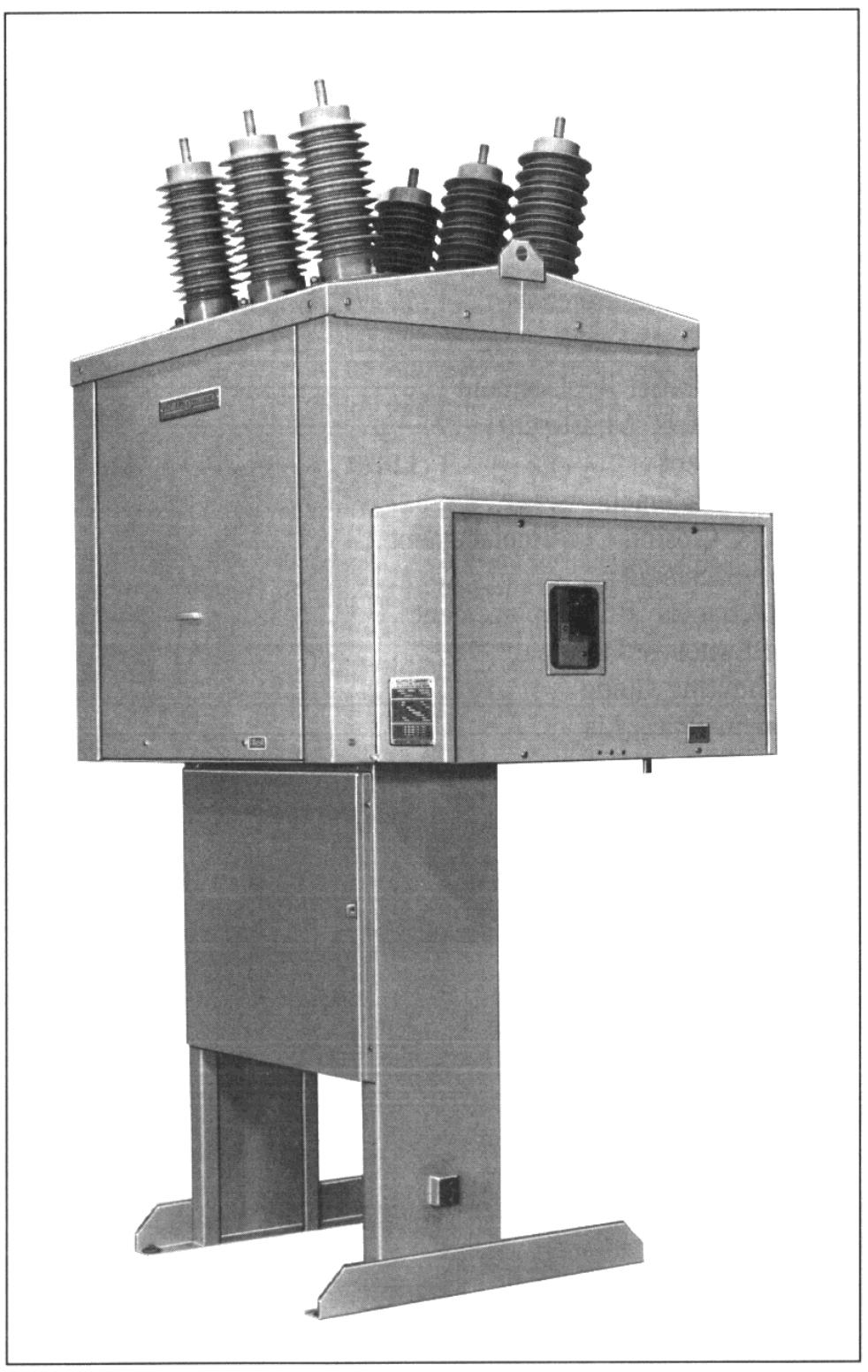
January, 1989

Manual 6060-3

Instruction & Maintenance Manual

SF_6 Substation Circuit Breakers

Type FB (Series 2)



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CONTENTS

I. INTRODUCTION

This manual provides handling, installation, operation, and maintenance instructions for FB series 2 substation breakers. The FB substation breaker features the latest advances in SF6 (Sulfur Hexafluoride) technology, combining superior performance with low maintenance.

FB breakers are built in two basic sizes; a smaller unit for use on 15.5 kV systems, and a larger unit for use on 25.8kV and 38 kV systems. The FB Circuit Breaker uses three sealed interrupter units. These interrupters are filled with SF6 gas to 22 psig at the factory and sealed for life. Field charging of these interrupters is not required. Breaking the seal on the interrupters will void the warranty.

The design ratings for the breakers are shown in Table 1. If further questions exist contact your local Square D Company representative for comprehensive factory and/or field support.

SF_6 SUBSTATION CIRCUIT BREAKER
TYPE FB (Series 2)

STANDARD FB BREAKER RATINGS

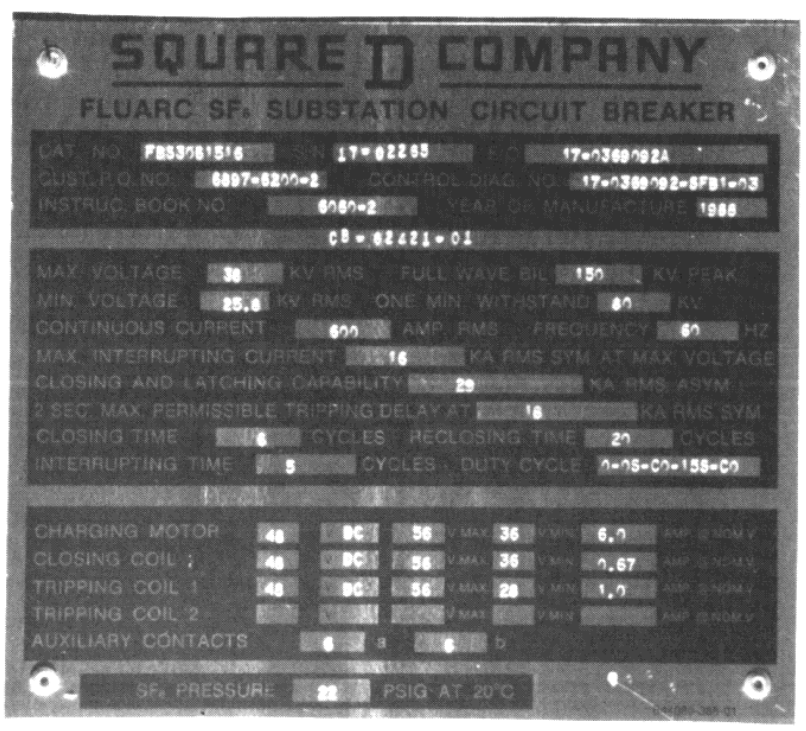
FB BREAKER	15.5kV	25.8kV	38kV
Rated Frequency	60 Hz	60 Hz	60Hz
Maximum Design Voltage	15.5kV	25.8kV	38kV
Voltage Range Factor	1	1	1
1.2 x 50 Full Wave Impulse Voltage	110kV peak	125kV peak	150kV peak
60 Hz. Withstand Capability Dry — 1 minute Wet — 10 seconds	 50kV rms 45kV rms	 60kV rms 50kV rms	 80kV rms 75kV rms
Minimum External Creep Distance	20.5 inch	25.75 inch	47 inch
Minimum External Strike Distance Phase to Ground	14 inch	16 inch	22 inch
Minimum External Strike Distance Phase to Phase	10 inch	12 inch	13.50 inch
Interrupting Time	5 cycles	5 cycles	5 cycles
Time Between Coil Energization and Contact Parting	45-65 msec.	45-65 msec.	45-65 msec.
Spring Charging Time	8-11 sec.	8-11 sec.	8-11 sec.
Time Between Coil Energization and Contact Closing	85 msec.	85 msec.	85 msec.
Minimum Reclosing Time	0.3 sec.	0.3 sec.	0.3 sec.
Continuous Current	1200A rms	1200A rms	1200A rms
Interrupting Capacity at Max. Voltage	25 kA rms sym	25 kA rms sym	25 kA rms sym
Close and Latch Capacity	40 kA rms asym	40 kA rms asym	40 kA rms asym
3-second Short Time Capacity	25 kA rms sym	25 kA rms sym	25 kA rms sym

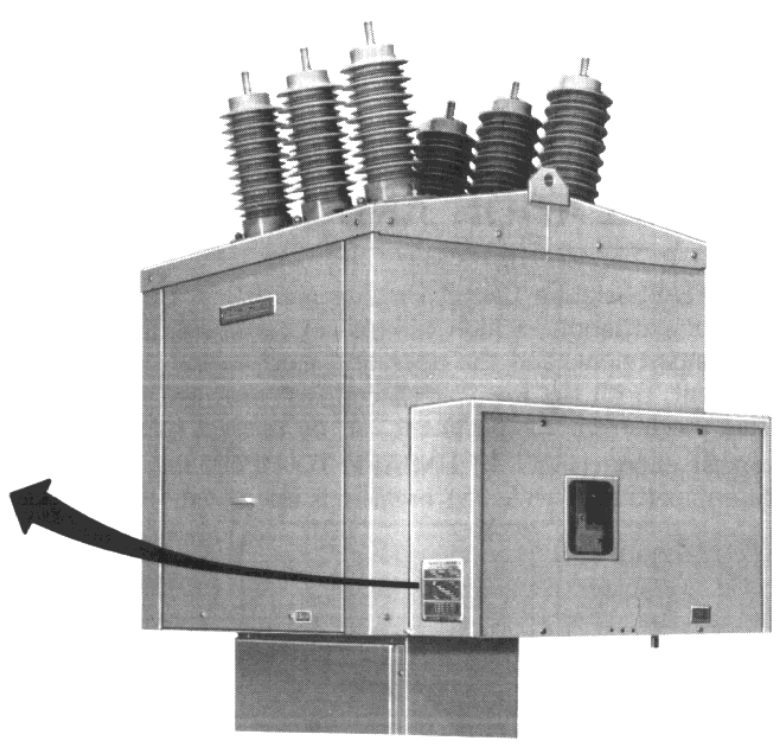
TABLE 1

II. RECEIVING

Upon receipt by the customer, remove the shipping material from the breaker to carefully inspect for any damages that may occur during shipping. From the rating nameplate on the front side of the breaker housing, verify that the breaker specifications match the order specifications.

A claim for damages should be filed at once with the transportation company if there is any visual evidence of damage. Notify Square D Company of the damages and/or discrepancies noted.

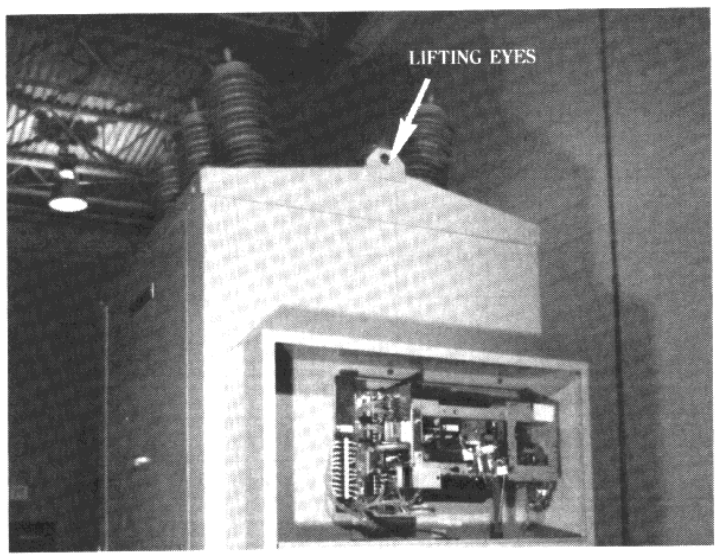




III. HANDLING

For ease of transportation and to avoid damages from the unit being tipped over (unit is top heavy), the breaker should remain on its shipping pallet until installed on the pad at the job site. The recommended method of handling the breaker is by using a crane or hoist. Two lifting eyes have been welded to the top of the breaker housing for lifting by crane or hoist.

HANDLE WITH CARE; meters and relays may be damaged by rough handling.



IV. STORAGE

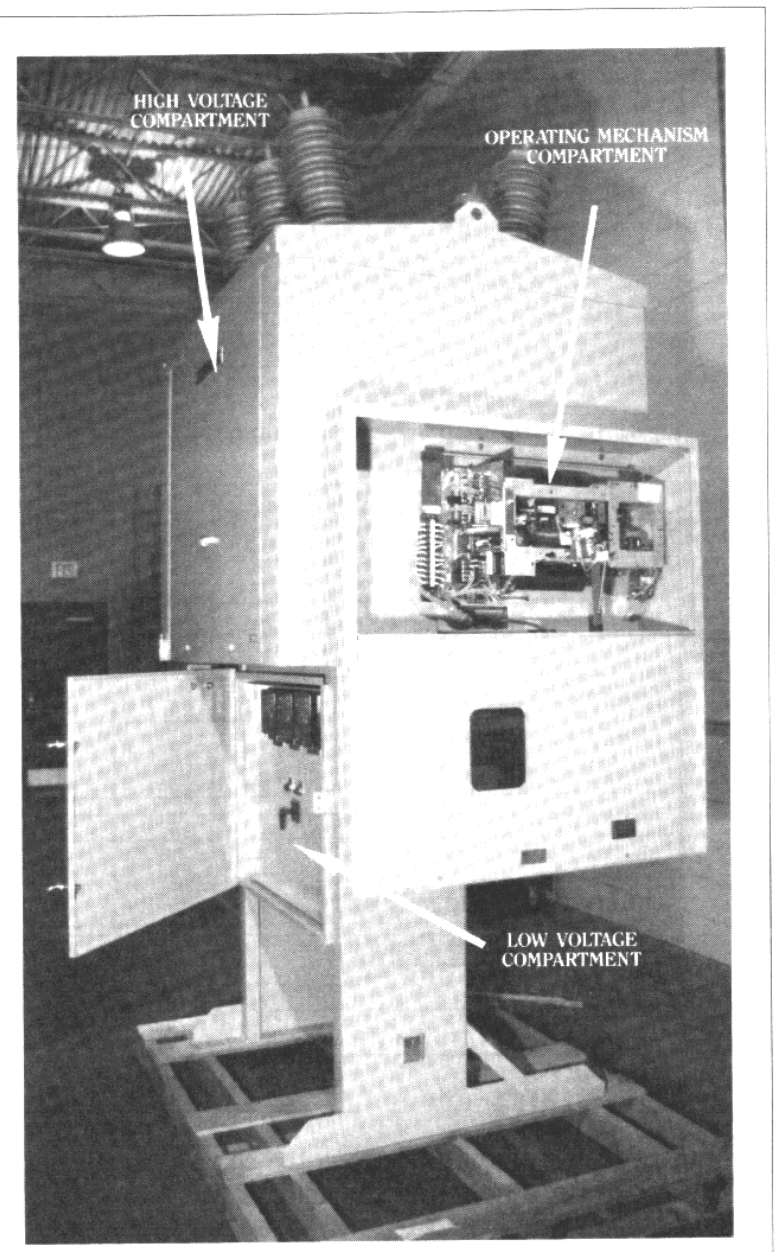
All breakers are shipped, and should be stored, in open position with operating mechanism in the discharged position. If the breaker is stored prior to installation, provisions must be made for energizing the space heaters to prevent condensation inside the enclosure. These units must be kept in a place that is clean, dry, and free of corrosive elements.

If the breaker is stored for an extended period of time prior to placing in service, regular inspection is required and, if necessary, spray the unplated parts lightly with oil. Periodic exercising of the breaker is recommended. The time between exercise periods should be no greater than one year.

V. INSTALLATION AND OPERATION

ENCLOSURE

The type FB Substation Circuit Breaker consists of three separate compartments; a high voltage compartment, a low voltage compartment, and the operating mechanism compartment. Both the low voltage compartment and the operating mechanism compartment can be opened safely with the breaker energized. **IT IS UNSAFE TO OPEN** the high voltage compartment while the breaker is energized.



Two access panels allow entry into the high voltage compartment. Caution should be exercised when removing the access panels due to the size, weight (100 lbs.), and location of these panels. DO NOT ATTEMPT TO REMOVE ACCESS PANELS WHILE BREAKER IS ENERGIZED. The bushing, CT's, sealed interrupters, operating linkage, contact wear indicator, and strip heater are located in the high voltage compartment.

PRECAUTION: Two men are recommended to remove the access panels from the 25.8/38 kV unit.

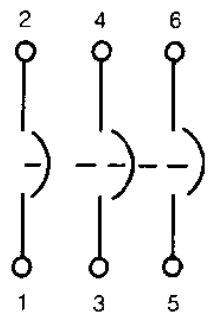
A ventilation grill is mounted on the bottom side of the high voltage compartment directly behind the low voltage compartment. Removal of this grill exposes the opening springs and rotary shaft mechanisms. Access to live parts is shielded by the circuit breaker support channel; however, do not remove the grill while the breaker is energized. Six cycloaliphatic cast epoxy bushings protrude through the roof of the high voltage compartment. Provisions are included on each unit to mount up to two current transformers on each bushing.

CONTINUED

PAD MOUNTING

DIMENSIONS (INCHES)						
RATING	A	B	C	D	E	F
15.5 kV	43	58	13	10	.5	4
25.8 kV	48	70	15	14	3	10
38 kV	48	70	15	14	3	10

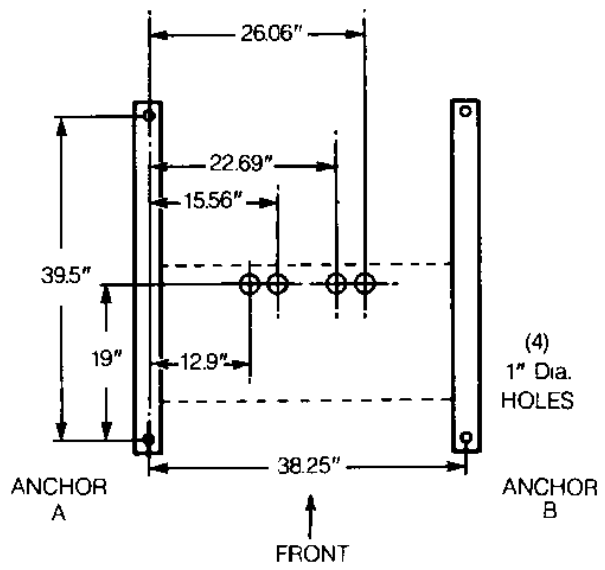
15.5 kV - Wt. = 2,000 lbs.
25.8/38 kV - Wt. = 2,500 lbs



BREAKER SCHEMATIC

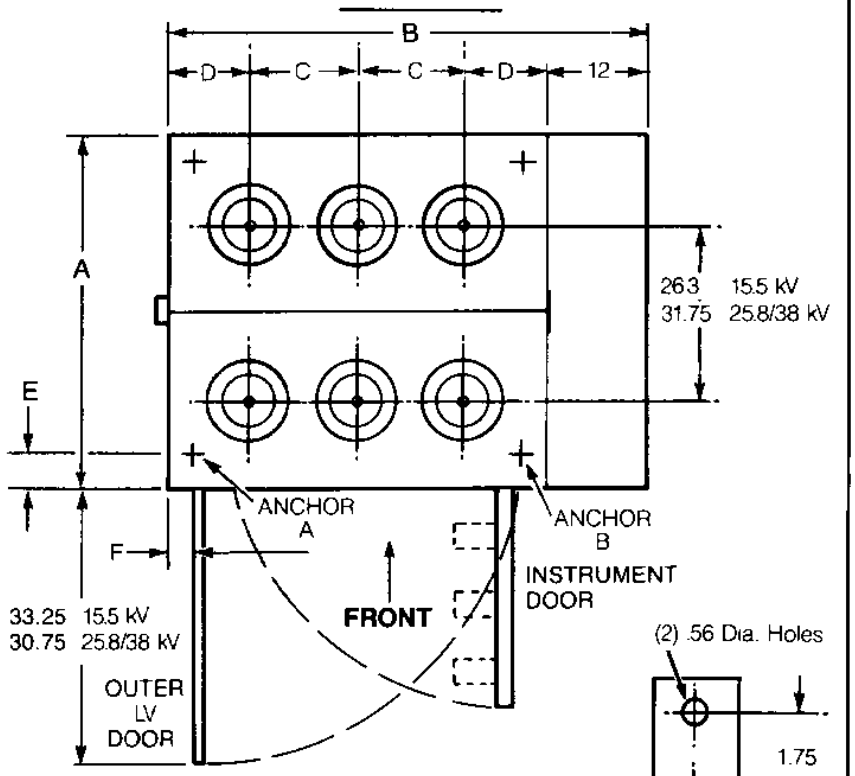
NOTE: Fixed-Height Breaker shown; Adjustable-Height design available to reduce height up to 18″ in 6″ increments.

