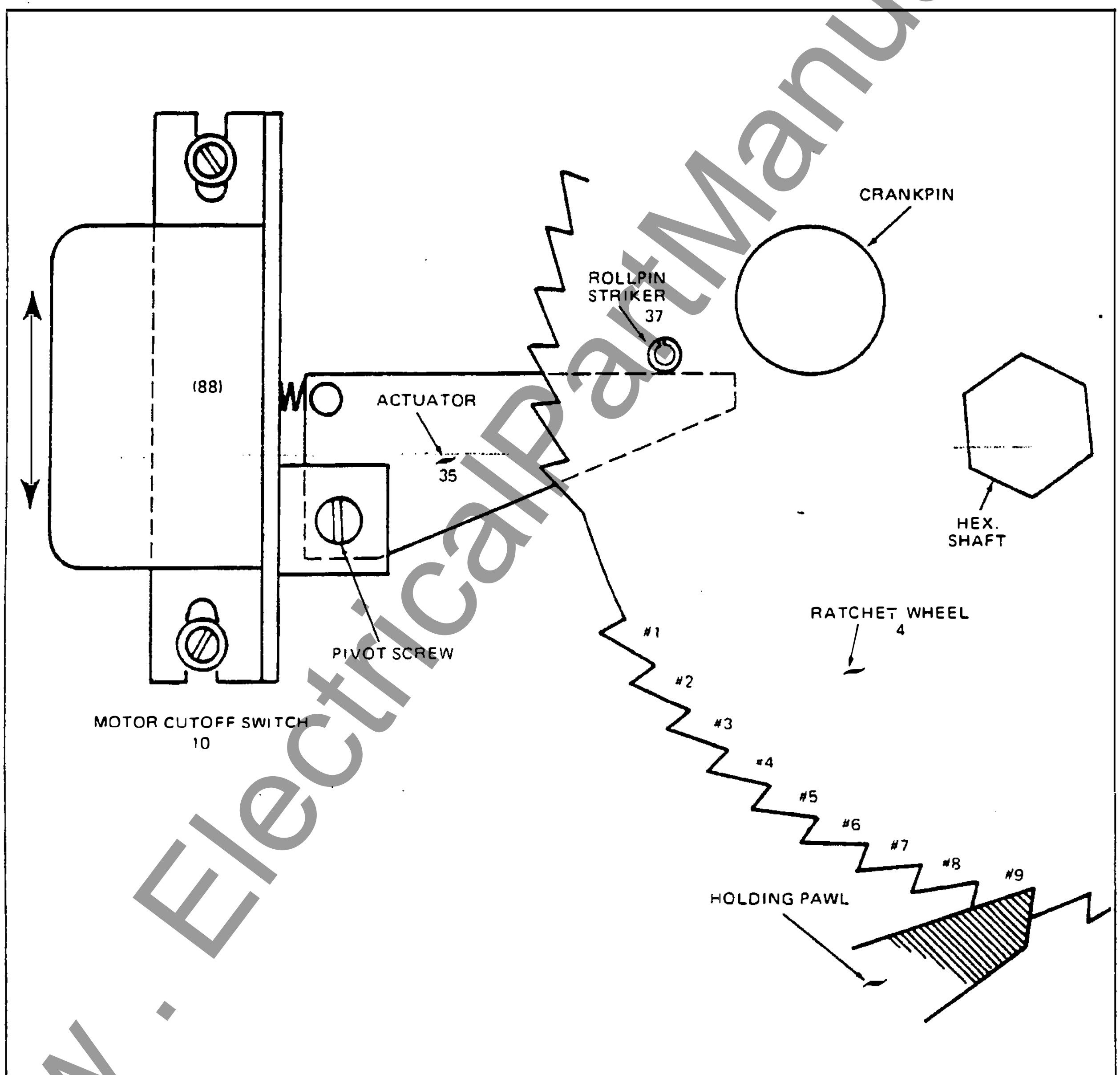

Figure 16. Motor Cutoff Switch

Close Latch Bite Adjustment — free jam nut and place latch in horizontal position (Figure 18). Visual accuracy. Measure "D" directly above latch pivot. Reproduce this dimension plus 0.062" (1.6 mm) at the latch face as shown in the figure above by rotating the adjustment screw. Secure jam nut. This adjustment should produce a latch bite of 0.151 to 0.216 inches (3.8-5.5 mm).

Close Latch Check Switch Adjustment (Figure 18) — is to be performed only after completing the latch bite adjustment described above.

A clearly audible "click" should be heard from the switch with latch spaced 1/32" (0.8 mm) from latch adjustment screw. The latch switch actuator may be bent slightly to obtain switch operation at this point. Maximum permissible bend is 1/8" (3.2 mm) as shown.

If switch actuator is bent, observe latch fully closed against adjusting screw and make certain the switch actuator has not contacted the switch body. A 1/64" (0.4 mm) clearance should exist as shown in Figure 18.

Free Height Adjustment (Figure 19) — is achieved by blocking the actuating roller to the indicated height and adjusting a pair of jam nuts, located on the manual closing pull rod, to maintain the roller in this position with blocking removed. Return spring adjusting nut should be set to produce 0.5 ± .06 inch (12.7 ± 1.6 mm) deflection in return spring.

The following adjustments are to be made only after completing the close latch bite adjustment described on the previous page and after adjusting connecting link as shown on Figure 18.

Trip Adjustment (Figure 19) is made by varying the penetration of the "curved actuating rod" in its attachment clevis. A 5/16" (7.94 mm) drill is placed between the upper latch surface and the latch adjusting bolt. A 2.906" (73.81 mm) block is to be inserted between the actuating roller and floor. The "curved" rods upper yoke is nested against a forward roll pin in the closing latch and the lower clevis is adjusted to insure the closing latch will not move more than 1/16 inches (1.6 mm) as measured between adjusting screw and latch surface when the 5/16" (7.94 mm) drill is removed.

