Types AHJ-54 and AHJ-60 Oil Circuit Breakers
Installation, Maintenance, Adjustments, and Parts Replacement Instructions

Solvay, NY

CONTENTS

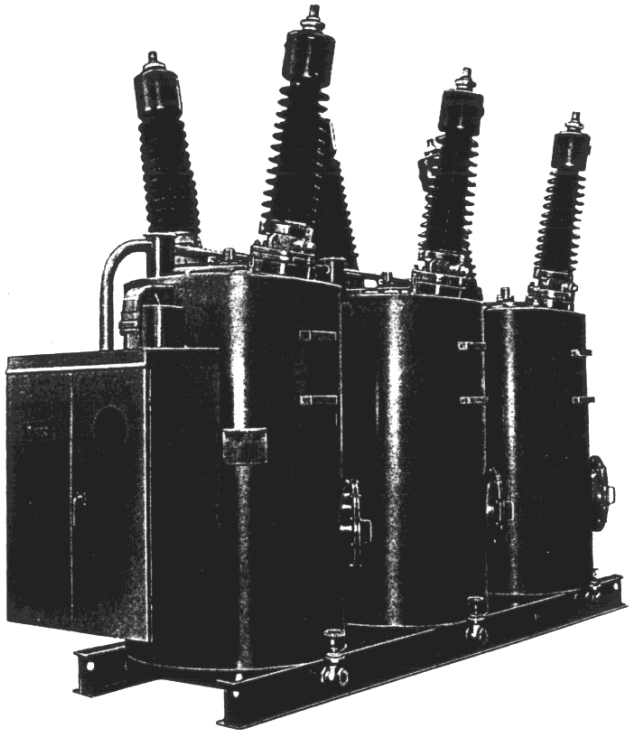

FIGURE 1
Typical AHJ oil circuit breaker with OA-4 operating mechanism mounted on pole 1.

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 POWER SYSTEMS DIVISION
BOX 440, CANONSBURG, PENNSYLVANIA 15317

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GENERAL

Service Information S290-30-1 pertains specifically to McGraw-Edison Type AHJ-54 (115-kv) and Type AHJ-60 (138-kv) oil circuit breakers. (Figure 1)

Detailed outline and control drawings and connection diagrams are issued for—and accompany—each breaker.

When installing, performing maintenance work, making adjustments, or replacing parts on an AHJ-54 or an AHJ-60 oil circuit breaker, the latest revision of the following instructions—copies of which accompany each breaker—must also be followed:

- Operating mechanism: *Service Information S290-52-1, Type OA-4 Operating Mechanism.*
- Oil: *PTI S-266, Oil Circuit Breaker Insulating Oil and Oil Handling.*
- Bushing current transformers: *Service Information S290-80-2, Type OE Bushing Current Transformers.*
- Bushings: *Service Information S315-10-1, Type PA Apparatus Bushings.*
- Spare parts: *Supplement 1 to Service Information S290-30-1, Types AHJ-54 and AHJ-60 Oil Circuit Breakers Spare Parts List.*
- Long-term storage: *Supplement 2 to Service Information S290-30-1, Preparing Types AHJ-54 and AHJ-60 Oil Circuit Breakers for Long-Term Storage.*

AHJ-54 and AHJ-60 oil circuit breakers conform to all applicable national standards for electrical characteristics, mechanical features, and accessories.

The standard NEMA numbers shown in Figure 2 are used when referring to the poles of AHJ-54 and AHJ-60 breakers. Facing the mechanism, poles (front to back) are numbered 1, 3, and 5 on the left and 2, 4, and 6 on the right.

