

Type PSD Magnetic-Air Circuit Breakers (15 kv)

Installation, Operating Principles, Maintenance, Adjustments,
Parts Replacement, and Testing Instructions

Service Information

S300-10-1

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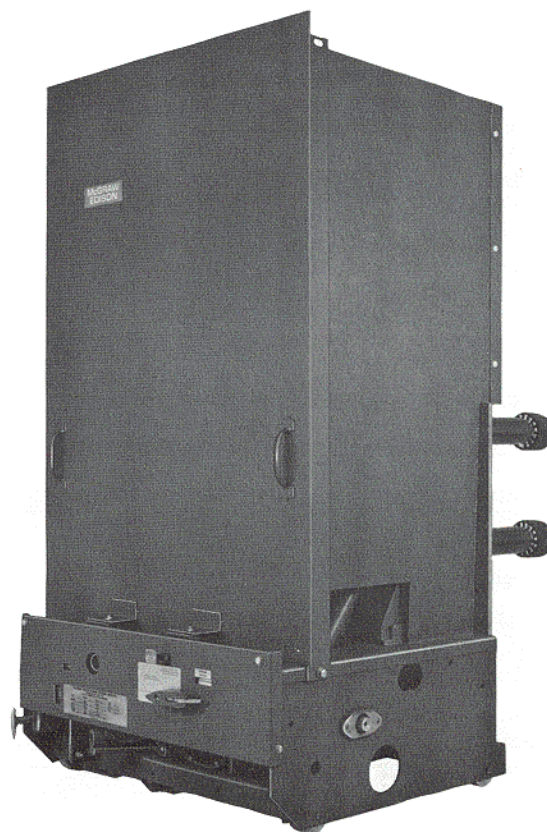


FIGURE 1
Typical McGraw-Edison Company
15-kv PSD magnetic-air circuit breaker.

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These instructions do not claim to cover all details or variations in the equipment, procedure, or process described, nor to provide directions for meeting every possible contingency during installation, operation, or maintenance. When additional information is desired to satisfy a problem not covered sufficiently for the user's purpose, please contact your McGraw-Edison Power Systems Division sales engineer.



McGRAW-EDISON COMPANY
Power Systems Division
Canonsburg, Pennsylvania 15317

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New Issue

GENERAL

Service Information S300-10-1 pertains specifically to McGraw-Edison 15-kv Type PSD magnetic-air circuit breakers (Figure 1). This breaker is operated by a hydraulically charged, compressed-spring, stored-energy mechanism.

PSD magnetic-air circuit breakers conform to all applicable national standards for magnetic-air, three-pole circuit breakers.

A detailed wiring diagram of the breaker and instruction book for the auxiliary switch are supplied with each order.

IDENTIFICATION RECORDS

Retain the following records for permanent breaker identification:

- Wiring diagrams.
- All pertinent instructions.

Accurate and complete identification—including serial number and rating—must accompany any reference to, or inquiry about, the breaker to McGraw-Edison Power Systems Division.

SHIPPING

Each PSD circuit breaker is shipped disassembled in two corrugated cardboard containers. The containers are enclosed in polyethylene bags and wire-strapped to wood pallets. One carton contains the circuit breaker with the operating mechanism installed; the other carton contains the steel front ground barrier, the interphase barrier assembly; and the three arc chutes packed with desiccant.

INITIAL INSPECTION

Immediately upon receipt of the equipment:

1. Open the shipment:

NOTE: Exercise care not to damage the equipment while uncrating.

- A. Remove the banding.
- B. Remove the tie-down blocks from the skid.
- C. Remove the polyethylene-covered carton by lifting the carton straight up.

2. Inspect the equipment for damage, evidence of rough handling in transit, and/or shortage.

- A. If there is damage, evidence of rough handling in transit, and/or shortage, notify—and file a claim with—the carrier at once.
- B. Also notify McGraw-Edison Company, Power Systems Division, Switchgear Service Section, Canonsburg, Pa 15317.

NOTE: Notification of shipping damage claims beyond 15 days after receipt cannot be handled on a warranty basis due to the difficulty in establishing carrier/purchaser responsibility for damage.

STORAGE

If the breaker is not to be placed in service immediately upon receipt, the contents of both containers must be resealed.

1. Replace the polyethylene-covered cartons.
2. Replace—and secure—the tie-down blocks on the skids.
3. Store—but do not stack—the cartons in a clean, dry storage area.

UNCRATING

Do not reopen the cartons containing the breaker, steel front barrier, interphase barrier assembly, and arc chutes until ready to install the breaker in the metalclad compartment.

1. Uncrate the breaker:

- A. Remove the tie-down blocks from the skid.
 - B. Remove the polyethylene-covered carton by lifting the carton straight up.
 - C. Remove all the packing.
 - D. Remove the bolts securing the breaker to the skid.
 - E. Remove the breaker from the skid.
- (1) If necessary, attach a hoist—or similar overhead lifting device equipped with a spreader bar that will protect the current-carrying components—to the lifting holes in the sides of the breaker. (Figure 2)

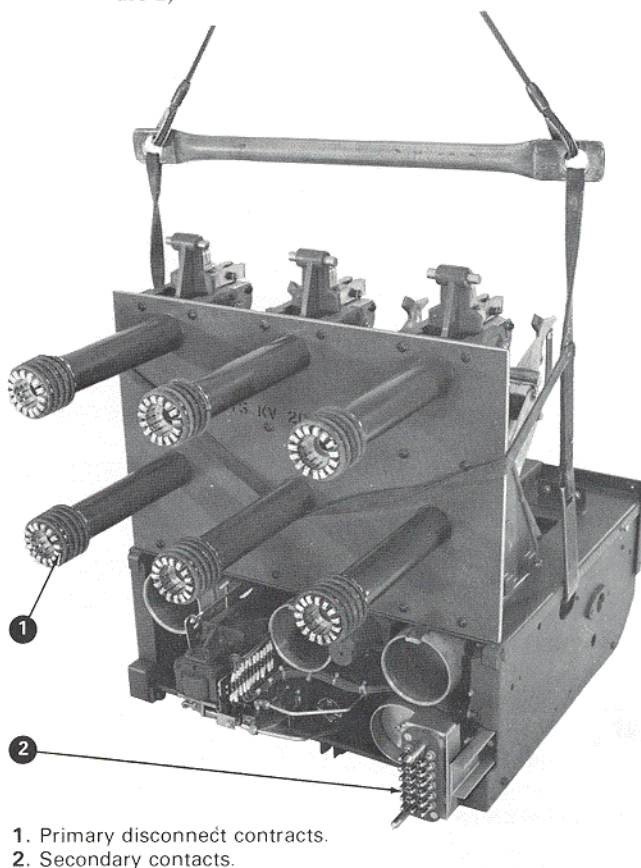


FIGURE 2

Lifting a 15-kv PSD circuit breaker.

2. Uncrate the steel front barrier:

- A. Remove the tie-down blocks from the skid.
- B. Remove the polyethylene-covered carton by lifting the carton straight up.
- C. Remove the cushioning material and desiccant.
- D. Lift the steel front barrier from the skid and set it aside.

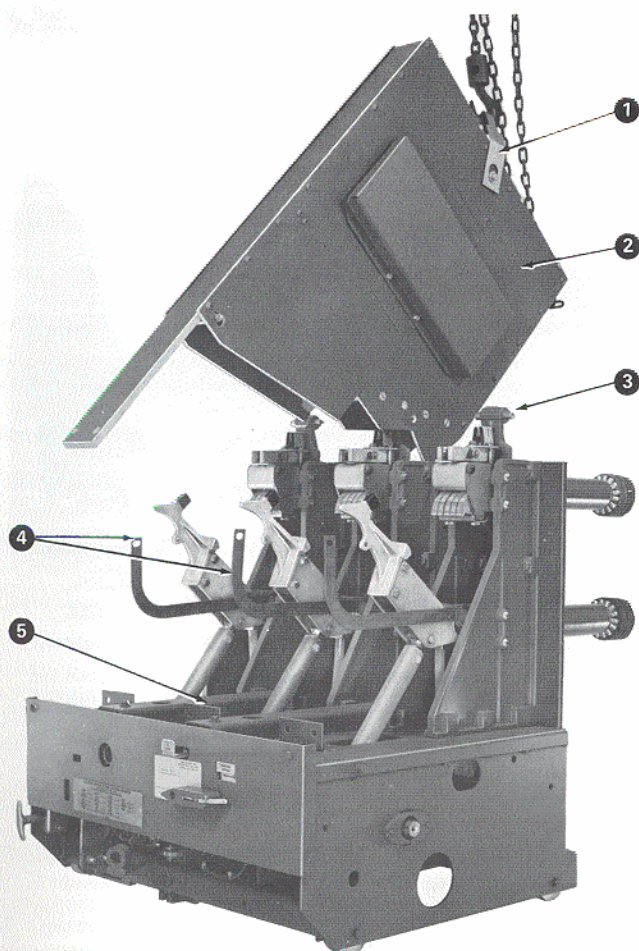
3. Uncrate the interphase barrier assembly:

- A. Unbolt and remove the wood brace from the three arc chutes.
- B. Carefully lift the interphase barrier assembly up over the arc chutes and set it aside.

4. Uncrate the arc chutes:

Uncrate arc chutes (which are packed upside down for shipping) one at a time and, as each chute is removed from the skid, it should be installed on the breaker.

- A. Remove one corrugated block.
- B. Carefully roll one arc chute off the skid onto its end.
Do not drop or bump the chute. The ceramic-type material in the arc chute will break if abused.
- C. Inspect the arc chute for damage and/or foreign material.
 - (1) To remove foreign material, blow out the chute with dry, filtered, low-pressurized air.
- D. Slip the lifting yoke (supplied with the metalclad unit) over the extended lugs at the top center on each side of the arc chute as shown in Figure 3.
- E. Using a small hoist—or similar overhead lifting device—carefully lift the arc chute and move it into position above the breaker.



1. Lifting yoke.
2. Arc chute in tilted position.
3. Hinge pin.
4. Fasten connector to arc chute terminal.
5. Fasten arc chute with bolts, washers, and nuts.

FIGURE 3

Installing an arc chute on a 15-kv PSD circuit breaker.

ASSEMBLY

1. Install the arc chutes:

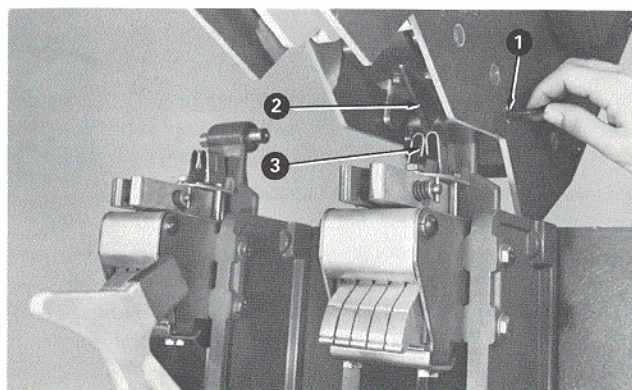
Install the middle arc chute first (Figure 3).

- A. Remove the shipping bag from the breaker and take out the flathead, hex-socket Nylok capscrews.
- B. Be sure the arc chute contact at the top of the arcing contact assembly has been coated at the factory with a very thin film of contact grease. (Figure 4)
 - (1) Contact grease should be a lubricant such as Dearborn Chemical Company NO-OX-ID "A".
- C. Lower the arc chute in a tilted position onto the breaker and maneuver the slots on the inside lower back of the chute over the hinge pin on the breaker as shown in Figure 3.
- D. Make sure the rear runner blade is lined up to engage the arc chute contact. (Figure 4)
- E. Screw a flathead, hex-socket Nylok capscrew through the hole on each side of the arc chute and into the hinge pin as shown in Figure 4.
 - (1) Draw up the screw, but not so tight as to prevent tilting the arc chute.
- F. Remove the hoist and lifting yoke from the arc chute.
- G. Remove from the breaker the bolts, washers, and nuts which are supplied to fasten down the arc chute.
- H. Tilt the arc chute down.
 - I. Reinstall the bolts, washers, and nuts through the arc chute into the breaker and fasten them securely.
 - J. Remove the nut and washers on the terminal at the lower right side of the arc chute.
- K. Place the hole of the connector (Figure 3) over the bolt, replace the washers and nut, and tighten the nut securely.

Caution

An improper connection between the connector and the arc chute terminal may cause equipment failure. Only one arc chute is to be tilted back at any one time.

- L. With the middle arc chute installed, follow the same procedure for installing the other two arc chutes.



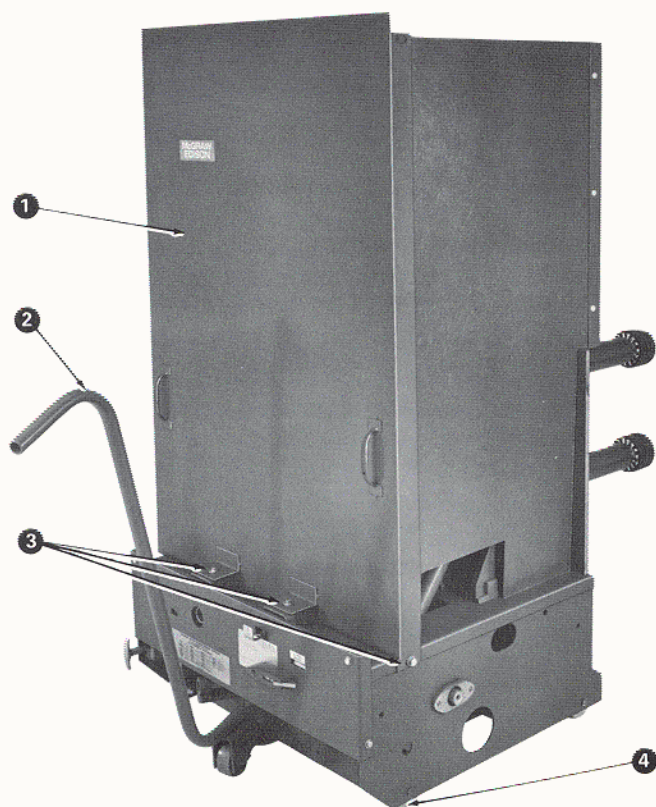
1. Flat-head, hex-socket Nylok capscrew.
2. Rear arc chute runner blade.
3. Arc chute contact (coated with thin film of contact grease).

FIGURE 4

Securing an arc chute to a 15-kv PSD circuit breaker.

ASSEMBLY (continued)

2. Install the interphase barrier assembly by placing the assembly over the arc chutes on the breaker.
3. Install the grounded steel front barrier:
 - A. Remove the four bolts and washers from the side and the top of the breaker. (Figure 5)
 - B. Place the steel front barrier on the breaker.
 - C. Reinstall the four bolts and washers on the sides and the top of the breaker and fasten the front barrier securely in position. (Figure 5)



1. Steel front barrier
2. Handling dolly
3. Bolts for steel front barrier
4. Front wheel.

FIGURE 5

15-kv PSD breaker with steel front barrier installed and handling dolly engaged.

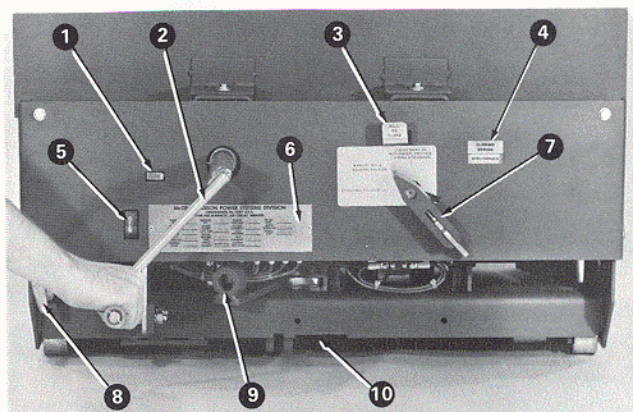
INSTALLATION

1. Position the assembled breaker directly in front of the metalclad breaker compartment:

Caution

Do not attempt to lift an assembled PSD breaker. When the arc chutes, interphase barrier assembly, and steel front barrier are in place on the breaker, lifting may result in damage to the breaker.

- A. Move the breaker on its wheels, using the handles on the steel front barrier.
- B. Steer the breaker around corners by using the handling dolly (supplied with the metalclad unit) as shown in Figure 5.
 - (1) To engage the handling dolly, slip the dolly hook under the notch in the front of the breaker frame. (Figure 6)
 - (2) Push down on the handle until the front wheels of the breaker are lifted from the floor.
 - (3) Steer the breaker by moving the handling dolly horizontally as shown in Figure 5.

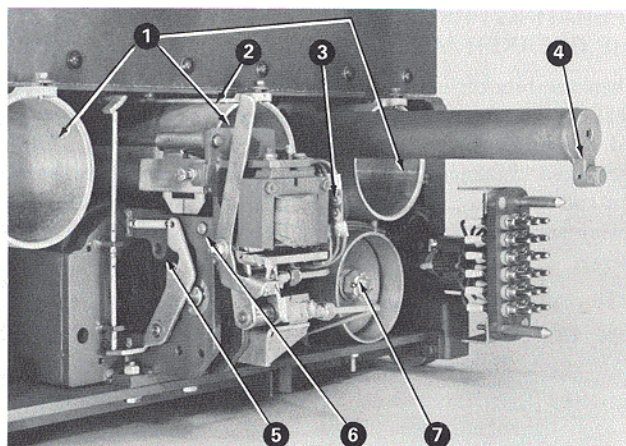


1. Total number of breaker operations.
2. Racking crank handle.
3. Manually close the breaker.
4. Position of closing spring.
5. Position of breaker contacts (open or closed)
6. Breaker nameplate.
7. Positioning handle
8. Secondary contact handle
9. Insert lever here to handpump hydraulic system of breaker operating system.
10. Notch for handling dolly hook.

FIGURE 6

Control panel.

2. Extend the racking device which is shipped in the retracted position:
 - A. Hold the positioning handle on the control panel in the racking position. (Figure 6)
 - B. Insert the racking crank handle (Figure 6) all the way in and, with inward pressure, turn slowly until engaged.
 - C. Turn the crank counterclockwise approximately $41\frac{1}{3}$ turns until it stops.
 - D. Make sure the roller cam at the end of the racking device (at the back of the breaker) is in the down position. (Figure 7)
 - E. Remove the racking crank handle.



1. Puffer.
2. Manual close linkage rod.
3. Terminal block.
4. Roller cam in down position.
5. Insert safety pin here.
6. Safety pin storage.
7. Opening spring.

FIGURE 7
Back of breaker.

3. Make sure the primary disconnect contacts and secondary contacts are clean and free of foreign material. (Figure 2)
4. Install the breaker into the storage position in the breaker compartment:

- A. Align the guide beneath the breaker with the rail on the breaker compartment floor.
- B. Make sure the racking device is extended and the roller cam at the end of the racking device is in the down position. (Figure 7)

- C. Turn and hold the positioning handle on the breaker control panel in the **CUBICLE ENTRY OR WITHDRAWAL POSITION** and carefully roll the breaker into the compartment as far as it will go.