Overtravel (Figure 19) — no adjustment required. Check with 3.125" (79.4 mm) blocking below actuating roller. Closing solenoid link should provide freedom of latch movement without jamming.

Close Latch Mechanical Interlock Adjustment (Figure 20) — is to be undertaken only after completing the close latch bite adjustment described above (Figure 18).

Adjust actuator rod displacement from support angle to 1.06 ± .015 inches (27.0 ± 0.4 mm). See detail of adjusting nut "A" (Figure 20).

Insert a 1/4" (6.35 mm) drill between upper surface of close latch and latch adjustment screw.

Check guide bushings to insure they stand off the frame 1/4" (6.4 mm) as shown.

Free Nut "B" below attachment clevis, and adjust Nuts "B" and "C" to depress pawl return spring and pawl until 1/16 to 3/32 inch (1.6-2.4 mm) clearance is obtained between tip of pawl and ratchet teeth. This clearance is measured during the clockwise rotation of the pawl as its tip is toward the ratchet (power stroke).

The pawl must be rotated using a 1/2" (12.7 mm) square insert in the eccentric drive shaft or by low voltage (slow rotation) of drive motor or manual charging.

Return the jam nut "C" attachment clevis to bottom on bracket, and tighten external jam nut "B" securely. MAINTAIN CLEVIS PARALLEL TO FRAME.

Remove 1/4" (6.35 mm) drill, restoring latch to its normal position. Again rotate eccentric drive shaft. The tip of the drive pawl should engage the full face of each ratchet tooth with a clearance of .030" (0.8 mm) between the base of the tooth and the engaged tip of the drive pawl.

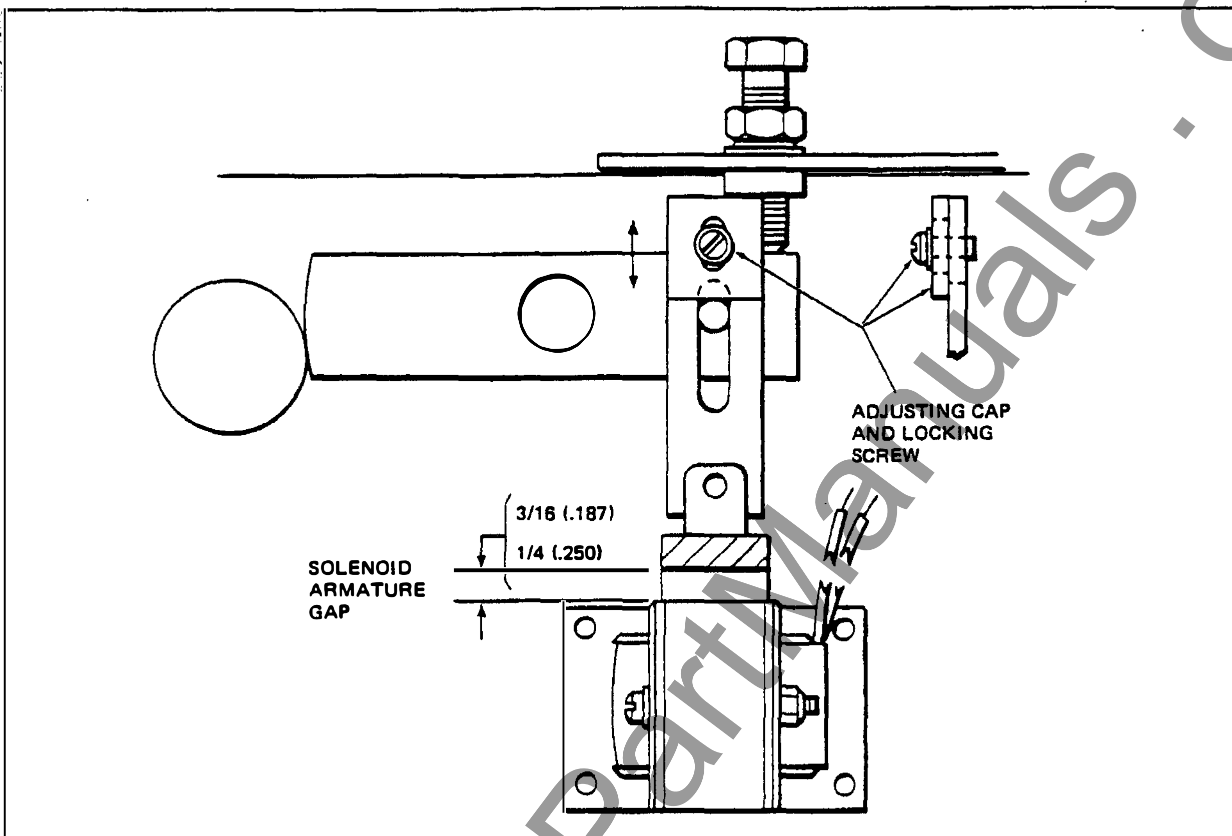

Figure 17. Spring Release Solenoid Armature Cap Adjustment

This adjustment is to be performed only after completing the spring release latch bite adjustment.

The purpose of this adjustment is to establish an armature gap of 3/16 (.187) to 1/4 (.250) inches. A suitable feeler gage of optimum thickness, 7/32 (.218), should be inserted in the armature gap. That is, the space between the ground surfaces of the solenoid frame and ground "T" shaped extensions of the solenoid plunger.