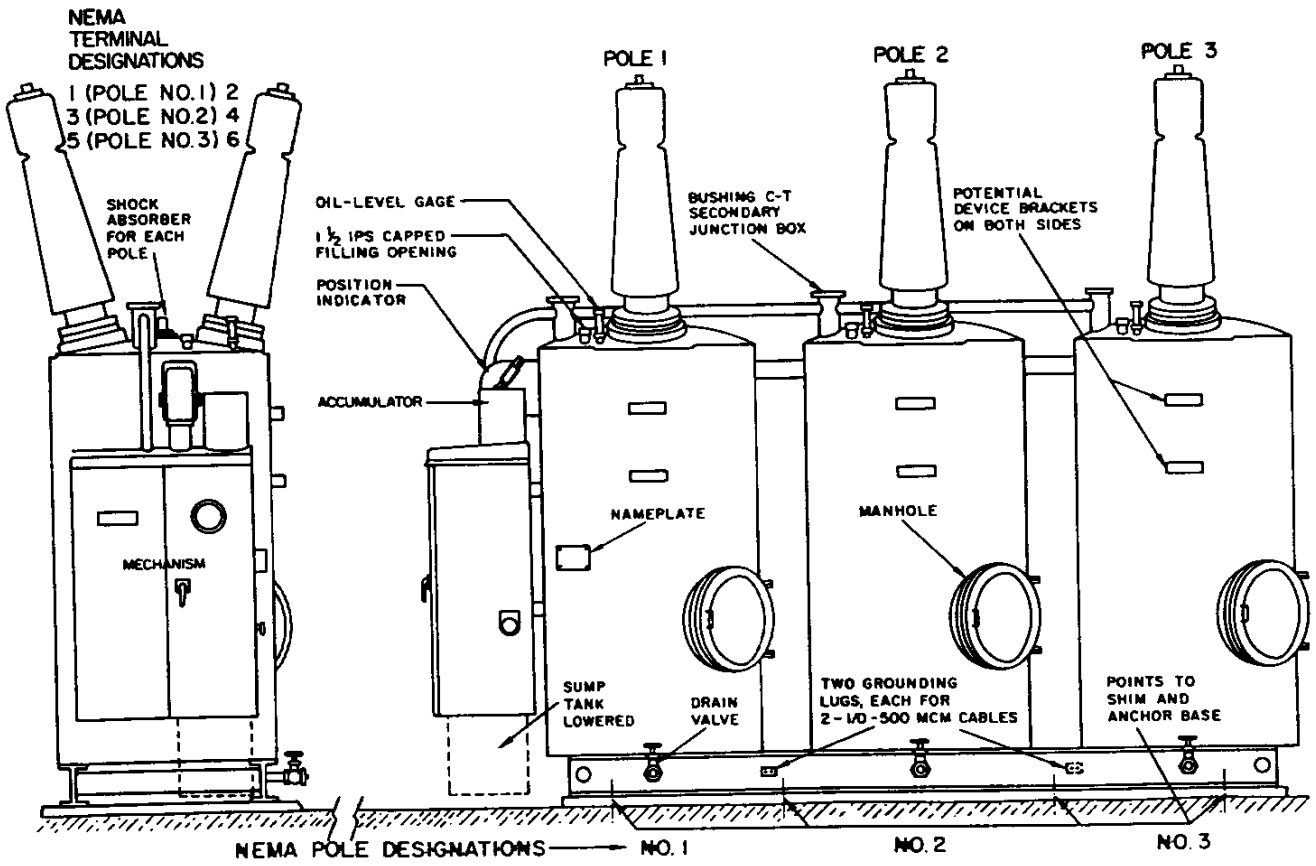

FIGURE 2
Outline of typical AHJ oil circuit breaker.

SHIPPING

Except in special cases, each AHJ-54 and each AHJ-60 breaker is shipped assembled with the operating mechanism and the bushings in place. Tanks are welded to common structural base members. Where required, parts are blocked and braced for shipment. Small accessory parts are shipped in marked packages. Oil is shipped separately.

Detailed outline drawings, control drawings, connection diagrams, all pertinent instructions, and packing lists are shipped protected in each operating mechanism cabinet. A shipping list in a weatherproof envelope is attached to each shipment.

NOTE: Breakers shipped overseas require special disassembled packaging.

INITIAL INSPECTION

Refer to Service Information S290-52-1, Type OA-4 Operating Mechanism Instructions, for initial inspection of the operating mechanism.

Immediately upon receipt of the breaker:

1 Inspect the exterior of the breaker for evidence of rough handling or damage in transit and shortage.

2 Unbolt and open the three tank manholes, being especially careful to avoid damaging the sealing gaskets.

3 Inspect the interiors of the three tanks for evidence of rough handling or damage in transit and shortage.

NOTE: Do not remove bracing or blocking at this time.