(4) 2.38 DIA. KNOCKOUTS
AVAILABLE FOR CONDUIT ENTRANCE

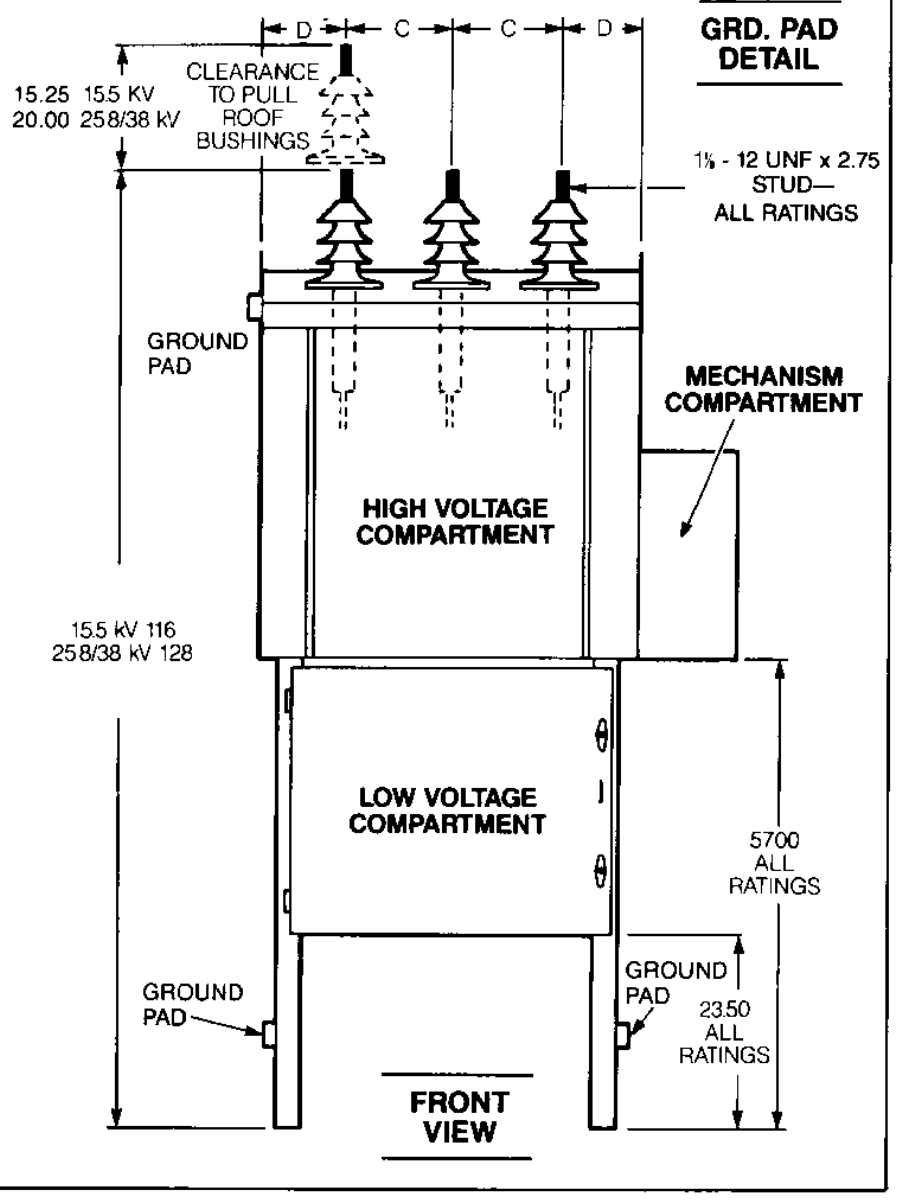


LV CONDUIT AND ANCHOR BOLT LOCATIONS

TOP VIEW



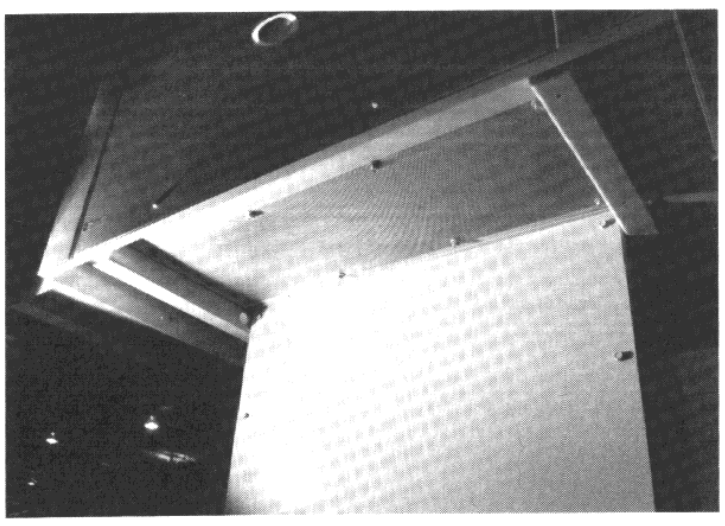
GRD. PAD DETAIL



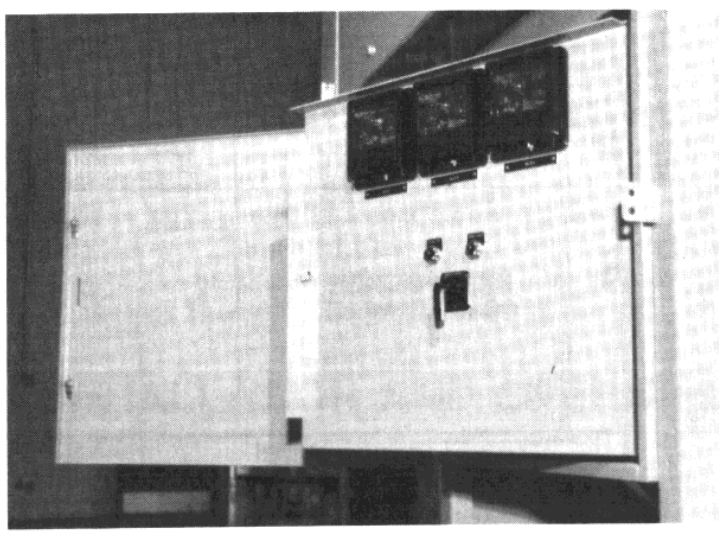
FRONT VIEW

Figure 1 - ELEVATIONS And WEIGHTS

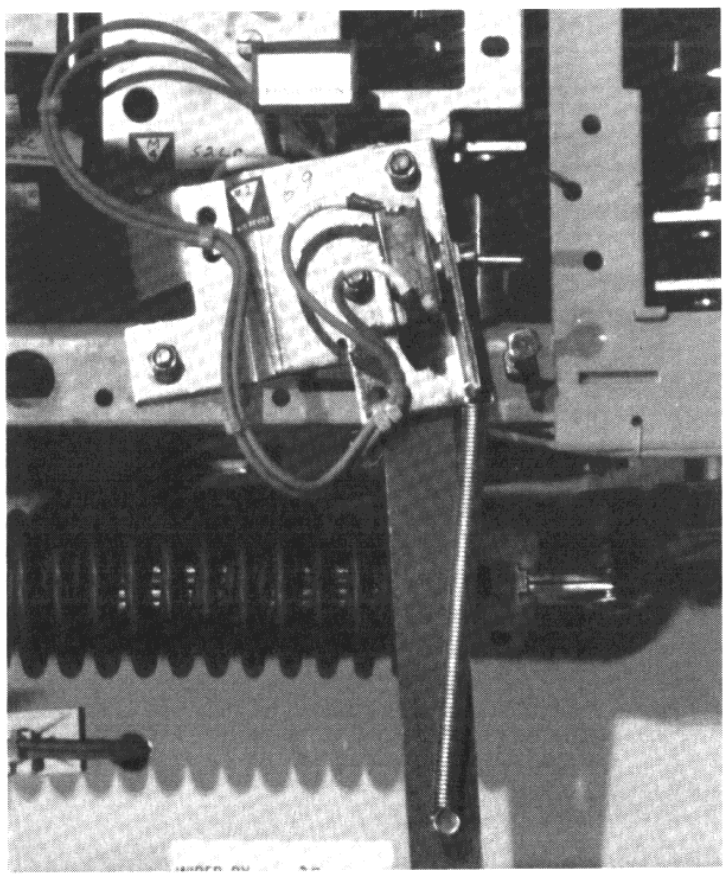
V. INSTALLATION AND OPERATION (Cont.)



The low voltage compartment is located beneath the high voltage compartment and is isolated from the high voltage compartment by the high voltage compartment floor. The control components are located in the low voltage area. A hinged inner door for mounting instruments and relays, a strip heater, and terminal strips are all accessible through a hinged front door. A padlockable front door with two tee handles is provided. A wind stop and instruction manual holder are provided within the low voltage area.

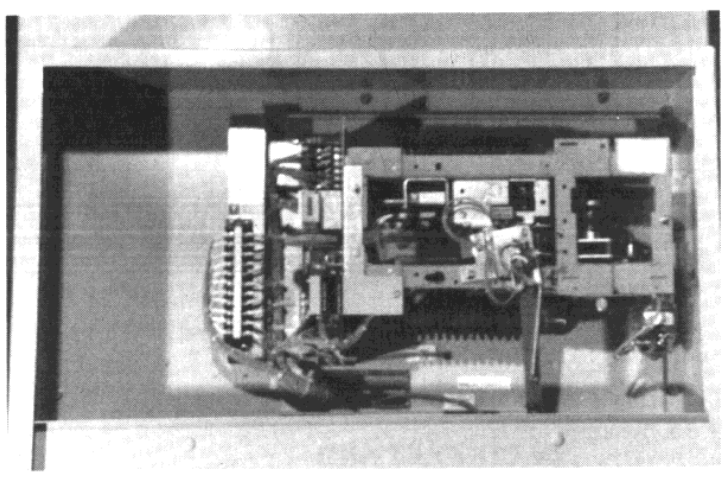


The operating mechanism compartment is located on the end of the high voltage compartment and houses the stored energy spring operating mechanism. A large viewing window provides easy viewing of the circuit breaker operations counter, mechanical open/close indicator, and closing springs charge indicator. An emergency trip handle is provided that includes lockout provisions and an electrical/mechanical hand reset interlock (ANSI 69 switch). This red emergency trip handle protrudes through the bottom of the operating mechanism compartment. To trip the breaker pull the red handle down and a 69 switch contact is opened. The 69 switch locks out the breaker electrically to prevent automatic reclosing. To reclose the breaker electrically the 69 switch must be reset manually by pushing the toggle switch lever down to its original position.



Operating Mechanism Description

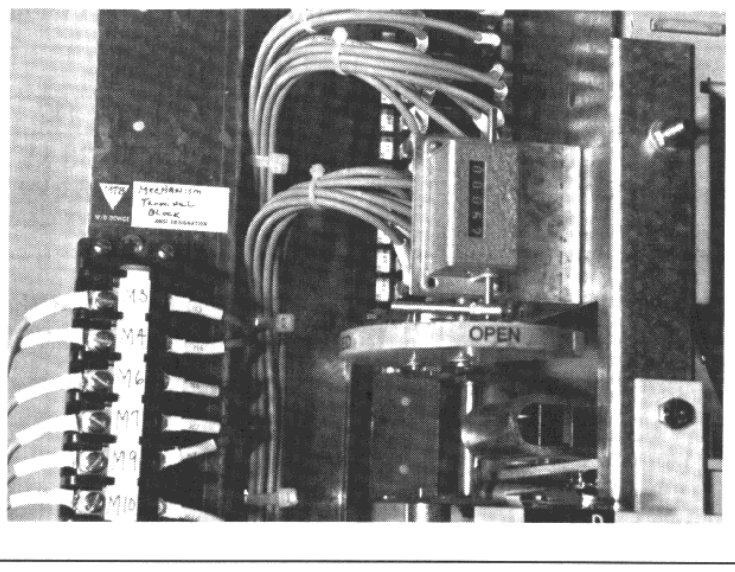
A stored energy mechanism is located in the operating mechanism compartment and consists of high energy closing springs and a ratcheting system for charging these springs. The breaker is prevented from being closed until the springs are fully charged. After the springs are fully charged, the breaker may be closed either electrically or manually. The opening and closing speeds are independent of the method by which the springs are charged.



The breaker may be operated electrically by the breaker control switch located in the low voltage compartment. Place the switch in the open position to trip the breaker and in the

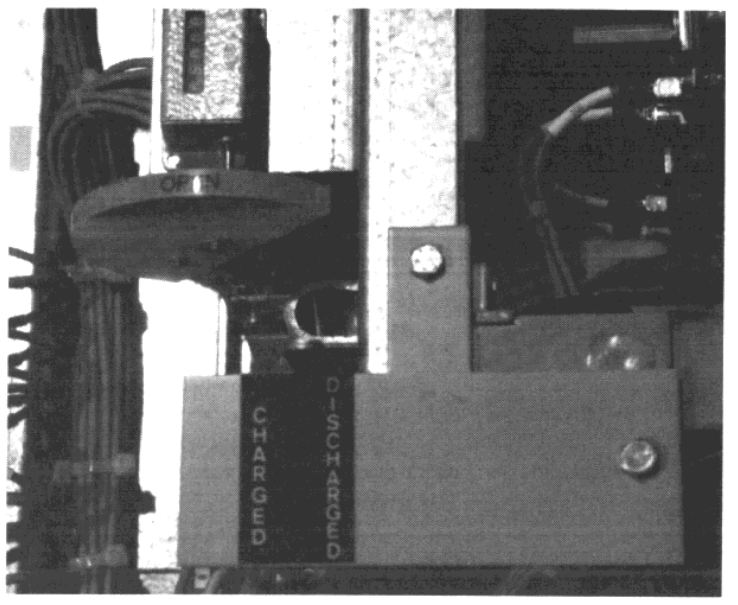
close position to reclose the breaker. The closing springs recharge automatically immediately after the breaker closes.

The breaker may be operated manually by operating the close/open button located in the operating mechanism compartment. Pull the button to close the breaker and push to open. The closing springs can be charged by ratcheting manually with the manual charging handle (located in the operating mechanism compartment) until the "Springs Charged" indicator snaps to the charged position.



The position of the breaker contacts is given by a position indicator on the mechanism. The position indicator consists of a white flag with the word "close" indicating that the breaker is in the close position. A green flag with the word "open" indicates that the breaker is in the open position. This indicator is not intended to be used as a final authority to indicate the safety of the power circuit.

The "Springs Charged" indicator is located below the manual charging handle slot. This indicator shows whether the closing springs are fully charged or discharged. If the springs are partially charged, the indicator will be in the discharge position.



An operations counter counts the number of close/open cycles. The counter advances by one on the closing stroke. The breaker is rated for 10,000 operations at 1200A, however the life of the interrupters can be considerably less depending upon the current switched with each operation. The life of the SF6 interrupters can be predicted by use of the graph below showing the relationship between interrupter current and number of operations.

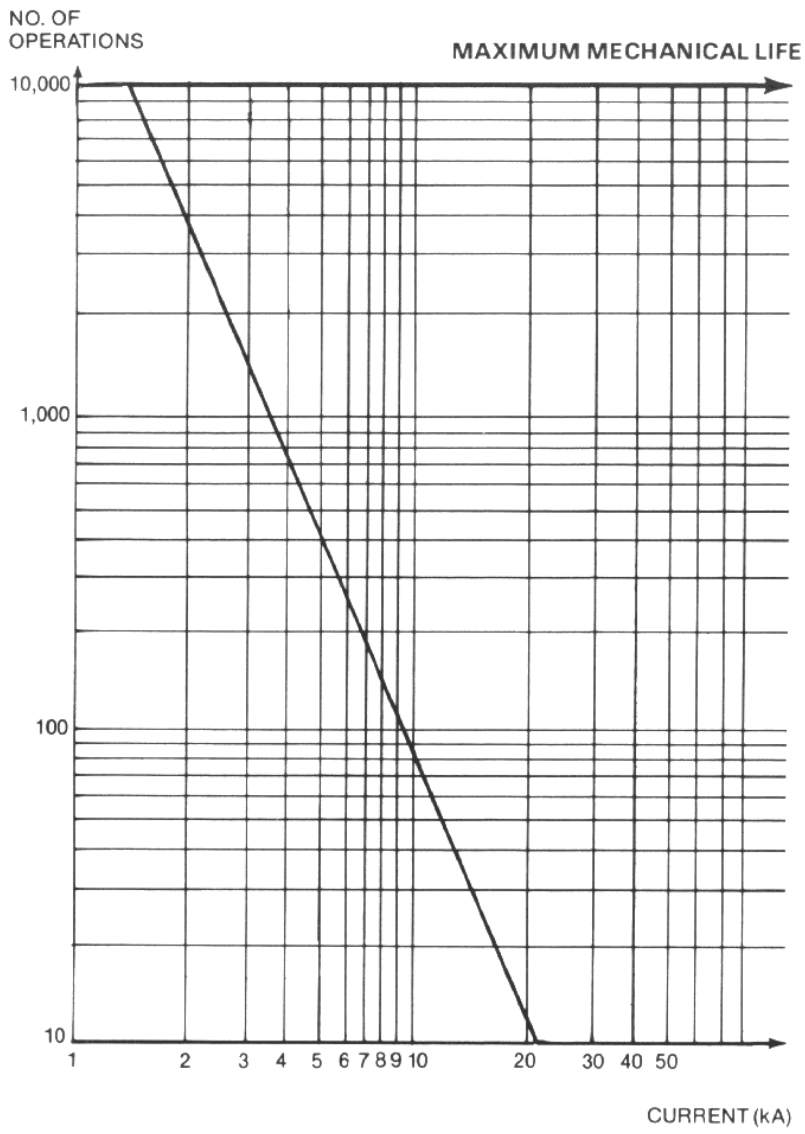


Figure 2
Life Expectancy Curve

The need for inspections and possible interrupter replacement should be based upon the frequency of operation, types and levels of interruptions, and environmental conditions (See contact wear measurement section).

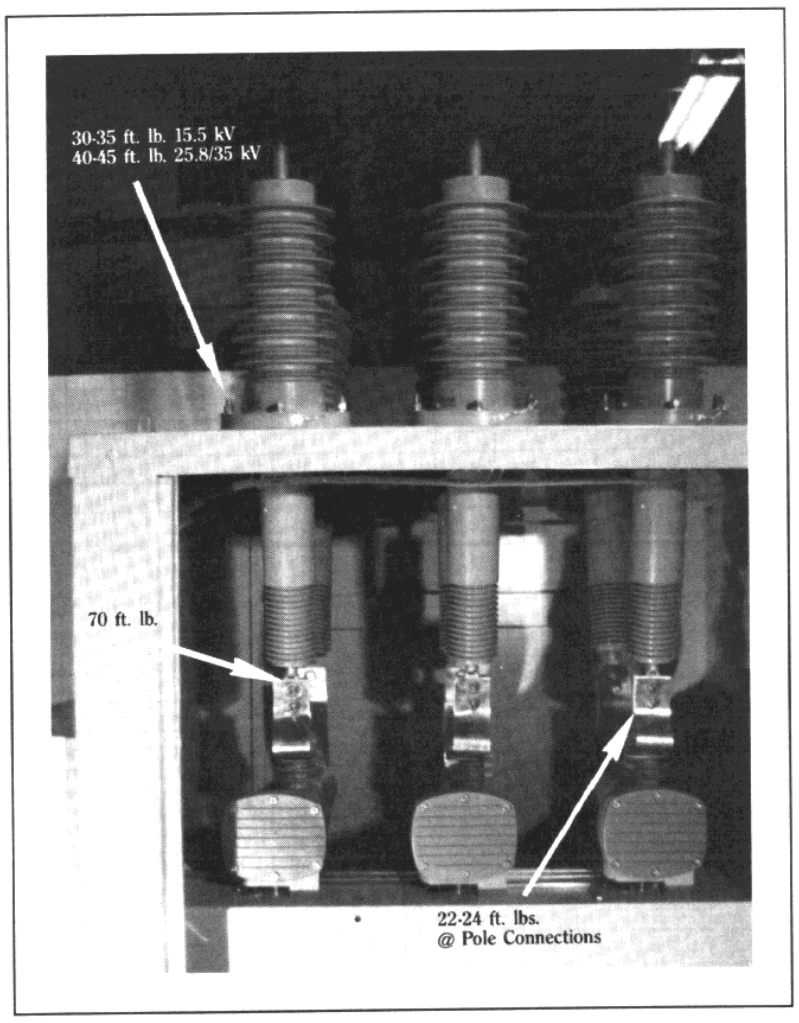
CONTINUED

V. INSTALLATION AND OPERATION (Cont.)

PRE-SERVICE INSPECTION

All personnel responsible for supervision and operation should be familiar with the breaker and its functions. Prior to placing the breaker in service, perform the following checks:

1. Open all panels and inspect the entire breaker for any shipping damages such as broken parts or loose hardware.



2. Verify the tightness of the flex connector to interrupter pole connections (22-24 ft.lbs.), of the flex connector to bushing connections (70 ft.lbs.), and the tightness of the hardware used to mount the bushings onto the roof (30-35 ft.lbs. for 15.5 kV & 40-45 ft.lbs. for 25.8/38 kV). These checks are part of the normal factory quality procedures, however, it is suggested that these items be re-checked prior to actual energization.
3. Clean the bushings, interrupters, and all insulating parts by wiping with a soft dry cloth. For more extensive cleaning a nonflammable solvent is recommended.
4. Manually charge the closing springs, close and trip the breaker.
5. If relays are supplied, remove blocking on relay armatures.
6. Apply control power and operate the breaker electrically.
7. Make resistance measurements on each interrupter with breaker in closed position. A new breaker should measure 130 micro ohms or less, from bushing to bushing, using a low resistance ohmmeter.
8. To ensure that damage has not occurred during shipment, perform a hi-pot test across the open contacts of each SF6 interrupter. Then with the breaker in the closed position, perform a phase to phase and a phase to ground hi-pot test for each pole. Gradually raise the test voltage to the level shown and hold for one minute.

Rated Maximum Voltage	Test Voltage	
	AC	DC
15.5 kV	27 kV	38 kV
25.8 kV	45 kV	63 kV
38.0 kV	60 kV	84 kV

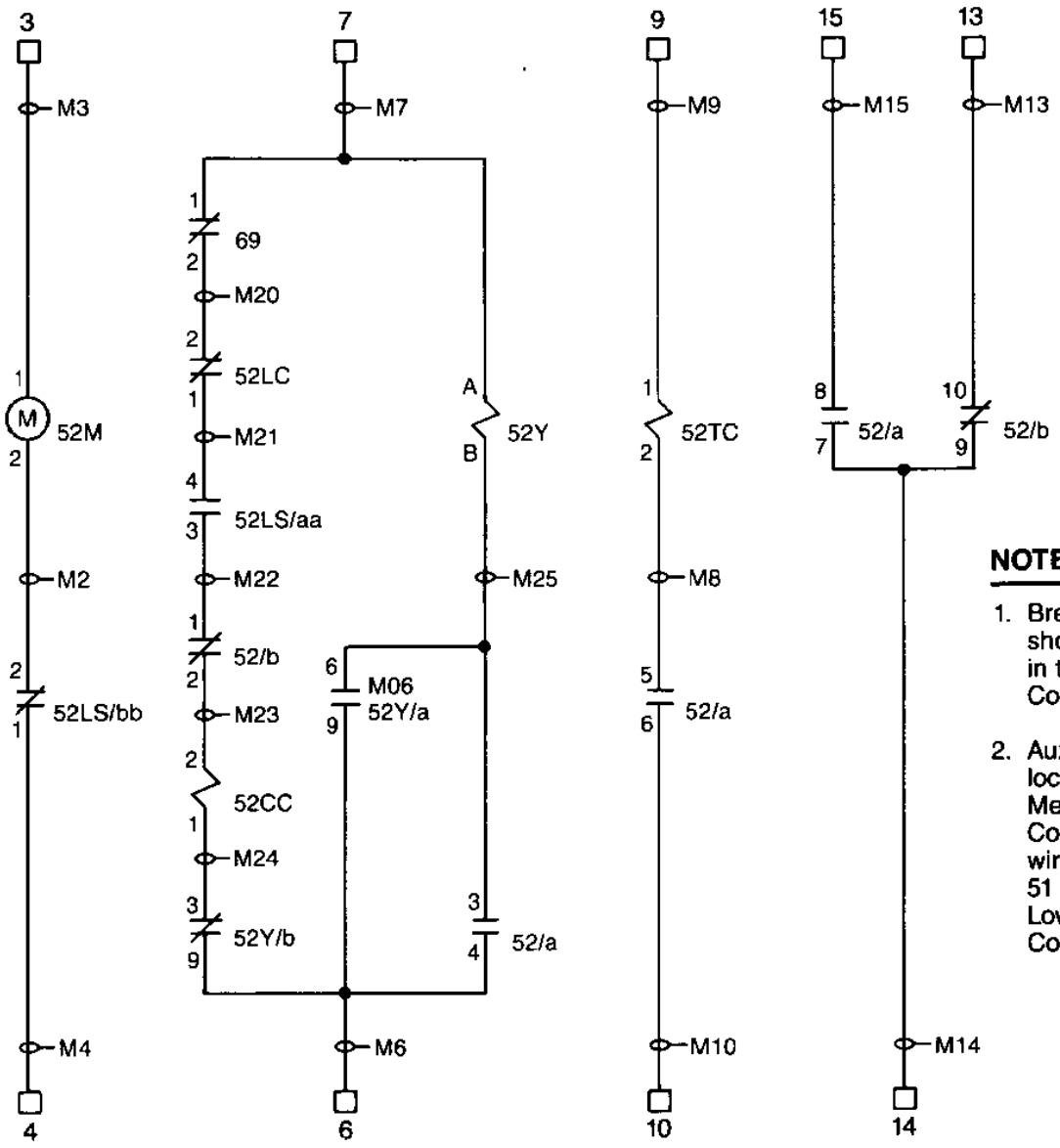
The above AC test voltages are 75% of those applied at the factory in accordance with ANSI recommendations.