The connecting link between the solenoid plunger and spring release latch should be adjusted to maintain the plunger in this position. The locking screw is released and the adjusting cap shifted until the effective length of the link supports the plunger within the indicated range.

MAINTENANCE AND TESTING

GENERAL

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.

ALWAYS INSPECT A BREAKER WHICH HAS INTERRUPTED HEAVY FAULT CURRENT. All contacts, arc runners, transfer stacks and arc chutes should be examined to determine if repair or replacement of parts is required. Inspect for pieces of barrier stack and transfer material in the cubicle as well as the circuit breaker.

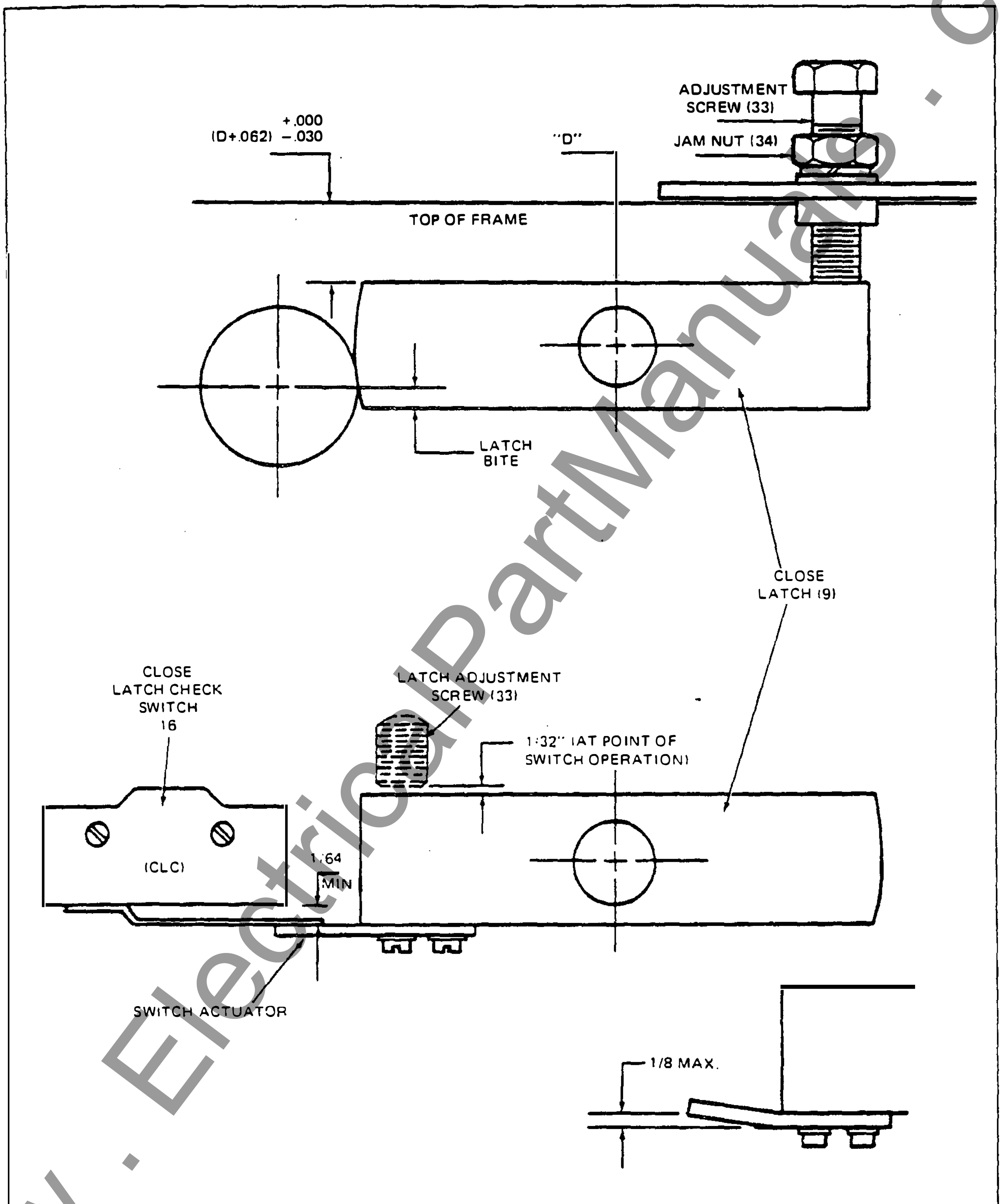

Figure 18. Close Latch Bite and Check Switch Adjustments

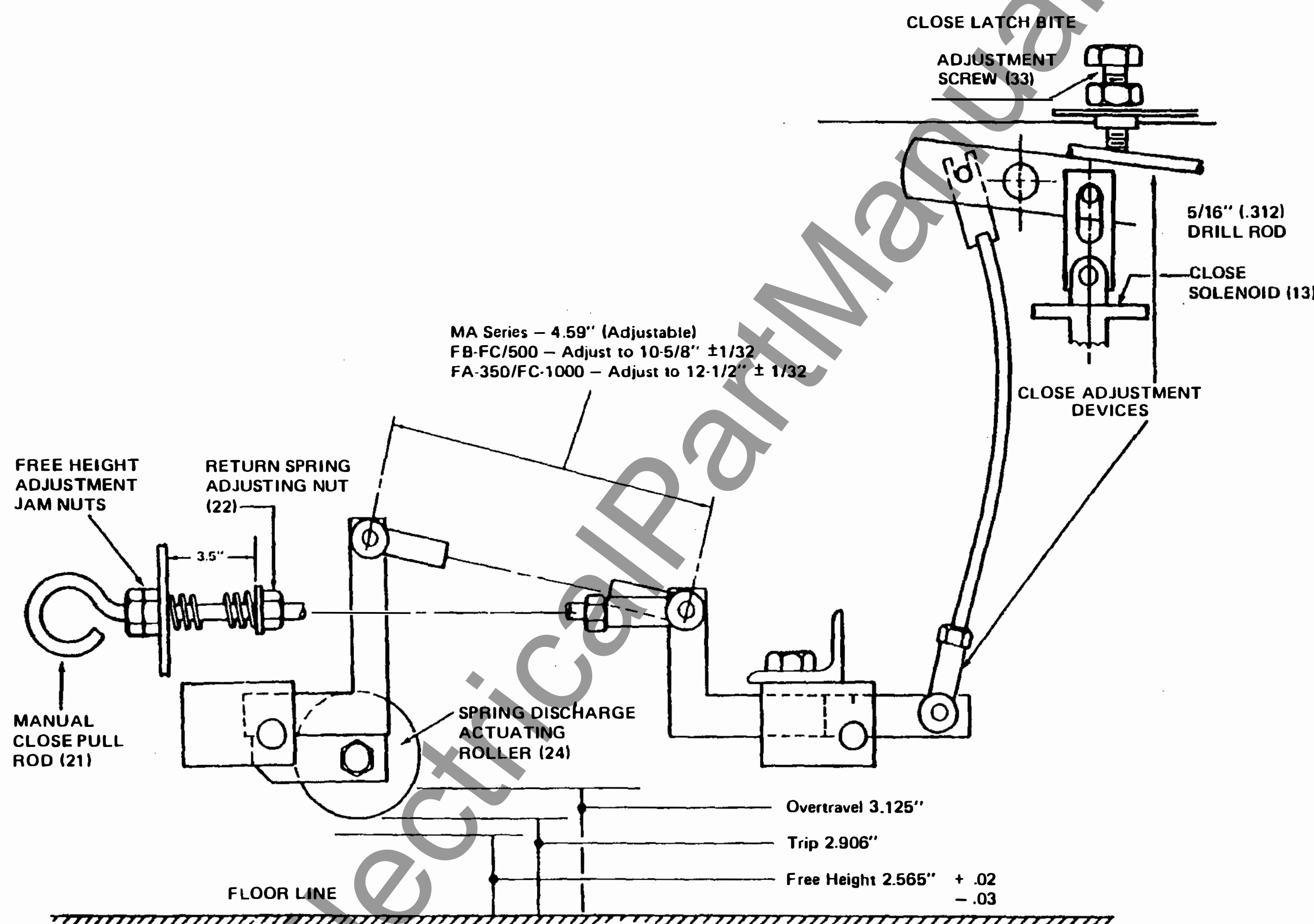

Figure 19. Closing Spring Discharge Mechanism

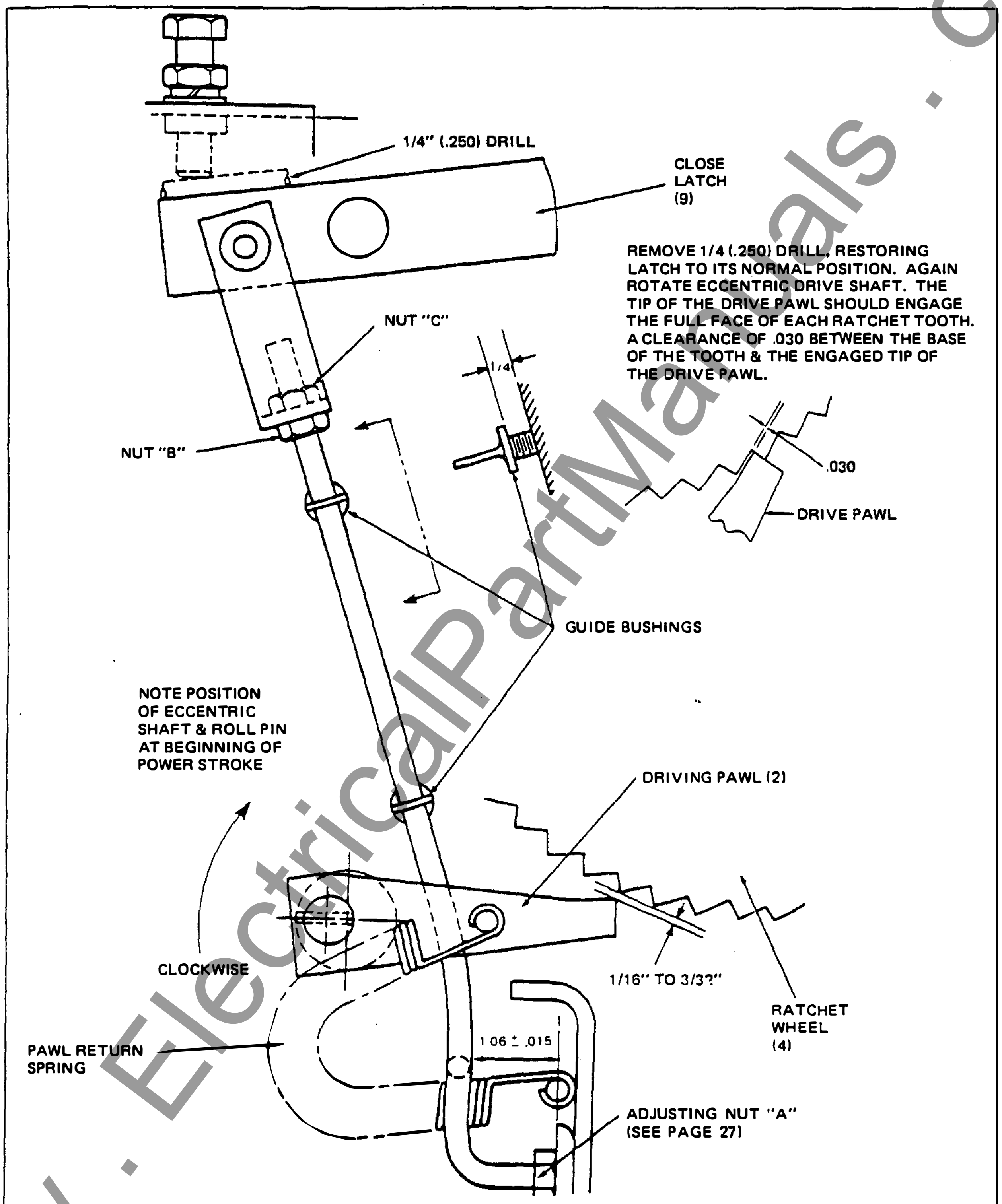

Figure 20. Close Latch Mechanical Interlock

"AS FOUND" TESTS

Some users perform "As Found" insulation tests using a megger or "Doble" testing to give an "As Found" value for future comparative indication of insulation change. This is desirable for new circuit breakers if they are to be stored for extended periods, and may absorb moisture and contaminants. Contact resistance tests can also be made using a "Ductor."

Since wide variations can occur in insulation values and contact resistance because of atmospheric conditions, contamination and test equipment, discrete values cannot be given. However, making and recording these tests on new equipment, and at regular intervals will give a comparative indication of insulation and/or contact resistance change. Maintaining a permanent record of these values for each circuit breaker should be part of the Maintenance Program.

PERIODIC INSPECTION AND MAINTENANCE

Prior to performing any maintenance work, make certain all control circuits are open, and that the breaker has been completely withdrawn from the metal-clad unit.

CAUTION

Do not work on the breaker or operating mechanism while the breaker is in the closed position. Do not work on the breaker or operator while the closing springs are charged.