4 Close and bolt the three tank manholes promptly to prevent entrance of dirt and moisture.

5 Remove all masking tape. (Later removal may be very difficult.)

Should initial inspection reveal evidence of rough handling or damage in transit and/or shortage, notify—and file a claim with—the carrier at once. Also notify McGraw-Edison Power Systems Division, Canonsburg, Pa 15317.

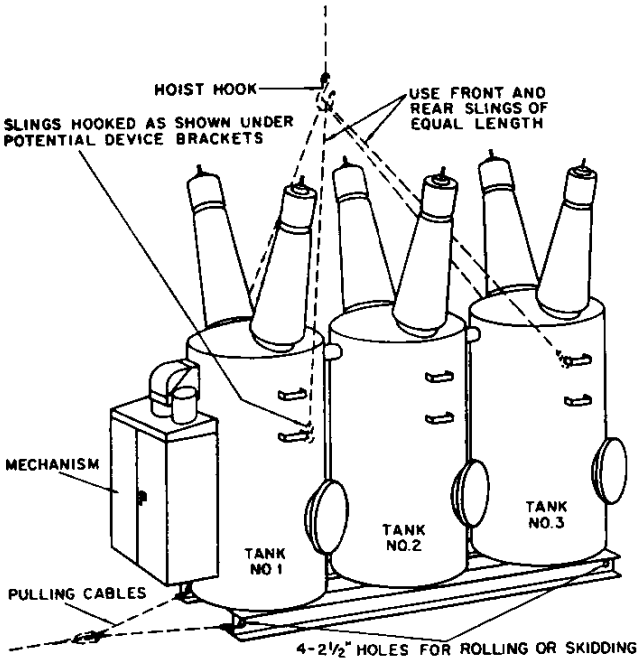

FIGURE 3

Rigging for hoisting, skidding, or moving an AHJ oil circuit breaker—without oil—on rollers.

BREAKER IDENTIFICATION RECORDS

Retain permanently complete identification records for each breaker:

- Detailed outline drawings.
- Control drawings.
- Connection 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.

UNLOADING AND /OR MOVING FROM TRANSPORTING VEHICLE TO INSTALLATION LOCATION

Refer to—and follow—Service Information S290-52-1, Type OA-4 Operating Mechanism Instructions, for handling the operating mechanism when unloading and/or moving the breaker.

Safety Precaution

Slings used for hoisting, skidding, or moving an AHJ-54 or an AHJ-60 oil circuit breaker on rollers must have adequate lifting or pulling capacity. Refer to the nameplate for the weight of the breaker. Nearly one-half of the total breaker weight —without oil—is in the operating mechanism and tank no. 1.

Hoisting

Breakers are usually hoisted without oil. If an AHJ-54 or an AHJ-60 breaker is to be hoisted with oil in the tanks, contact McGraw-Edison Power Systems Division, Canonsburg, Pa. 15317, for instructions pertaining to the specific breaker.

To hoist an AHJ-54 or an AHJ-60 breaker without oil:

1 Attach slings of equal length to balance the breaker as shown in Figure 3:

A Hook the front sling onto the lower bracket.

B Hook the back sling onto the upper bracket.

NOTE: Be careful not to damage the bushings with the lift rigging.

2 Lift the breaker.

Skidding or Moving on Rollers

To skid or move on rollers an AHJ-54 or an AHJ-60 breaker with oil in the tanks:

1 Attach pulling cables to the holes in the ends of the structural base members to balance the breaker as shown in Figure 3.

2 Skid or move the breaker on rollers.

NOTE: When pulling the breaker from the operating mechanism end, be careful to prevent uplift pressure of the cables on the operating mechanism cabinet.

PREPARING A BREAKER FOR STORAGE

If the breaker is not to be placed in the service-ready condition immediately upon receipt, it is considered to be in storage.

Short-term storage: A breaker on its foundation for an appreciable period of time before it is made ready for service.

Long-term storage: A breaker on its foundation for more than a few months before it is made ready for service.