Observe the following precautions when performing the hi-pot test.

1. Do not exceed the above voltages.
2. All persons should stay at least three feet away from "live" parts during testing.
3. Perform tests only when all insulating parts are installed. The operator should be positioned so that one of the metal sides of the enclosure is between the operator and the interrupter being tested.
4. Discharge to ground all "live" parts before handling. These parts can retain a static charge after a hi-pot test.

SF_6 SUBSTATION CIRCUIT BREAKER
TYPE FB (Series 2)

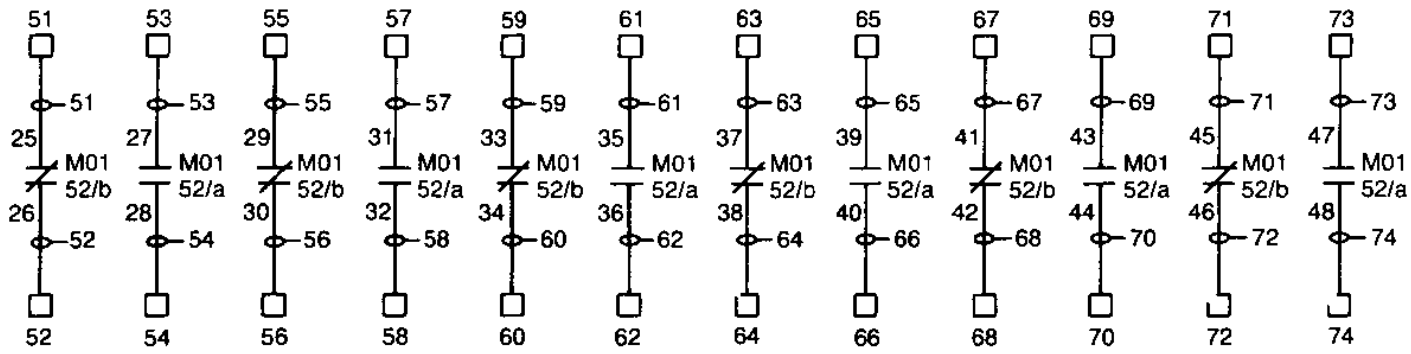
ELEMENTARY DIAGRAM—BREAKER CONTROLS



NOTES:

1. Breakers Controls shown here are located in the Mechanism Compartment.
2. Auxiliary switches are located in the Mechanism Compartment, but are wired out to terminals 51 through 74 in the Low Voltage Compartment.

BREAKER AUXILIARY CONTACTS



LEGEND

□	TERMINAL BLOCK.
52/a	CIRCUIT BREAKER AUXILIARY CONTACT, NORMALLY OPEN.
52/b	CIRCUIT BREAKER AUXILIARY CONTACT, NORMALLY CLOSED.
52M	CLOSING SPRINGS CHARGING MOTOR.
52TC	BREAKER TRIP COIL.
52CC	BREAKER CLOSING COIL.
52LC	LATCH CHECK SWITCH.
52Y	ANTI-PUMP RELAY.
52Y/a	ANTI-PUMP RELAY CONTACT, NORMALLY OPEN.
52Y/b	ANTI-PUMP RELAY CONTACT, NORMALLY CLOSED.
52LS	CLOSING SPRINGS CHARGED LIMIT SWITCH.
52LS/aa	CLOSING SPRINGS CHARGED LIMIT SWITCH CONTACT, OPEN WHEN SPRINGS ARE NOT CHARGED AND CLOSED WHEN SPRINGS ARE CHARGED.
52LS/bb	CLOSING SPRINGS CHARGED LIMIT SWITCH CONTACT, CLOSED WHEN SPRINGS ARE NOT CHARGED AND OPEN WHEN SPRINGS ARE CHARGED.
69	MANUAL TRIP AND LOCKOUT SWITCH.

Figure 3

VI. PREVENTIVE MAINTENANCE

This equipment, like all other equipment, requires two types of maintenance; scheduled preventive maintenance to avoid equipment problems and troubleshooting/corrective maintenance to repair the equipment as quickly as possible after a problem has occurred.

1. Only qualified and authorized personnel should be permitted to handle or operate the breaker.
2. Do not work around live parts.
3. Any switch or breaker that has been opened to de-energize the equipment being serviced should be effectively locked, tagged, and even blocked open if possible to prevent accidental energization of equipment.
4. Service current carrying parts only when these parts are disconnected from the system and grounded to the ground bus.

MAINTENANCE SCHEDULE

Preventive maintenance increases the life of the equipment and greatly reduces the possibility of equipment problems and unscheduled downtime. The schedule for preventive maintenance is dependent on the environment, number of switching cycles, loads handled, and schedules of other equipment in the system. In determining the minimum requirements, Square D Company recommends a check every 3000 operations or 36 months, whichever comes first. Consideration for more frequent maintenance should be given to applications in environments with high temperatures or contaminated atmospheres.

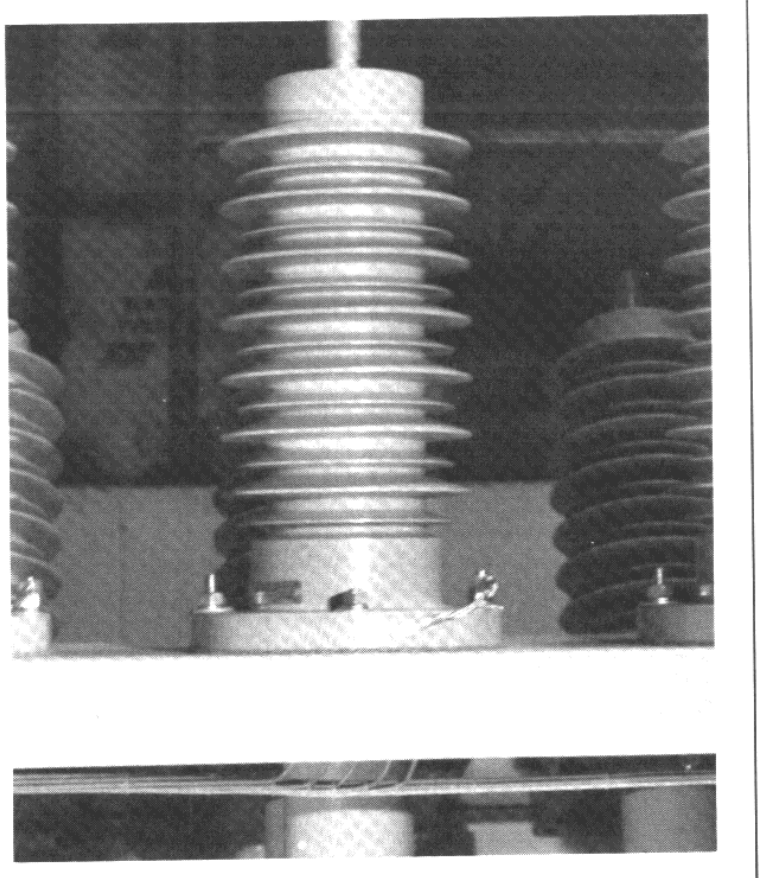
1. At the time of normal relay maintenance it is recommended that the breaker be totally exercised by closing and opening through all available means while checking the control functions.
2. The design has been tested to 10,000 operations with a very slight (1.0 ft./second) speed variation over the test. Adjustments are not required over the life of the breaker in regard to speed of operation.

Opening speed	8.7 - 11.3 ft/sec.
Closing speed	6.9 - 9.5 ft/sec.

3. It is not recommended that user check the gas pressure, however, if the maintenance policy of the user requires this check, special instructions must be obtained from the factory.

FIELD TESTING OF BUSHINGS

The Square D Company Cast Epoxy Apparatus Bushing is a solid dielectric construction made of filled cycloaliphatic epoxy. These bushings have been designed, tested, and exceed the requirements of ANSI/IEEE standards 21 and 24 for apparatus bushings. Performance and field experience have indicated no need for regularly scheduled field testing. It is expected that this bushing will provide service free performance for the life of the FB Substation breaker.



If for any reason field testing of bushing is required, an effective bushing test is the one minute, power frequency dielectic test. The ground insert for this bushing's internal ground screen is located on the bushing mounting flange. This insert is connected to ground during normal service and should remain connected during this test. Isolate bushing and apply test voltage (line to ground) as follows:

Rated Maximum System Voltage	Field Test Voltage	
	AC	DC
15.5 kV	27 kV	38 kV
25.8 kV	45 kV	63 kV
38.0 kV	60 kV	84 kV

Power factor measurements have proven to be valuable for some insulation medium, but are far less effective for cast epoxy and other similar solid dielectric materials. Power factor measurements above 1% for Square D epoxy bushings do not indicate pending failure. Readings up to 25% have been recorded with no adverse effect.

CLEANING: Square D bushings may be cleaned with most commercial detergent and water as is used in high pressure cleaning equipment. Bushings should be allowed to air dry before energization.

Occasionally, a foreign object or a branch from a tree may cause an electrical arc to be established over the surface of the bushing. This event may leave a track of burnt debris which remains embedded into the surface of the epoxy. Normal cleaning may be insufficient to remove debris embedded in the surface. Such areas may be ground out using a small engraving router or grinder. The area may also be sandblasted using clean silica sand. The treated area is then polished using wet 400 grit silica-carbide sandpaper. The cleaned area should be blended into adjoining surface contours.

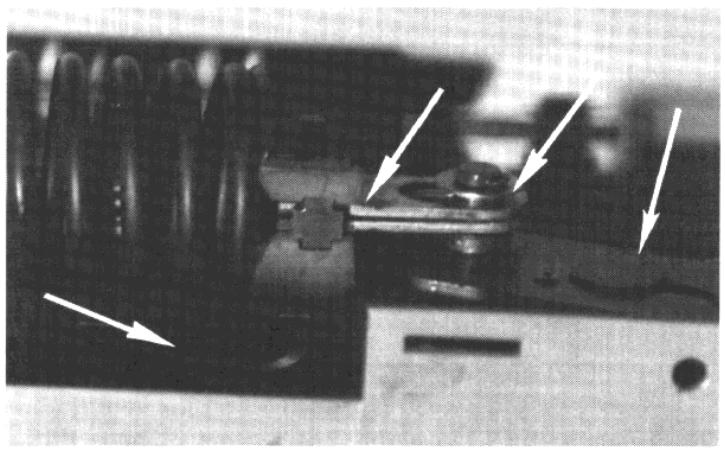
SF_6 SUBSTATION CIRCUIT BREAKER
TYPE FB (Series 2)

FIELD LUBRICATION

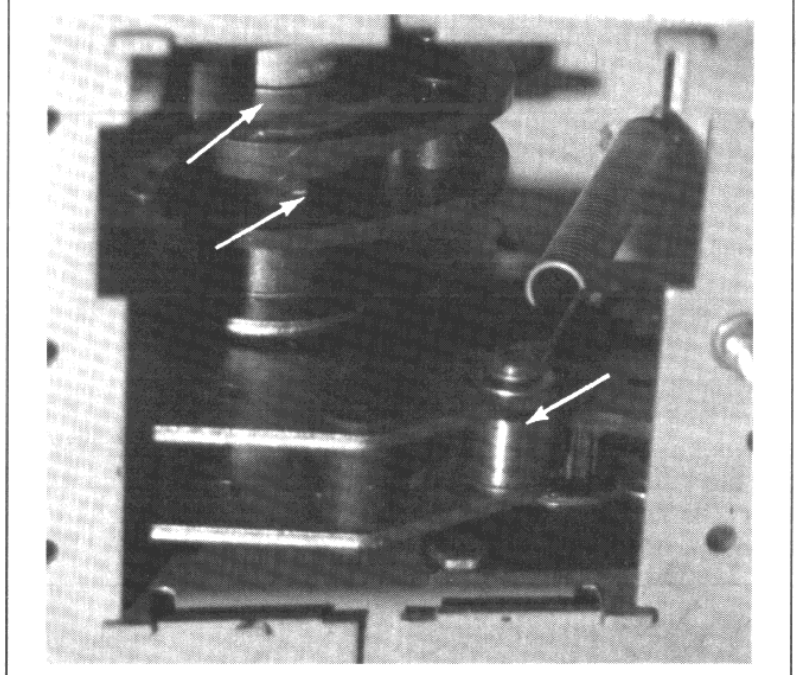
Proper lubrication of bearing surfaces and cleanliness is of prime importance. Dirt on the exterior surface of parts does not necessarily indicate the condition of the bearing surfaces. In many instances it is better to lubricate without cleaning, as long as dirt is not forced into the bearing surface areas. Should cleaning be necessary, consideration needs to be given to the part and bearing surface being cleaned so that dirt is not introduced into the bearing areas. Parts to be cleaned should be disassembled and cleaned thoroughly before new lubricants are applied. It is recommended that cleaning be limited to portions of the mechanism that can be disassembled, cleaned, inspected, lubricated, and reassembled.

Field lubrication consists of adding lubricants without cleaning in most instances. Below is a list of cleaning agents and lubricants required for preventive maintenance.

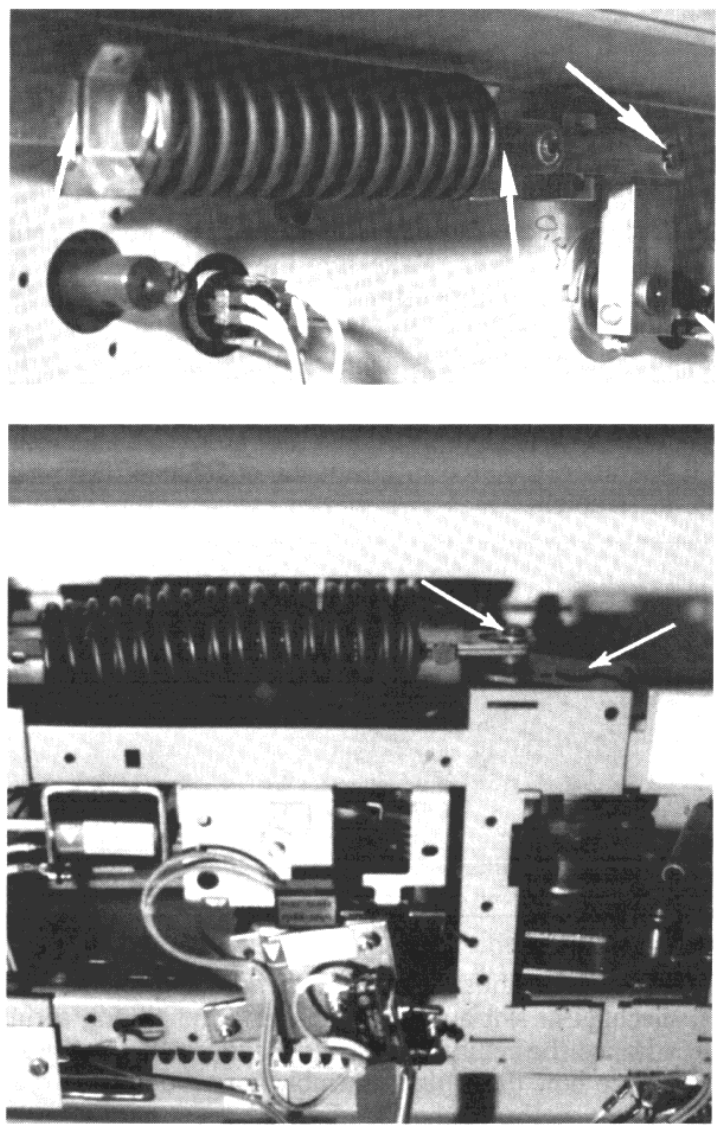
APPLICATIONS	ITEM
Cleaning	Non-flammable solvent
Lubricating pivot points & bearings	SAE 10W40 Oil
Lubricating spring guides & gears	Ball joint grease - Molybdenum Disulfide type



1. Locate all mechanical bearing surfaces such as rotary shafts in bearings, or parts sliding in relation to each other. Apply sufficient amount of multi-grade oil in the most direct fashion available to assure that the oil gets applied to the surface to be lubricated. Operate the mechanism a few times and relubricate to improve the flow of lubricant. Wipe away excess lubricant making sure not to force dirt into lubricated areas.



2. Lubricate the opening and closing spring guides with molybdenum disulfide grease.



3. Lubricate trip latch surfaces and gears using molybdenum disulfide grease.

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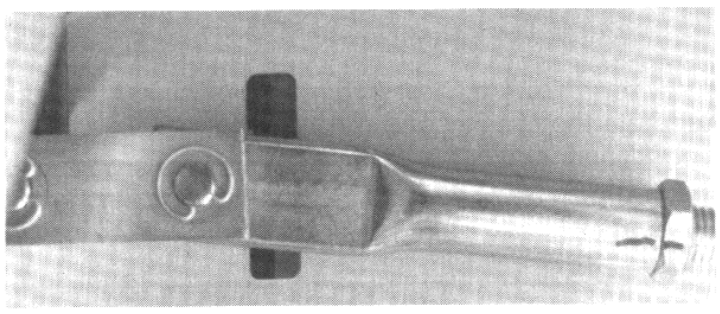
VI. PREVENTIVE MAINTENANCE (Cont.)

CONTACT WEAR MEASUREMENT:

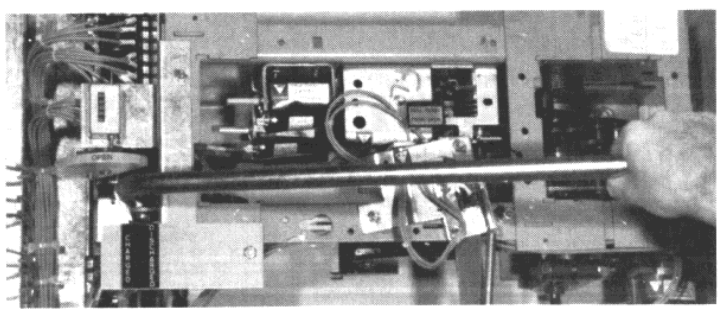
Required tools: two 3/16″ dia. pin or bolt (approx. 3/4″ - 1″ long), test light or ohmmeter for testing continuity, needle nose pliers, 9/16″ wrench or 9/16″ socket & ratchet

The total life of an interrupter is determined by a combination of interrupting current and number of operations, and is measured through contact erosion. A red and green indicator is provided for determining whether or not the interrupter should be replaced. To check the contact wear it is necessary to remove the closing springs and slow-close the breaker.

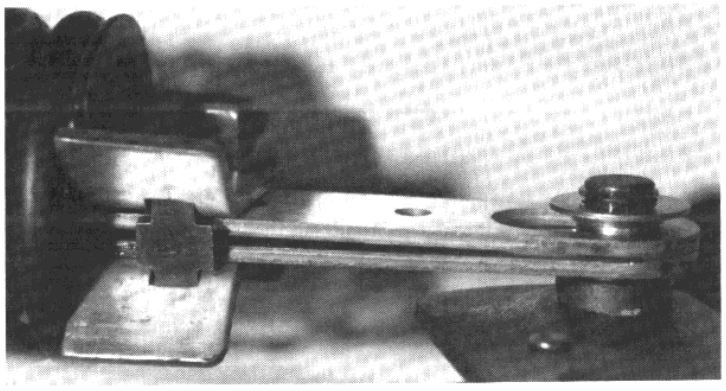


Use the following procedure to measure contact wear.

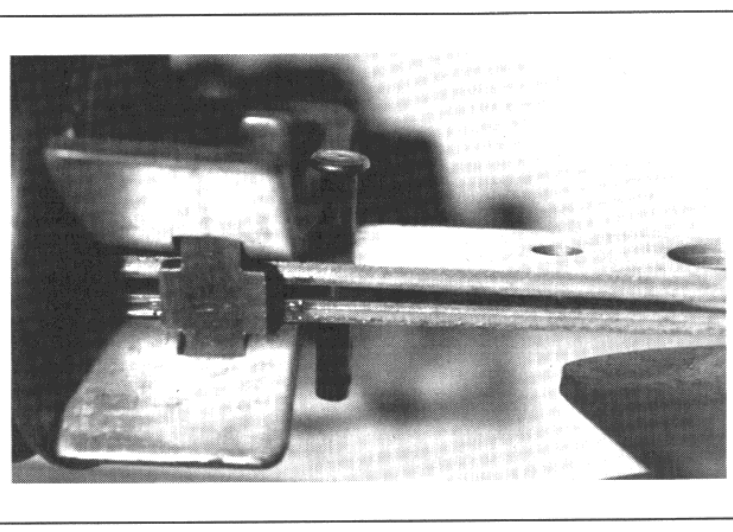
1. Totally remove the high voltage from the roof bushings and ground them. Make sure the breaker is open and the springs, both closing and opening, are discharged. Pull the close/open button and then push the button to be certain the mechanism springs are discharged.
2. The closing springs on the front of the mechanism must be removed in order to perform the slow closing operation required to check the contacts of the interrupters.