1. Remove interphase barriers (refer to page 15, Phase Barrier Assembly) and clean them and all other insulating surfaces with dry compressed air — a vacuum cleaner, or clean lint free rags. Inspect for signs of corona, tracking or thermal damage.

2. Tilt the arc chutes to expose the main contacts (refer to page 17 and Figure 2A, Tilting Arc Chutes).

3. Contacts

Examine the contacts (Figure 11). The major function of the air circuit breaker depends upon correct operation of its contacts. This circuit breaker has three contacts on each pole; mains, tertiary and arcing. When closed, practically the entire load current passes through the main contacts. If the resistance of these contacts becomes high, they will overheat. Increased contact resistance can be caused by pitted contact surfaces, corrosion of contact surfaces, or weakened contact spring pressure. This will cause excessive current to be diverted through the arcing contacts, with consequent overheating and burning. Verify proper main contact pressure by checking penetration (refer to page 20, Procedure B).

Tertiary contacts act intermediately between main and arcing contacts upon contact separation. They assist current transfer from the mains to arcing contacts.

On the magnetic blowout air circuit breaker, the arc is quickly removed from the arcing contacts by magnetic forces and transferred to arc runners in the arc chute (Figure 6). The arcing contacts are expendable and may eventually burn enough to require replacement.

The main and arcing contacts are made of tungsten alloy to resist deterioration due to arcing. If the surfaces are only roughened or slightly pitted, they can be smoothed with crocus cloth or draw filed. Be careful not to remove much material, as this would shorten the contact life. If significant erosion has occurred, the arcing contact lead must be checked and adjusted.

If they are badly pitted or burned, they should be replaced (refer to page 17).

The main contacts may be lubricated per Figure 21, but **DO NOT LUBRICATE THE ARCING CONTACTS.**

4. Transfer Tips:

The transfer tips (Item 1, Figure 11D) serve as runners for the arc to transfer from the stationary contacts (5). Accumulated dirt or carbon should be wiped off with crocus cloth or lint free rags. The tungsten tip, which resists erosion from the arc, should be replaced if brazed joints are badly burned or the base plate and extension piece are distorted. Adjustment procedure on page 20 should be followed when replacing the transfer tips.

5. Disconnect Arm Hinge Joint

Contact pressure of the disconnect arm hinge joint is established by spring pressure, and does not require adjustment. Hinge contacts may be inspected and maintained as follows (refer to Figure 11B).

Remove disconnect arms as a unit by removing cotter pin (19), 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 applying Siemens-Allis electrical contact lubricant, 15-171-370-002 sparingly. Reassemble hinge joint. Tighten screw (5) and nut (10) so that cotter pin (19) can be reinstalled. 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.

6. Arc Chutes and Transfer Stacks

Inspect the arc chutes and transfer stacks. This includes inspection of the ceramic parts (barrier stack, transfer stack and flash plates) for breakage, erosion and dirt; inspection of the blowout coil insulation; and of the entire arc chute for dirt, moisture or contaminates which might affect insulation strength.

Dirt or contaminates may be removed from the barrier stack and transfer stack with a cloth, by light sanding or by scraping with the end of a file. Wire brushing or emery cloth is not approved because metallic particles may become embedded in the insulating material.

Arc flash plates in the lower portion of the arc chute may be cleaned by sand blasting or by sanding with coarse grain paper, to remove glaze and metal deposits from the surface.

Blow out particles with dry compressed air.

Small cracks or pieces chipped or broken from ceramic parts may be ignored. A barrier stack split vertically along a rope seam may be repaired with epoxy cement. A barrier stack split horizontally or one with several broken plates should be replaced. A transfer stack split vertically or horizontally or one with several broken plates should be replaced.