NOTE: A mechanical stop on the compartment floor prohibits the installation of a 1200-amp breaker in a 2000-amp compartment; however, a 2000-amp breaker will enter a 1200-amp compartment.

- D. Return the positioning handle on the breaker control panel to the **OPERATING POSITION**.

NOTE: When the positioning handle is in the operating position, the interlock bar beneath the breaker engages the slot in the rail on the compartment floor. The breaker can be left in this position in the compartment for storage. *Any further engagement of the breaker must be done by racking with the crank handle.*

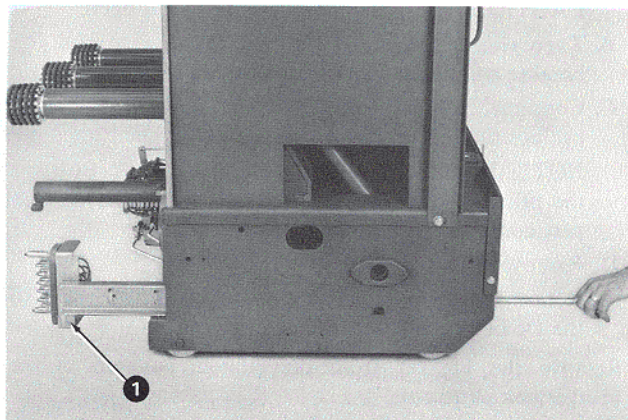
5. Operate the breaker in the storage position in the breaker compartment:

- A. Pull the secondary contact handle (Figure 8) all the way out.
- B. Turn the handle 90 degrees clockwise (do not turn the handle counterclockwise) to the horizontal position.
- C. Push the handle back into the breaker, making sure to securely engage the receptacle in the back of the breaker compartment.

NOTE: An impact motion is most effective.

- D. Make sure the positioning handle is in the **OPERATING POSITION**.

- E. Energize the desired control circuits.
- F. Retract the secondary contact plug by pulling out the handle or by rolling out the breaker.
- G. Turn the handle 90 degrees counterclockwise (do not turn the handle more than 90 degrees) to the vertical position.
- H. Slide the handle into the breaker for storage.



1. Secondary contacts.

FIGURE 8
Secondary contacts extended halfway.

6. Install the breaker into the connect (operating) position in the breaker compartment:

Warning

Never connect a breaker to an energized circuit unless the arc chutes, interphase barrier assembly, and grounded steel front barrier are securely fastened in place on the breaker.

- A. With the breaker in the storage position in the breaker compartment, turn the positioning handle to the **RACKING POSITION** and, while holding the handle in this position, insert the racking crank handle all the way.

- B. Turn the crank handle clockwise to move the breaker into the compartment.

NOTE: On the first one-third turn of the crank, the roller cam at the end of the racking device rotates in the keyhole at the back of the compartment and opens the shutter covering the primary terminals.

- C. Continue racking until the connect position is reached and the crank will no longer turn.

NOTE: Racking becomes more difficult as the primary disconnect contacts and the secondary contacts join with their respective connections in the back of the compartment.

- D. Remove the crank handle and return the positioning handle to the **OPERATING POSITION**.

REMOVING THE BREAKER FROM THE COMPARTMENT

To remove the breaker from the metalclad compartment:

1. Remove the breaker from the connect position:
 - A. Turn the positioning handle to the RACKING POSITION and, while holding the handle in this position, insert the racking crank handle all the way in.
CAUTION: If the breaker is closed, it will open.
 - B. Turn the crank handle counterclockwise and the breaker will move out of the breaker compartment.
 - C. Continue cranking until the breaker reaches the storage position and the crank can no longer be turned.
NOTE: The shutter will automatically close, isolating the primary terminals, as soon as the primary disconnect contacts are clear.
 - D. Remove the crank handle.
 - E. Return the positioning handle on the control panel to the OPERATING POSITION.
2. Remove the breaker from the storage position in the breaker compartment:
 - A. Turn and hold the positioning handle on the control panel in the CUBICLE ENTRY OR WITHDRAWAL POSITION.
CAUTION: The breaker will open and the closing spring will discharge when the positioning handle is turned to the CUBICLE ENTRY OR WITHDRAWAL POSITION.
 - B. Roll the breaker out of the compartment by using the handles on the steel front barrier.

OPERATING PRINCIPLES OF THE BREAKER MECHANISM

When the breaker is shipped, or has been removed from the breaker compartment, it is de-energized. The breaker is open and closing spring 18 (Figure 9) and opening spring 14 are discharged. Linkage 11 (Figure 9) is in the collapsed position and hold-on catch 12 is held down by that linkage. The closing spring must have an initial charge for the breaker to operate.

1. To charge the closing spring initially:
 - A. Energize the control circuit by one of the following means:
 - (1) Insert the breaker into the connect position in the breaker compartment.
 - (2) Insert the breaker into the storage position in the breaker compartment and extend the secondary contacts.
 - (3) Attach a jumper cable (accessory) between the secondary contacts of the breaker and the breaker compartment to operate the breaker outside the compartment.
 - (4) Attach the cable from the control test cabinet (accessory) for remote operation.
 - B. As soon as control voltage is applied, motor-driven hydraulic pump 7 (Figure 9) forces hydraulic fluid into charging cylinder 9 which, in turn, compresses closing spring 18.
 - C. As charging cylinder 9 moves back, it is followed by drive block 10.
 - D. The charging action continues until closing latch 3 (Figure 10) catches closing pin 8 and roller 2 is set; at which time, mechanical linkage opens charging motor cutoff switch (SC) 5, interrupting the supply voltage to motor 6 and the charging sequence is halted.
 - E. The movement of drive block 10 has set linkage 11, trip roller 17 on trip latch 20, and closed the linkage check switch (LCS) in series with closing coil 1.
NOTE: On some earlier models, the mechanism did not have a linkage check switch.
 - F. Simultaneously, as the charging sequence stops, pressure-release valve 4 (Figure 10) is opened to sump 7, releasing the hydraulic pressure to charging cylinder 9 and permitting closing pin 8 to load closing latch 3.
 - G. As pressure-release valve 4 reduces pressure, dump valve 13 is opened by an internal spring to sump 7 so that the charging hydraulic fluid is now at sump pressure.
 - H. When the dump valve opens, the closing coil switch (CCS) in series to closing coil 1 is made, permitting the closing coil to be energized.
The breaker is now ready for a closing operation. (Figure 10)

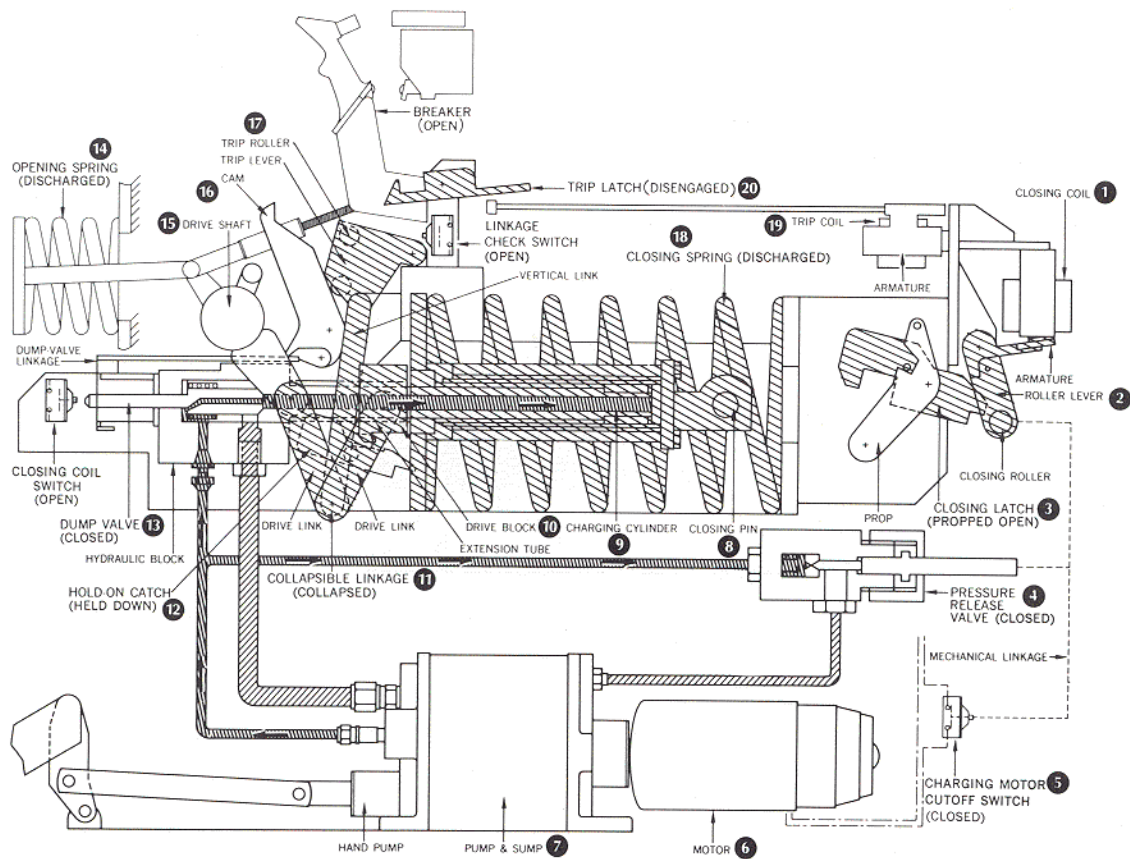


FIGURE 9
PSD operating mechanism: breaker open, closing spring discharged.

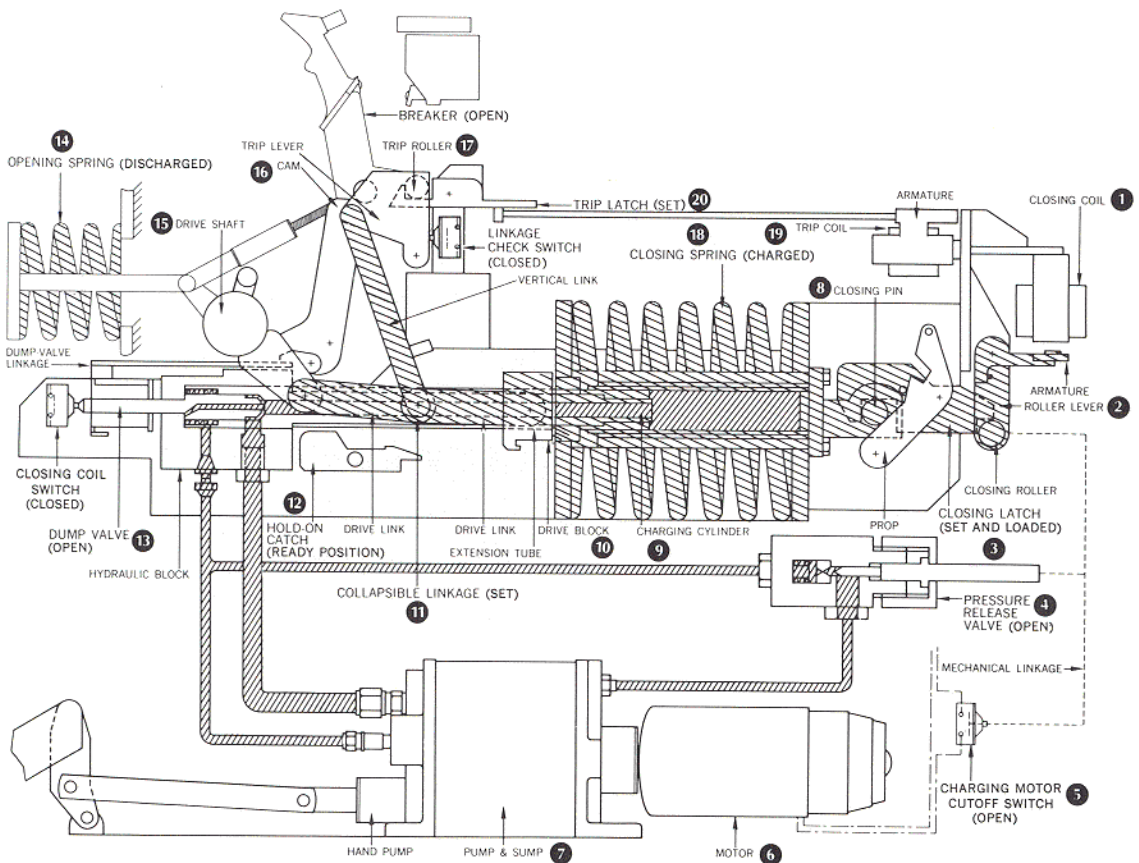


FIGURE 10
PSD operating mechanism: breaker closed, closing spring charged.

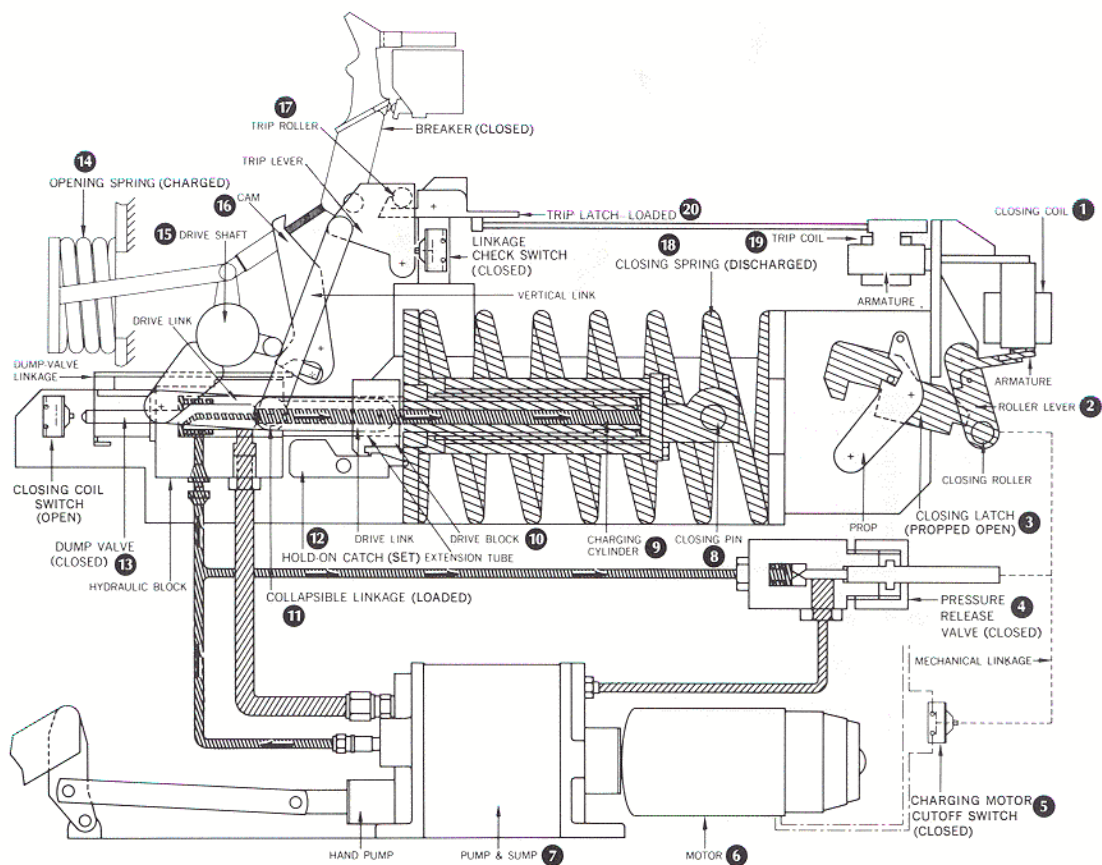


FIGURE 11

PSD operating mechanism: breaker closed, closing spring discharged.

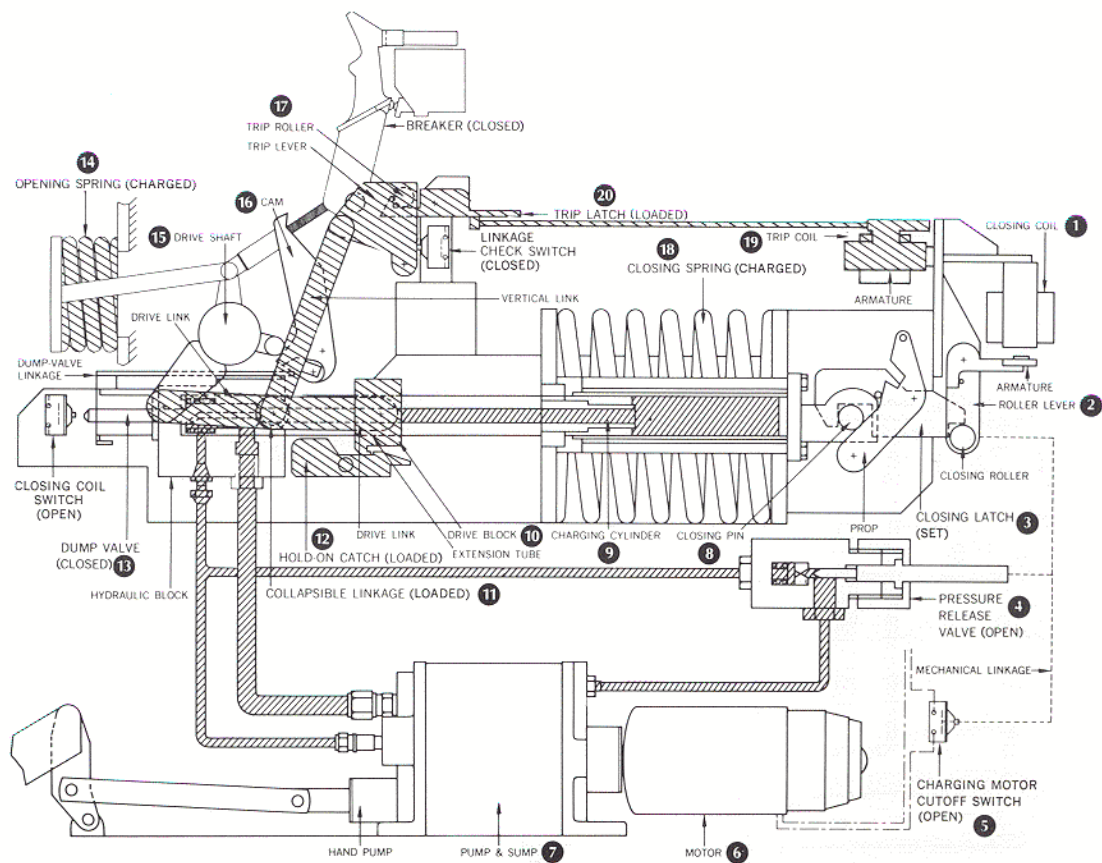


FIGURE 12

PSD operating mechanism: breaker closed, closing spring charged.