Short-Term Storage

1 Prepare the operating mechanism for storage in accordance with *Service Information S290-52-1, Type OA-4 Operating Mechanism Instructions.*

2 Open the three tank manholes, being careful not to damage the gaskets.

3 Remove all packing materials that might possibly collect moisture.

Do not remove desiccants (if supplied). Maintain desiccants intact until the breaker is made ready for service.

Do not remove any bracing or blocking. Maintain bracing and/or blocking intact until the breaker is made ready for service.

4 Remove all boxes from the tanks.

5 Open all boxes.

A. Make sure the contents are clean, dry, and in good condition.

6 Reseal all boxes to exclude moisture.

7 Store all boxes indoors in a dry place.

8 Check the interiors of the three tanks to make sure they are clean, dry, and free from foreign materials.

9 Remove the protective coverings from all bushings.

10 Make sure all bushings are clean, dry, and in good condition.

11 Replace the protective coverings on all bushings.

12 Check the manhole door gaskets to make sure they are in place and in good condition.

NOTE: Each gasket is factory-cemented into a groove in the flange.

13 Coat each gasket surface that meets a door face with grease to prevent it from sticking.

14 Bolt the three manholes closed, pulling up the bolts in small increments progressively around the doors until metal-to-metal contact is obtained.

15 Store oil indoors in accordance with *PTI S-266, Oil Circuit Breaker Insulating Oil and Oil Handling Instructions.*

Long-Term Storage

To prepare an AHJ-54 or an AHJ-60 oil circuit breaker for long-term storage, refer to—and follow—*Supplement 2 to Service Information S290-30-1, Preparing Types AHJ-54 and AHJ-60 Oil Circuit Breakers for Long-Term Storage.*

INSTALLATION

Safety Precautions

It is extremely important that all safety precautions described in these instructions and in *Service Information S290-52-1, Type OA-4 Operating Mechanism Instructions,* be clearly understood and carefully followed.

Although AHJ-54 and AHJ-60 breakers have been designed with the safety of operating personnel foremost in mind, the inherent mechanical characteristics of the breakers—along with the necessary activities of operating personnel—make cautious work habits essential.

1 Prepare concrete piers or a flat slab to meet foundation requirements of the drawings submitted for the breaker.

2 Level and bolt the breaker solidly in place at the points shown on the outline drawing.

NOTE: Use shims where—and as—needed to level the base and distribute the load evenly.

A Using a spirit level, make sure the breaker is level from front to back and from side to side.

B Make sure the walls of the tanks are vertical.

3 Clean the ground lugs located diagonally opposite one another on the breaker base. (Figure 2)

4 Install two grounding connections with the capacity to carry—without damage—the full-ground short-circuit current of the system.

NOTE: The ground lugs on the breaker base have two ½-13UNC tapped holes on 1¾-in. centers and double-cable lugs for 1/0—500-mcm conductors.

5 Prepare the operating mechanism for service in accordance with *Service Information S290-52-1, Type OA-4 Operating Mechanism Instructions.*

6 Open the three tank manholes, being careful not to damage the gaskets.

7 Remove all packing materials, bracing, and blocking (including liftrod tiedowns, external and/or internal shipping collars around each bushing) from inside the three tanks.

Do not remove moisture barriers and desiccants (if supplied) at this time.

8 Make sure all internal and external fasteners are tight.

9 Using the operating mechanism red maintenance-positioning valve, slow-close the breaker, allowing it to settle on the latch with no overtravel.

Refer to—and follow—the special maintenance operation nameplate on the OA-4 operating mechanism.

10 Check liftrod linkage measurement T (Figure 4):

A Place a square against each liftrod with the blade of the square touching the lever hub as shown in Figure 4.

B With a non-carbon, grease-base pencil, mark each liftrod directly across from the lever hub.

C Using the operating mechanism green maintenance-positioning valve, slow-open the breaker.

Refer to—and follow—the special maintenance operation nameplate on the OA-4 operating mechanism.