The action of the arc on ceramic causes slight melting. Small milky glass nodules on the edges and surfaces of the ceramic barrier stack and transfer stack plates are normal after interruption. With severity and number of operations, this melting and glazing increases. When ceramic plates are heavily glazed (milky white along the edges of the V slots) the barrier stacks or transfer stacks should be replaced.

Sideplate supports of transfer stacks should be rigidly fastened in place.

7. Mechanism — Stored Energy Operator

The circuit breaker mechanism should be inspected at 1000 operation intervals. This inspection should check for loose hardware and any broken parts. The control wiring should be checked for loose connections and frayed or damaged insulation. The "close latch check switch", "trip latch check system" (if furnished), and "mechanical interlock" switch should be checked for mounting tightness. The satisfactory operation of each switch element should be assured with a continuity meter and manual manipulation of the switching element, and adjusted if necessary. Verify that operation of "Close Latch Mechanical Interlock" is proper (refer to page 31 and Figure 20).

After 5000 operations, the operating mechanism should be given a general overhaul and all worn parts replaced. Excessive wear will usually be indicated when adjustments can no longer be satisfactorily made. The general overhaul will require disassembly of the operating mechanism. All bearings and surfaces receiving wear should be examined carefully and re-lubricated in accordance with lubrication instructions which follow.

The removal of the closing springs will be necessary in order to permit overhaul of the breaker. These springs may be removed as described on page 24).

8. Lubrication

NOTE

The Siemens-Allis electrical contact lubricant supplied with the accessories is intended to be used exclusively on the contacts and must not be used on any part of the circuit breaker mechanism.

Recommended circuit breaker lubrication points are shown in Figures 21 and 22. The chart (Figure 23) outlines two methods of lubrication. Refer to this chart for recommended lubricant and points of application. The first method requires no disassembly and is suggested for the prevention of problems which could be created by severe environmental or operating conditions. The second method follows procedures similar to those performed on the breaker at the factory. Follow this procedure only in case of a general overhaul or disassembly.

Needle and roller bearings are factory lubricated for life and should not require attention. However, the best of greases are affected by time and atmospheric conditions and may require service.

To lubricate these bearings when parts are disassembled, the following procedure is recommended. Clean in solvent, wash in alcohol, spin in light machine oil, drain and repack with Beacon P-325 grease. **DO NOT REMOVE NEEDLE BEARINGS FROM THE RETAINING PART.**

9. Air Puffers

Air puffers (10, Figure 2) are important to the interruption process because they provide a flow of air which assists in controlling the shape of the arc column at low