OPERATING PRINCIPLES OF THE BREAKER MECHANISM (continued)

2. To close the breaker:

- A. Using the proper voltage, energize closing coil 1 (Figure 11) or pull the handle marked PULL TO CLOSE on the breaker control panel.
- B. Roller lever 2 is moved from under closing latch 3 and the closing latch is driven free of closing pin 8 by the force of closing spring 18.
- C. Charging cylinder 9 moves forward, forcing drive block 10 along with it.
- D. The interconnecting links rotate drive shaft 15, closing the main contacts.
- E. The puffer pistons reset and take in a fresh charge of air.
- F. The hydraulic fluid is returned to sump 7 through dump valve 13.
- G. Opening spring 14 is compressed.
- H. Cam 16 mechanically closes dump valve 13. (Figure 11)
- I. Mechanical linkage closes motor control switch 5, energizing motor 6 and closing pressure-release valve 4 so that there is pressure in charging cylinder 9.
- J. Charging cylinder 9 moves back immediately, returning closing spring 18 to the charged position. (Figure 12)
- K. Drive block 10 is held in the set position by hold-on catch 12 and linkage 11 is loaded.

The breaker is now ready for an opening operation. (Figure 12)

3. To open the breaker:

- A. Using the proper voltage, energize trip coil 19 (Figure 12) or turn the positioning handle on the control panel to MANUAL TRIP.
- B. Trip latch 20 mechanically moves, allowing linkage 11 to collapse by the force of opening spring 14.
- C. The interconnecting links rotate drive shaft 15, moving the main contacts into the open position.
- D. The puffer pistons discharge a blast of air past the main contacts.
- E. As linkage 11 collapses, hold-on catch 12 is knocked loose and drive block 10 moves back against charging cylinder 9 and linkage 11 resets.

The breaker is now ready to be reclosed. (Figure 10)

OPERATING PRINCIPLES OF THE ANTI-PUMP STATIC CONTROL UNIT (52 X-Y)

The anti-pump static control, normally supplied on the circuit breaker, is a solid-state d-c electronic unit.* Two units, each having two different voltage ratings (terminals 3 and 1) are available, 24/48 vdc and 125/250 vdc. The breaker control voltage determines whether terminal 3 (24 or 125 vdc) or terminal 1 (48 or 250 vdc) is to be used on the unit.

1. With the breaker open, interlock bar down, closing spring charged, trip linkage set, and switch contacts 52b, CCI, CCS, and LCS closed (Figure 13) the circuit breaker is prepared for a closing operation.
2. Closing the breaker control switch (CS-C) establishes the circuit through the 52 x-y unit, energizing the closing coil (52cc) and the breaker closes.
3. As the breaker closes, contacts 52b open, interrupting the closing coil circuit.
4. If the breaker opens immediately while the breaker control switch contacts are still made to close the breaker, the 52 x-y unit blocks the closing coil circuit.
5. The breaker cannot close until the breaker control switch contacts are opened and remade.

*If electromechanical x-y closing control relays were supplied in place of the electronic unit, they are mounted in the breaker compartment. Refer to the schematic and wiring diagram for specific x-y device type and location.

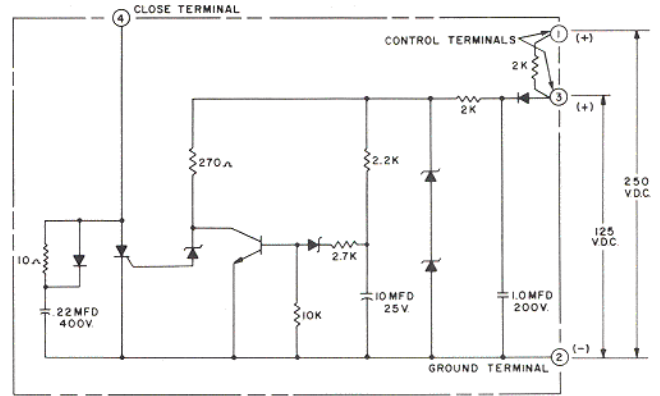


FIGURE 13-A

Typical 125/250-vdc anti-pump static control unit (52 x-y).
If 24/48-vdc unit is supplied, refer to accompanying wiring diagram.

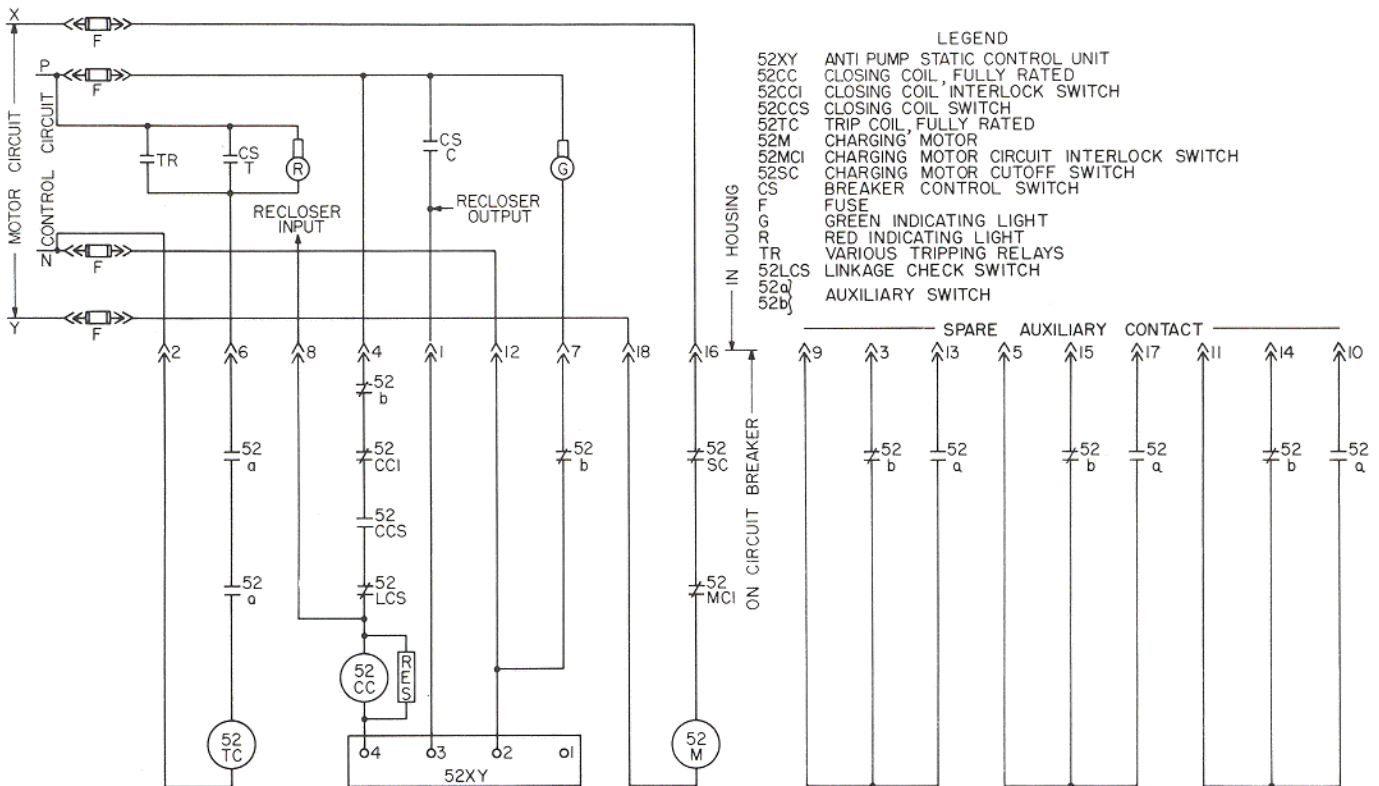


FIGURE 13

Typical wiring diagram.

MAINTENANCE

The frequency of maintenance depends upon the degree of exposure to contaminating atmospheres and the severity of operating duty. It is good practice to inspect the breaker at 2000-operation intervals or after a severe fault interruption near its maximum rating. All adjustments are set at the factory and none are required unless the breaker has had severe wear or rough handling.

Cleanliness is the best assurance of trouble-free operation. The breaker should be cleaned and restored to high dielectric levels before a hazardous condition is reached. Wipe ceramic parts with a lint-free cloth and, if necessary, sand lightly. Wipe non-ceramic parts with a cloth moistened with a cleaning solution.

Materials

- Clean, lint-free rags.
- Preferred cleaning solutions obtainable from most oil companies: heptane, Stoddard's solvent, cleaner's naphtha.

Warning

Preferred cleaning solutions are flammable. Avoid sparks and flames. Use in an area where there is adequate ventilation.

- Lubricants:
Operating linkages (pins, anti-friction bearings, links):
 Keystone Oil Company no. 4062, Standard (California) RPM Handy Oil, or Texaco Capella AA.
Roller bearings: Shell Oil Company Aeroshell no. 14 grease.
Current-carrying joints: Dearborn Chemical Company NO-OX-ID "A" grease.
 Lubricate moving parts sparingly, then wipe off any excess. Roller bearings require packing only after they have been removed for a complete overhaul. Current-carrying joints should receive a light application of contact grease, but not on the contact surfaces of the main and arcing contacts.
- Hydraulic fluid:
 Shell Oil Company Aeroshell Fluid no. 4; Standard Oil Co of California RPM Aviation Hydraulic Oil no. 2; Texaco Inc Aircraft AA hydraulic oil; Humble Oil & Refining Co Univis J-43.

Procedure

Caution

De-energize the PSD circuit breaker before performing any inspections or maintenance work. Keep clear of all moving parts of the breaker unless the closing spring is discharged and the main contacts are open.

1. Inspect the racking device for proper operation:

A. Check for racking device vertical alignment:

- (1) Install the breaker into the storage position in the breaker compartment.

- a. Align the guide beneath the breaker with the rail on the breaker compartment floor.

- b. Turn the positioning handle on the breaker control panel to the CUBICLE ENTRY OR WITHDRAWAL POSITION and hold.

CAUTION: The breaker will open and the closing spring will discharge when the positioning handle is turned to the CUBICLE ENTRY OR WITHDRAWAL POSITION if the breaker was previously closed and charged.

- c. Carefully roll the breaker into the compartment as far as it will go.

- (2) The roller cam end of the racking device should align properly with the keyhole at the back of the compartment.

- a. The racking device is free to self-align horizontally.

- b. The racking device must be in vertical alignment with the keyhole.

B. Check for racking device undertravel:

- (1) Install the breaker into the connect position in the breaker compartment.

- a. With the breaker in the storage position in the breaker compartment, turn the positioning handle to the RACKING POSITION and hold while inserting the racking crank handle all the way in.

CAUTION: If the breaker is closed, it will open.

- b. Turn the crank handle clockwise until the breaker reaches the connect position.

NOTE: On the first one-third turn of the crank, the racking device opens the shutter covering the primary terminals. Racking becomes more difficult as the primary disconnect contacts and the secondary contacts join with their respective connections in the back of the compartment.

- c. Remove the crank handle.

- (2) Return the positioning handle to the OPERATING POSITION.

- a. If the positioning handle does not return to the OPERATING POSITION, check for racking undertravel by pushing the breaker—by hand—all the way into the connect position.

C. Remove the breaker from the compartment and make all necessary adjustments.

- (1) If the racking device is not in vertical alignment with the keyhole, refer to *Racking device vertical alignment* in the Adjustments section. (Page 20)

- (2) If racking undertravel has occurred, refer to *Racking device undertravel* in the Adjustments section. (Page 20)

MAINTENANCE (continued)

2. Inspect the primary disconnect contacts (Figure 2):

NOTE: Contacts are mounted as a cluster assembly on the contact studs at the back of the breaker and are free to self-align.

A. Make sure the contacts are clean and uneroded.

- (1) If the contacts are worn or eroded, refer to *Primary disconnect contacts* in the Parts Replacement section. (Page 24)

3. Inspect the secondary contacts (Figure 2):

A. Make sure the contacts are straight, clean, and uneroded.

- (1) If the contacts are worn or eroded, refer to *Secondary contacts* in the Parts Replacement section. (Page 24)

4. Remove the grounded steel front barrier.

5. Remove the interphase barrier assembly by lifting it up and over the arc chutes.

6. Inspect the interphase barrier assembly:

A. Check for missing screws and broken or cracked insulation panels.

- (1) If a panel is broken or cracked, replace the panel.

7. Inspect the arc chutes one at a time:

A. Unfasten the front of the arc chute by removing the two bolts at the frame (Figure 3) and the connector from the arc chute terminal. (Figure 3)

B. Tilt the arc chute back slowly.

Caution

Tilt back only one arc chute at a time. (Tilt rack accessory is available.)

C. Clean the arc chute.

- (1) Blow air-borne dust out of the chute with dry, low-pressurized air.

- (2) Wipe away loose soot from around the contact area with a clean, lint-free rag.

NOTE: When an arc strikes a ceramic part in the arc chute, the surface of the ceramic will melt slightly. When it solidifies again, the surface will have a glazed, whitish appearance. At low and medium current, this effect is very slight; however, high-current arcs repeated many times may boil away an appreciable amount of ceramic.

- (3) Remove metallic arc-gas stains by lightly sanding with medium-grain sandpaper.

D. Check the arc chutes for broken or cracked ceramic parts.

NOTE: Breaks in the ceramic stacks—particularly cracks extending from the inverted V slot out to the edge or to the top of the ceramic plates—may interfere with the performance of the breaker.

- (1) If ceramic plates are broken or cracked, replace the entire ceramic stack.

- (2) If other ceramic parts are broken or cracked, replace the parts.

Refer to *Arc chute repair* in the Parts Replacement section. (Page 24)

8. Inspect the breaker contacts:

A. With one arc chute tilted back at a time or all the arc chutes removed from the breaker, inspect and clean the arcing and main contacts.

B. Check the arcing contacts and dress only in case of extreme burning.

C. Make sure the main contacts are clean and show no evidence of erosion.

D. Insert the maintenance handle on the breaker drive shaft. (Figure 14)

Warning

Before using the maintenance handle, the circuit breaker must be open and the closing spring discharged. Personnel should stand aside while the maintenance handle is used. Should the handle inadvertently slip from the operator's grasp, it will return at contact-opening velocity. Always remove the handle when it is not being used.

NOTE: If the breaker is equipped with a cell switch actuating cam on the drive shaft of the breaker, it must be removed in order to insert the maintenance handle.

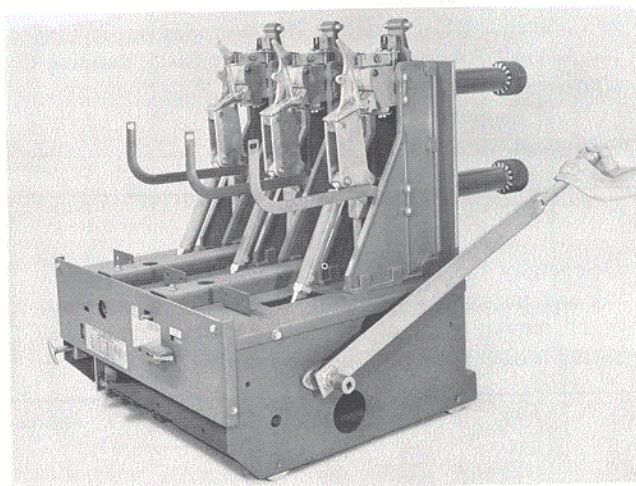
E. Close the breaker contacts slowly to see that the movable arcing contact is aligned when entering the stationary arcing contacts as shown in Figure 14.

F. With the movable arcing contact just touching the stationary arcing contacts, the gap between the main contacts should be no less than 3/16 in.

NOTE: As the breaker operates in service, especially under fault conditions, the arcing contacts burn away. This deterioration causes a change in the relationship of the arcing contacts to the main contacts.

- (1) If the contacts are eroded, extremely burned (less than 3/16 in. gap) or misaligned, refer to *Breaker contacts* in the Parts Replacement section. (Page 24)

NOTE: If a movable contact is replaced, it is recommended that the stationary contact also be replaced.

**FIGURE 14**

Slow-closing the breaker contacts using the maintenance-positioning lever.

9. Remove the control panel (Figure 6).

A. Remove the hex-socket flathead capcrew holding the positioning handle onto its shaft.

B. Pull the positioning handle straight out and off the shaft.

C. Remove the two bolts and the washers on the front and the two bolts and the washers at the bottom sides of the control panel.

(1) Note the location of the spacing washers so they may be returned to their proper places when replacing the control panel.

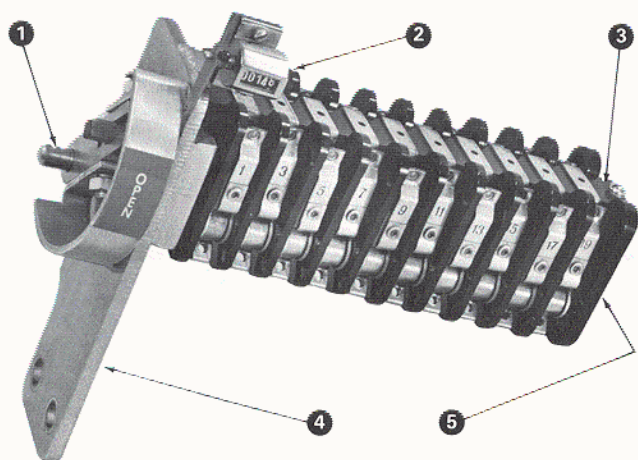
D. Lift off the control panel, being careful not to pull off the CHARGED indicator flag or the PULL TO CLOSE handle.

NOTE: The same control panel is to be replaced on the breaker from which it was removed (Figure 16, Item 13).

10. Inspect the auxiliary switch (Figure 15):

Refer to — and follow — the manufacturer's instruction book that accompanies the breaker.

A. If it is necessary to replace the auxiliary switch, refer to *Auxiliary switch* in the Parts Replacement section. (Page 26)



1. Auxiliary switch linkage
2. Operation counter
3. Fixed contacts and supports
4. Mounting bracket
5. Tiebolts (on end; not visible)

FIGURE 15
Auxiliary switch

11. Inspect the interlock for proper operation (Figure 16):

NOTE: The interlock is designed for safe operation of the breaker and no attempt should be made to bypass any of its functions. All components broken or bent due to misuse must be replaced immediately.

A. Place the positioning handle on its shaft in the operating position.

B. Slowly turn the positioning handle clockwise to the **MANUAL TRIP & RACKING POSITION**.

(1) The interlock linkage must open the closing coil interlock switch and charging motor circuit interlock switch (both wired—normally closed). (Figure 16)

a. Check for loose wires.

(2) The interlock cam must actuate the manual trip lever which will open the breaker. (Figure 16)

(3) The interlock linkage must rotate the shutter in the racking device, permitting insertion of the racking crank handle.

(4) The interlock bar under the breaker must move up, permitting the breaker to be moved between the storage and the connect positions in the breaker compartment.