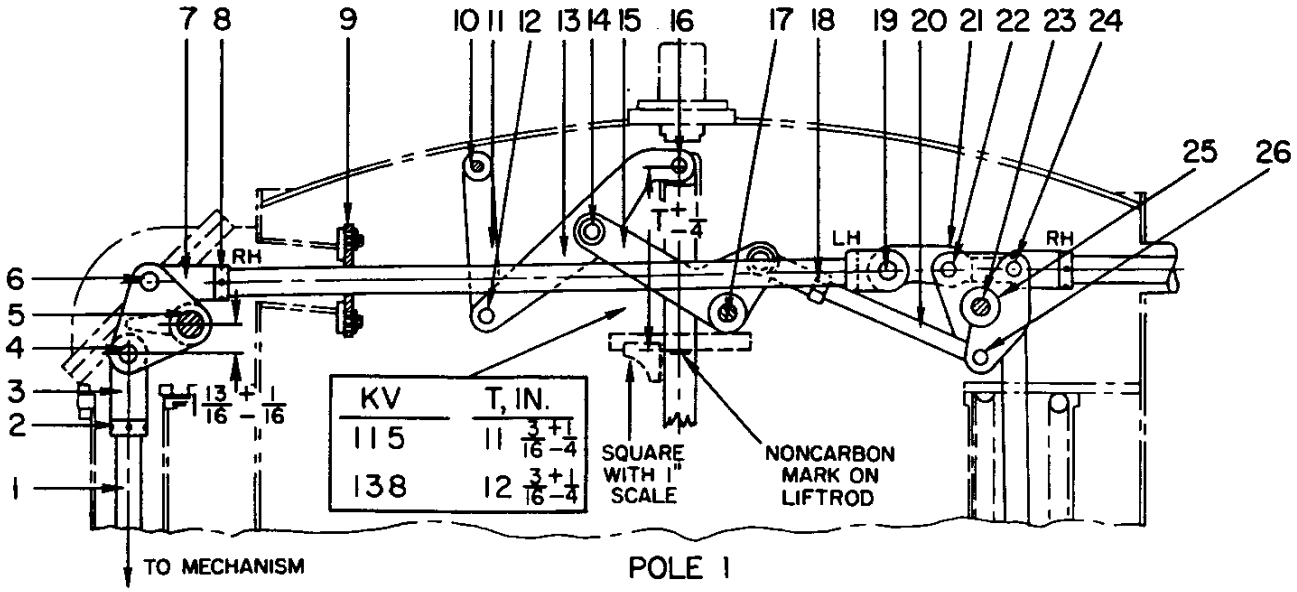

FIGURE 4

Section of pole 1 of the AHJ breaker linkage in the closed position. Adjustment values are identical for all three poles.

1. Pullrod
2. Adjustment for mechanism pullrod
3. Rod end
4. Pin
5. Bellcrank and pivot pin
6. Pin
7. Rod end
8. Righthand nut and lockwasher
9. Sliding seal on pullrod (identical for all poles)
10. Pin
11. Lever
12. Pin
13. Lever
14. Pin
15. Lever
16. Pin
17. Stationary bearing pin
18. Adjustment for link between lift and drive cranks
19. Pin
20. Pullrod
21. Pullrod end assembly
22. Pin
23. Pin
24. Pin
25. Lever
26. Link bearing pin

D Measure from the non-carbon mark on each liftrod to the center of pin 16 (Figure 4).

- AHJ-54 breakers: Measurement T should be $11\frac{3}{16}$ in. ± ¼ in.
- AHJ-60 breakers: Measurement T should be $12\frac{3}{16}$ in. ± ¼ in.

E If measurement T is not within the tolerance specified, refer to *Liftrod linkage* in the Adjustments section.

Correct this condition before proceeding to the next installation step.

11 Check liftrod stroke (Figure 5):

A Holding a square on the non-carbon mark made on each liftrod, measure the distance from the top of the scale to the underside of the lever hub in the open position.

- AHJ-54 breakers: Stroke measurement should be 18 in. ± ¼ in.
- AHJ-60 breakers: Stroke measurement should be 20 in. ± ¼ in.

B If the stroke measurement is not within the tolerance specified, refer to *Liftrod stroke* in the Adjustments section.

Correct this condition before proceeding to the next installation step.