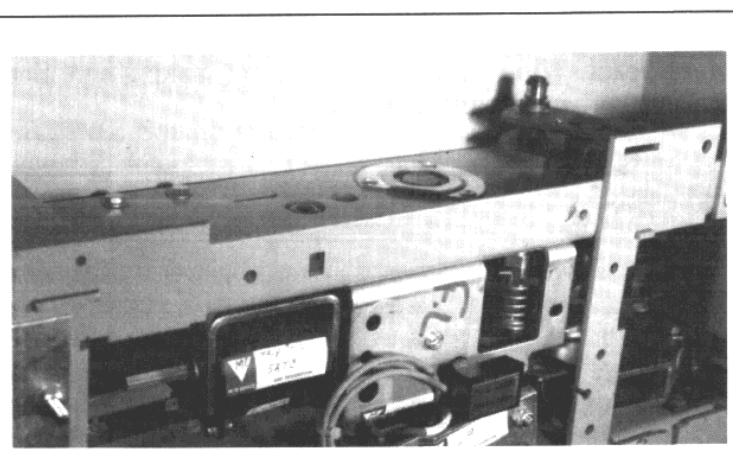
3. Insert the manual charging lever into the ratcheting mechanism slot and begin charging the closing springs, advance the ratchet mechanism one notch at a time. Notice how the spring assembly bars slide inside the springs as the ratchet is advanced.
4. Stop the charging motion at the point just before the edge of the bar is visible in the hole.



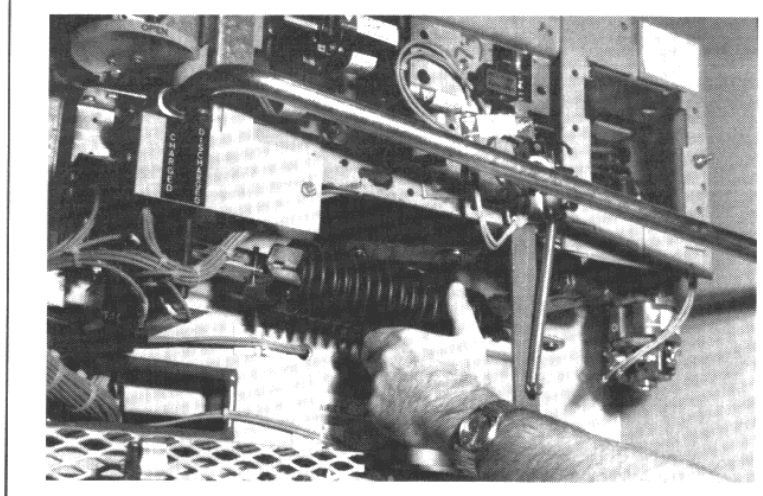
5. Carefully pull the charging lever just enough so the hole barely allows insertion of a 3/16″ dia. pin or bolt.



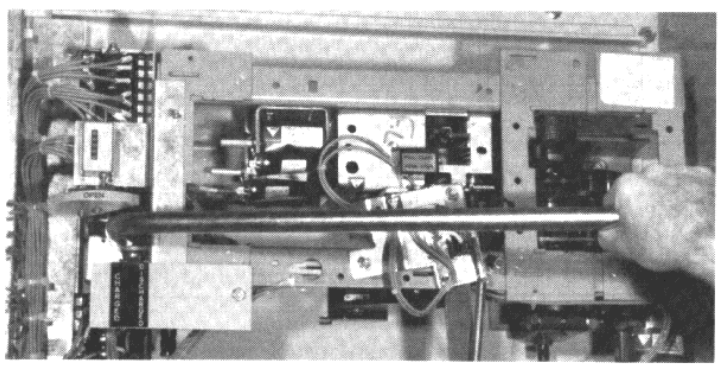
6. Continue to put a slight pressure on the charging handle, insert a 3/16″ dia. pin or bolt in the hole through the bars.
7. Do not advance the manual charging lever, allow it to return slowly. This should release the force of the springs to act against the inserted pin or bolt. If the spring force does not act against the pin when the charging lever is returned, remove the pin and completely charge the springs, perform a close/open operation (as in step 1) and repeat steps 3-6. When performed correctly the springs should be inoperative.



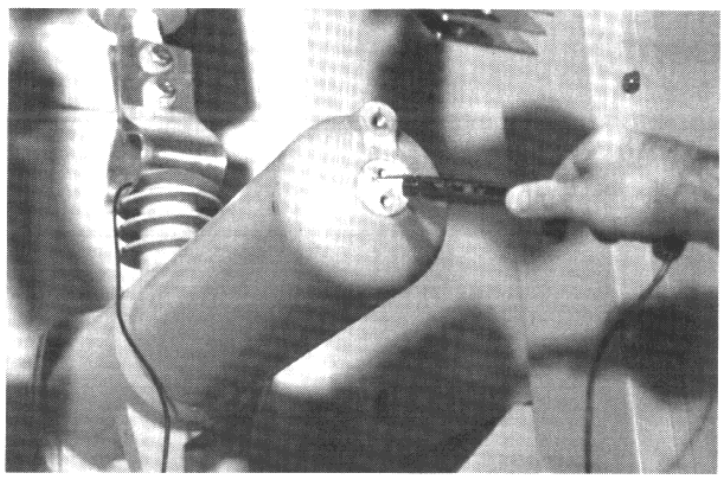
8. Detach and remove the springs by removing the snap ring from the crank end of the spring, and then slide the entire spring assembly toward the fixed end and slip the assembly over the pin. This must be performed on both the upper and lower closing springs. Note the position of washers and main pins so they can be placed in the same manner when reassembling.



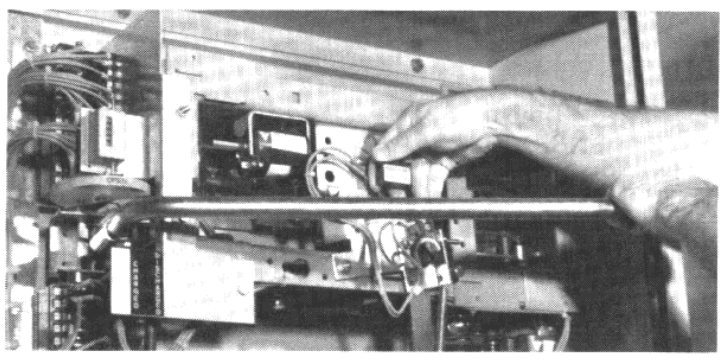
9. **CAUTION:** Once the two spring assemblies have been removed, do not drop or jar the blocking pins loose; springs will fly off.



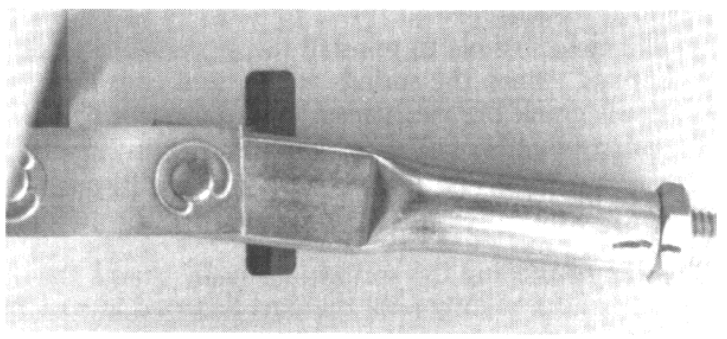
10. Crank the mechanism manually until a click is heard and the manual charging handle becomes inoperative.
11. Remove the side access panels.



12. Attach a test light or ohmmeter between the two terminals of one interrupter to check the contact "make" point of the interrupter.



13. Pull the close/open button out while continuing to charge the breaker using the manual charging handle. This allows the breaker to slow close.
14. Slowly continue cranking the mechanism, check for the contact "make" point of the interrupter.

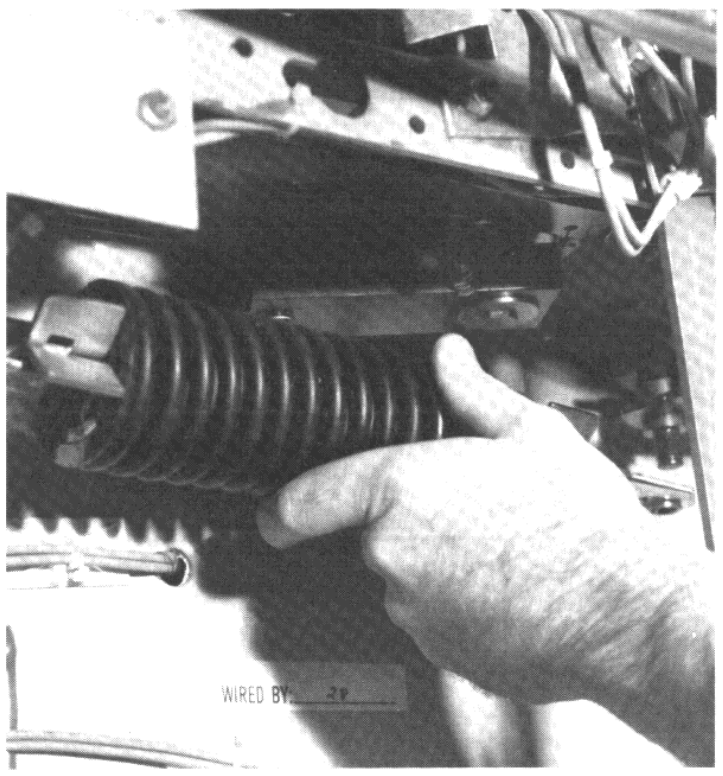


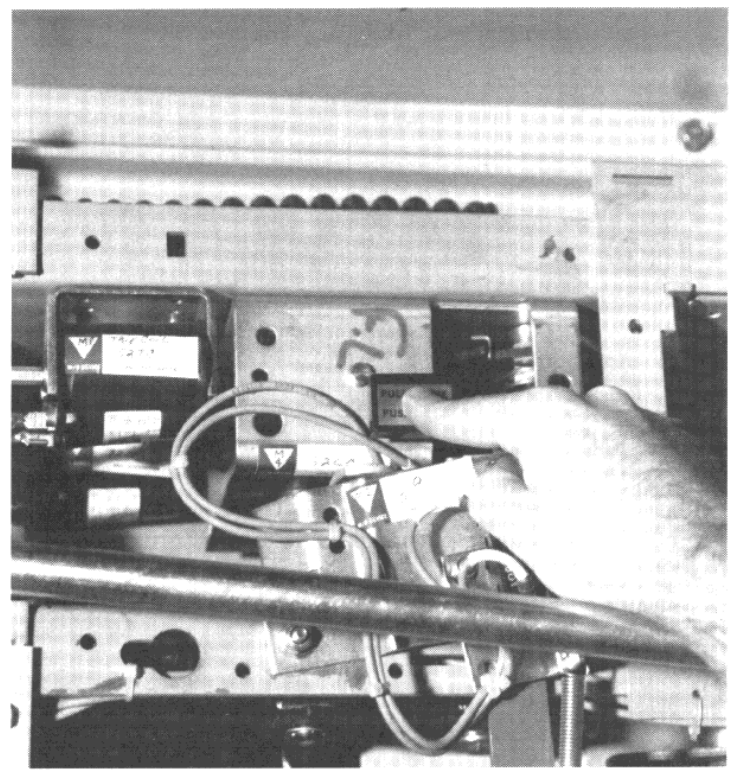
15. As long as the end of the connecting link (index) is not in the red zone when contact is made, the contact condition is considered good.
16. Repeat this procedure (steps 12-15) for the other two poles.
17. When the edge of the connecting link is at the red/green transition line the interrupters should be replaced.

CONTINUED

VI. PREVENTIVE MAINTENANCE (Cont.)

18. If one of the interrupters actuates the tester when the index is in the red zone, all three interrupters must be replaced (no adjustment exists).
19. If the interrupter bottles need replacing, go to step 1 of the bottle replacement procedures.





To reinstall the closing springs use the following procedure.

1. After the contacts have been checked for each bottle and all are performing acceptably, crank the mechanism to slow close the breaker until a click is heard.
2. It is now possible to reinstall the top and bottom springs. Attach the springs at the fixed ends first, then slowly crank the mechanism until the crank end of the spring assembly just slides over the shaft.

   CAUTION: Replace all washers and pins exactly as they were removed.
3. After reinstalling the springs, manually charge the mechanism slightly until the pins (inserted in step #6) can be removed.
4. Fully charge the mechanism manually, close and trip the breaker to ensure proper mechanical operation. The breaker should now be ready for reenergization.

VII. CORRECTIVE MAINTENANCE

FB breaker interrupters contain approximately .18 lbs. of sulfur hexafluoride (SF6 gas) a colorless, odorless, nonflammable, non-toxic, and chemically inert gas. There are no known ill effects as result of exposure to a small quantity of the pure gas. As the gas arcs on interruption inside the interrupter, a portion of the gas decomposes into toxic compounds. These toxic compounds are absorbed by an internal filter. Should used interrupters be opened or accidentally broken, observe the following precautions:

1. Avoid breathing the gases coming from the equipment.
2. Ventilate the area thoroughly.
3. Wear gloves to avoid direct skin contact with any internal component of the interrupter.

If personnel must remain near damaged units, air masks or breathing apparatus with self-contained oxygen should be used.

Some gases formed from the decomposition of SF6 have a "rotten egg odor" and may be smelled long before concentration of the toxic gases are harmful. Halogen detectors are recommended to determine the relative concentration of gases present in the atmosphere.

INTERRUPTER (BOTTLE) REPLACEMENT

New parts required: interrupter pole unit, lock pin, 1/2" flat washers

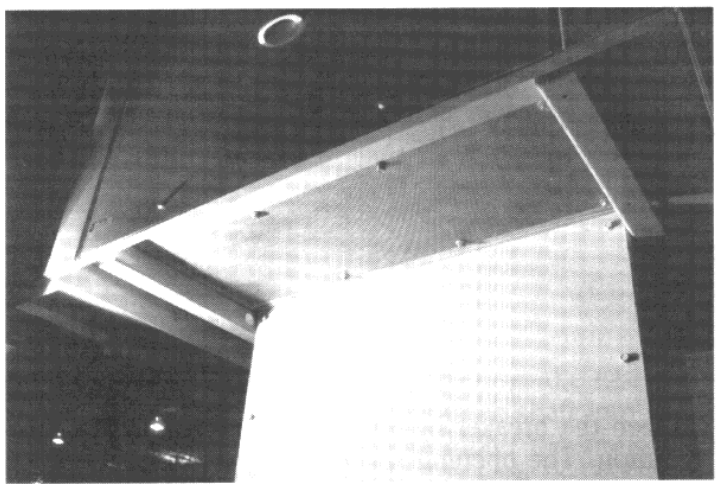
Required tools: clean rag, 12mm open end wrench, gear puller, 3/16" dia. pin or bolt (approx. 3/4" - 1" long), torque wrench, multi-purpose grease, dressing file (fine teeth), 9/16" socket & ratchet or 9/16" wrench, needle nose pliers, hammer, 8mm, 10mm, 12mm sockets.

Removal of old interrupter:

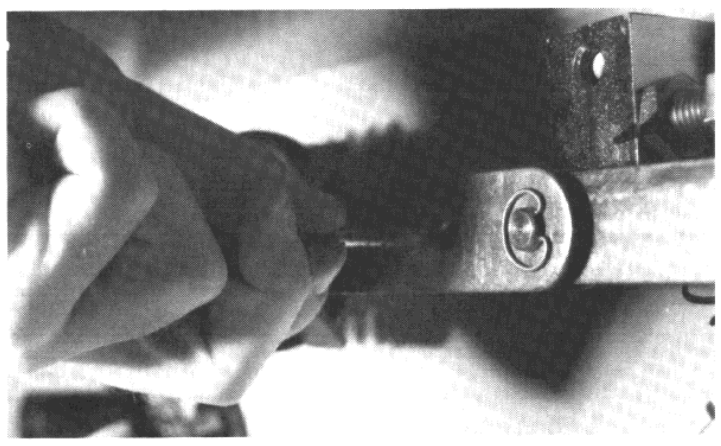
The following instructions assume that the interrupter coupled to the opening spring is being changed. For the other two interrupter poles simply unbolt the interrupters from the mounting frame by removing the three mounting bolts. Careful not to loose steel spacer between interrupter and frame.

1. Remove all power from the breaker and operate the breaker to discharge all springs.

2. Manually charge the mechanism.
3. Manually close the breaker by pulling out the manual close button.



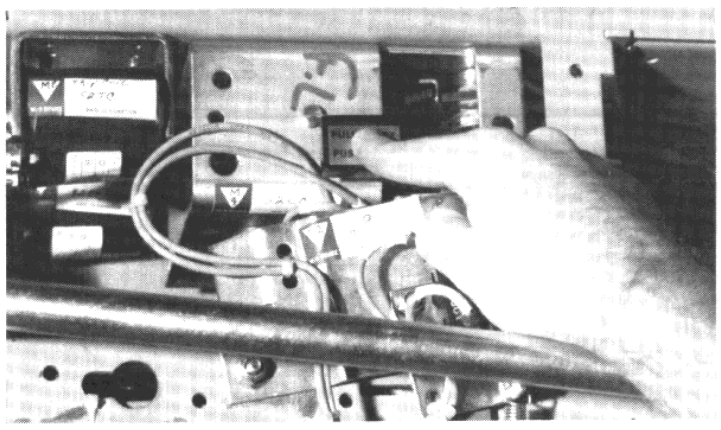
4. Remove the two access panels and the ventilation grill mounted on the bottom side of the high voltage compartment to gain access to the opening spring and the interrupters.
5. Replace one interrupter at a time.



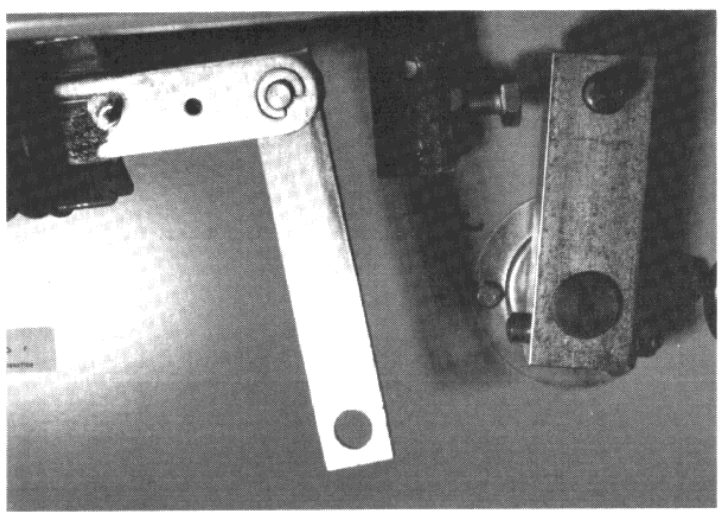
6. On the end of the opening spring guide farthest from the mechanism component, two holes will be visible. Insert a 3/16" dia. pin or bolt into the hole nearest the spring.

CONTINUED

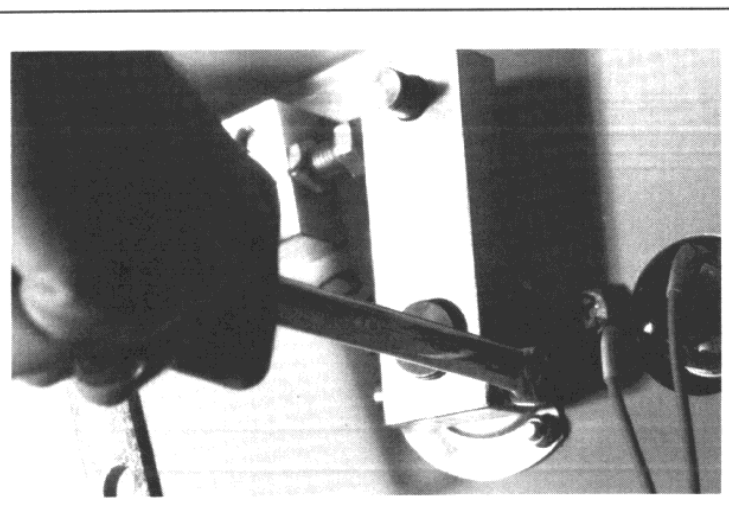
VII. CORRECTIVE MAINTENANCE (Cont.)



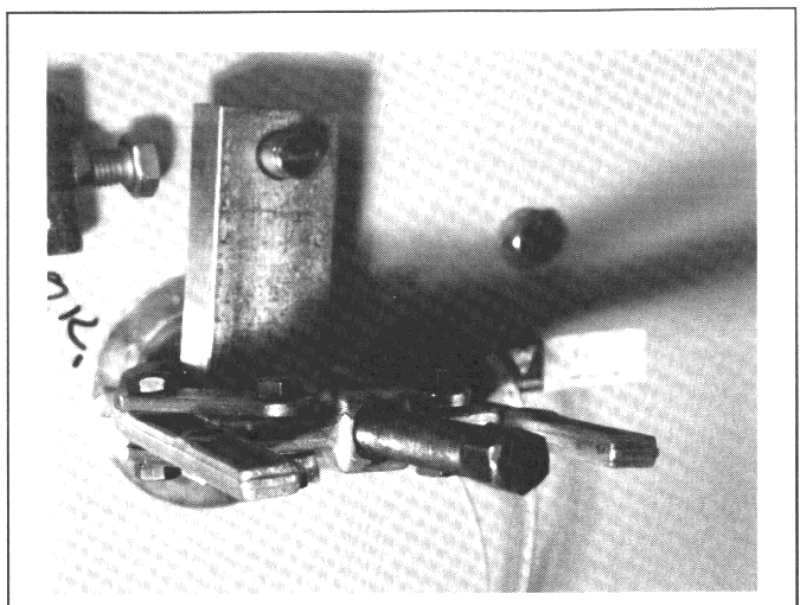
7. Open the breaker by pushing in the manual trip button. The opening spring is now blocked. Check that the spring force is acting against the pin before removing the spring. If it is not, remove the pin and repeat steps 2-7.



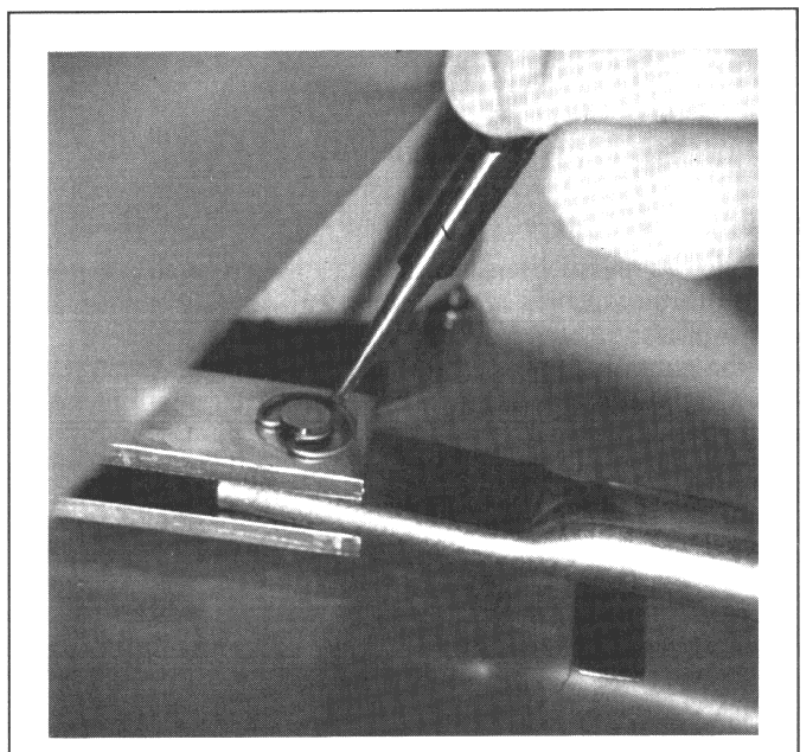
8. The next step is to remove the stop crank from the interrupter shaft. This requires disconnecting the rod that links the opening spring guide to the stop crank by removing the Baumann ring.