C. Slowly turn the positioning handle clockwise to the **CUBICLE ENTRY OR WITHDRAWAL POSITION** **SPRING DISCHARGED**.

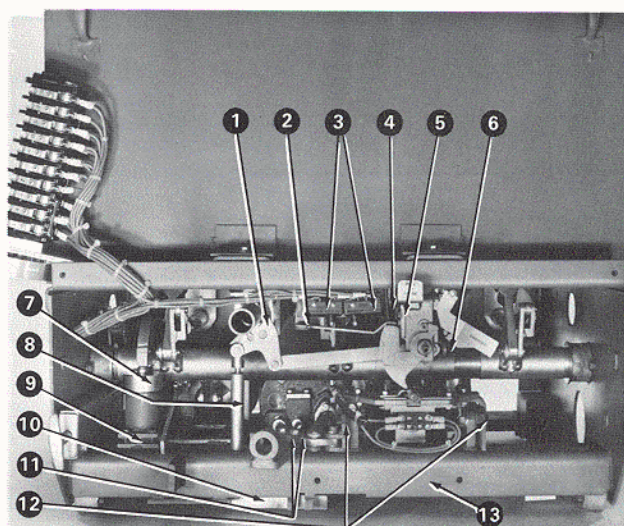
NOTE: The positioning handle will not turn if the racking crank handle is in the racking device or if the racking device is not extended.

(1) The interlock linkage must rotate the shutter in the racking device, blocking the insertion of the racking crank handle.

(2) The interlock cam must actuate the closing spring discharge lever which will discharge the closing spring.

(3) The interlock bar under the breaker must move up, permitting the breaker to be moved between the storage position and the outside of the breaker compartment.

If the interlock fails to operate properly, refer to *Interlock* in the Adjustments section. (Page 20)



1. Racking device shutter
2. Actuating arm
3. Closing coil interlock switch and charging motor circuit interlock switch
4. Manual trip linkage rod
5. Manual trip lever
6. Closing spring discharge lever
7. Opening buffer
8. Interlock adjustment bar
9. Shims
10. Interlock bar
11. Bolts securing handpump extension
12. Bolts securing operating mechanism to breaker frame front
13. Serial number stamped in cross member.

FIGURE 16

Front of breaker with control panel and auxiliary switch removed.

MAINTENANCE (continued)

12. Inspect the puffers:

- A. Clean the puffer cylinder walls with one of the preferred cleaning solutions (heptane, Stoddard's solvent, or cleaner's naphtha).
- B. Check the puffer cylinder walls for scoring due to excessive dirt in the breaker compartment.
 - (1) If extensive score marks are found in the cylinders, the puffers may have to be replaced.

13. Charge the closing spring manually:

- A. Insert the handpump handle (supplied with the metal-clad unit) into the socket below the breaker nameplate. (Figure 6)
 - B. Pump approximately 10 to 12 strokes for one charge operation.
 - (1) When the closing spring is charged, loss of pressure will be felt in the pumping operation.
 - (2) If no pressure loss is felt, inspect the dump valve and pressure-release valve.
 - C. At the back of the breaker, make sure that the closing latch is holding the closing pin.
- NOTE: The handpump could be used for emergency operation to charge the closing spring of the circuit breaker in the event of loss of control power.

14. Insert the safety pin:

- A. Remove the retaining rings from the safety pin and the pin from its storage position in the operating mechanism frame. (Figure 7)
- B. Place the safety pin through the holes in the operating mechanism frame just above the closing latch and replace the retaining rings.

Warning

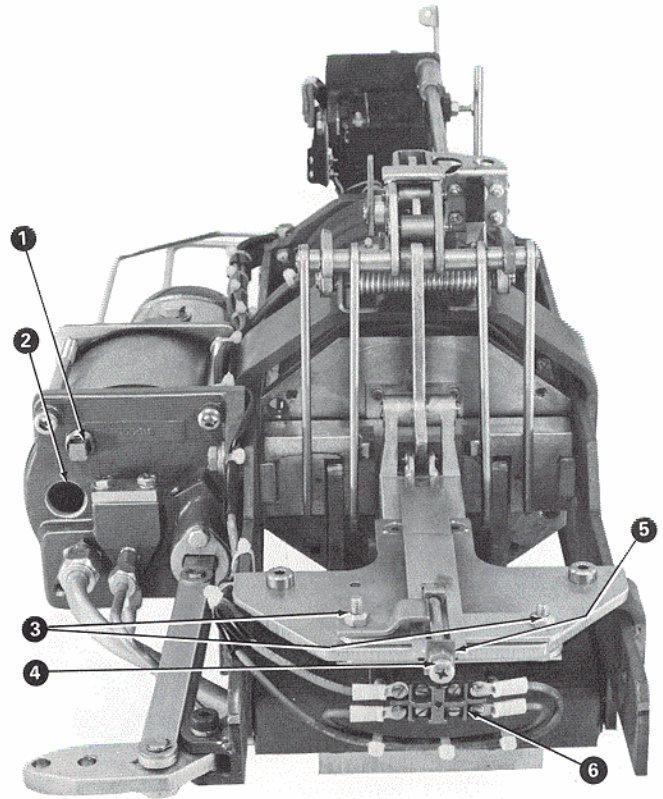
Always insert the safety pin when the closing spring is charged and not required to discharge during maintenance.

15. Inspect the dump valve:

- A. Make sure that no hydraulic fluid is leaking at the dump valve and that connections are tight.
- B. Make sure the stem of the dump valve is extended (open) and depressing the closing coil switch button.
 - (1) If the dump valve is not operating properly, refer to *Dump valve* in the Adjustments section. (Page 20)

16. Inspect the closing coil switch (dump valve check switch) (Figure 17):

- A. Check for broken or cracked switch and loose wires.
- B. Make sure the switch (which is wired—normally open) is closed when the button is depressed by the dump valve stem.
 - (1) If the switch is not closed by the dump valve, refer to *Closing coil switch* in the Adjustments section. (Page 21)



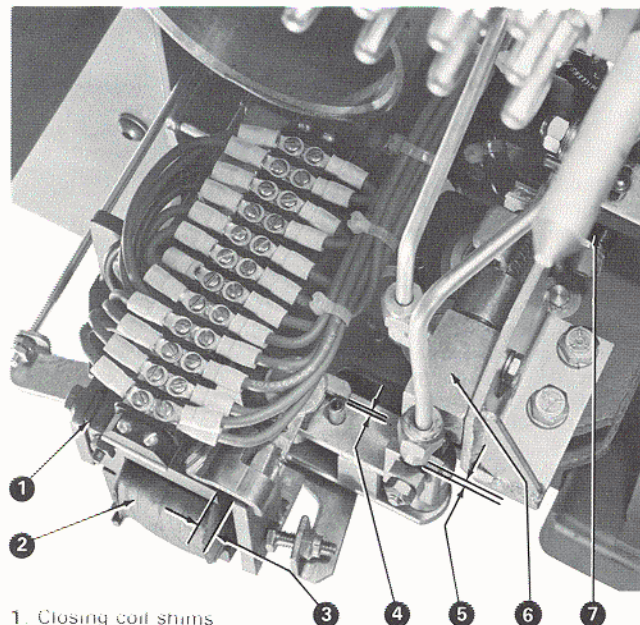
- 1. Plug.
- 2. Sump sight glass.
- 3. Nuts and bolts holding closing coil switch assembly.
- 4. Dump valve adjusting screw.
- 5. Lockplate.
- 6. Closing coil switch (dump valve check switch).

FIGURE 17

PSD operating mechanism (removed from breaker)

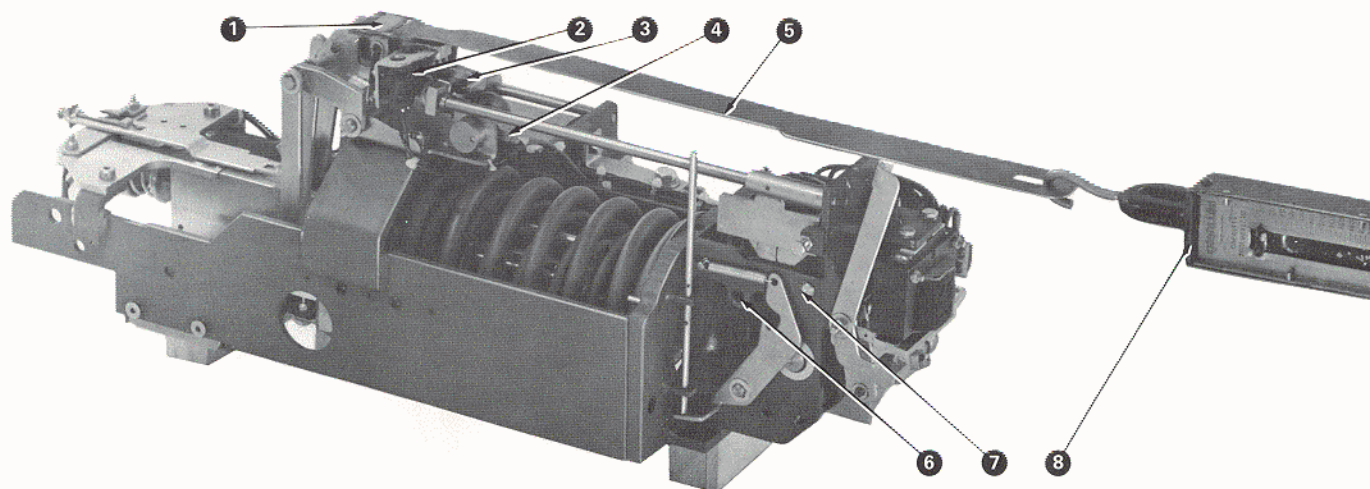
17. Inspect the pressure-release valve (Figure 18):

- A. Make sure there is no hydraulic fluid leak at the pressure-release valve and that the connections are tight.
- B. To make sure that the pressure-release valve is open: When the handle marked PRESSURE RELEASE is pushed, it should not actuate the valve linkage.
 - (1) If the pressure-release valve is not operating properly, refer to *Pressure-release valve* in the Adjustments section. (Page 21)



- 1. Closing coil shims
- 2. Closing coil.
- 3. 1/16-in spacer, breaker will close
3/32-in spacer, breaker will not close
- 4. 1/32-in gap between close armature and roll pin on roll lever
- 5. 1/16-in. adjustment for pressure-release valve linkage.
- 6. Pressure-release valve
- 7. Motor cutoff switch.

FIGURE 18
Back of breaker



- 1. Trip lever bridge
- 2. Linkage check switch
- 3. Trip latch
- 4. Adjustment of trip latch
- 5. Metal strap hooked through trip lever bridge
- 6. Insert safety pin here
- 7. Safety pin storage.
- 8. Spring scale which will read from 10 to 100 lb

FIGURE 19

PSD operating mechanism (removed from breaker to illustrate trip latch—latch load and reset measurement).

18. Inspect the motor cutoff switch (Figure 18):

- A. Check for cracked or broken switch and loose wires.
- B. Make sure the switch (which is wired—normally closed) is open when the button is depressed by the pressure-release valve linkage.
 - (1) If the motor cutoff switch is not opened by the pressure-relief valve linkage, refer to *Motor cutoff switch* in the Adjustments section. (Page 21)

19. Inspect the linkage check switch (Figure 19):

NOTE: On some earlier breakers, there was no linkage check switch.

- A. Looking through the right lift hole of the breaker frame, make sure that the switch, mounted on the trip latch, is not broken or cracked and that there are no loose wires.
- B. Make sure the switch (which is wired—normally open) is closed when the button is depressed by the trip lever.

Refer to the wiring diagram (the wiring diagram number is stamped on the breaker nameplate) to determine which wires are to be checked at the terminal block on the back of the mechanism frame.

- (1) Test the circuit with the applicable wires to make sure the switch is closed properly.

- a. If the switch is not operating properly, replace the switch.

NOTE: The breaker operating mechanism should be removed from the breaker to replace the switch. Refer to *Operating mechanism* in the Maintenance section. (Page 18)

MAINTENANCE (continued)

20. Inspect the closing coil (Figure 18):

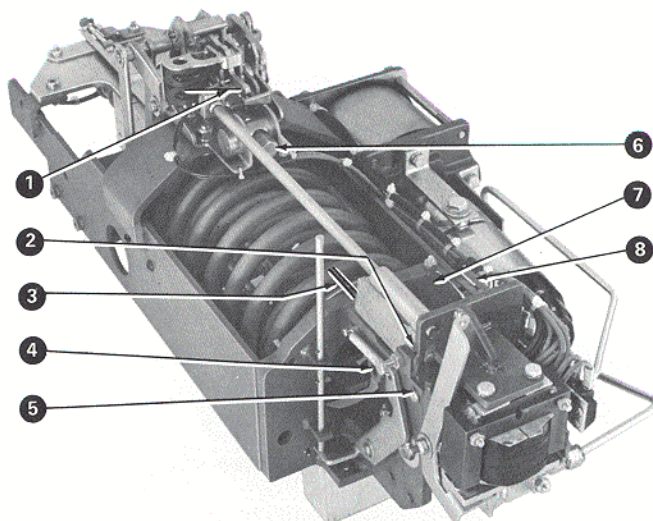
Warning

To inspect the closing coil, the closing spring must be free to discharge and will do so at high speed, closing the breaker. Keep fingers and foreign objects away from the spring and associated linkage. Always insert the safety pin when the closing spring is charged and not required to be discharged.

- A. Remove the safety pin from above the closing latch (Figure 7).
- B. Place a 3/32-in. spacer in the closing coil—armature air gap.
- C. Try to close the circuit breaker.
 - (1) By hand, push the armature toward the closing coil or manually operate the PULL TO CLOSE handle.
 - a. The armature should close on the spacer, but the breaker should not close.
- D. Replace the 3/32-in. spacer with a 1/16-in. spacer.
- E. Try to close the circuit breaker.
 - (1) By hand, push the armature toward the closing coil or manually operate the PULL TO CLOSE handle.
 - a. The armature should close on the spacer and the breaker should close.
 - If the breaker closes too soon or not at all, refer to *Closing coil* in the Adjustments section. (Page 21)

21. Inspect the trip coil (Figure 20).

- A. With the breaker closed and the closing spring discharged, place a 3/32-in. spacer in the trip coil—armature air gap.
- B. Try to open the circuit breaker.
 - (1) By hand, push the armature toward the trip coil.
 - a. The armature should close on the spacer, but the breaker should not open.
- C. Replace the 3/32-in. spacer with a 1/16-in. spacer.
- D. Try to open the circuit breaker.
 - (1) By hand, push the armature toward the trip coil.
 - a. The armature should close on the spacer and the breaker should open.
 - If the breaker opens too soon or not at all, refer to *Trip coil* in the Adjustments section. (Page 22)



1. Maintain 1/32-in. gap.
2. Measure and adjust gap here.
3. Coil/armature air gap:
1/16-in. spacer: breaker will close.
3/32-in. spacer: breaker will not close.
4. Insert safety pin here.
5. Safety pin storage.
6. Trip latch adjustment.
7. Trip coil.
8. Trip coil shims.

FIGURE 20

PSD operating mechanism (removed from breaker to illustrate trip coil).

22. Inspect the trip latch.

NOTE: On some earlier breakers, the trip latch was not adjustable. Refer to the factory for the required inspection and correction procedures.

- A. With the breaker open and the closing spring discharged, charge the closing spring and observe the trip latch action.
 - (1) Energize the breaker control circuit with the proper voltage: The motor-driven hydraulic pump will compress the closing spring and the collapsible linkage should set on the trip latch.
- B. Operate the PULL TO CLOSE handle to close the breaker.
 - (1) The motor-driven hydraulic pump will again compress the closing spring.
- C. Turn the positioning handle to MANUAL TRIP and observe the trip latch action.
 - (1) The trip latch will disengage, allowing the linkage to collapse, opening the breaker.
 - (2) The linkage will immediately reset on the trip latch.
- D. The trip latch should function with quick, positive action.

- E. If the trip latch action is erratic or sluggish, measure the latch load and reset values to determine the efficiency of the trip latch.

NOTE: The latch load is the force required to pull the trip roller away from the latch surface on the trip latch. The reset is the force at which the roller snaps back against the latch surface of the trip latch.

- (1) Operate the PULL TO CLOSE handle to close the breaker.
 - a. The motor-driven hydraulic pump will again compress the closing spring.
- (2) Hook a metal strap or wire through the bridge on the trip lever and bring it out the rear of the breaker (Figure 19).
- (3) Attach a spring scale which will measure from 10 to 100 lb to the end of the strap or wire.
- (4) Take—and record—three sets of latch load and reset value measurements.

NOTE: Between each set of measurements, remove the measuring apparatus and trip open and close the breaker.

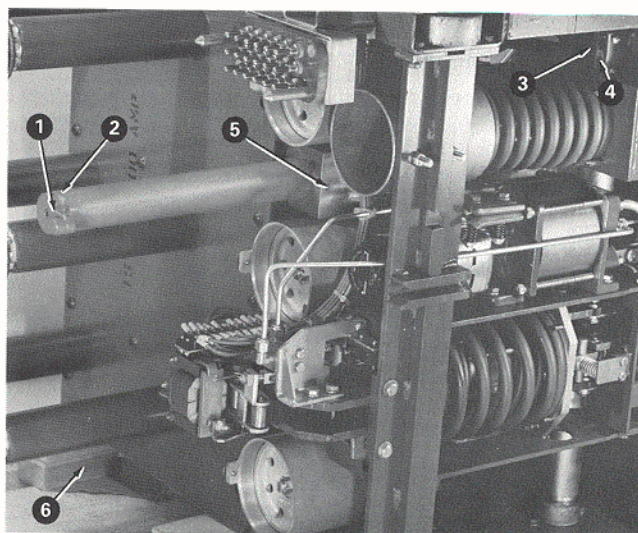
- a. Slowly pull on the scale until a light snap is felt (latch load).
- b. Slowly relax the pull on the scale until a light snap is felt (reset).
- c. If the values do not fall within 70 lb minimum and 100 lb maximum latch load and 10 lb minimum reset, refer to *Adjustable trip latch* in the Adjustments section. (Page 22)

23. With the breaker closed and the closing spring charged, disconnect the breaker electrical power source.

24. Inspect the closing buffer. (Figure 21)

NOTE: The closing buffer is located in back of the drive shaft and absorbs the shock of the drive shaft closing stroke.

- A. Insert the safety pin in place above the closing latch (Figure 19).
- B. With a pencil, reach through the lift hole in the left side of the frame and mark the buffer plunger in the depressed position where it protrudes from the top of the buffer cap.
- C. Open the breaker by turning the positioning handle to MANUAL TRIP.
- D. Measure the travel of the buffer plunger; i.e., the distance from the pencil mark to the top of the buffer cap.
 - (1) The travel of the buffer plunger must be within 1/32 to 3/32 in.
 - a. If the travel of the buffer plunger is not within 1/32 to 3/32 in., refer to *Closing buffer* in the Adjustments section. (Page 22)



1. Travel adjustment screw (1/2—13UNC x 2-21/32-lg hex-socket setscrew).
2. Adjustment lock screw (1/4—20UNC x 5/16 hex-socket setscrew).
3. Closing buffer.
4. Shims.
5. Vertical alignment adjustment screw (3/8—16UNC x 3/8-lg hex-socket Nylok setscrew).
6. Contact support plate braced with block.