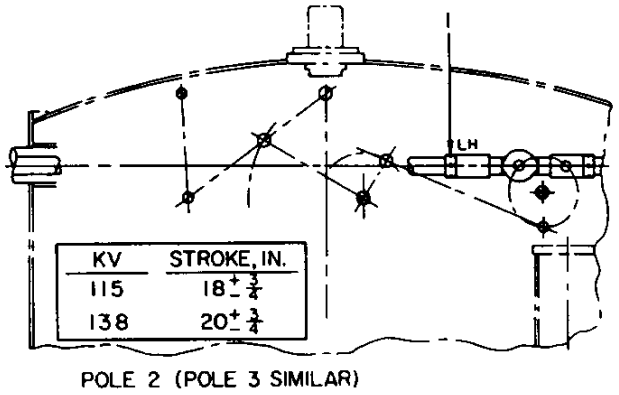

FIGURE 5

Section of pole 2 of the AHJ breaker linkage in the closed position. Pole 3 is similar

1. Lefthand nut and starwasher (pole 3 is identical)

INSTALLATION (continued)

12 Check liftrods 20 (Figure 6) and contact blades 16 (Figure 6) visually to make sure they are vertical and, therefore, parallel to one another.

A If a liftrod or a contact blade is not vertical, refer to *Liftrod and contact blade verticality* in the Adjustments section.

Correct this condition before proceeding to the next installation step.

13 With a non-carbon, grease-base pencil, mark the location and position of each interrupter chamber so that, after being removed, it can be returned to its original location and position.

14 Remove the nuts in the mounting studs holding interrupter chambers 14 (Figure 6) in place.

15 Remove the interrupter chambers.

16 Check contact blade alignment:

A Using the operating mechanism red maintenance-positioning valve, slow-close the breaker completely.

(1) Make sure the contact blades enter the stationary contact shoe clusters on center, making the clusters spread evenly with equal distance between the shoes.

(2) If the contact blades do not enter the stationary contact shoe clusters on center, refer to *Contact blade alignment* in the Adjustments section.

Correct this condition before proceeding to the next installation step.

NOTE: Pressure of the individual shoes in each contact cluster is controlled by a compression spring that requires no checking or adjustment.

17 Using the operating mechanism green maintenance-positioning valve, slow-open the breaker.

18 Check contact blade penetration:

A Make a scribe mark 1⅜ in. from the tip end of each contact blade as shown in Figure 6.

B Using the operating mechanism red maintenance-positioning valve, slow-close the breaker, allowing it to settle on the latch.

C Check the scribe mark.

- The scribe mark should be even with the ends of the contact shoes ± 1/16 in.

D If contact blade penetration is not 1⅜ in. ± 1/16 in., refer to *Contact blade penetration* in the Adjustments section.

Correct this condition before proceeding to the next installation step.

19 Using the operating mechanism green maintenance-positioning valve, slow-open the breaker.

20 Reinstall interrupter chambers 14 (Figure 6) in their original locations and positions.

A Make sure the interrupter chambers are vertical and coaxial with the contact blades.

B Make sure the exhaust ports in the interrupter chambers face outward toward the tank wall on one side and inward toward the jet nozzles on the opposite side.

C Make sure the nuts on the mounting studs are tight.

21 Check the horizontal and vertical positioning of jet nozzles 14 (Figure 7):

A Horizontal: Make sure the centerline of each jet nozzle aligns with the center of its exhaust port (Figure 7).

NOTE: The centerline of each jet nozzle can be determined by the straightedge projection on the tapered outside face.

B Vertical: Make sure the center of each jet nozzle is directed toward the upper exhaust port at a level 9/16 in. ± 1/16 in. from the bottom of the upper port as shown in Figure 7.

C If the jet nozzles are not properly positioned horizontally and/or vertically, refer to *Jet nozzle positioning* in the Adjustments section.

Correct this condition before proceeding to the next installation step.

22 Using the operating mechanism green maintenance-positioning valve, slow-open the breaker.

23 Remove moisture barriers and desiccants (if supplied) from the three tanks.

24 Check the electrical resistance of liftrods 7 (Figure 7) and guide rods 8 (Figure 7).

NOTE: Both the liftrods and the guide rods are made of organic insulating material and, when not immersed in dry oil, they can absorb moisture.

A Conduct a megger test over the full length of each liftrod and the full length of each guide rod from the clevis at the top of the liftrod down to crosshead 19 (Figure 6).