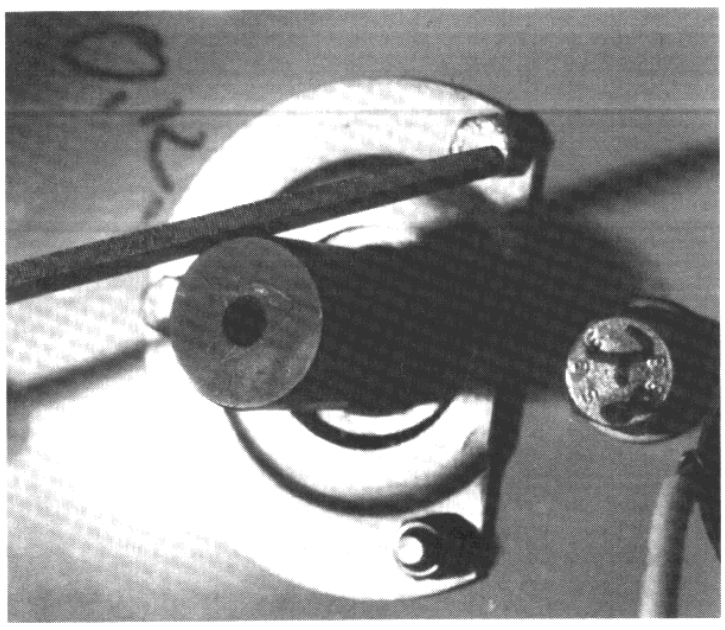
9. Remove the nut from the locking pin and knock out the locking pin.



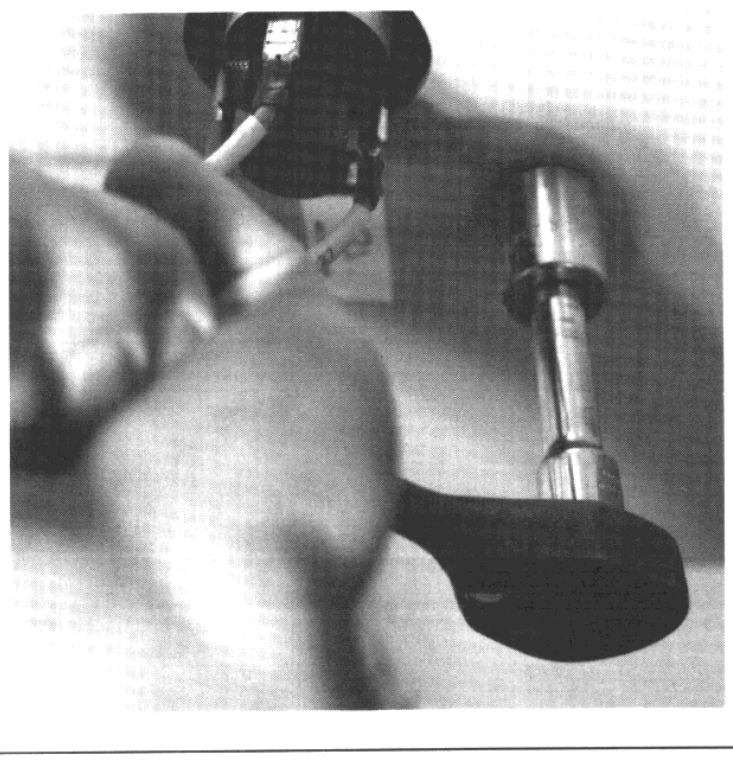
10. After marking the direction the locking pin fits into the stop crank, use a gear puller to remove the stop crank.



11. Remove the connecting rod between interrupters by removing the five accessible Baumann rings (two on either end, one in the center).
12. Disconnect the flex connectors from the interrupter bottle and retain all hardware.



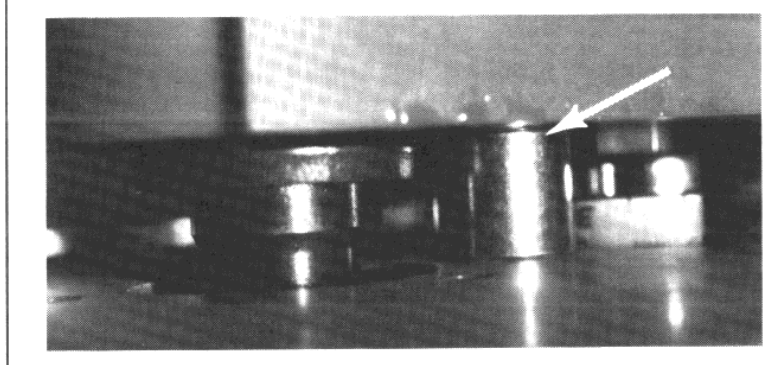
13. The rotating shaft of the bottles fits through a close fitting bearing. Burrs are formed on the bottle shaft due to breaker operation. It is necessary to remove these burrs by carefully filing before removing the bottle.
14. Wipe shaft of filings before removing bottle.



15. While supporting the interrupter remove the three mounting bolts from the interrupter. Carefully remove the interrupter (weighs approx. 35 lbs.) by lifting it from the mounting channel and out of the high voltage compartment.

CAUTION: Handle the interrupter with care, as it is pressurized to 22 psig, and may explode if dropped.

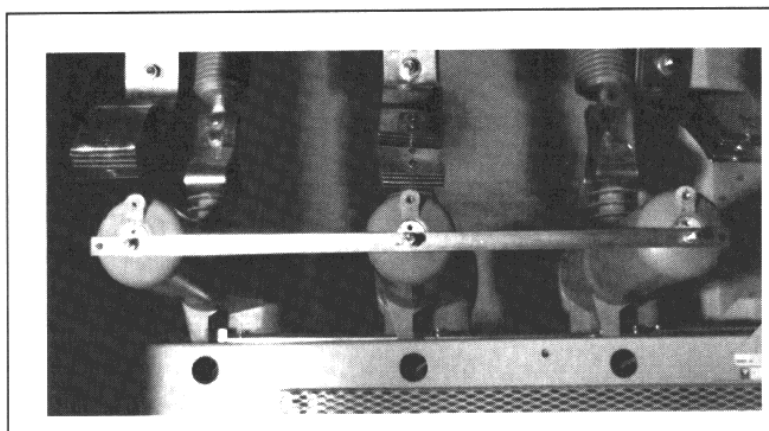
16. The interrupter removed should be discharged of SF6 gas and disposed of properly according to local codes and regulations.



(Note: the spacer between the interrupter and the frame should be kept for reuse.)

INSTALLATION OF NEW INTERRUPTER:

1. Remove the cardboard protection from the new interrupter bottle and insert its drive shaft into the bearing. Tighten the three interrupter mounting bolts finger tight using the longest bolt with the spacer, do not tighten at this time.



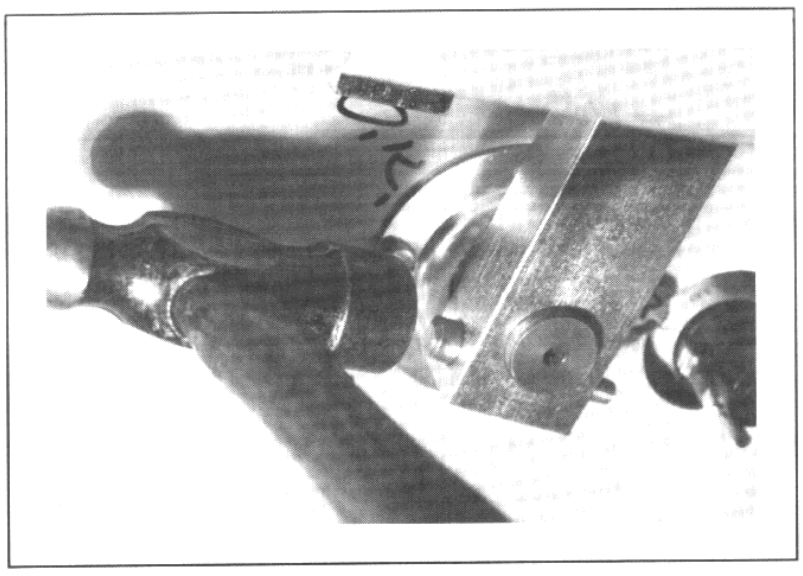
2. The bottles must be aligned properly with respect to each other. Adjust the new interrupter for correct spacing by using the connecting rod (removed in step 11) as a spacer gauge. To do this, first remove the flex connectors located at the end of each bottle. Attach the interpole connecting rod to the terminal of each bottle using the flex connector bolts to attach the rod. After this positioning of the bottle, tighten the three mounting bolts under the breaker frame to 28 ft.lbs.

   After the bottles are replaced, re-attach the flex connectors to the bottles (torque to 22-24 ft. lbs.).

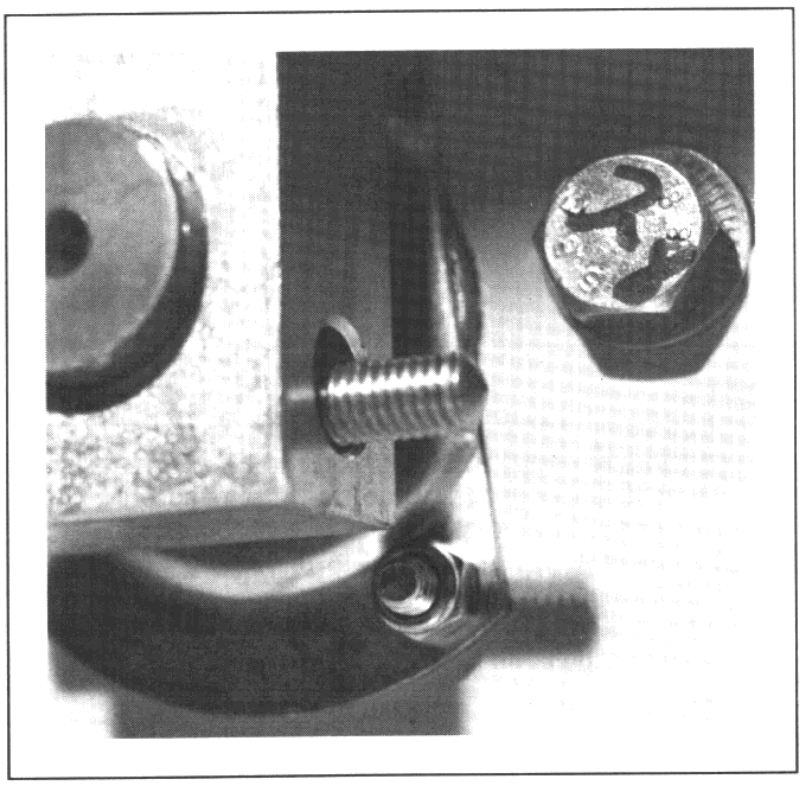
3. Next reinstall the stop crank. This requires slipping the stop crank over the bottle shaft.

CONTINUED

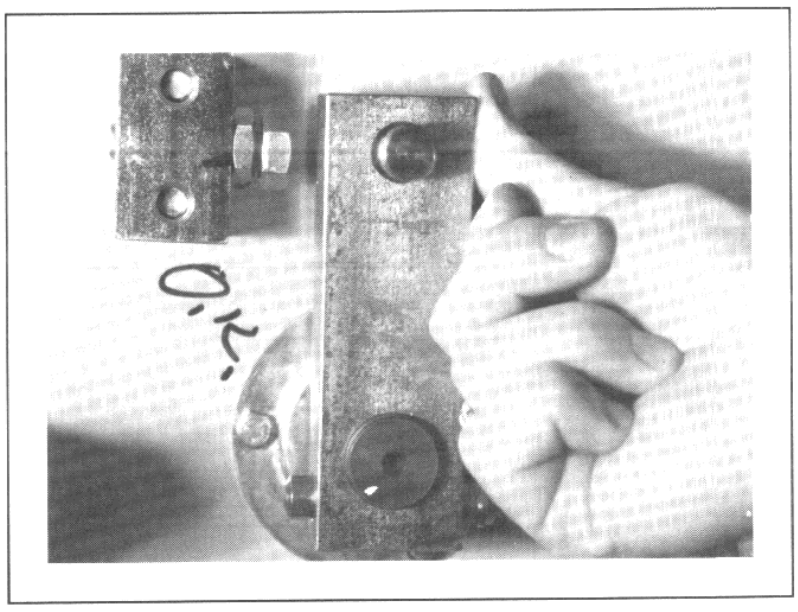
VII. CORRECTIVE MAINTENANCE (Cont.)



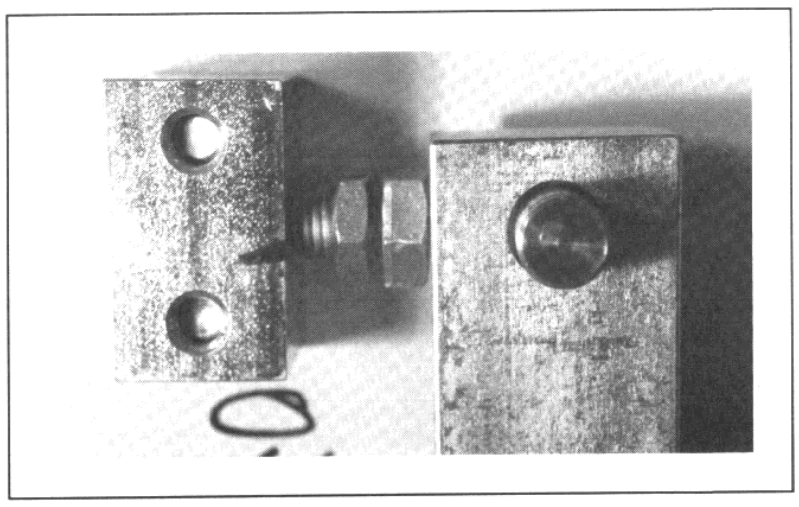
4. Grease the new lock pin, position the pin (as marked in step #10) and drive in the new pin in the same direction as the old pin was. (Driving the pin the wrong direction makes it extremely difficult to remove later.)



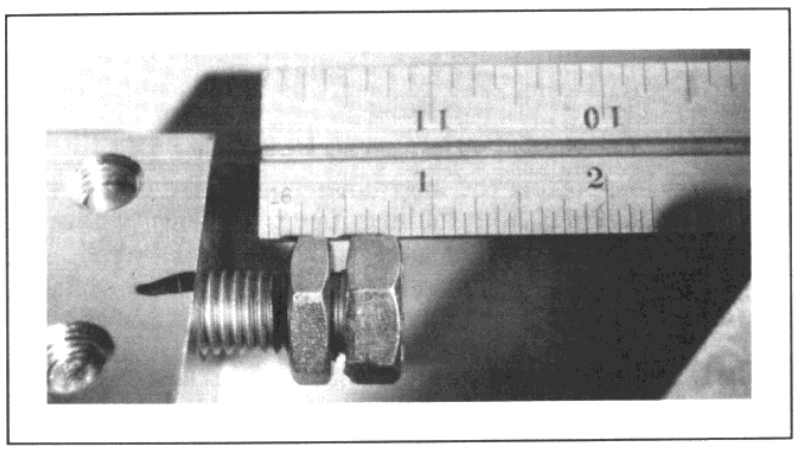
5. If the body of the lock pin can be seen sticking past the edge of the stop crank, add washers and then tighten the nut (removed in step #9) to a torque of 16 ft.lbs.



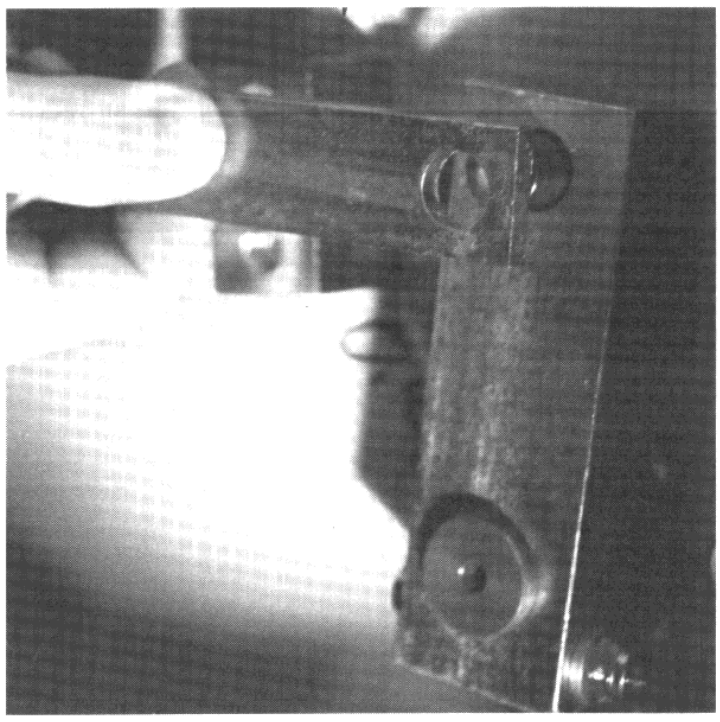
6. Next adjust the opening safety clearance to prevent the pistons from hitting the bottom of the poles when the breaker opens. This requires loosening the locknut on the stop block and threading the stop bolt completely in. Rotate the stop crank toward the stop bolt until the interrupter bottoms on the inside of the bottle. A gap should exist between the stop crank and the stop bolt.
7. Reinstall the connecting rod between the interrupters with five Baumann rings.



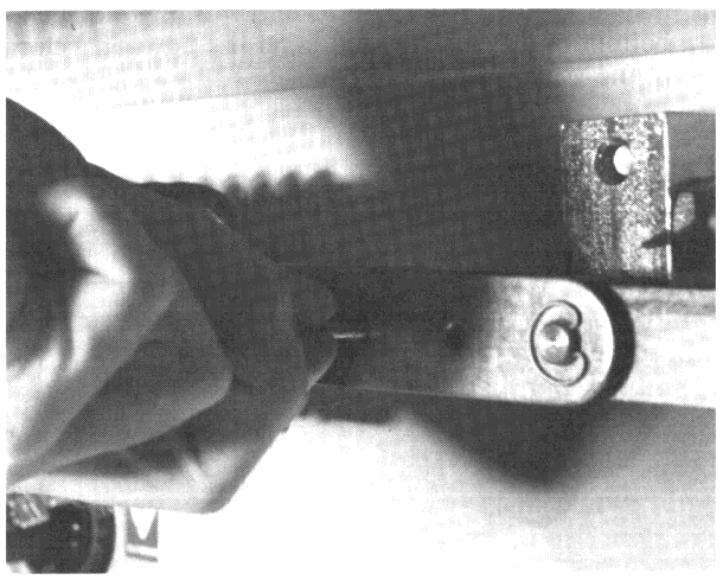
8. With the stop crank rotated as far as possible toward the stop bolt, unscrew the stop bolt until it just touches the edge of the stop crank.



9. Unscrew the stop bolt an additional .18″ (this will push the stop crank away from the stop block) and tighten the locknut to hold this position.



10. Reconnect the opening spring by attaching the rod (removed in removal procedure step #8) to the opening spring guide and the stop crank.
11. Manually charge the breaker and then manually close the breaker by pulling out the manual close button.



12. When this process is completed, the breaker should be closed and the opening springs charged. Remove the 3/16″ dia. pin from the hole in the spring guide.
13. Push the close/open button to open the breaker. Recheck that all snap rings are still secured in the proper position on the opening spring assembly.
14. A bottle contact test should now be performed to assure that all bottle contacts "make" within the acceptable range (begin with step #3 of the contact wear measurement procedure).
15. After the contact wear measurements are complete, replace the ventilation grill on the underside of the breaker. Reconnect the flex connectors to the bottles tightening them to a torque of 22-24 ft.lbs. Reattach the side access panels.
16. The breaker is now ready for reenergization.

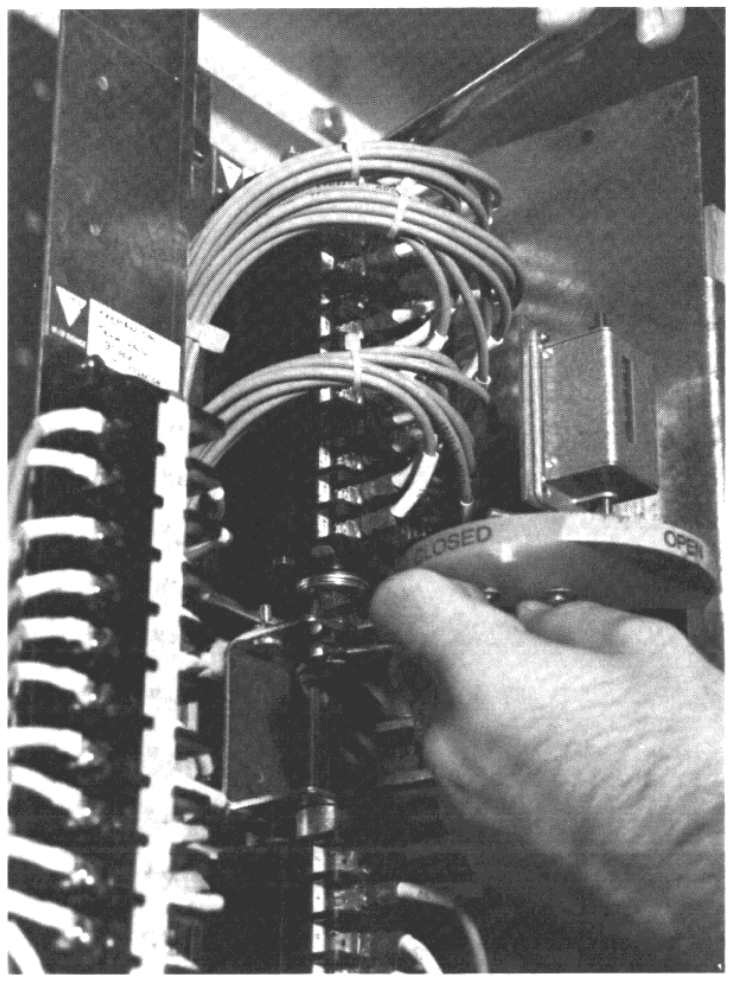
AUXILIARY CONTACT ADJUSTMENT

New parts required: none

Required tools: 8mm open end wrench, 13mm wrench, thin bladed screwdriver

As standard, FB breakers are equipped with twelve auxiliary switches. Unless specified otherwise, the twelve auxiliary switches are arranged as six normally open "a" contacts and six normally closed "b" contacts. The contacts are field convertible as follows:

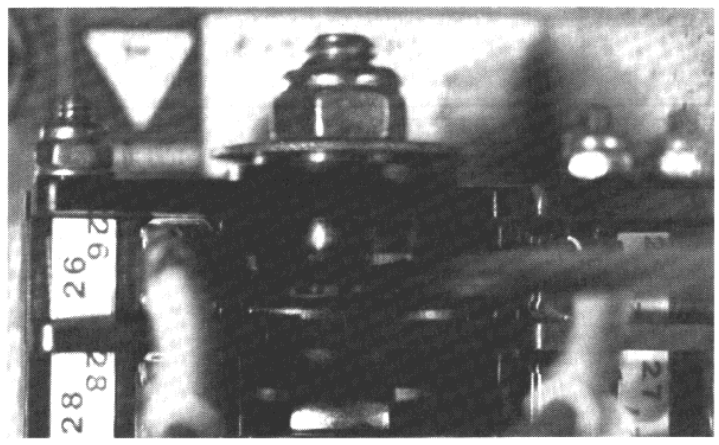
1. Note the position of each cam with the breaker closed and opened. A pencil sketch is recommended.
2. Open or close the breaker to position the cam, to be adjusted, in the open position.
3. Hold the square end of the shaft using an 8mm open end wrench.