FIGURE 21

Racking device adjustments

25. With the steel front ground barrier, the interphase barrier assembly, and the three arc chutes removed, the closing spring charged, and the safety pin fastened in place above the closing latch, carefully turn the breaker over onto its right side, bracing the contact support plate with a block as shown in Figure 21.

MAINTENANCE (continued)

26. Inspect the opening buffer. (Figure 16)

NOTE: The opening buffer is located in front of the drive shaft. The opening buffer absorbs the shock and regulates the stop position of the drive shaft opening stroke.

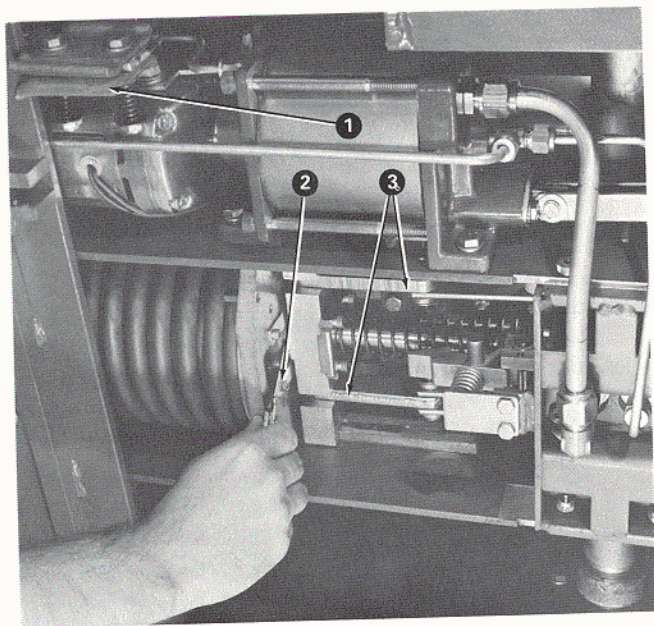
A. With the collapsible linkage set, measure the distance between the drive block and the wiper ring in the charging cylinder as shown in Figure 22.

(1) The distance between the drive block and the wiper ring must be between 1/32 to 1/16 in.

a. If the distance between the drive block and the wiper ring is not between 1/32 to 1/16 in., refer to *Opening buffer* in the Adjustments section. (Page 23)

27. Inspect the ground contact. (Figure 22)

A. If the breaker ground contacts are excessively worn, replace the contacts.



- 1. Ground contact
- 2. 1/32- to 1/16-in. distance between drive block and charging cylinder.
- 3. Collapsible linkage (shown set)

FIGURE 22

Inspecting the opening buffer and ground contact

28. Carefully place the breaker upright on its wheels, remove the safety pin from above the closing latch, and discharge the closing spring by turning the positioning handle clockwise to CUBICLE ENTRY OR WITHDRAWAL POSITION. SPRING DISCHARGED.

29. Inspect the operating mechanism:

- A. Make sure there are no hydraulic fluid leaks and that all connections are tight.
- B. For detailed inspection of the operating mechanism, motor, or sump/pump, and linkage check switch, the operating mechanism must be removed from the circuit breaker.

Warning

Both operating springs must be discharged before removing the operating mechanism from the breaker.

(1) At the back of the breaker: (Figure 7)

a. Remove the leads from the bottom of the terminal block and swing the wiring harness away from the operating mechanism.

NOTE: If necessary, remove one or two tie wraps.

b. Remove the two 10-32 nuts and lockwasher securing the manual close linkage rod to the closing lever at the closing coil.

c. Mark the opening spring backplate location on the inside of the spring-retaining tube with a pencil.

d. Remove the opening spring by:

Withdrawing the cotter pin;

Removing the nut;

Pulling the spring backplate and spring out the back of the breaker.

(2) At the front of the breaker: (Figure 16)

a. Remove the front control panel, steel from barrier, interphase barrier assembly, and the three arc chutes.

b. Stroke the handpump three or four times to compress the closing spring approximately 2 in.

c. Remove the two bolts securing the handpump extension and remove the handpump extension.

d. Disconnect the manual trip linkage rod by removing the two 10-32 nuts and lockwasher securing the trip to the interlock assembly. (Figure 16)

e. Carefully place the breaker on its right side with the secondary block uppermost and brace the contact support plate with a block as shown in Figure 21.

- (3) At the underside of the breaker (Figure 23):
- Make sure the drive block is not being held by the hold-on catch.
 - Remove the two pins, each of which captures five links, by removing the required retaining rings and washers. (Figure 23)
 - Remove the spacers from between the links, noting the number of spacers between the various links so they can be replaced properly later.
 - Remove the two bolts securing the operating mechanism to the breaker frame at the front. (Figure 23)
 - Remove the two spacers aligning the operating mechanism and the breaker frame at the front, marking the spacers' locations so they can be replaced properly later.
 - Supporting the operating mechanism, remove the four bolts and washers (two near each rear wheel), freeing the support plate on which the rear of the mechanism is mounted. (Figure 23)
 - Continue to support the operating mechanism, gently swing the back portion away from the breaker about 4 or 5 in. to clear the puffers.
 - Slowly move the mechanism out of the breaker until it is free of the two supporting lugs on the cross channel at the front of the breaker.
NOTE: Be careful not to catch any mechanism rods on the breaker frame.
- (4) Place the operating mechanism on a work bench for inspection and maintenance.

- (5) After all inspection and maintenance work on the operating mechanism has been completed:
- Handpump and charge the mechanism by stroking the pump three or four times to compress the closing spring approximately 2 in.
 - Lower the trip lever from the trip latch and hold it in the down position.
 - Replace the operating mechanism in the circuit breaker by reversing the steps taken to remove it.
NOTE: Make sure the two pairs of links from the drive shaft clear the hydraulic block support.

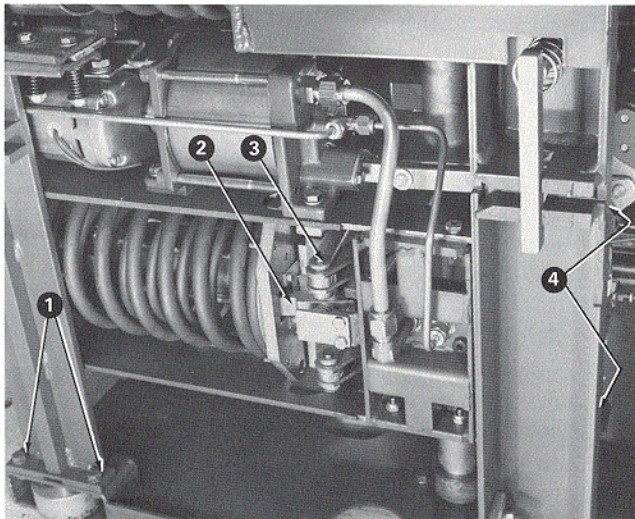
- C. Carefully place the breaker upright on its wheels.
- D. At the pressure-release valve at the back of the breaker, push the handle marked PRESSURE RELEASE so that the operating mechanism is fully discharged.

- E. Through the sight glass, check the hydraulic fluid level in the sump. (Figure 17)

- (1) The fluid must not be above the glass nor lower than the half-way point on the glass.

NOTE: An empty hydraulic system requires approximately 1½ pints of fluid to fill the sump to the proper level.

- To add hydraulic fluid, remove the plug from above the sight glass and, using one of the preferred hydraulic fluids (Shell Oil Company Aeroshell Fluid no. 4, Standard Oil Co of California RPM Aviation Hydraulic Oil no. 2, Texaco Inc Aircraft AA hydraulic oil, or Humble Oil & Refining Co Unisvis J-43), fill the sump to the proper level.



1. Bolts to free rear support plate.
2. Hold-on catch not holding drive block.
3. Pin holding five links together.
4. Two bolts securing operating mechanism to breaker frame at front.

FIGURE 23
Underside of breaker.

ADJUSTMENTS

1. Racking device undertravel (Figure 21):

A. Loosen the adjustment lock screw which is located approximately 90 degrees counterclockwise from the roller cam at the end of the racking device. (Figure 21)

B. Back out the travel adjustment screw slightly. (Figure 21)

NOTE: The travel adjustment screw must not protrude from its hole because there is no adjustment at this point and the interlock and shutters will not function properly.

C. Tighten the adjustment lock screw.

D. Test the adjustment by racking the breaker into the connect position of the breaker compartment.

2. Racking device vertical alignment (Figure 21):

A. If the roller cam end of the racking device is high or low, loosen or tighten the vertical alignment adjustment screw. (Figure 21)

B. Test the adjustment by placing the breaker into the storage position of the breaker compartment.

3. Interlock (Figure 16):

NOTE: Before any adjustments are made on the interlock, rule out all other problem possibilities.

A. Remove the control panel and replace the positioning handle.

B. Adjust the closing coil interlock switch and charging motor interlock switch (both wired—normally closed) so that, when the positioning handle is turned, the actuating arm depresses the switch buttons 1/16 in. past the switch open point. (Figure 16)

(1) Loosen the two switch mounting screws.

(2) Rotate the switch to the proper position.

(3) Tighten the two switching mounting screws.

(4) Check the adjustment.

C. Adjust the two nuts on the manual trip linkage rod so that, when the positioning handle is turned to MANUAL TRIP & RACKING POSITION, the trip latch will trip open the breaker contacts.

(1) Loosen the two nuts on the manual trip linkage rod. (Figure 16)

(2) Turn the nuts to the proper location against the manual trip lever.

(3) Tighten the nuts against one another.

(4) Test the adjustment.

D. Adjust the interlock bar under the breaker so that, when the positioning handle is turned to CUBICLE ENTRY OR WITHDRAWAL POSITION—SPRING DISCHARGED or MANUAL TRIP & RACKING POSITION, the bar will just clear the rail on the floor of the breaker compartment.

NOTE: When the positioning handle is returned to the OPERATING POSITION, the bar should drop into, but not bottom in, the rail notch of the storage and connect positions.

(1) Remove the retaining ring, washer, and pin fastening the racking device shutter to the adjustment end of the interlock bar.

(2) Turn the threaded end to change the effective length of the interlock bar to the proper position as shown in Figure 16.

(3) Replace the pin, washer, and retaining ring through the adjustment end and racking device shutter.

(4) Test the adjustment.

E. Adjust the two nuts on the manual close linkage rod (Figure 7) at the back of the breaker so that, when the positioning handle is turned to CUBICLE ENTRY OR WITHDRAWAL POSITION—SPRING DISCHARGED, the closing spring will discharge.

(1) Loosen the two nuts on the manual close linkage rod. (Figure 7)

(2) Turn the nuts to the proper location against the lever.

(3) Tighten the nuts against one another.

(4) Test the adjustment.

4. Dump valve:

A. With the breaker open and the closing spring discharged, remove the control panel and replace the positioning handle.

B. Bend back the lockplate and loosen the locknut on the dump valve adjusting screw. (Figure 17)

C. Turn the adjusting screw counterclockwise until there is no tension in the adjustment.

D. Connect the proper motor voltage and energize the circuit.

(1) The motor will run at a steady rate.

E. Turn the adjusting screw clockwise until tension is felt on the screw, then slowly turn the screw until the dump valve operates and the charging cylinder starts to move toward the closing latch.

F. Turn the screw clockwise 1½ turns more (do not over-adjust) and tighten the locknut.

G. Make sure the closing spring is fully charged and held by the closing latch.

H. Close and open the breaker several times to be sure it is operating properly.

(1) Operate the PULL TO CLOSE handle to close the breaker.

(2) Turn the positioning handle to MANUAL TRIP to open the breaker.

I. If a malfunction exists, readjust the screw no more than one-half turn clockwise (do not overadjust).

J. Bend the lockplate over.

K. Disconnect the motor voltage.

5. Closing coil switch (Figure 17):

- A. Adjust the closing coil switch with the breaker open, the closing spring charged, and the safety pin in place above the closing latch. (Figure 19)
- B. Make sure the dump valve stem is extended (valve open).
- C. Loosen the two self-locking nuts and bolts which hold the switch assembly. (Figure 17)
- D. Position the switch (wired—normally open) so that the dump valve stem depresses the switch button $1/32$ in. past its close point.
- E. Tighten the self-locking nuts and bolts to hold the switch assembly securely.
- F. Remove the safety pin from above the closing latch.

6. Pressure-release valve (Figure 18):

- A. Adjust the pressure-release valve with the breaker open, the closing spring charged, and the safety pin in place above the closing latch. (Figure 19)
- B. Make sure the pressure-release valve is open. (Figure 18)
 - (1) To check the open position of the pressure-release valve: When the PRESSURE RELEASE handle is pushed, it should not actuate the valve linkage.
- C. Loosen the locknut on the linkage to free the square adjusting nut. (Figure 18)
- D. Turn the square nut, allowing $1/16$ -in clearance to the roller lever as shown in Figure 18.
- E. Tighten the locknut against the square nut.
- F. Remove the safety pin from above the closing latch.

7. Motor cutoff switch (Figure 18):

- A. Adjust the motor cutoff switch with the breaker open, the closing spring charged, and the safety pin in place above the closing latch. (Figure 19)
- B. Make sure that the pressure-release valve linkage is properly positioned to actuate the switch.
 - (1) To check the position of the linkage: When the PRESSURE RELEASE handle is pushed, it should not actuate the valve linkage.
- C. Loosen the two switch mounting screws.
- D. Position the switch (wired—normally closed) so that the button is depressed $1/16$ in. past the opening point as shown in Figure 18.
- E. Tighten the two switch mounting screws.
- F. Remove the safety pin from above the closing latch.

8. Closing coil (Figure 18):

- A. Adjust the closing coil with the breaker open, the closing spring charged, and the safety pin in place above the closing latch. (Figure 19)
- B. Adjust the lever in the manual close linkage so that there is a $1/32$ -in. gap between the close armature and the rollpin in the roller lever as shown in Figure 18.
 - (1) Loosen the self-locking nut on the hex-head bolt at the bottom end of the lever under the armature.
 - (2) Turn the hex-head bolt until the bolt head locates the armature for the correct gap.

NOTE: The two nuts on the manual close linkage rod at the top end of the lever may require repositioning.
 - (3) Tighten the self-locking nut against the face of the lever.
- C. Remove the safety pin from above the closing latch.

Warning

To properly determine the closing coil adjustment, the closing spring must be free to discharge and will do so at high speed, closing the breaker. Keep fingers and foreign objects away from the spring and associated linkage. Always insert the safety pin when the closing spring is not required to discharge.

- D. Determine the amount of adjustment required in the closing coil by inserting an adjustable spacer, such as an auto sparkplug gap gage, into the coil-armature air gap.
 - (1) If the closing spring discharges with a $3/32$ -in. spacer in the air gap when the closing coil is energized, increase the spacer thickness until the spring does not discharge.
 - a. Record the difference.
 - (2) If the closing spring does not discharge with a $1/16$ -in. spacer in the air gap when the closing coil is energized, reduce the spacer thickness until the spring does discharge.
 - a. Record the difference.
- E. Insert the safety pin in place above the closing latch.
- F. Set the proper air gap between the closing coil and the armature by adjusting shims between the coil base and the mechanism frame. (Figure 18)
 - (1) Remove the two bolts and washers which mount the coil to the mechanism frame.
 - (2) Remove the shims, measure them, and correct for necessary height.
 - (3) Replace the shims (corrected for height) and fasten the coil to the mechanism frame with the two bolts and washers.
 - a. Make sure the bolts are tight.
- G. Test the adjustment.

ADJUSTMENTS (continued)

9. Trip coil (Figure 20):

- A. Adjust the trip coil with the breaker closed, the closing spring charged, and the safety pin in place above the closing latch. (Figure 19)
- B. Make sure there is a 1/32-in. gap between the trip latch and the trip bar, but measure the gap and make the adjustment at the trip armature as shown in Figure 20.
 - (1) Loosen the locknut and bolt through the mechanism frame at the trip armature.
 - (2) Depress the springloaded armature toward the trip coil until the trip bar touches the underside of the trip latch.

Caution

If the trip armature is pushed in too far—past touch with trip latch—the trip latch will activate, the opening spring will discharge, and the breaker will open.

- (3) Place a 1/32-in. spacer between the armature and the bolt end.
- (4) Screw in the bolt until it touches the spacer.
- (5) Remove the spacer and secure the locknut against the mechanism frame.
- C. Remove the safety pin from above the closing latch.

Warning

While determining the proper trip coil adjustment, the opening spring will discharge at high speed, opening the breaker. Keep fingers and foreign objects away from the spring and associated linkage.

- D. Determine the amount of adjustment required in the trip coil by inserting an adjustable spacer, such as an auto sparkplug gap gage, in the coil-armature air gap. (Figure 20)
 - (1) If the opening spring discharges with a 3/32-in. spacer in the air gap when the trip coil is energized, increase the spacer thickness until the spring does not discharge.
 - a. Record the difference.
 - (2) If the opening spring does not discharge with a 1/16-in. spacer in the air gap when the trip coil is energized, reduce the spacer thickness until the spring does discharge.
 - a. Record the difference.

- E. Open the breaker and discharge the closing spring.
- F. Set the proper air gap by changing the shims between the coil base and the mechanism frame as shown in in Figure 20.
 - (1) Remove the two bolts and washers which mount the coil to the mechanism frame and, if necessary, remove some wiring from the terminal block.
 - (2) Remove the shims, measure them, and correct for necessary height.
 - (3) Replace the shims (corrected for height) and fasten the coil and terminal block mounting bracket to the mechanism frame with the two bolts and washers.
 - a. Make sure the bolts are tight.

G. Test the adjustment.

10. Adjustable trip latch (Figure 19):

- A. Adjust the adjustable trip latch with the breaker closed, the closing spring charged, and the safety pin in place above the closing spring. (Figure 19)
- B. Use a socket and long extension to turn the 5/8-in. hex adjustment at the rear of the trip latch. (Figure 20)
 - (1) The latch load will increase approximately 2½ lb per flat of the hex adjustment when turned clockwise.
 - (2) The latch load will decrease approximately 2½ lb per flat of the hex adjustment when turned counterclockwise.
- C. Check the trip latch for proper adjustment by again taking latch load and reset value measurements.