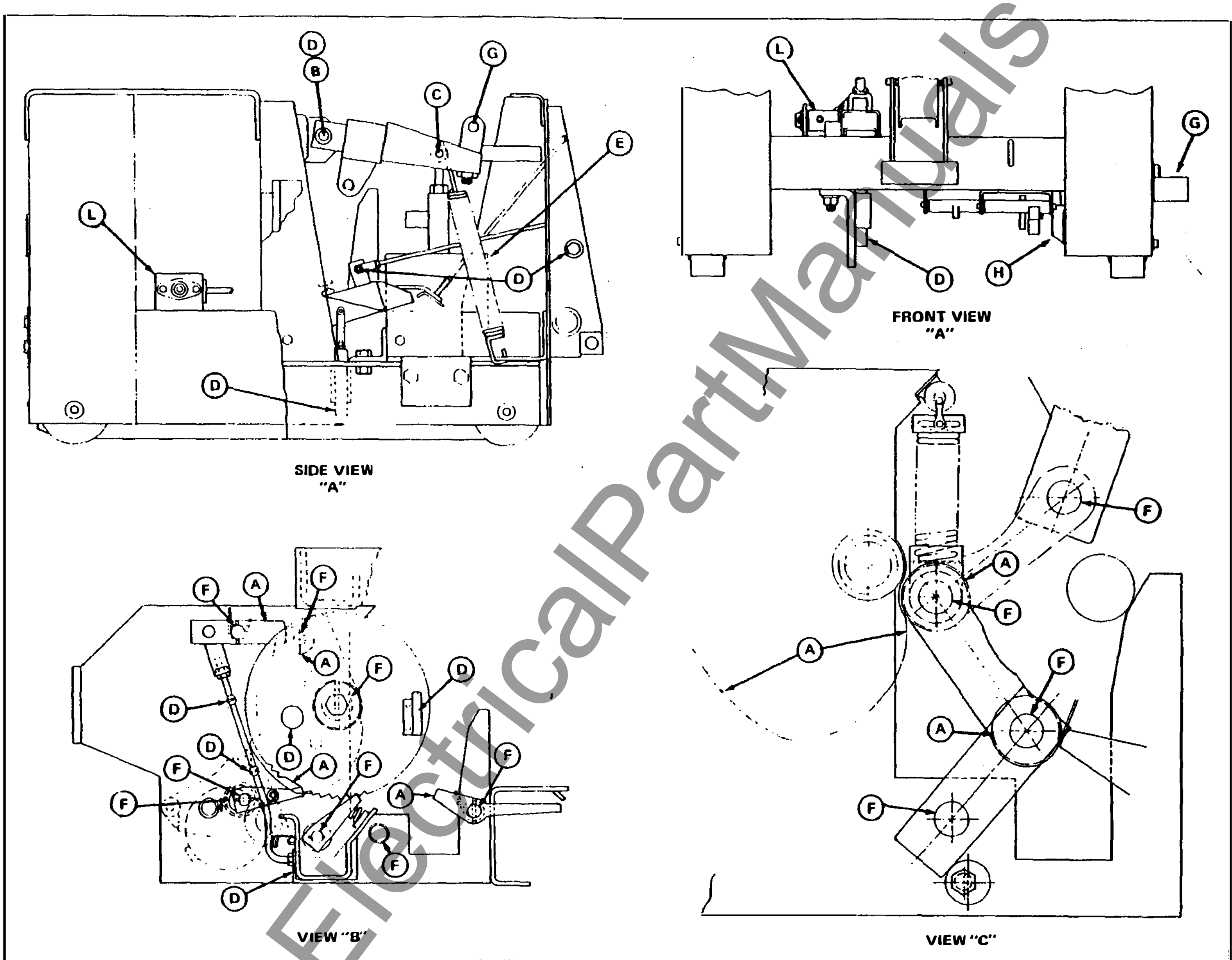

Figure 21. Lubrication Points on Frame and Operator (View A) Drive Assembly (View B) and Linkage Assembly (View C)

current values. This control causes the arc to make an earlier transfer to the arc runners, thereby energizing the magnetic circuit which drives the arc into the barrier stack. This action produces a shorter arcing time than would be possible by relying only on the thermal effects of the arc to achieve the transfer to the arc runners.

The puffers are located within the breaker frame directly below the stud and support assembly. The system employs two bellows whose volume is swept by linkage driven platens during the breakers opening operation. Pressurized air is distributed by a manifold and individual nozzles to each breaker pole.

The air puffer system should be inspected during regular maintenance periods. Hoses and nozzles should be checked for tight connections, flexibility and freedom from kinking or collapse. The platen and its linkage should be checked for freedom of movement and wear. The bellows should be inspected for holes or obvious leakage.

The air output from the puffer nozzle may be checked with the arc chutes tilted (refer to "Tilting Arc Chutes", page 17 and Figure 2A). Crush a 4-1/2 x 4-1/2 inch (115 x 115 mm) sheet of tissue paper, place it in the nozzle opening and check to see that it is dislodged when the breaker is opened.

10. Shock Absorbers

Shock absorbers (10, Figure 2) arrest and cushion the opening motion of the radius arm and movable disconnect blades. The dashpots are comprised of connecting rod, piston, seals and cylinder.

The shock absorber should be inspected at regular maintenance periods. Cylinders should be checked for cleanliness and freedom from deposits which might retard motion. The piston should be checked for free movement within the cylinder. Seals are to be flexible and contact

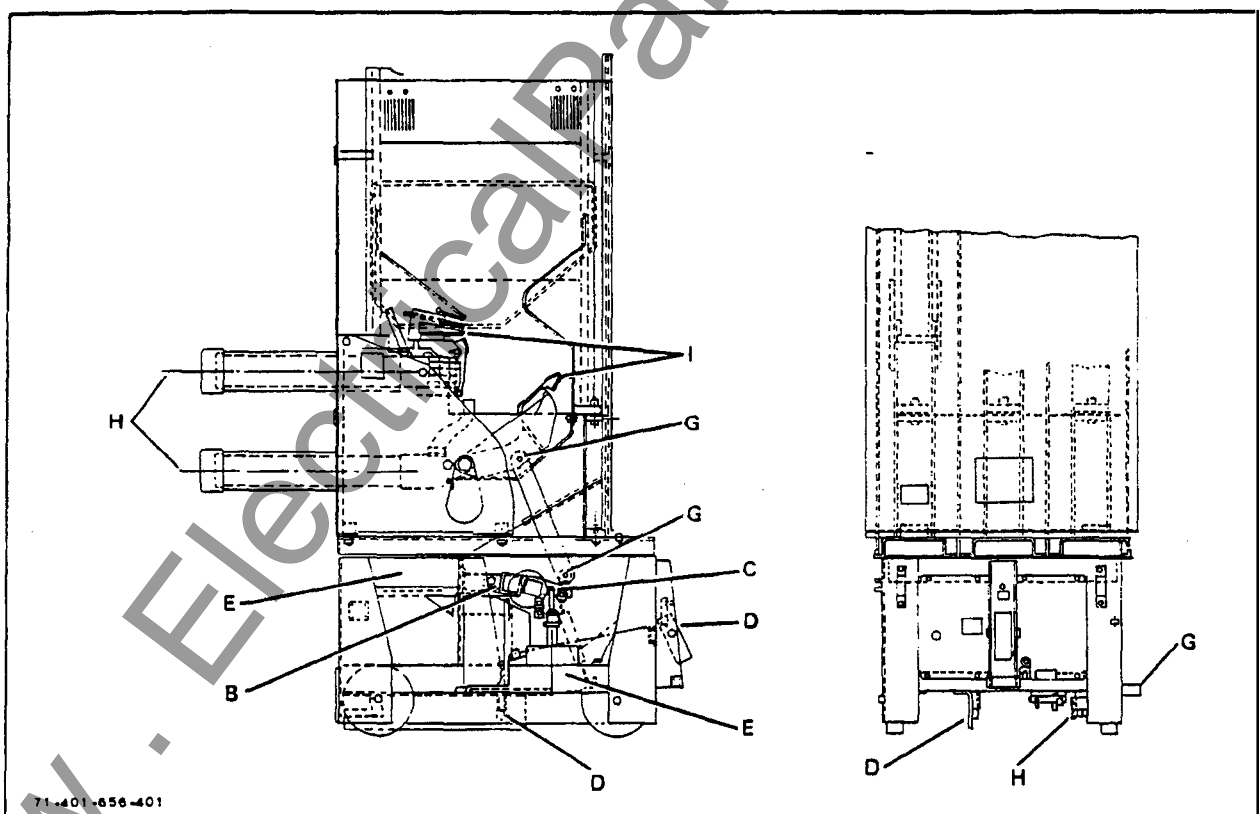

Figure 22. Lubrication Point on Breaker

the cylinder walls. Transformer oil is used on felt seals to keep the material pliable, reduce shrinkage and provide lubrication. The oil should moisten but not saturate the felt. Seal material must be replaced if it becomes inflexible or does not make contact with the cylinder walls.