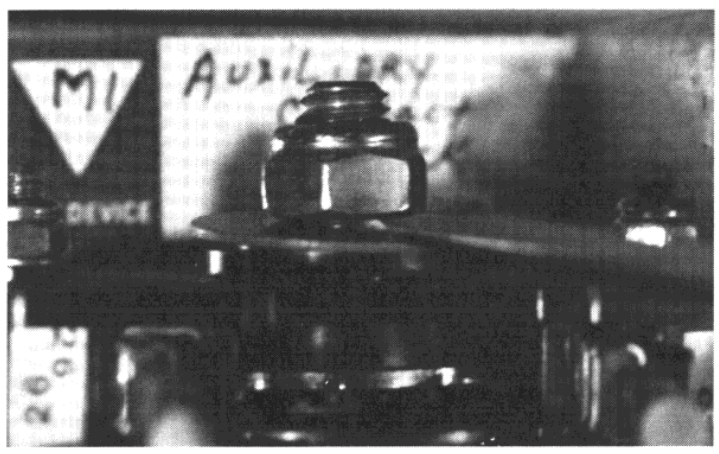
4. Using a 13mm wrench, loosen the locknut on the opposite end of the shaft one or two turns.

CONTINUED

VII. CORRECTIVE MAINTENANCE (Cont.)



5. Insert a thin bladed screwdriver between the metal cam and the notched ring of the contact to be adjusted to separate and release the indentation in the metal cam from the notched ring.
6. The cam is now free to turn. Rotate the cam to the new position.

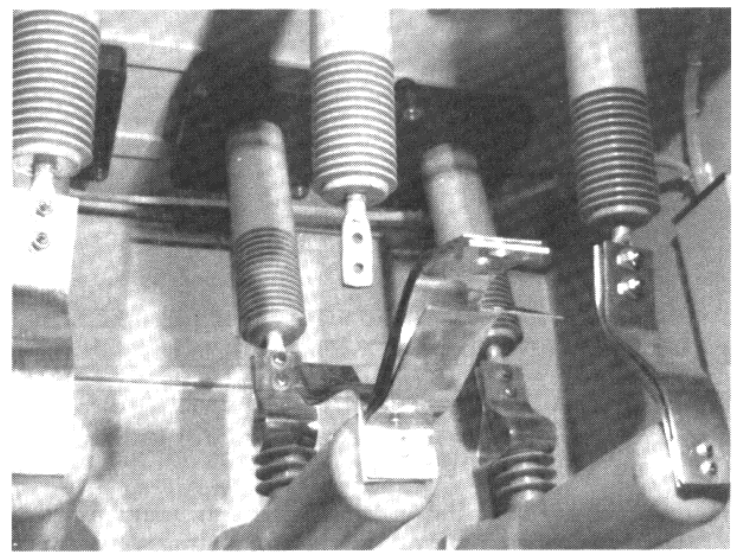


7. Insert the screwdriver between the nut and washer at the end of the block to reclose the gap between the metal cam and the notched ring. The cam may need to be moved slightly to align the indentation and the notch.
8. Retighten the 13mm locknut taking care that all of the other cams are in their original position and all the cam indentations are properly seated in their respective notches.
9. Operate the breaker to assure that the adjustment accomplished the purpose intended, and that all other cams operate as before.

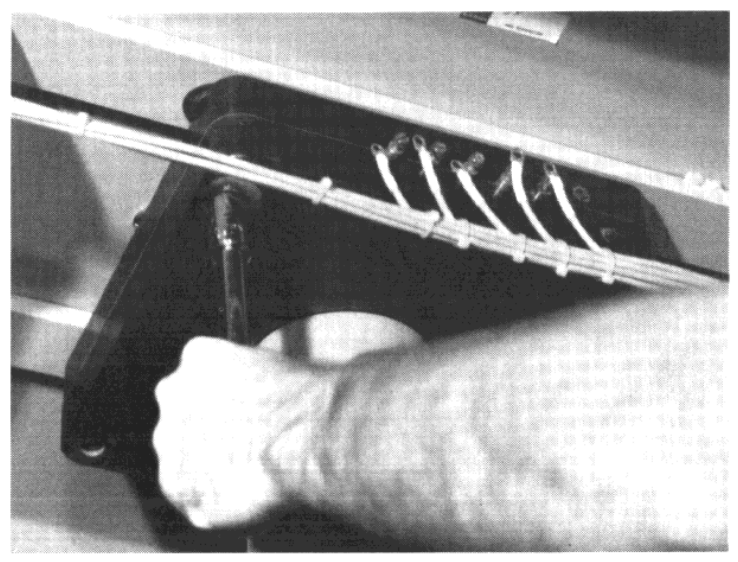
CT REPLACEMENT

New parts required: new CT to be installed
Required tools: 9/16″ open end wrench, ratchet, 9/16″ socket, 3/4″ socket, 3/4″ combination wrench, torque wrench and 5/16″ socket with drive to fit torque wrench.

1. Remove all power from the breaker.
2. Remove the two access panels from the high voltage compartment to gain access to the CT's.

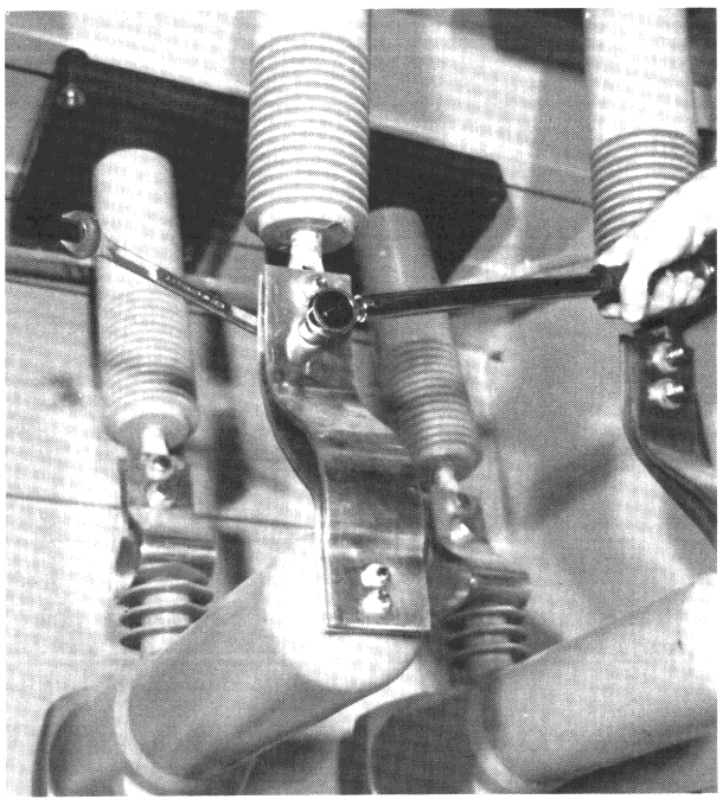


3. Unbolt the flex connector at its connection on the bottom of the bushing and bend the flex connector out of the way.
4. Disconnect the CT wiring at the CT.



5. Remove the two 3/8-16 retaining nuts used to hold the CT in place and remove the CT.
6. Be certain to observe the polarity marks when installing the new CT's. Install the new CT with polarity marks in the same direction as the old CT.

7. Bolt the new replacement CT back into place with the two retaining nuts (removed in step #5) and torque each to 25 ft.lbs.
8. Reconnect the CT wiring at the CT and torque each connection to 30 in.lbs.



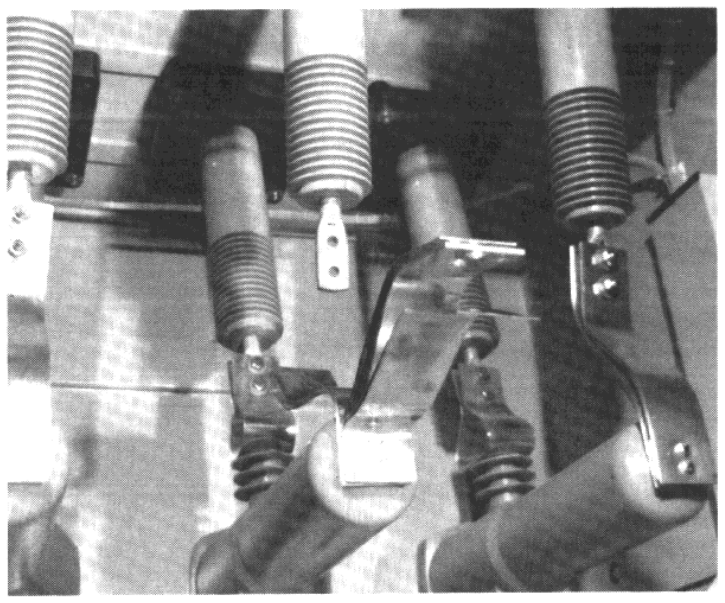
9. Bolt the flex connector back onto the bushing with a required torque of 70 ft.lbs.
10. Reattach the side access panels, the breaker is now ready for reenergization.

BUSHING REPLACEMENT

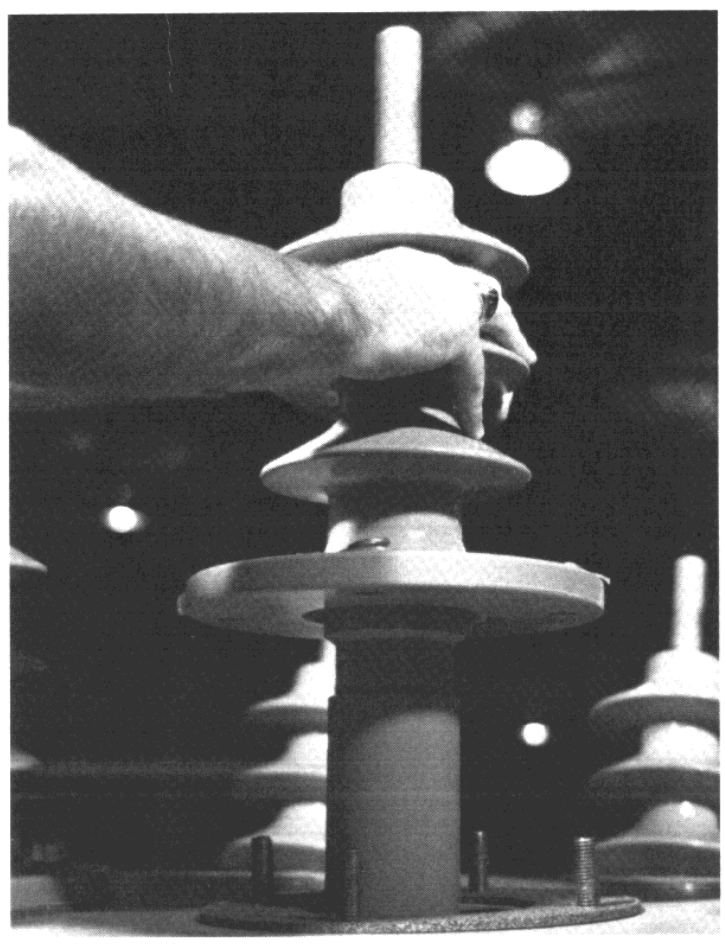
New parts required: silicone caulking, new bushing, cork neoprene gasket, ground strap

Required Tools: caulking gun, screwdriver, ratchet, 9/16″ socket, 3/4″ socket, 9/16″ open-end wrench, 3/4″ combination wrench, torque-wrench, 7/16″ socket

1. Remove all power from the breaker.
2. Remove the two access panels from the high voltage compartment to gain access to the bushings.



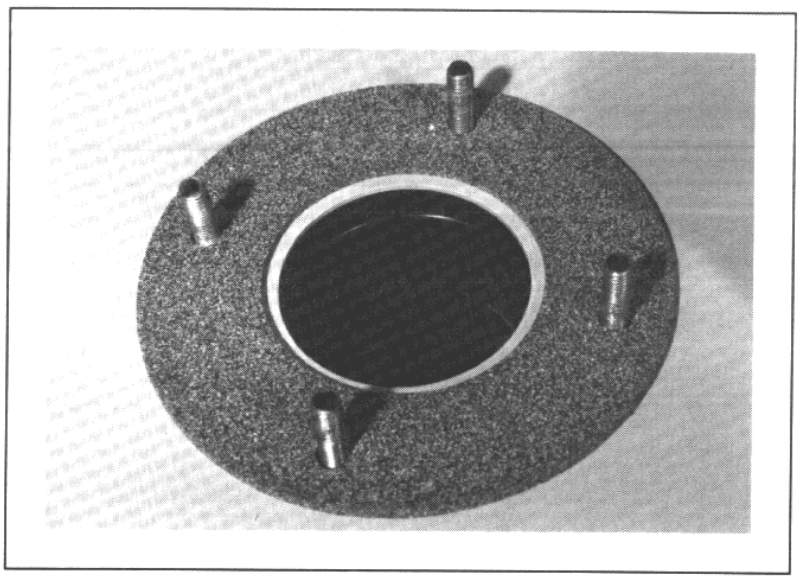
3. Unbolt the flex connector at its connection on the bottom of the bushing and bend the flex connector out of the way.
4. Remove all four bolts mounting the bushing to the roof.



5. After unbolting the bushing, lift the bushing out through the top of the roof.

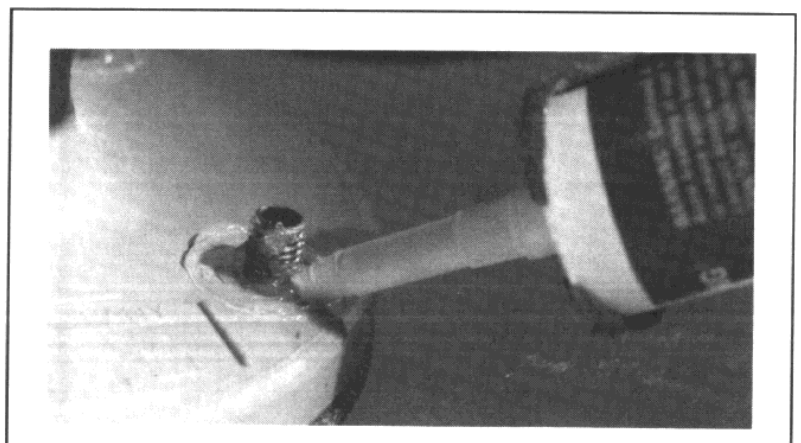
CONTINUED

VII. CORRECTIVE MAINTENANCE (Cont.)

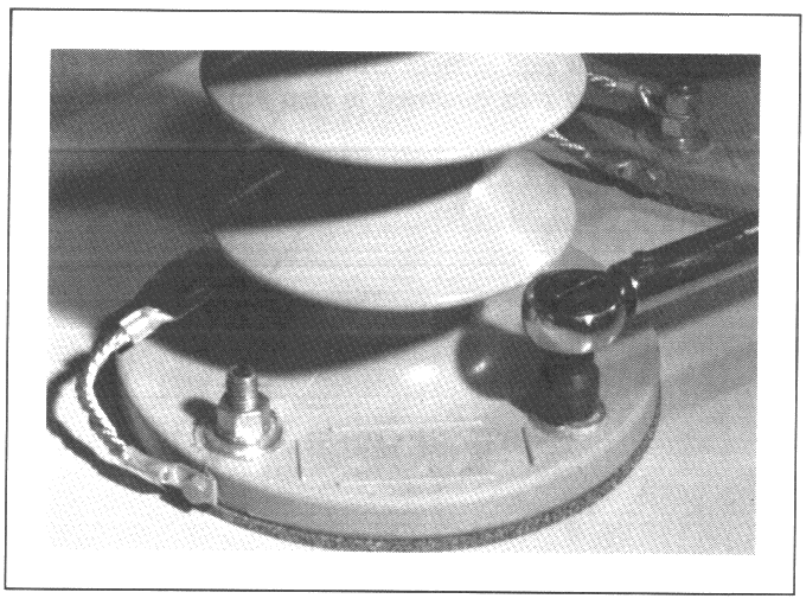


6. Before installing a new bushing, examine the condition of the cork gasket. If the old gasket is damaged or appears brittle, a new gasket should be used.

7. Remove the ground strap from the old bushing and examine. If the ground strap appears damaged, replace it with a new ground strap.



8. Insert the new bushing into place. Silicone caulk should be used to fill the gap between each mounting bolt and each clearance hole in the bushing to avoid any water getting into the high voltage compartment.



9. Carefully tighten one bolt and then the one opposite to evenly distribute the force on the bushing flange. Gradually torque each mounting bolt to 30-35 ft.lbs. for 15.5 kV and 40-45 ft.lbs. for 25.8/38 kV.
10. Bolt the flex connector back onto the bushing with a required torque of 70 ft.lbs.
11. Reattach the side access panels, the breaker is now ready for reenergization.

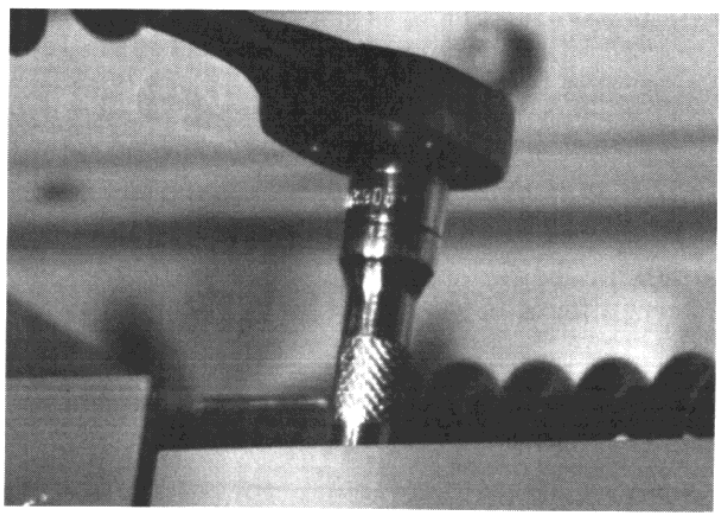
OPENING AND CLOSING SOLENOID REPLACEMENT

New parts required: Opening or closing solenoid.

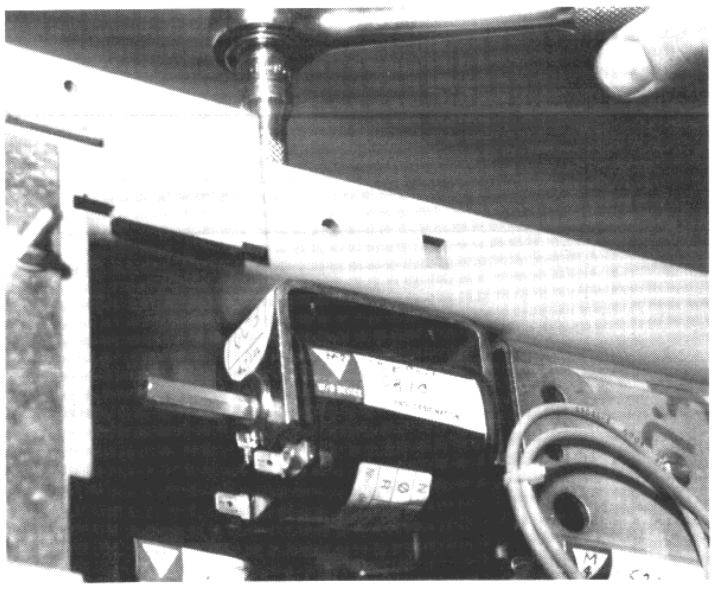
Required tools: 10mm sockets, ratchet.

The following instructions are for the replacement of either solenoid:

1. With the mechanism discharged and the breaker open, disconnect all control power.



2. Remove wires, unscrew both screws to remove the solenoid.
3. Before installing the new solenoid, check that the part number of the new solenoid corresponds to that of the old solenoid.