11. Closing buffer (Figure 21):

- A. Adjust the closing buffer with the breaker open and the closing spring discharged.
- B. Remove the four bolts and nuts mounting the buffer to the breaker frame (Figure 21) and remove the buffer.
- C. To obtain the correct 1/32-to 3/32-in. buffer plunger travel, adjust the number of shims placed under the buffer on the breaker frame:
 - (1) Add shims to lengthen the plunger travel.
 - (2) Remove shims to shorten the plunger travel.
- D. Check the SAE 30 motor oil level in the buffer.
 - (1) Unscrew the buffer cap and lift out the cap-plunger-spring assembly.
 - (2) Make sure the oil level is 1-3/16-in from the buffer top.
 - (3) Replace the cap-plunger-spring assembly, screwing the cap on securely.
- E. Reinstall the buffer using the four bolts and nuts.
 - (1) Make sure the bolts are tight.
- F. Close the breaker.
- G. Recheck the plunger travel to make sure the travel is within 1/32 to 3/32 in.

12. Opening buffer (Figure 16):

- A.** Adjust the opening buffer with the breaker closed and the closing spring discharged.
- B.** Remove the four bolts and nuts mounting the buffer to the breaker frame and remove the buffer.
- C.** To obtain the correct stop position of the buffer plunger travel, adjust the number of shims under the buffer on the breaker frame:
 - (1)** Add shims to lengthen the distance between the drive block and the wiper ring in the charging cylinder. (Figure 22)
 - (2)** Remove shims to shorten the distance between the drive block and the wiper ring in the charging cylinder. (Figure 22)
- D.** Check the SAE 30 motor oil level in the buffer.
 - (1)** Unscrew the buffer cap and lift out the cap-plunger-spring assembly.
 - (2)** Make sure the oil level is 1-3/16 in. from the buffer top.
 - (3)** Replace the cap-plunger-spring assembly, screwing the cap on securely.
- E.** Reinstall the buffer using the four bolts and nuts.
 - (1)** Make sure the bolts are tight.
- F.** Charge the closing spring.
- G.** Insert the safety pin in place above the closing latch.
- H.** Trip open the breaker.
- I.** Carefully place the breaker on its right side.
- J.** Make sure the distance between the drive block and the wiper ring in the charging cylinder is between 1/32 and 1/16 in. as shown in Figure 22.

PARTS REPLACEMENT

1. Primary disconnect contact (Figure 2):

- A. Remove the self-locking nut and washer or the hex-socket-head shoulder bolt and washers from inside the contact cluster assembly.
- B. Slide the cluster off the contact stud.
- C. Apply a thin film of contact grease to the contact stud end.
- D. Install the new contact cluster.
 - (1) Slide the cluster onto the contact stud.
 - (2) Replace the washer and self-locking nut and tighten, then back off one (1) turn *or* replace the hex-socket-head shoulder bolt and washer and tighten securely.

2. Secondary contact (Figure 2):

- A. Remove the screws, washers, and wire terminals from the contacts.
 - (1) Label the wiring.
- B. Remove the nuts and washers from the two flat-head screws and guide pins.
- C. Remove the secondary contact plug.
- D. Install the new contact plug.
 - (1) Replace the nuts and washers on the two flat-head screws and guide pins.
 - (2) Replace the wire terminals, washers, and screws on the contacts.
 - a. Be sure to follow the wire labeling.

3. Arc chute repair (Figure 3):

- A. Remove the arc chute from the breaker.
- B. Lay the chute down on its side.
- C. Remove the four mounting screws securing the magnet plate.
- D. Remove the magnet plate.
- E. Remove all the screws securing the side sheet.
- F. Lift off the side sheet.
- G. Replace damaged ceramic parts.
- H. Reinstall the side sheet, tightening the screws securely.
- I. Reinstall the magnet plate, tightening the four mounting screws securely.
- J. Reinstall the arc chute on the breaker.

4. Breaker contacts (Figures 24 and 25):

- A. Replace the breaker contacts with the breaker open and the closing spring discharged.
- B. To replace the movable arcing and main contacts:
 - (1) Remove the two nuts, washers, and bolts mounting the movable contacts on the hinge arms. (Figure 24)
 - (2) Lift off the movable contacts.
 - (3) Mount the new contacts on the hinge arms.
 - a. Make sure the two nuts, washers, and bolts are tight.

C. To replace the stationary arcing contacts:

- (1) Remove the two nuts and washers from the contact posts on each side of the stationary contacts. (Figure 24)
- (2) Remove the bolt from the center of the stationary contacts.
- (3) Lift off the stationary arcing contact assembly and bottom washer.
- (4) Remove the nut from the center bolt of the replacement stationary arcing contacts.
- (5) Lightly coat the moving joints of the replacement contacts with contact grease (see page 11), but do not grease the copper-tungsten arc tips.
- (6) Position the replacement contacts on the breaker, tightening the center bolt securely.
- (7) Replace the two nuts and washers on the contact posts on each side of the stationary contacts, tightening the nuts securely.

D. To replace the stationary main contacts:

NOTE: The five stationary main contacts are each individually loaded with one spring and two guide pins. When removing the contacts, be very careful not to drop any parts into the breaker.

- (1) Substitute—one at a time—the two front 10-32 UNF- $\frac{1}{4}$ -lg hex-socket-head capscrews and washers in the bottom plate under the contact with 10-32 UNF- $\frac{3}{8}$ -lg hex-socket-head capscrews. (Figure 25)
- (2) Unscrew the four hex-socket-head capscrews slowly and carefully until the back mounting points of the bottom plate are loose and the front mounting points can be moved down approximately $\frac{1}{8}$ in.
- (3) Remove and replace one contact at a time by pushing the contact in and up at a point above its silver-tungsten contact tip, rotating up to clear the lip of the bottom plate.

NOTE: There is a guide pin in the back of the contact, a spring, and a second guide pin in the bottom plate.

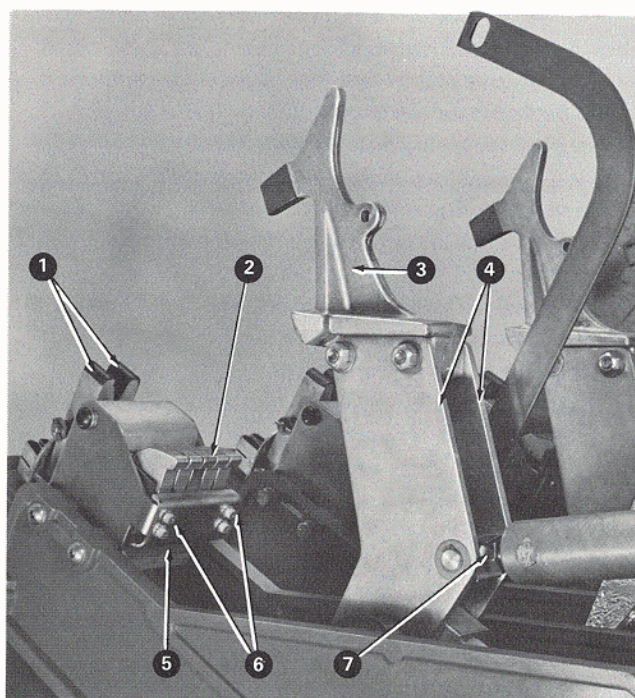
Do not remove the spacers on either side of the contact. The spacers must be in the same position when inserting the new contact.
- (4) Insert the short end of the guide pin from the old contact into the replacement contact and, if necessary, tap it in for a secure seat.
- (5) Make sure the short end of the guide pin in the bottom plate is in place.
- (6) Lightly coat the pivot area of the replacement contact with contact grease, but do not grease the silver-tungsten contact tip.
- (7) Holding the spring on the contact guide pin, insert the contact so that the spring is over the guide pin in the bottom plate.
- (8) After all contacts have been replaced, replace the two temporary hex-socket-head capscrews with 10-32 UNF- $\frac{1}{4}$ -lg hex-socket-head capscrews and external-tooth lockwashers, tightening the capscrews securely.

E. Close the breaker to adjust replacement contacts.

- (1) Insert the handpump handle into its socket and pump approximately two or three strokes.
- (2) Remove the handpump handle.
- (3) Insert the maintenance handle on the breaker drive shaft and pull down on the handle to close the contacts all the way.
- (4) Remove the maintenance handle.

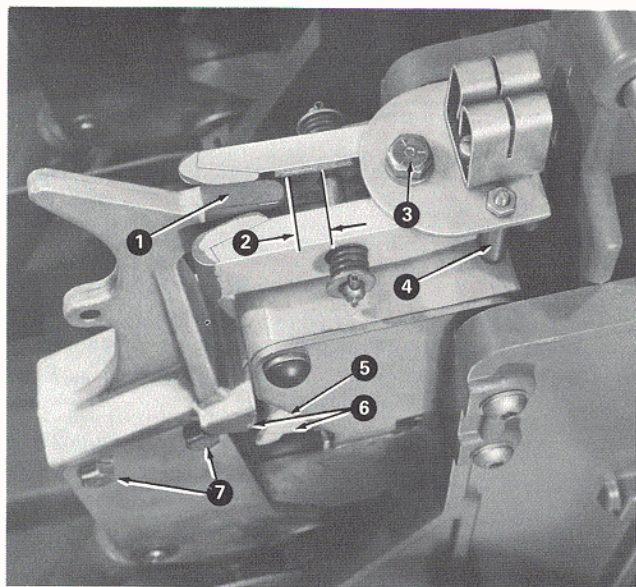
F. To adjust contact penetration:

- (1) Bend back the lockplate and loosen the two nuts on the pushrod located between the hinged arms. (Figure 25)
- (2) Contact penetration is correct when the moving arc contact is $\frac{3}{8}$ in. $+1/16$ in. -0 in. from the pin through the two stationary arc contacts and the five main stationary contacts are depressed a minimum of $\frac{1}{8}$ in. as shown in Figure 24.
- (3) Tighten the two nuts on the pushrod.
- (4) Trip open and close the breaker contacts to check adjustment.
- (5) Make sure the two nuts on the pushrod are tight, then bend over the lockplate.
- (6) Make sure the hinge pin (on which the hinged arms rotate) is tight.
 - a. Remove the roll pin from one of the hinge pin nuts.
 - b. Tighten the hinge pin nut until the belleville washers are compressed flat.
 - c. Back off one-quarter turn.
 - d. Replace the roll pin in the hinge pin nut.



1. Stationary arcing fingers.
2. Five main contacts. (Push in and rotate up to remove.)
3. Movable arcing and main contacts.
4. Hinge arms.
5. Bottom plate.
6. Two front 10-32UNF $\frac{1}{4}$ -lg hex-socket-head capscrews
7. Contact adjustment nuts.

FIGURE 25
Breaker contacts



1. Arcing contacts
2. $\frac{3}{8}$ in. $+1/16$ in. -0 in.
3. Center bolt
4. Contact post
5. Depressed minimum of $\frac{1}{8}$ in.
6. Main contacts
7. Movable arcing and main contact mounting bolts

FIGURE 24
Correct contact penetration

PARTS REPLACEMENT (continued)

5. Auxiliary switch (Figure 15):

(Refer to—and follow—the switch manufacturer's instructions for internal adjustment of the auxiliary switch.)

To remove for replacement:

- A. Replace the auxiliary switch with the breaker open and the closing spring discharged.
- B. Remove the cotter pin, washer, and pin from the switch linkage.
- C. Remove the two nuts, washers, and bolts holding the switch mounting bracket to the breaker frame.
- D. Remove the switch wiring.

NOTE: It is recommended that all wiring be labeled to assure ease of reinstallation.

- E. Note the position of the contacts and the remaining linkage on the switch:

- (1) Looking from the linkage end, the linkage should be at an approximate 7:30 o'clock position and, typically, *a* contacts 1 and 2 should be open, *b* contacts 3 and 4 should be closed, *a* contacts 5 and 6 should be open etc. (Figure 15)

- (2) Operate the old switch and the replacement switch counterclockwise 90 degrees to approximately a 4:30 o'clock position, noting the action of the contacts.

- (3) Contact for contact, the old and the replacement switch MUST OPERATE THE SAME (discounting a broken stage in the old switch). For any switch adjustment, refer to the switch manufacturer's instructions.

- F. Remove the remaining linkage from the old switch shaft, being careful not to pull or break off the operation counter arm.

- G. Remove the fixed contacts and support by removing the two screws and washers from the top of both the old and the replacement switches.

- H. Temporarily secure all stages together with twine or rubber bands.

- I. Unscrew—but do not remove—the two tie bolts through the switches, being careful not to let the stages separate.

NOTE: If the stages separate, the switch operating sequence will be changed.

- J. Slide the old switch out of the mounting bracket.

- K. Slide the new switch into the mounting bracket.

- L. Tighten the two tie bolts through the switches.

- M. Remove the twine or rubber bands holding the stages together.

- N. Replace the fixed contacts and support and fasten with the two screws and washers to the top of the new switch.

- O. Replace the switch wiring.

- P. Securely attach the switch mounting bracket to the breaker frame with the two bolts, washers, and nuts.

- Q. Replace the pin, washer, and cotter pin in the switch linkage.

6. Closing coil (Figure 18):

To replace a closing coil:

- A. Disconnect the closing coil wiring from the terminal block.

- B. Remove the two bolts and washers which mount the coil to the mechanism frame.

- C. Remove the shims from between the coil and the frame.

(1) Put the shims aside so they can be reused.

- D. Remove the coil.

- E. Mount the replacement coil on the mechanism frame, using the shims and the two bolts with washers.

- F. Check the closing coil adjustment. (Page 21)

7. Trip coil (Figure 20):

To replace a trip coil:

- A. Disconnect the trip coil wiring from the terminal block.

- B. Remove the two bolts and washers which mount the coil to the mechanism frame.

- C. Remove the shims from between the coil and the frame.

(1) Put the shims aside so they can be reused.

- D. Remove the coil.

- E. Mount the replacement coil on the mechanism frame, using the shims and the two bolts with washers.

- F. Check the trip coil adjustment. (Page 22)

8. Closing coil interlock switch (Figure 16), charging motor circuit interlock switch (Figure 16), and motor cutoff switch (Figure 18):

To replace the closing coil interlock switch, the charging motor circuit interlock switch, and the motor cutoff switch:

- A. Remove the mounting screws, nuts, and washers from the switch.

- B. Disconnect the switch wiring.

- C. Connect the wiring to the replacement switch.

(1) The closing coil interlock switch and the charging motor circuit interlock switch are wired—normally closed.

(2) The motor cutoff switch is wired—normally open.

- D. Mount the replacement switch, using the screws, nuts, and washers.

- E. Check the closing coil interlock switch and charging motor interlock switch adjustments. (Interlock, Page 20)

- F. Check the motor cutoff switch adjustment. (Page 21)

9. Closing coil switch assembly (Figure 17):

To replace the closing coil switch assembly:

- A. Disconnect the switch wiring.

- B. Remove the self-locking nuts and bolts which secure the switch assembly.

- C. Remove the switch assembly.

- D. Mount the replacement switch assembly, using the self-locking nuts and bolts.

- E. Connect the wiring so that the circuit is normally open.

- F. Check the closing coil switch adjustment. (Page 21)

TESTING

NOTE: Prior to conducting electrical tests, refer to the applicable breaker wiring diagram. The wiring diagram number is stamped on the breaker nameplate. Figure 13 is a typical wiring diagram.

1. Coil test.

- A. The resistance values of the close and the trip coils must be within $\pm 10\%$ of the values shown in the following table. Refer to the breaker nameplate to determine which close and trip values apply.

| Coil Rating (volts) | Resistance, dc ohms $\pm 10\%$ | Minimum Close (volts) | Required Trip (volts) | Maximum Voltage (volts) |
|---------------------|--------------------------------|-----------------------|-----------------------|-------------------------|
| 24 dc | 2.36 | 17 | 14 | 30 |
| 48 dc | 9.2 | 35 | 28 | 60 |
| 125 dc | 55.6 | 90 | 70 | 140 |
| 250 dc | 216.0 | 180 | 140 | 280 |
| 115 ac | 4.8 | 95 | 95 | 125 |
| 230 ac | 29.0 | 190 | 190 | 250 |

- B. Disconnect the coil wiring from the operating mechanism terminal block at the back of the breaker.

C. Test the coil.

D. Reconnect the wiring.

2. Charging motor test.

- A. Refer to the breaker nameplate to determine which motor voltage values from the following table apply:

| Motor Rating (volts) | Minimum Rating (volts) | Maximum Rating (volts) |
|----------------------|------------------------|------------------------|
| 125 dc | 90 | 130 |
| 250 dc | 180 | 260 |
| 115 ac | 95 | 125 |
| 230 ac | 190 | 250 |

3. Current-path electrical resistance test.

NOTE: The d-c resistance of the current-carrying path must be measured with no less than 100 amps flowing from terminal to terminal of each phase with the breaker in the closed position.

- A. Connect the testing apparatus wiring to the nut or bolt head in the center of the primary disconnect contact cluster assembly.

(1) Resistance limits are:

15-kv, 1200-amp breaker: 50 microohms maximum.

15-kv, 2000-amp breaker: 28 microohms maximum.

- a. If the d-c resistance value is greater than the limit shown, clean and tighten all current-carrying surfaces.

- b. If the d-c resistance value is as high as 150% over the limit shown, replace the contacts.

4. Anti-pump static control unit (52 x-y) test.

- A. Remove the three wires from the unit and label the wires so they can be reinstalled properly.
- B. Use the same voltage to test the unit as used in the control system. (Figure 26)
- C. Attach the negative (—) power source side to terminal 2.
- D. Attach to the positive (+) power source side: A test lamp and a momentary close switch in series to terminal 4.
- E. Attach to the positive (+) power source side: A control switch in series to either terminal 1 or terminal 3 (the same one used in the breaker).
- F. With the momentary close switch closed, close the control switch.
- (1) The lamp should light.
- G. Open and reclose the momentary close switch.
- (1) The lamp should go off and stay off.
- H. Open and reclose the control switch.
- (1) The lamp should re-light.
- I. Reconnect the wiring.

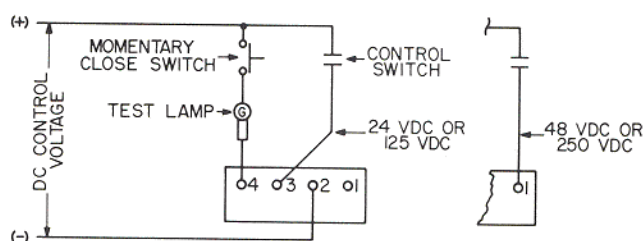


FIGURE 26

5. Low-frequency withstand voltage test of major insulation components.

- A. Apply 27-kv, 60-hz test voltage to the breaker for one minute in accordance with the following table:

| Breaker Position | Point of Application of Test Voltage | Ground |
|------------------|--------------------------------------|---------------------------------|
| Closed | Phases A, B, and C | Frame |
| Closed | Phase B | Phases A, C, and Frame |
| Open | Lower Phases A, B, and C | Upper Phases A, B, C, and Frame |

6. Secondary control circuit test.

- A. With the motor leads at the operating mechanism terminal block disconnected, all control wiring must withstand a 1500-volt, 60-hz test for one minute.
- B. Reconnect motor wiring.