11. Inspect for foreign objects which may have been left in the circuit breaker during previous steps. Check for loose hardware.

12. Check for mechanical freedom of disconnect arm movements by slowly closing the breaker. Reference page 24 for "Maintenance Slow Close" Procedure.

13. Trip breaker by depressing trip rod (Figure 2, Item 15).

14. Return arc chutes to upright position, **fasten both front and rear blowout coil connections** and replace phase barriers. Be sure screws on all phases are tightened securely.

15. "As Left" Tests

a. Insulation resistance tests should be made to verify the insulation integrity. These can include megger or Dobel tests. If possible, a high-potential test should be made for one minute at 27,000 volts ac or 38,200 volts dc. With the breaker open, check each phase across the open contacts by connecting from the upper to the lower primary disconnects. With the circuit breaker closed, check phase-to-phase and each phase-to-ground.

b. A dielectric test on secondary and control units should be made at 1200 volts.

c. If desired, contact resistance tests can be made using a Ductor.

d. Make a permanent record of all tests performed.

e. Compare with prior tests (see "As Found" Tests on page 31).

16. Inspect the primary disconnect contact finger assemblies (9, Figure 2).

The main contact surfaces should be clean and bright. However, discoloration of the silvered surfaces is not usually harmful unless caused by sulfide (insulating) deposits. These should be removed with alcohol or a silver cleaner. Slight impressions on the contacts will be caused by the pressure and wiping action of the contacts. Minor burrs or pitting can be allowed and projecting burrs may be removed by dressing. Nothing more abrasive than crocus cloth should be used on the silvered contact surfaces. Where serious overheating is indicated by discoloration of metal and surrounding insulation, the contacts and spring assemblies should be replaced. In this case, also investigate the cubicle mounted stationary disconnects, (with the switchgear de-energized) determine the cause of overheating and take corrective action.

17. Prepare the circuit breaker for service by repeating steps 9 through 22 on page 2.

LUBRICATION KEY	PART DESCRIPTION	SUGGESTED LUBRICATION AT EVERY 1000 OPERATIONS OR ONCE EVERY YEAR	ALTERNATE LUBRICATION (REQUIRES DISASSEMBLY) RECOMMENDED AFTER EVERY 5000 OPERATIONS
A	GROUND SURFACES SUCH AS LATCHES, ROLLERS, PROPS, ETC.	WIPE CLEAN AND SPRAY WITH *MOLYCOTE 557* 15-171-270-001.	WASH CLEAN AND SPRAY WITH *MOLYCOTE 557* 15-171-270-001.
B	NYLON SLEEVE BEARINGS, SUCH AS: THE CONTACT ARM HINGE PIN.	NO LUBRICATION REQUIRED.	NO LUBRICATION REQUIRED.
C	SLEEVE BEARINGS AND PIVOT PINS, ROTATING PARTS SUCH AS DRIVE PINION, DRIVING CRANKS, SLIDE AND PIVOT PINS.	LIGHT APPLICATION OF *MOLYCOTE PENELUBE* 15-171-270-002.	REMOVE PINS OR BEARINGS, CLEAN PER INSTRUCTIONS AND APPLY *BEACON P-290* 00-337-131-001.
D	SLIDING SURFACES.	LIGHT APPLICATION OF *MOLYCOTE 557*.	WIPE CLEAN AND APPLY *MOLYCOTE 557* LIBERALLY.
E	AIR PUFFER PIVOTS AND SHOCK ABSORBERS.		
F	ROLLER AND NEEDLE BEARINGS.	NO LUBRICATION REQUIRED.	CLEAN PER INSTRUCTIONS AND REPACK WITH *BEACON P-325*.
G	DRY PIVOT POINTS.	NO LUBRICATION REQUIRED.	NO LUBRICATION REQUIRED.
H	PRIMARY AND SECONDARY DISCONNECT FINGERS, ARCING CONTACT HINGE, GROUNDING CONTACT AND AUXILIARY SWITCH CONTACTS.	WIPE CLEAN AND APPLY A FILM OF SIEMENS-ALLIS CONTACT LUBRICANT 15-171-370-002.	
I	ARCING CONTACTS.	DO NOT LUBRICATE.	DO NOT LUBRICATE.
J	DISCONNECT ARM HINGE JOINT SILVER WASHER BETWEEN BUSHING AND THE CONTACT ARM.	WIPE CLEAN AND APPLY A FILM OF SIEMENS-ALLIS CONTACT LUBRICANT 15-171-370-002.	
K	CHARGING SPRINGS & SPRING RETAINERS.	NO LUBRICATION REQUIRED.	WIPE CLEAN AND COATWITH OF *BEACON P-325*.
L	MANUAL CHARGING BEVEL GEAR TRAIN, FB & FC SERIES ONLY.	REMOVE SNAP ON COVER & COAT TEETH LIGHTLY WITH *BEACON P-325*.	REMOVE SNAP ON COVER & COAT TEETH LIGHTLY WITH *BEACON P-325*. 15-337-131-001
M	ARCING CONTACT HINGE ASSEMBLY.	WIPE CLEAN AND APPLY A FILM OF SIEMENS-ALLIS CONTACT LUBRICANT 15-171-370-002.	

Figure 23. Lubrication Chart