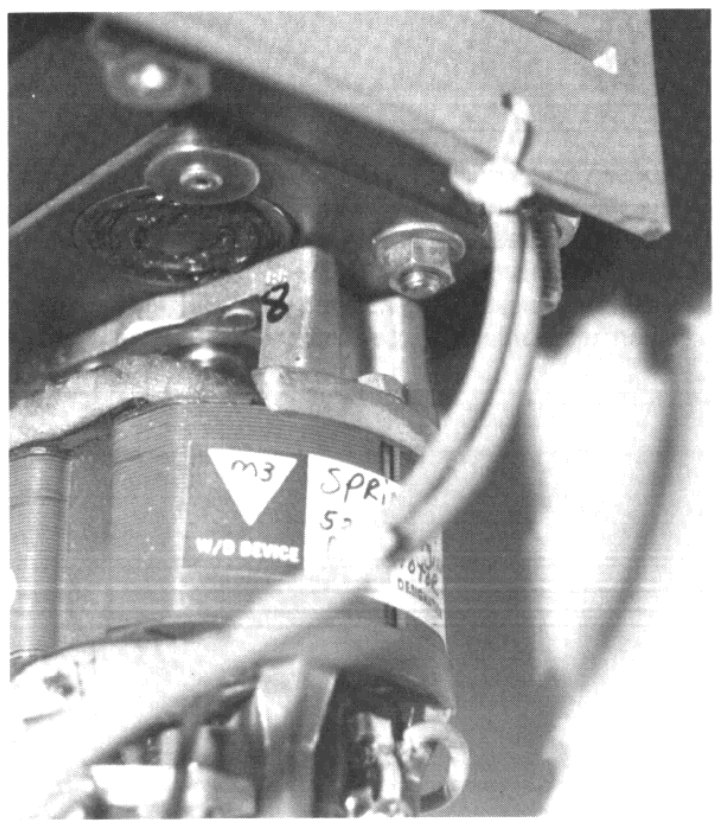
4. Position the new coil so that the plunger shaft is pointed toward the latch assembly. The opening coil should be positioned flush with the flange of the frame. No other special positioning is required.
5. Reattach wires.

MOTOR REPLACEMENT

New parts required: Motor

Required tools: 10mm socket, ratchet.

1. With the mechanism uncharged and the breaker open, disconnect the power.



2. Remove wires and unscrew both mounting screws to remove the motor.
3. Before installing the new motor, check the output pinion on the new motor is identical to that of the replaced motor.
4. Attach the motor to the mounting plate removed in step 2 and mount the plate to the frame with two screws removed in step 2.
5. Reattach the wires.

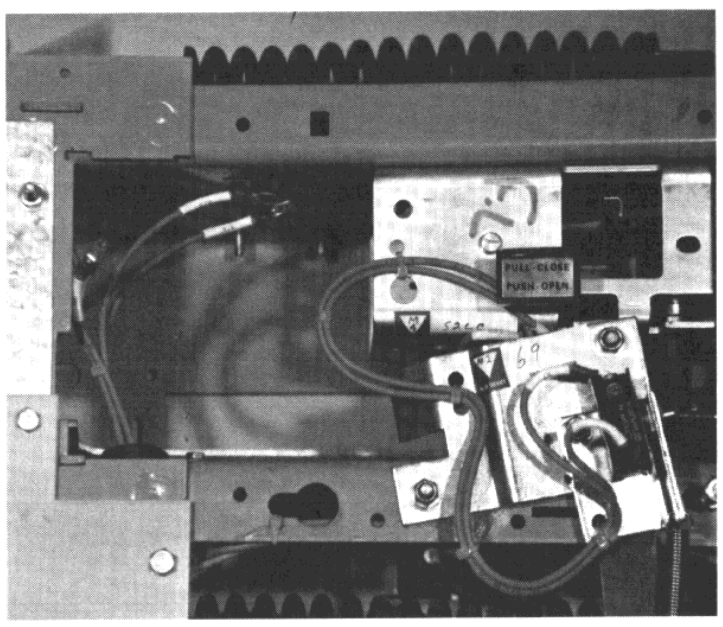
LATCH MECHANISM BOX REPLACEMENT

New parts required: latch mechanism box, .156″ dia. pop rivet.

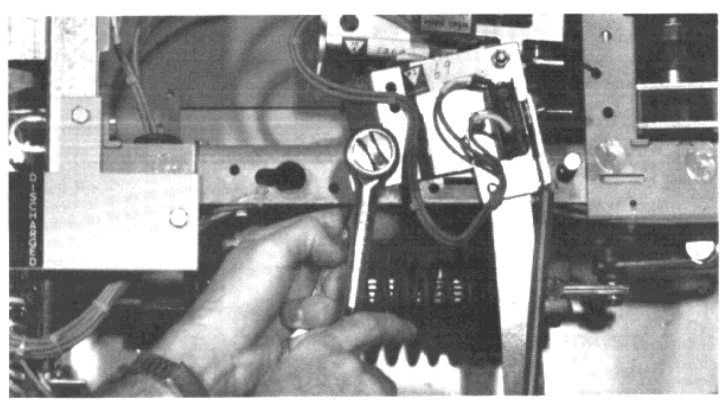
Required tools: .625″ dia. x 3.06″ long steel shaft, hand riveter, ratchet, 13mm socket, 13mm wrench, 5/16″ socket, 5/16″ wrench.

Should the latch mechanism need replaced, observe the following steps.

1. With the mechanism discharged and the breaker open, disconnect all control power.



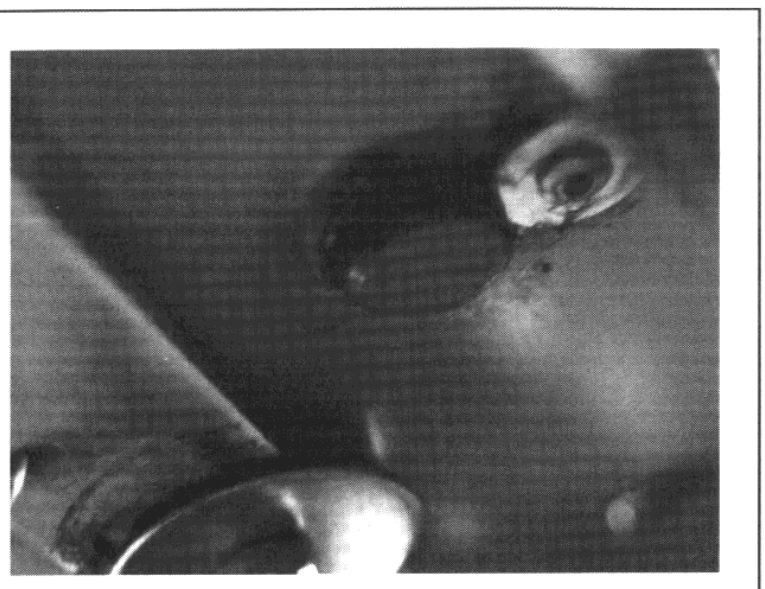
2. Remove the opening and closing solenoids to gain access to the latch mechanism box. (See the Opening and Closing Solenoid Replacement section for the instructions if needed.)



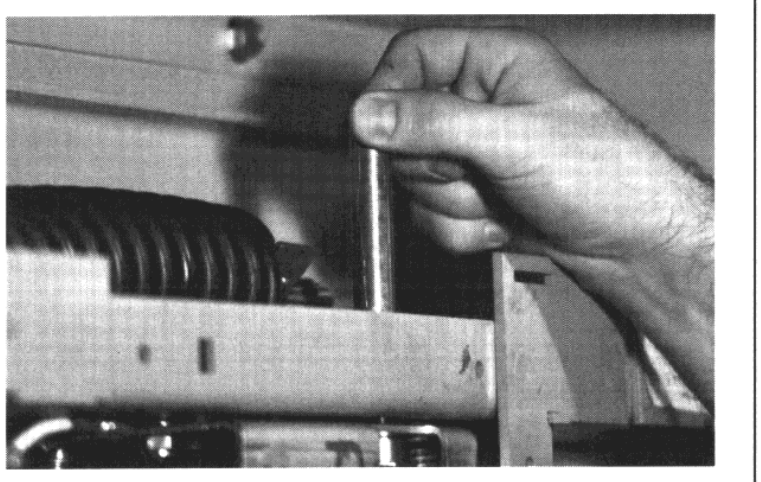
3. Remove the emergency trip mechanism by removing the mounting bolt in the frame.

CONTINUED

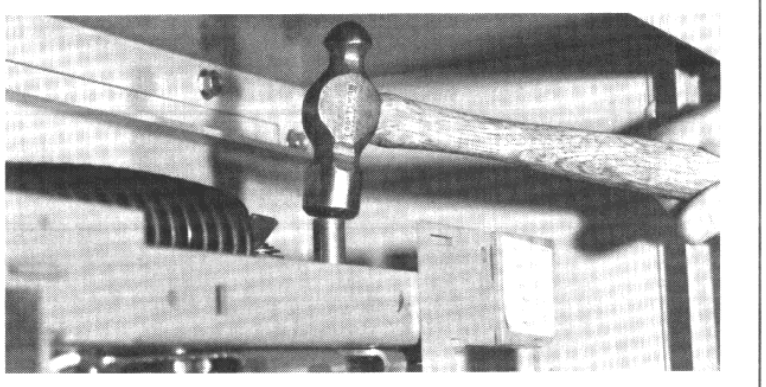
VII. CORRECTIVE MAINTENANCE (Cont.)



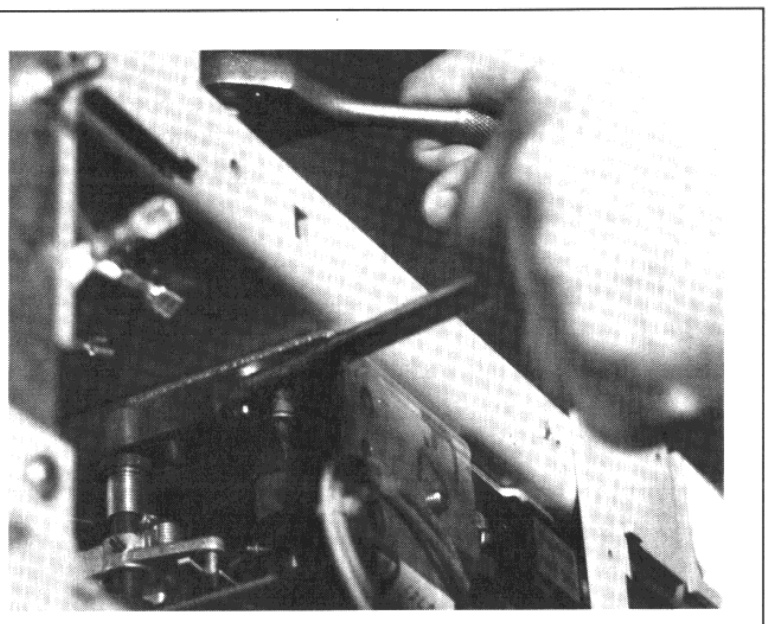
4. On the underside of the frame, the latch box shaft is held in position by a retaining washer fitted into a groove on the shaft. A pop rivet attaches the retaining washer to the frame; remove this pop rivet and then remove the washer.



5. The next step is to remove the mechanism latch box by replacing the original long shaft with the shorter 5/8″ x 3-1/16″ shaft. The shorter shaft allows the latch box to be removed and the shaft remains inside the removed latch box to keep all the internal parts aligned.

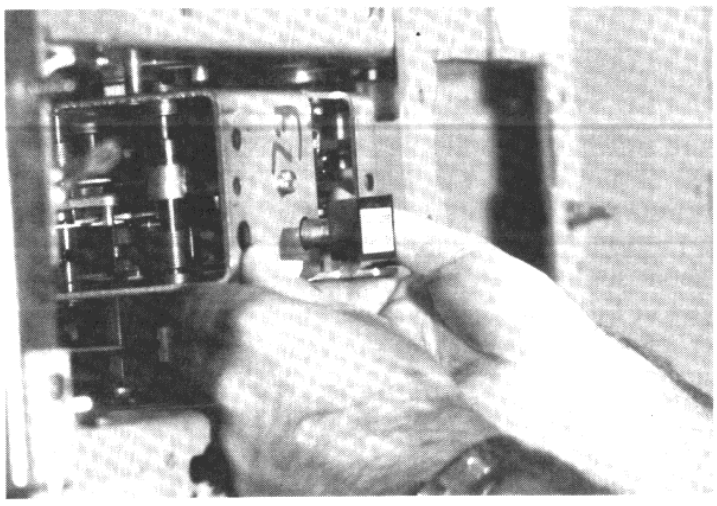


From the topside of the frame drive the 5/8″ x 3-1/16″ shaft downward displacing the original shaft just enough for the latch box and both shafts to clear the frame when removed.

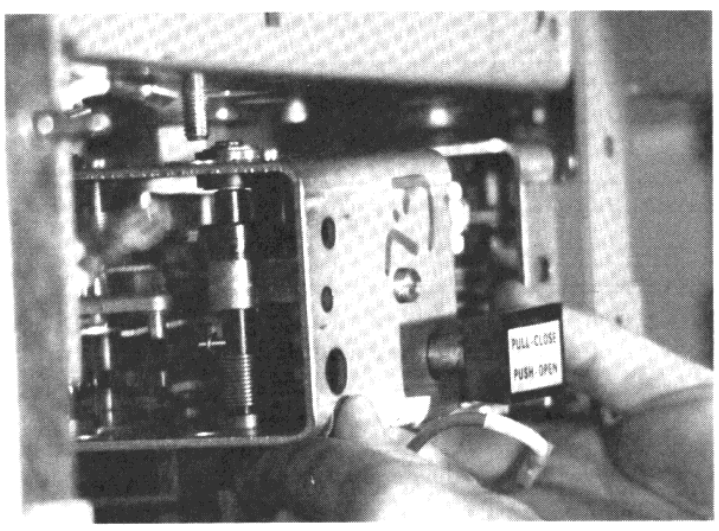


6. Loosen and remove the mounting bolt at the top of the mechanism frame. When the mounting bolt is removed a washer (spacer) will fall out from between the mechanism frame and the latch box. Save this washer; it must be used again as an alignment spacer when reinstalling the new latch box.

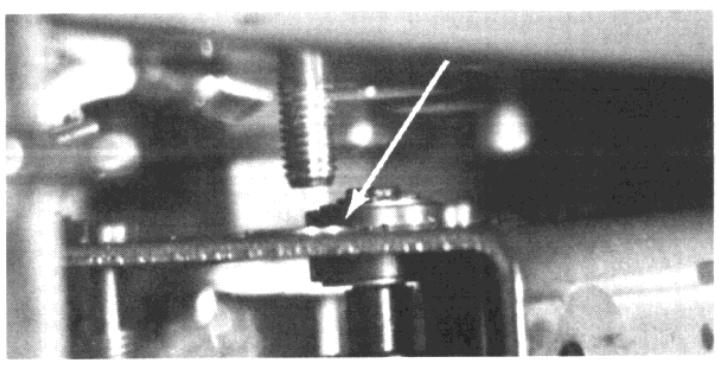
SF_6 SUBSTATION CIRCUIT BREAKER
TYPE FB (Series 2)



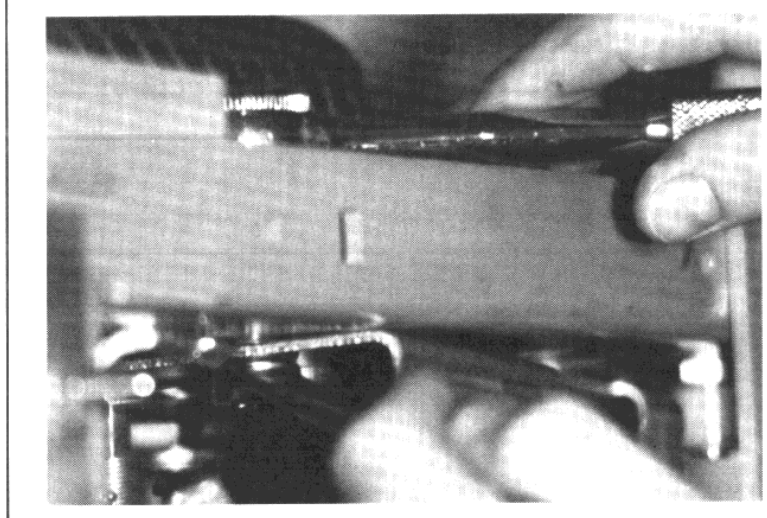
7. With the mounting bolt removed and the shaft displaced (in Step 5) allowing the latch box to clear, remove the entire latch box assembly.



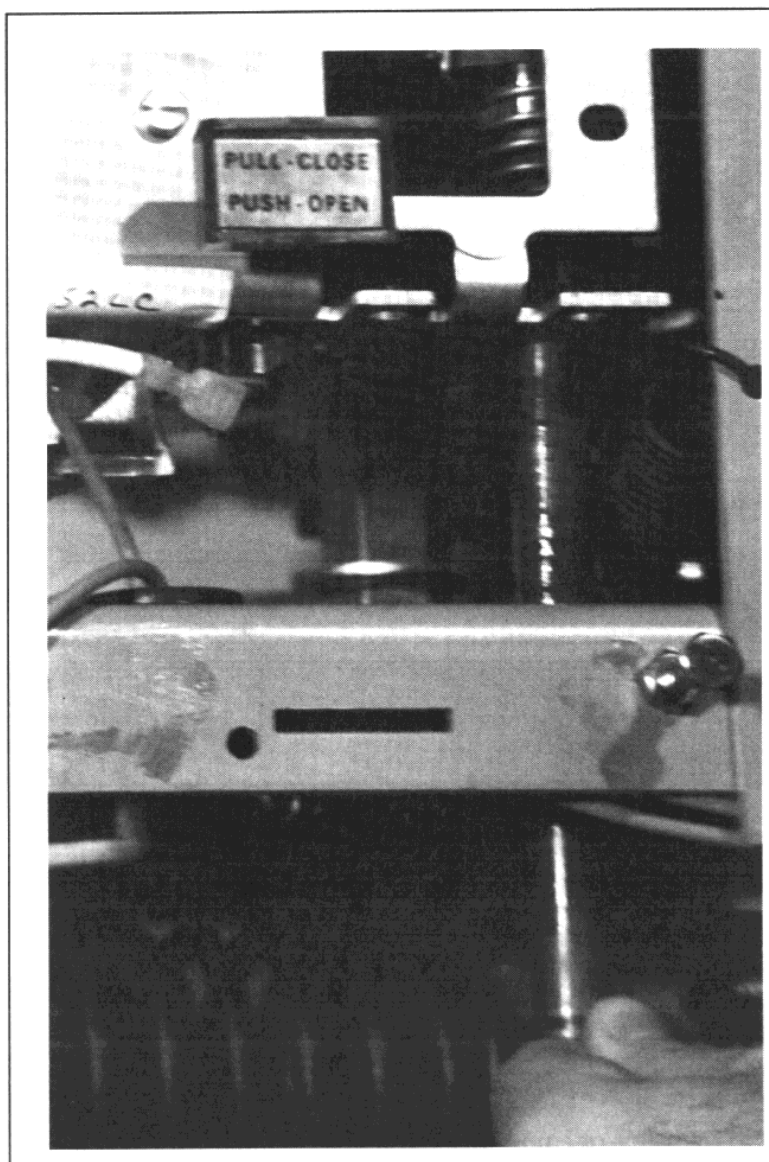
8. A short shaft (like the one inserted in Step 5) is supplied with the new latch box assembly to temporarily hold internal parts aligned and allow insertion of the latch box assembly into position. Slide the new latch box into its proper position.



9. Slide the washer removed in Step 6 between the latch box and the mechanism frame.



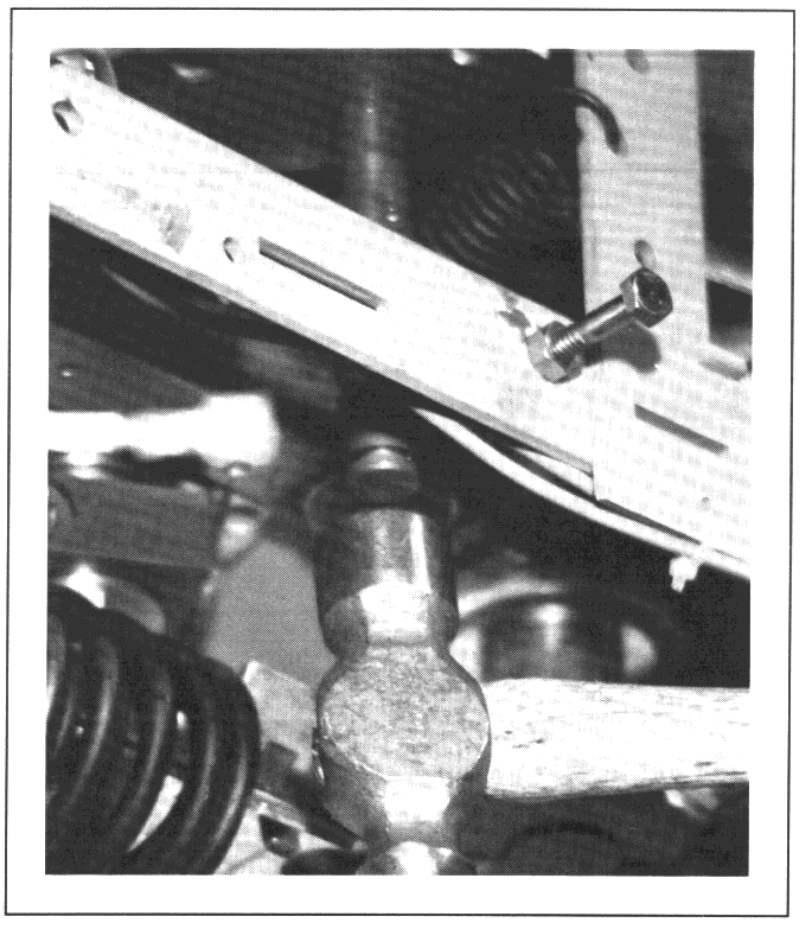
10. Insert the mounting bolt through the spacer, and partially tighten.



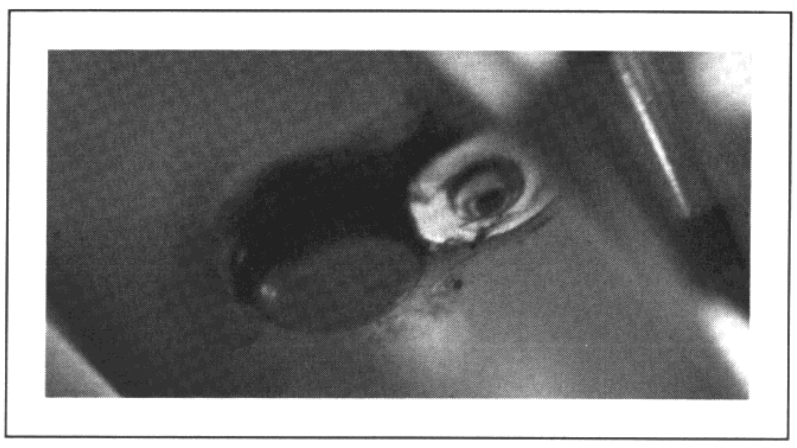
11. With the new latch assembly in position, push the long shaft into the latch assembly to remove the short shaft originally provided with the new latch assembly. Completely remove the short shaft and keep it for re-use with this replacement procedure again.

CONTINUED

VII. CORRECTIVE MAINTENANCE (Cont.)



12. Position the shaft so the retaining washer slides into the groove on the shaft, and attach the retaining washer to the frame with a 5/32″ dia. pop rivet or metric equivalent.