TROUBLESHOOTING CHART

Failure to Charge the Closing Spring

| Possible Cause | Solution |
|--|--|
| <ol style="list-style-type: none"> 1. Motor does not run: <ol style="list-style-type: none"> A. No supply voltage to motor. B. Charging motor cutoff switch (SC). C. Charging motor circuit interlock switch (MCI). 2. Motor does run: <ol style="list-style-type: none"> A. Insufficient oil in sump. B. Dump valve open. C. Pressure-release valve open. | <ol style="list-style-type: none"> A. Check fuses, wiring, and secondary contacts; see page 12. B. Check adjustment; see page 21. C. Check adjustment; see page 20. A. Fill sump to top of sight glass; see page 19. B. Check adjustment; see page 20. C. Check adjustment; see page 21. |

Failure of Breaker to Close

| Possible Cause | Solution |
|--|--|
| <ol style="list-style-type: none"> 1. Closing spring not charged. 2. No supply voltage to closing coil. 3. Closing coil interlock switch (CCI). 4. Closing coil switch (CCS). 5. Auxiliary switch. 6. Linkage check switch (LCS). 7. Open circuited closing coil. 8. Anti-pump relay contacts maintained closed. | <ol style="list-style-type: none"> 1. Charge spring. 2. Check fuses, wiring, secondary contacts; see page 12. 3. Check adjustment; see page 20. 4. Check adjustment; see page 21. 5. Inspect auxiliary switch; see page 13. 6. Inspect switch; see page 15. 7. Replace coil; see page 26. 8. Break the close circuit and remake. |

Failure of Breaker to Open

| Possible Cause | Solution |
|--|--|
| <ol style="list-style-type: none"> 1. Breaker not closed. 2. No supply voltage to trip coil. 3. Auxiliary switch. 4. Open circuited trip coil. | <ol style="list-style-type: none"> 1. Close breaker. 2. Check wiring, secondary contacts; see page 12. 3. Inspect auxiliary switch; see page 13. 4. Replace coil; see page 26. |

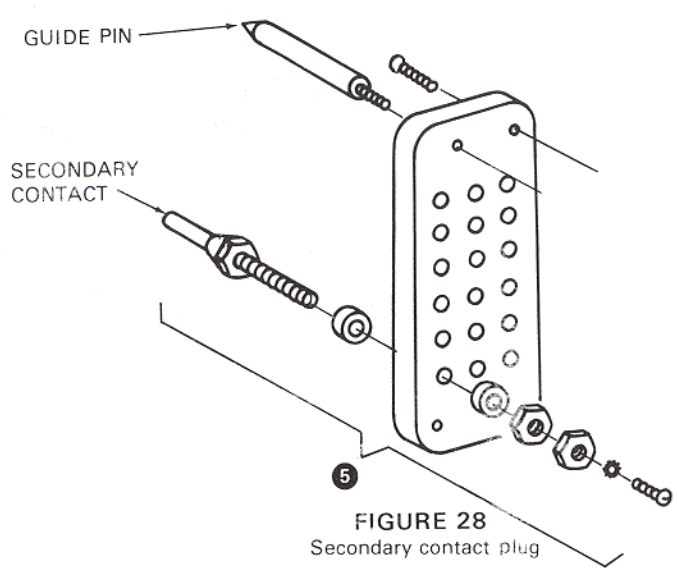
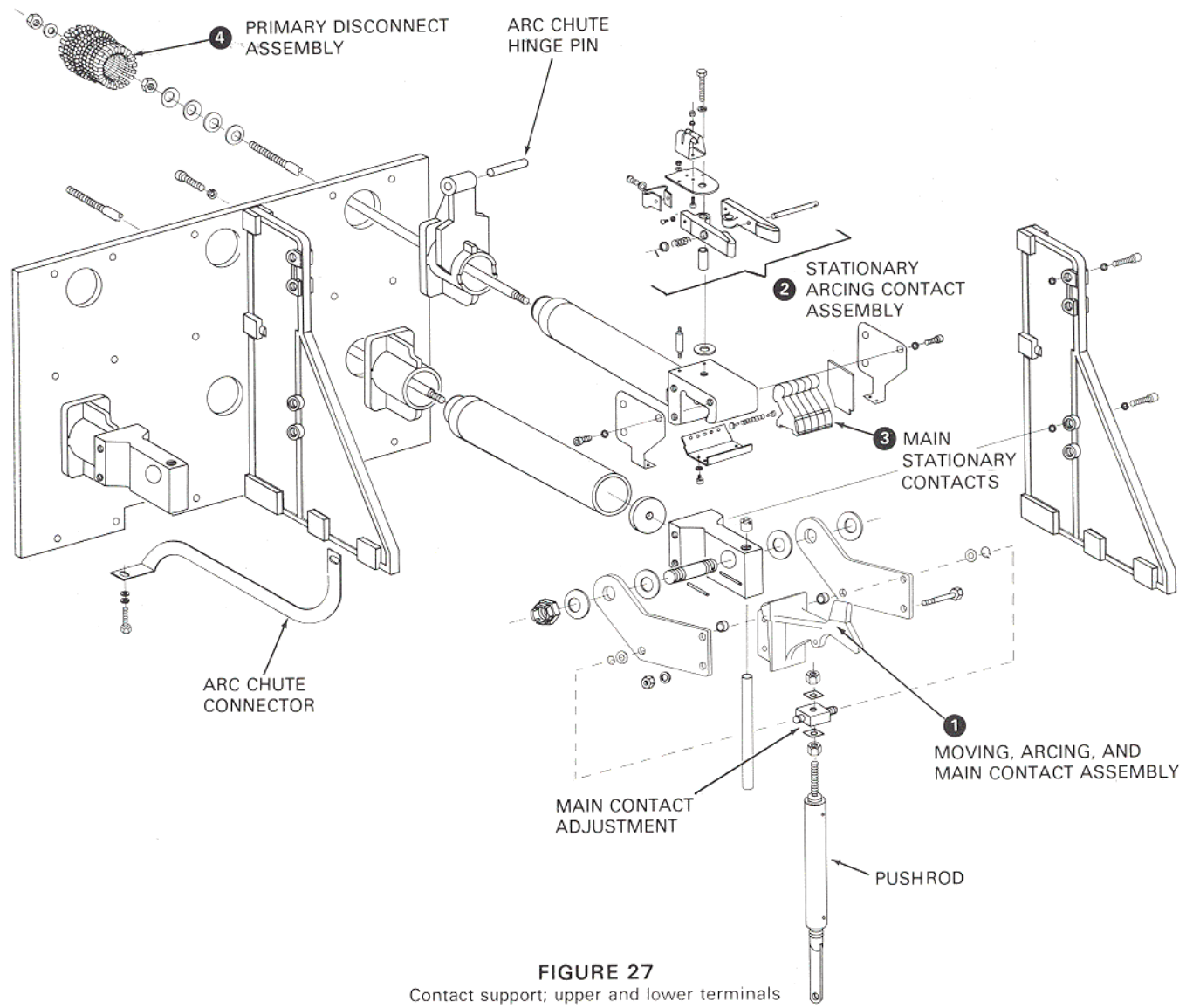
SPARE PARTS LIST

| Description | Figure No. | Item No. | Recommended Stock* | | | Parts List Reference |
|---|------------|----------|--------------------|------------------|------------------|----------------------|
| | | | 1 to 5 Breakers | 6 to 20 Breakers | Over 20 Breakers | |
| Contact—moving, arcing, and main (1 phase) | 27 | 1 | 1 | 2 | 3 | SFB00044A00A |
| Contact—arcing, stationary (1 phase) | 27 | 2 | 1 | 2 | 3 | SFB00151A00A |
| Contact—main, stationary (1 phase) | 27 | 3 | 5 | 10 | 15 | SFA00061A00A |
| Primary disconnect assembly | 27 | 4 | 3 | 6 | 12 | SFB00038A00A |
| Secondary contact plug | 28 | 5 | 1 | 2 | 4 | SFB00025A00A |
| Pump motor (include manufacturer's serial no. and motor voltage from PSD breaker nameplate for correct replacement) | 29 | 6 | 0 | 1 | 4 | SHB00060A |
| Pump | 29 | 7 | 0 | 2 | 3 | 310015250 |
| O-ring seals, set | 29 | 8 | 1 | 1 | 1 | SFA00523A001 |
| The following are included in set of 26: | | | | | | |
| Gasket | 29 | 9 | | | | SHA00284A001 |
| Pump gasket | 29 | 10 | | | | SHA00294A001 |
| O-ring | 29, 30 | 11 | | | | 223116113 |
| Back-up ring | 29 | 12 | | | | 223202113 |
| O-ring | 29 | 13 | | | | 223116020 |
| O-ring | 29 | 14 | | | | 223116013 |
| O-ring | 29 | 15 | | | | 223116014 |
| O-ring | 30 | 16 | | | | 223116011 |
| Back-up ring | 30 | 17 | | | | 223202011 |
| Back-up ring | 30 | 18 | | | | 223206113 |
| Back-up ring | 30 | 19 | | | | 223202120 |
| O-ring | 30 | 20 | | | | 223116120 |
| Back-up ring | 30 | 21 | | | | 223202121 |
| O-ring | 30 | 22 | | | | 223116121 |
| Wiper ring | 30 | 23 | | | | 652111102 |
| Seal | 30 | 24 | | | | 652111301 |
| O-ring | 31 | 25 | | | | 223116119 |
| Ring seal | 32 | 26 | | | | 223113301 |
| Wiper ring | 32 | 27 | | | | 652111101 |
| O-ring | 33 | 28 | | | | 223116010 |
| Seal | 33 | 29 | | | | 223205010 |
| Trip coil | 34 | 30 | 1 | 2 | 4 | SHB00069A |
| Closing coil | 33 | 31 | 0 | 1 | 2 | SHB00068A |
| Microswitch | 33, 35 | 32 | 0 | 1 | 2 | SFA00449A001 |
| Switch assembly | 30 | 33 | 0 | 1 | 2 | SHA00679A00A |
| Arc chute | 36 | 34 | 0 | 1 | 2 | SFD00016A00A |
| Truarc rings, set (15 rings, each size) | | 35 | 1 | 1 | 1 | |
| Crank handle** | | 36 | 1 | 1 | 2 | SFB00115A00A |
| Manual pump handle** | | 37 | 1 | 1 | 2 | SHA00303A00A |

*With more than 20 breakers on the premises, a spare breaker should be considered in addition to the recommended spare parts.

**One crank handle, one pump handle, one arc chute lift yoke, and one handling dolly will normally be provided with each line-up shipped.

SPARE PARTS LIST (continued)



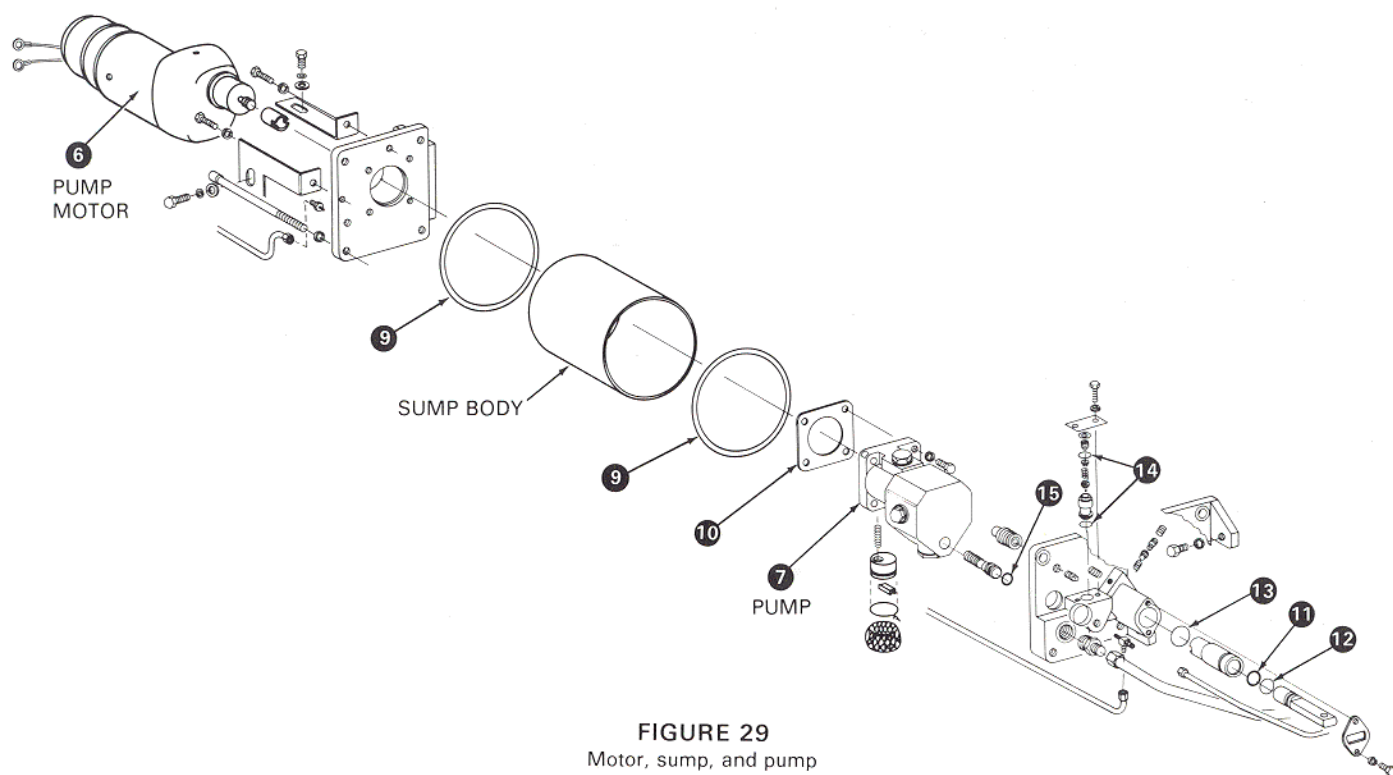


FIGURE 29
Motor, sump, and pump

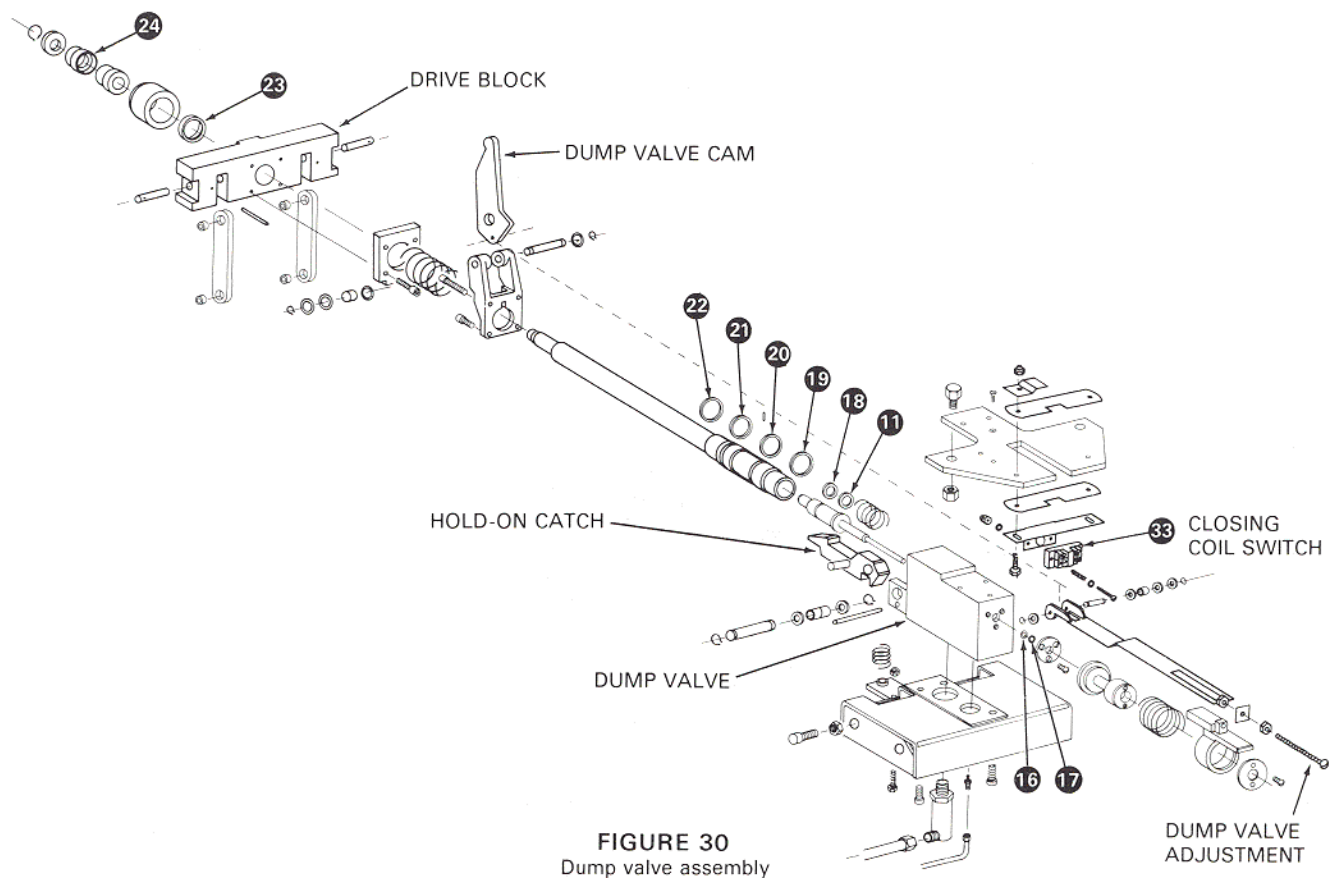
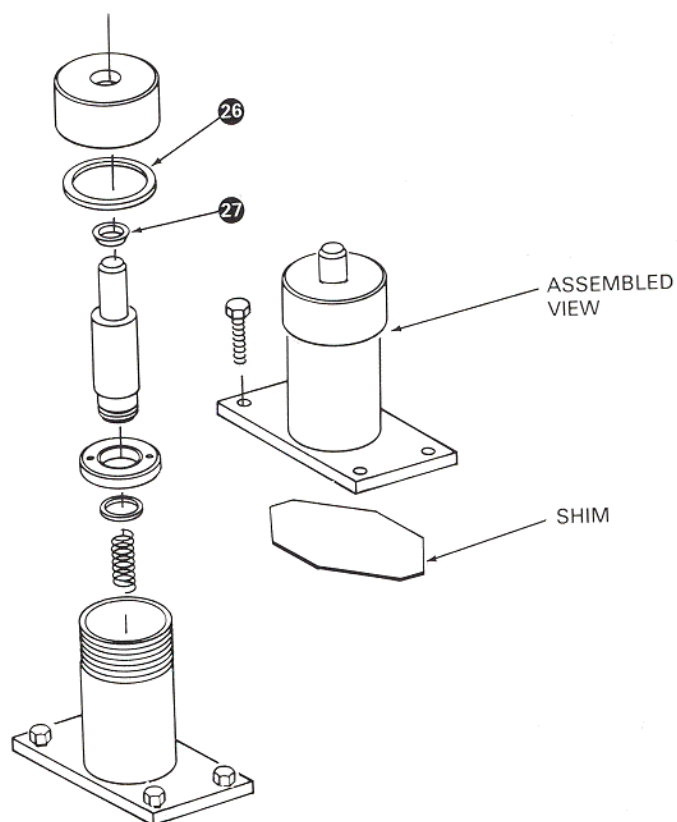
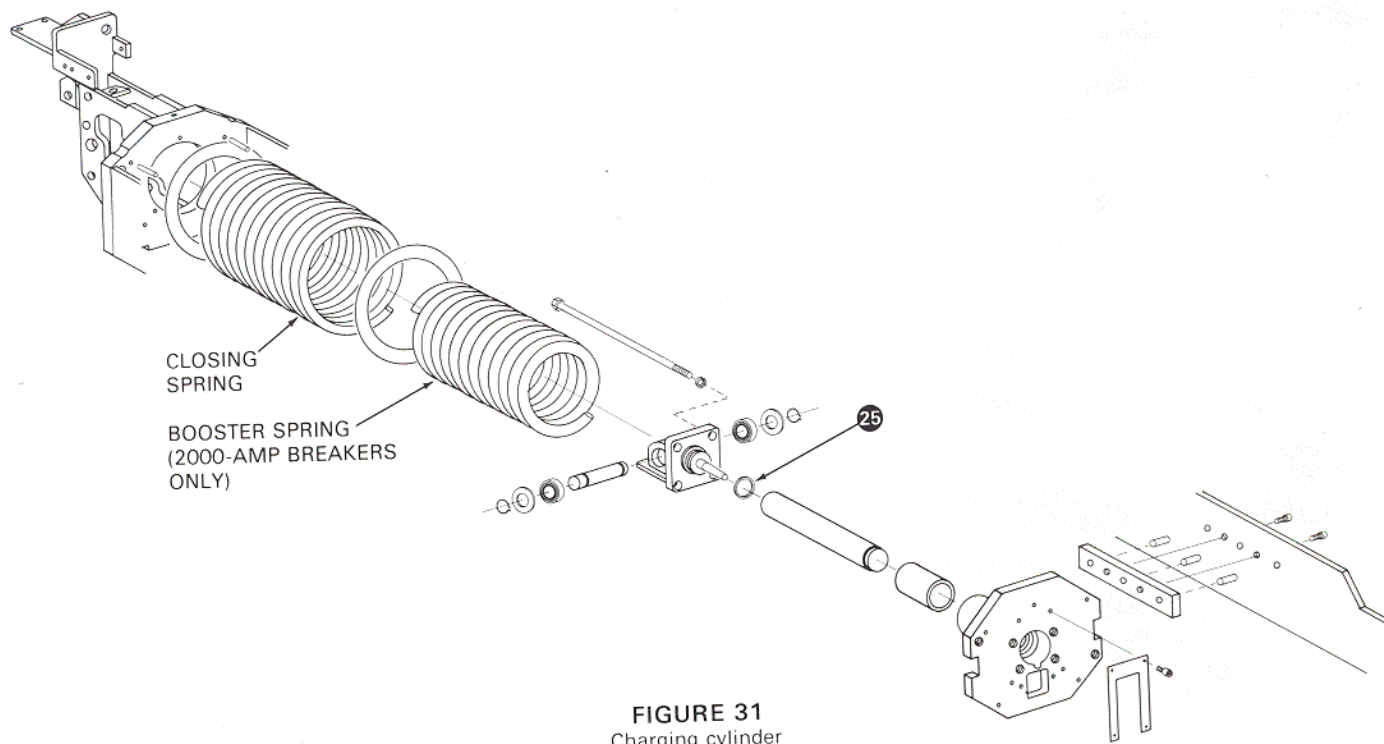


FIGURE 30
Dump valve assembly

SPARE PARTS LIST (continued)



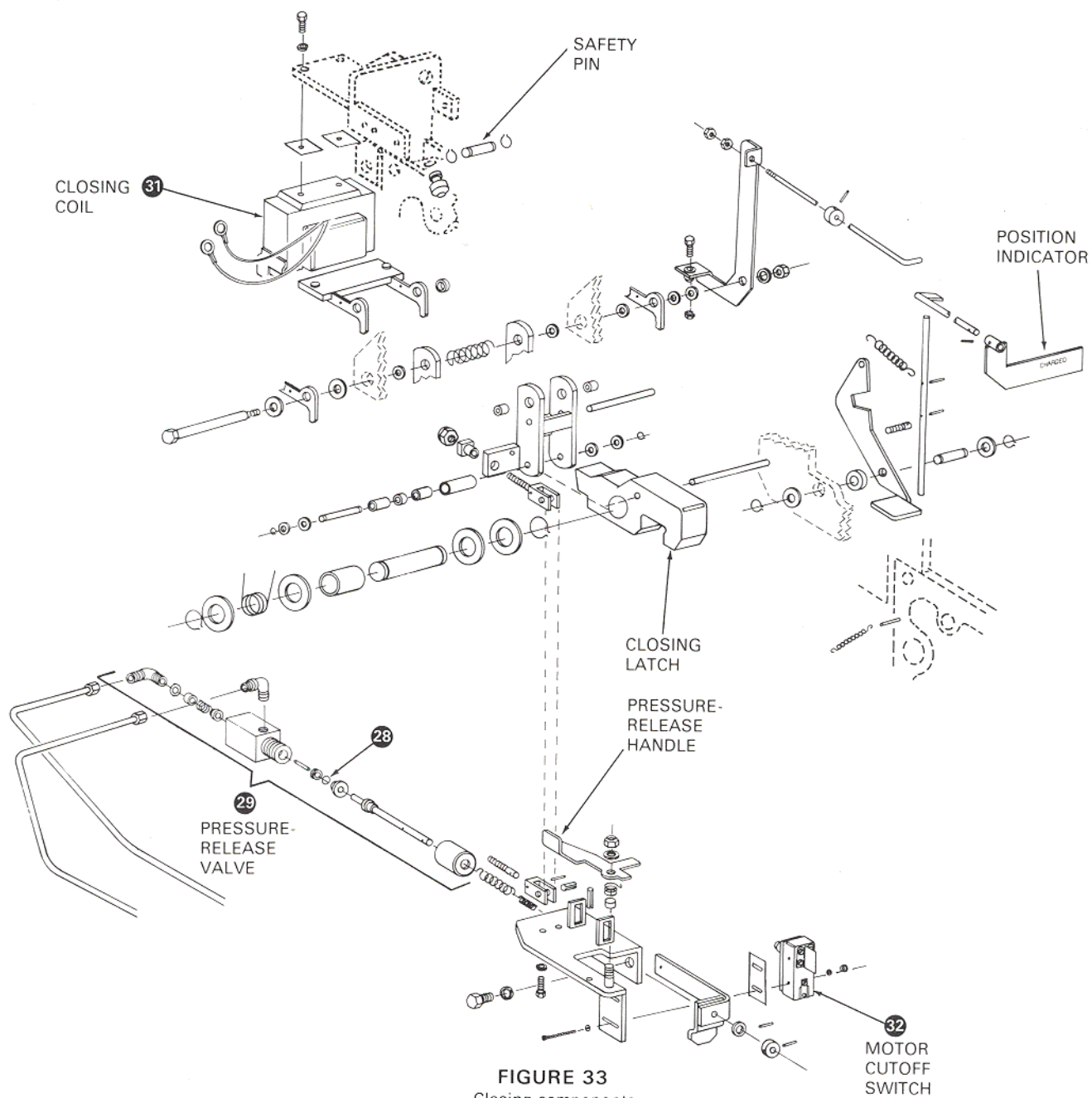


FIGURE 33
Closing components

SPARE PARTS LIST (continued)

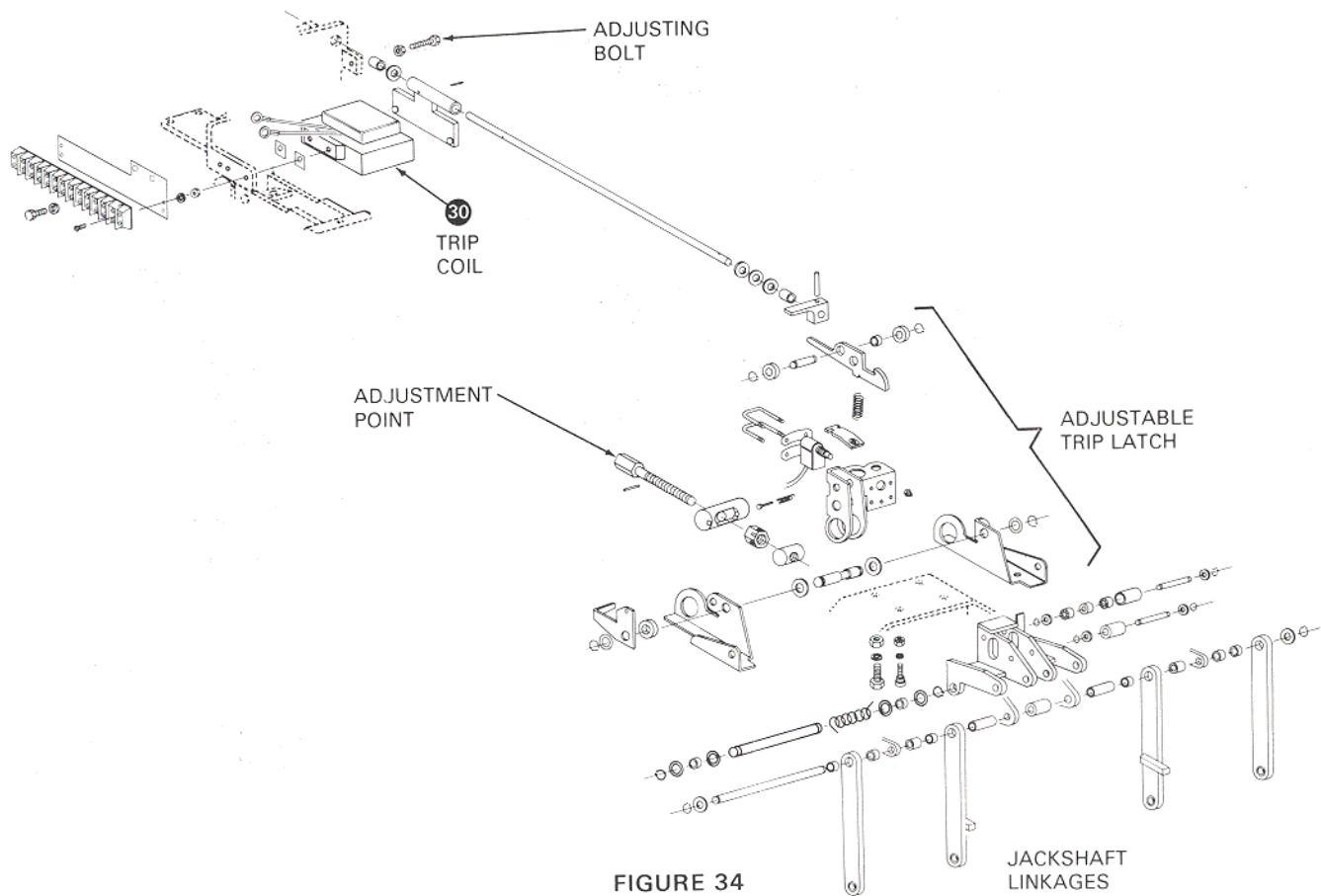


FIGURE 34
Tripping components

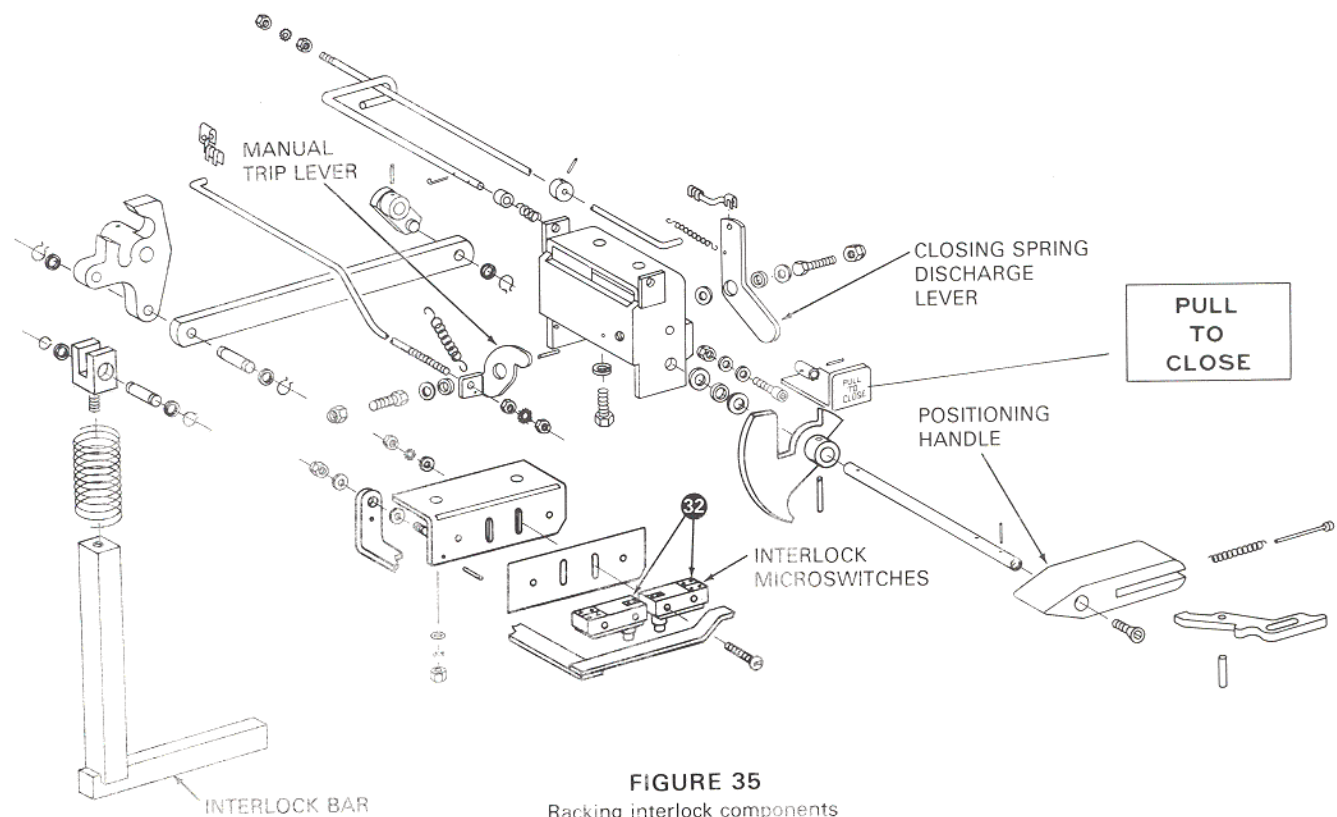


FIGURE 35
Racking interlock components

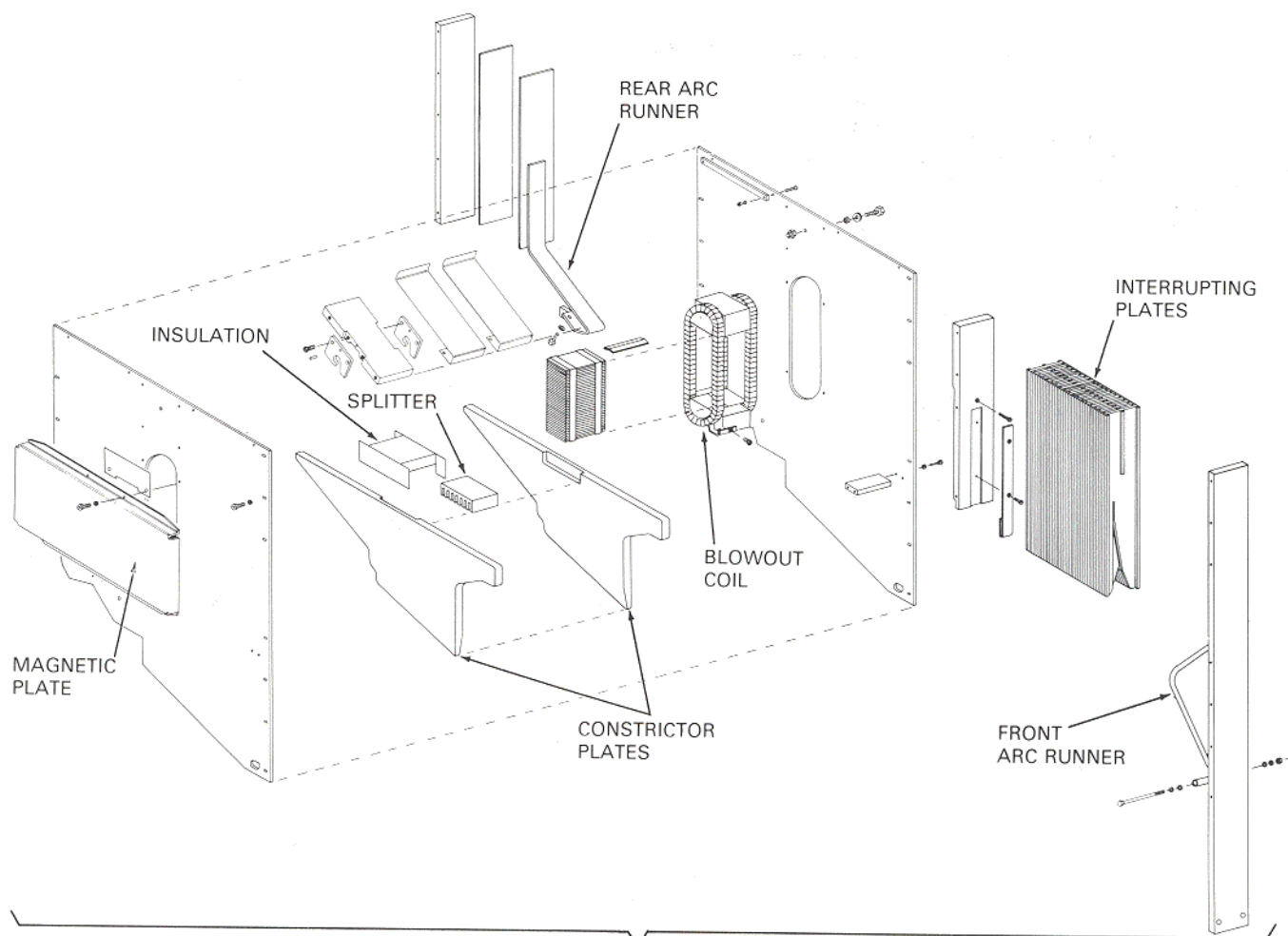


FIGURE 36
Arc chute components



McGRAW-EDISON COMPANY
Power Systems Division
Canonsburg, Pennsylvania 15317