13. Finish tightening the latch box mounting bolt from Step 10.
14. Reattach the emergency trip mechanism removed in Step 3.
15. Reinstall opening and closing solenoids. (See Solenoid Replacement section for further instructions if needed.)
16. The breaker should now be ready for re-energization.

PRESSURE SWITCHES

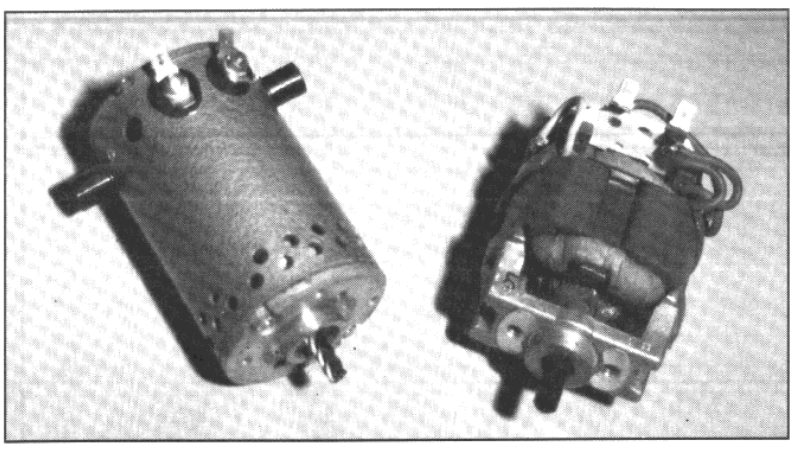
Pressure switches are available as optional equipment for the purpose of providing a warning of a low pressure situation. The pressure switch contact closes when the pressure goes below 7.5 psig. The pressure switches are part of the permanent sealing system of the interrupter and can not be replaced in the field. Contact your Square D field office for further information if you have or suspect a problem with the pressure switch.

TROUBLESHOOTING GUIDE

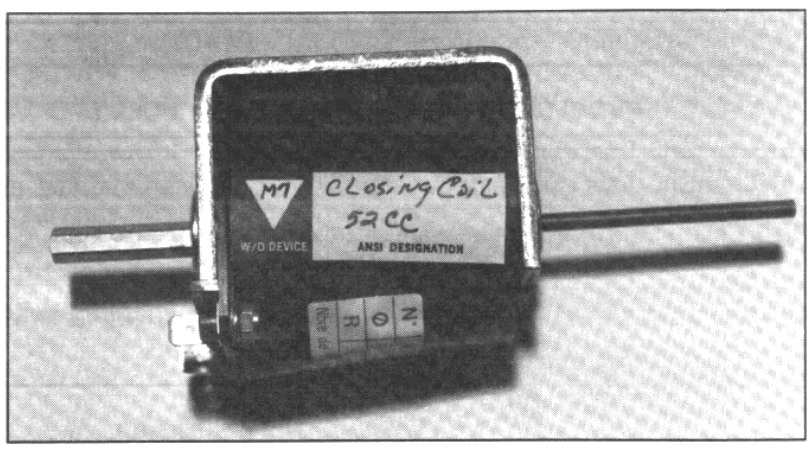
These instructions allow shutdown periods to be kept to a minimum. If the suggested remedies fail to solve the problem, refer to the factory.

PROBLEM	POSSIBLE CAUSE	PROBABLE REASON & REMEDY
Mechanism does not charge automatically	Electrical charging motor	Voltage across motor terminals too low • Correct the voltage • Replace the motor if necessary
	End of charging switch	• Check condition of switch • Replace switch if necessary
	Wiring	• Check connections of auxiliary circuits
Breaker will not close (indicator remains green)	Closing solenoid	Bad Connection • Check circuit Defective solenoid • Replace the solenoid
	End of charging switch	• Check condition of switch • Replace the switch if necessary
	Latch sub-assembly mechanism	Close Interlock out of position • Clean and oil Interlock Hinge Shaft
	Charging rachet system	Mechanism isn't getting charged • Change the mechanism
Breaker closes and opens immediately and remains open on subsequent attempt to close.	Continuous trip signal applied	Fault in the HV main circuit or protective relays adjusted incorrectly. • Eliminate the fault • Adjust protective relay
Breaker opens and closes alternately	Anti-pump relay	• Replace the relay
Breaker cannot be opened electrically	Auxiliary switch	• Check circuit
	Trip solenoid	Trip control power connections • Check the circuit Defective solenoid • Replace the solenoid • Check protective circuit

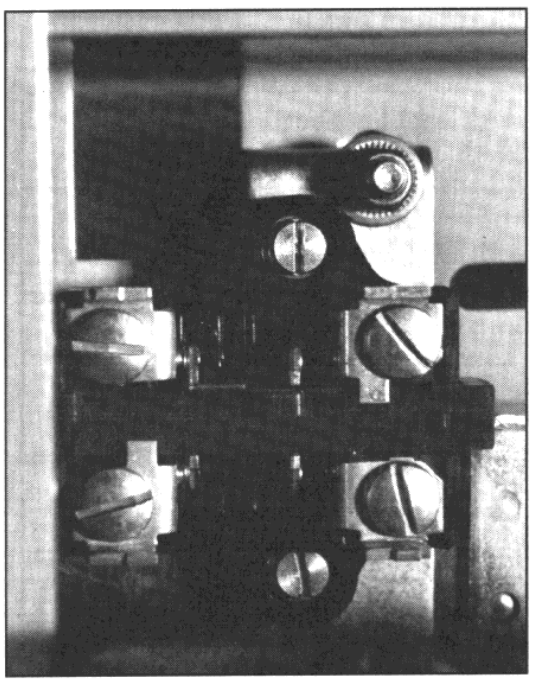
REPLACEMENT PARTS —See Page 30 for Part Numbers.



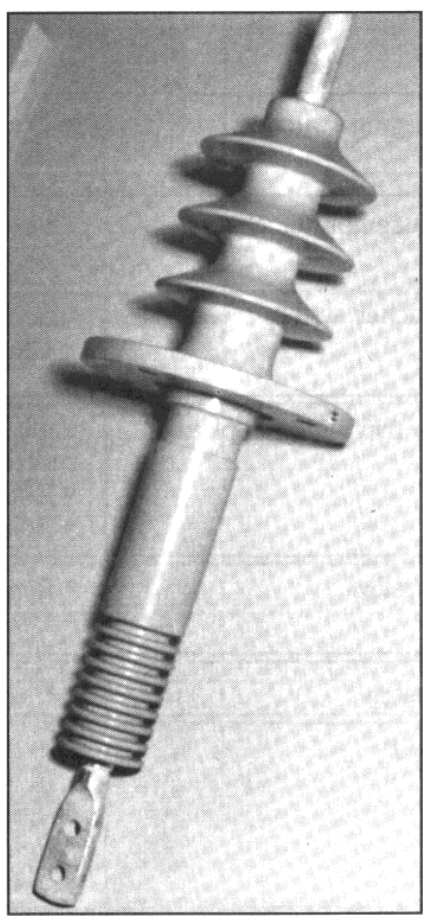
Charging Motors



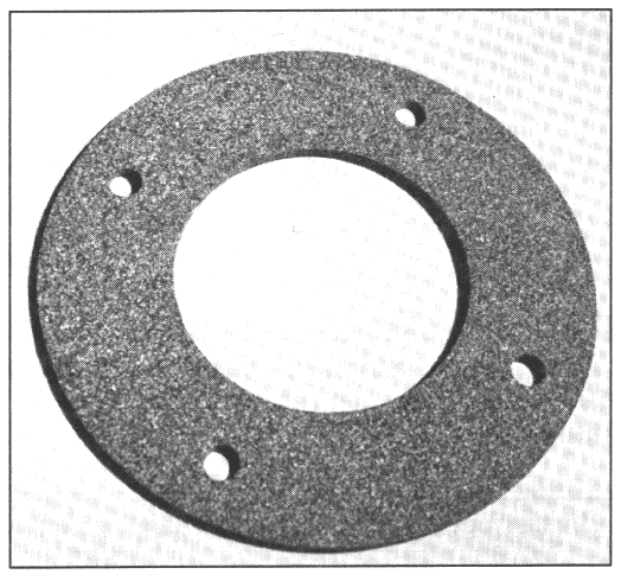
Closing Solenoid



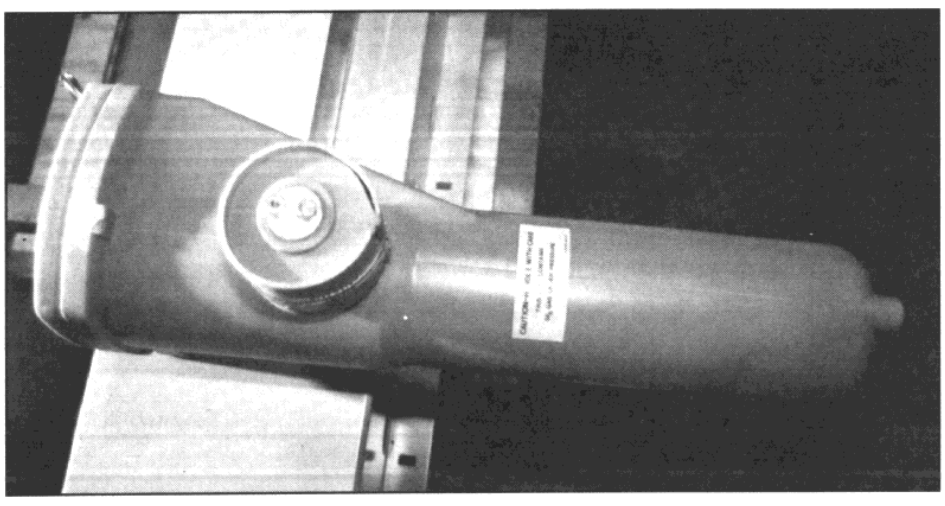
End of Charging Contact



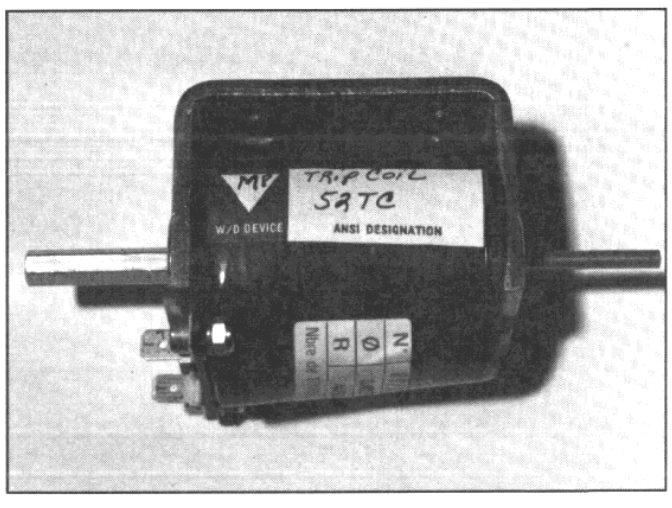
Bushings



Cork Bushing Gasket

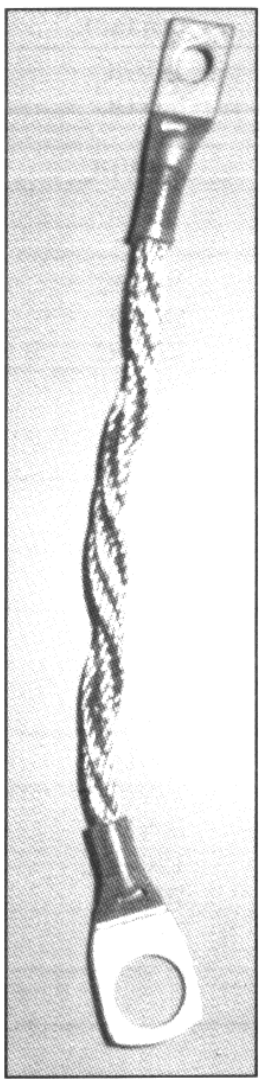


Interrupters

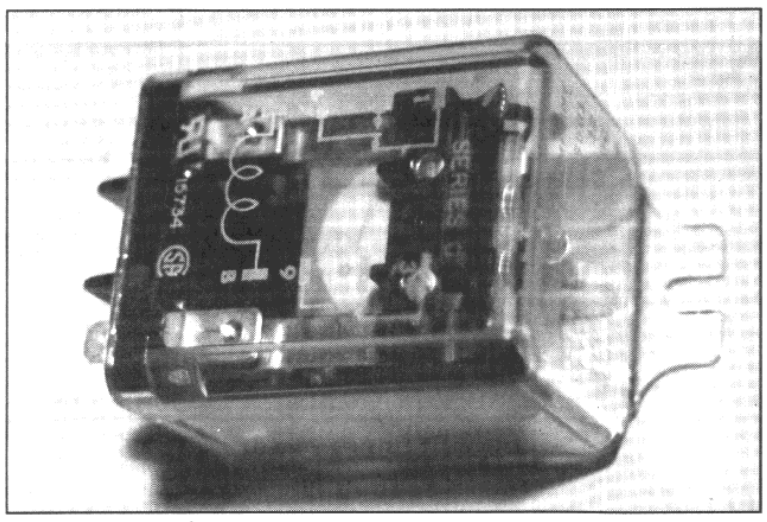


Trip Solenoid

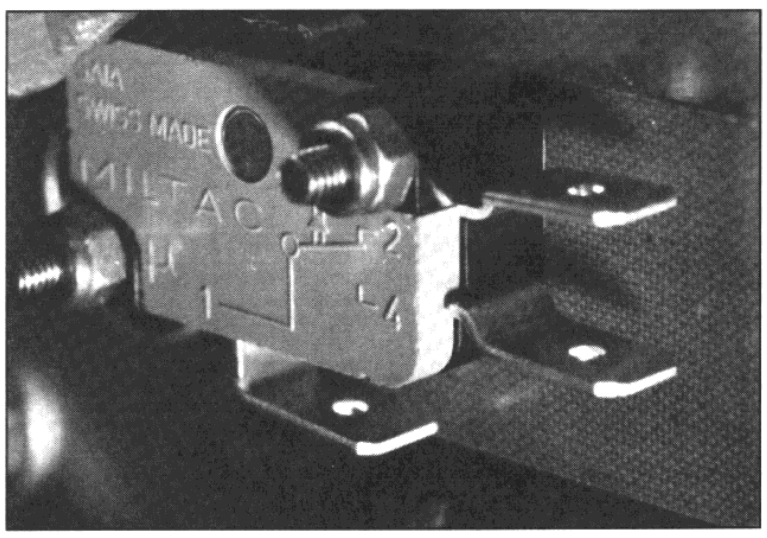
REPLACEMENT PARTS —See Page 30 for Part Numbers.



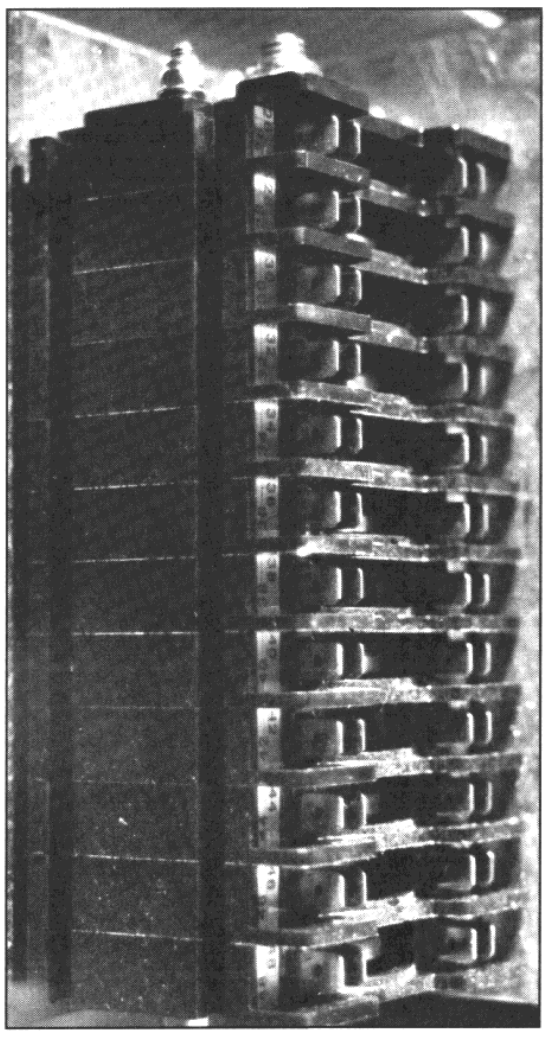
**Bushing
Ground Strap**



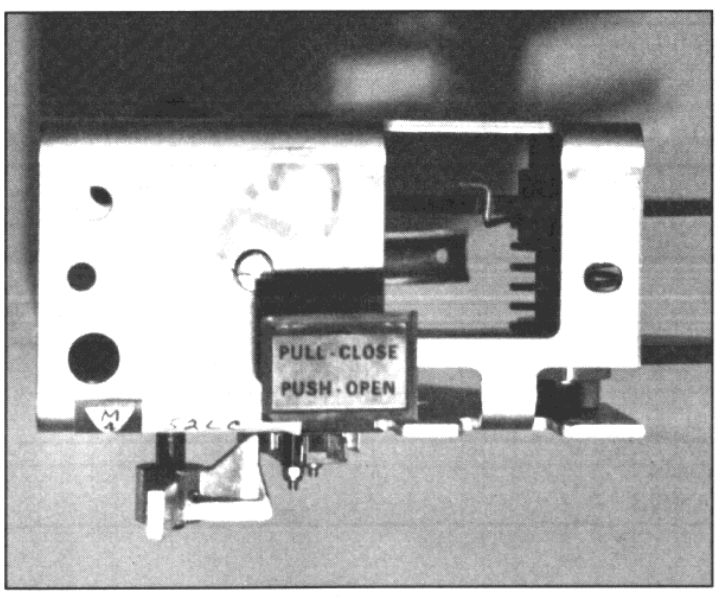
Anti-Pump Relay



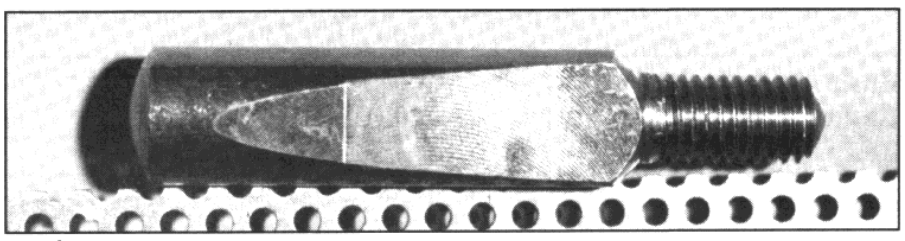
Latch Check Switch



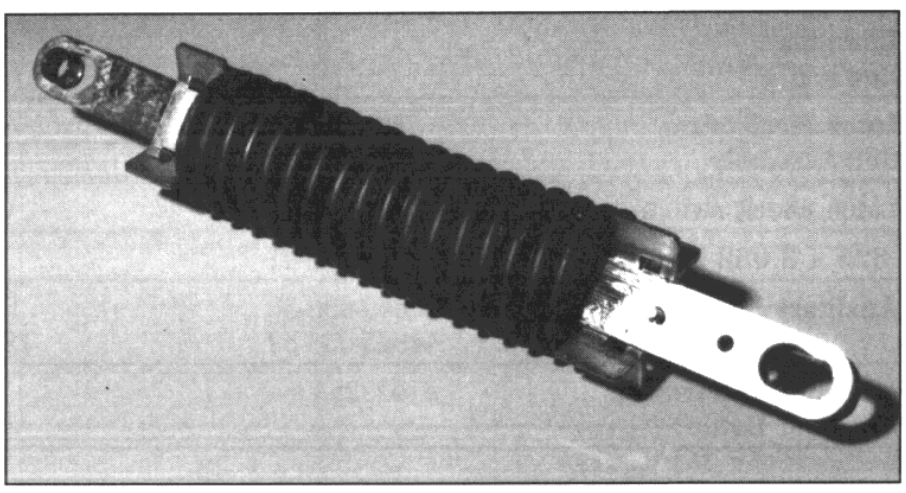
Auxiliary Contact Blocks



Latch Mechanism Assembly



Locking Pin



Spring Assembly

REPLACEMENT PARTS

When ordering replacement parts always specify the complete rating nameplate information, description of parts, operating voltage, and catalog number if applicable.

REPL. PART	PART NUMBER	RATING	VOLTAGE OPERATE RANGE	MINIMUM OPERATING VOLTAGE
Charging Motor	886657	24VDC		14VDC
	886658	48VDC	36-56VDC	30VDC
	886661	125VDC		
	886662	250VDC	180-280VDC	180VDC
	886661	120VAC		
	886662	240VAC		
Closing Solenoid	44065-389-01	24VDC		16VDC
	44065-389-02	48VDC	36-56VDC	28VDC
	44065-389-03	125VDC	90-140VDC	72VDC
	44065-389-04	250VDC	180-280VDC	126VDC
	44065-389-05	120VAC	104-127VAC	65VAC
	44080-590-01	240VAC	208-254VAC	120VAC
Anti-Pump Relay	8501KFD12-24VDC	24VDC		18VDC
	KUP11D55-48VDC	48VDC		36VDC
	8501KFD12-110VDC	125VDC	90-140VDC	94VDC
	8501KFD12-125VDC & 26160-21660	250VDC		
	8501KF12-120/60	120VAC	104-127VAC	98VAC
	44050-266-01	240VAC	208-254VAC	196VAC
Trip Solenoid	44080-590-20	24VDC	14-28VDC	12VDC
	44080-590-21	48VDC	28-56VDC	24VDC
	44065-389-23	125VDC	70-140VDC	60VDC
	44080-590-22	250VDC	140-280VDC	120VDC
	44065-389-25	120VAC	104-127VAC	70VAC
	44065-389-26	240VAC	208-254VAC	140VAC
	887191BJ	125VDC 3 AMP		
Bushing	44081-311-01	15.5 kV		
	44081-312-01	25.8/38 kV		
Interrupters	730031B + 730759B	Bottle w/o Pressure Switch		
	730031B + 730759C	Bottle w/Pressure Switch		
Bushing Gasket	44081-313-01	15.5 kV		
	44081-313-02	25.8/38 kV		
Bushing Ground Strap	44081-386-50			
End of Charging Contact	25710904			
Latch Mechanism Sub-Assembly	9011400C1			
Latch check switch	730734A			
.625 x 3.062 Shaft	44081-250-01			
Auxiliary Switches	44065-038-50	5 Contacts		
	44065-038-52	12 Contacts		
Locking Pin for Stop Crank of Bottle	#1022263			

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