- Electrical resistance of both the liftrods and the guide rods must be at least 10,000 megohms.

B If the electrical resistance of a liftrod or a guide rod is less than 10,000 megohms, refer to *Electrical resistance of liftrods and guide rods* in the Adjustments section.

Correct this condition before proceeding to the next installation step.

25 Check to make sure all the interrupter parts and the tank liners are dry.

A If all the interrupter parts and the tank liners are not dry, refer to *Interrupter parts and tank liners* in the Adjustments section.

Correct this condition before proceeding to the next installation step.

NOTE: To avoid absorption of excess moisture and to keep insulating values high, do not expose any insulating part to air with a relative humidity of over 50%.

26 Check to make sure all insulation -organic and inorganic--is clean.

NOTE: Contaminants on insulating parts facilitate electrical breakdown.

A Clean insulation with insulating oil and clean, lint-free rags.

27 Install oil-level gages as shown in Figure 2.

A Apply gasket cement to the threads before installing a gage.

28 Install drain valves as shown in Figure 2, making sure that the oil pressure will be under the seat (not on the top—or stem—side).

A Apply gasket cement to the threads before installing a drain valve.

NOTE: If plugs are used in the valves, do not cement the plugs.

29 Check the interiors of the three tanks to make sure they are thoroughly clean and dry.

30 Coat all three manhole door gaskets with grease to prevent them from sticking.

NOTE: Each gasket is factory-cemented into a groove in the flange.

31 Bolt the three manholes closed, pulling up the bolts in small increments progressively around the door until metal-to-metal contact is obtained.

32 Fill each tank with tested oil through the filter-press opening in the tank cover (Figure 2) or through the drain valve to the point indicated on the oil-level gage.

Refer to—and follow—PTI S-266, Oil Circuit Breaker Insulating oil and oil Handling, for testing the oil.

Safety Precaution

Never fast-operate the breaker until after the hydraulic jet cylinders have been filled with oil as outlined in step 33.

A Allow four hours for the oil to deaerate before energizing the breaker, especially if the tanks are filled from the top.

B After the oil has been deaerated, check each oil-level gage.

C If deaeration has reduced the oil volume, add more oil to the point indicated on the oil-level gage.

33 Using the operating mechanism maintenance-positioning valves, slow-close and slow-open the breaker three times to fill the hydraulic jet cylinders.

34 Recheck each oil-level gage.

A If necessary, add more oil to the point indicated on the oil-level gage.

35 Using the manual closing lever, fast-close the breaker, letting it latch closed.

36 Using the manual trip lever, fast-open the breaker.

37 Repeat the fast-closing and fast-opening operations twice.

38 Connect a temporary two-pushbutton station with open and close buttons close enough together to coordinate the electrical control of the breaker.

Refer to—and follow—the connection diagrams that accompany the breaker.

39 Using the temporary electrical controls, perform 10 full closing and opening operations, ending with a closing operation.

NOTE: If the OA-4 operating mechanism cuts out on low pressure during these operations, allow time for the pressure to return to normal before resuming the electrical control check.

40 Perform time-travel tests (if required).

A Remove the pipe plug from hole 2 (Figure 7).

B Insert a Cincinnati analyzer rod in hole 2.

NOTE: Fitting 6 (Figure 7) on each liftrod has a 10-32 tapped hole for the analyzer rod.

C Record direct readings of contact speed/motion characteristics.

D Remove the analyzer rod.

E Replace the pipe plug in hole 2 (Figure 7), sealing the plug in the hole with thread compound.

41 Check all painted surfaces, making sure they are clean.

A Retouch the paint where necessary for appearance and complete protection.

42 Place the breaker and the operating mechanism in the following service-ready condition:

A Pump motor switch closed and accumulator charged;

B Red closing and green opening maintenance-positioning valves closed;

C Breaker open;

D Heaters in operating mechanism cabinet energized.

Safety Precaution

Main (load) connections should not impose more than a 100-lb maximum cantilever pull on the bushings. Forces may be caused by expansion, contraction, wind loading, or foundation movement.

43 Establish permanent service records.

A Record the operation counter registration.

B Record pertinent facts regarding the condition of the breaker.

C Record complete nameplate information.

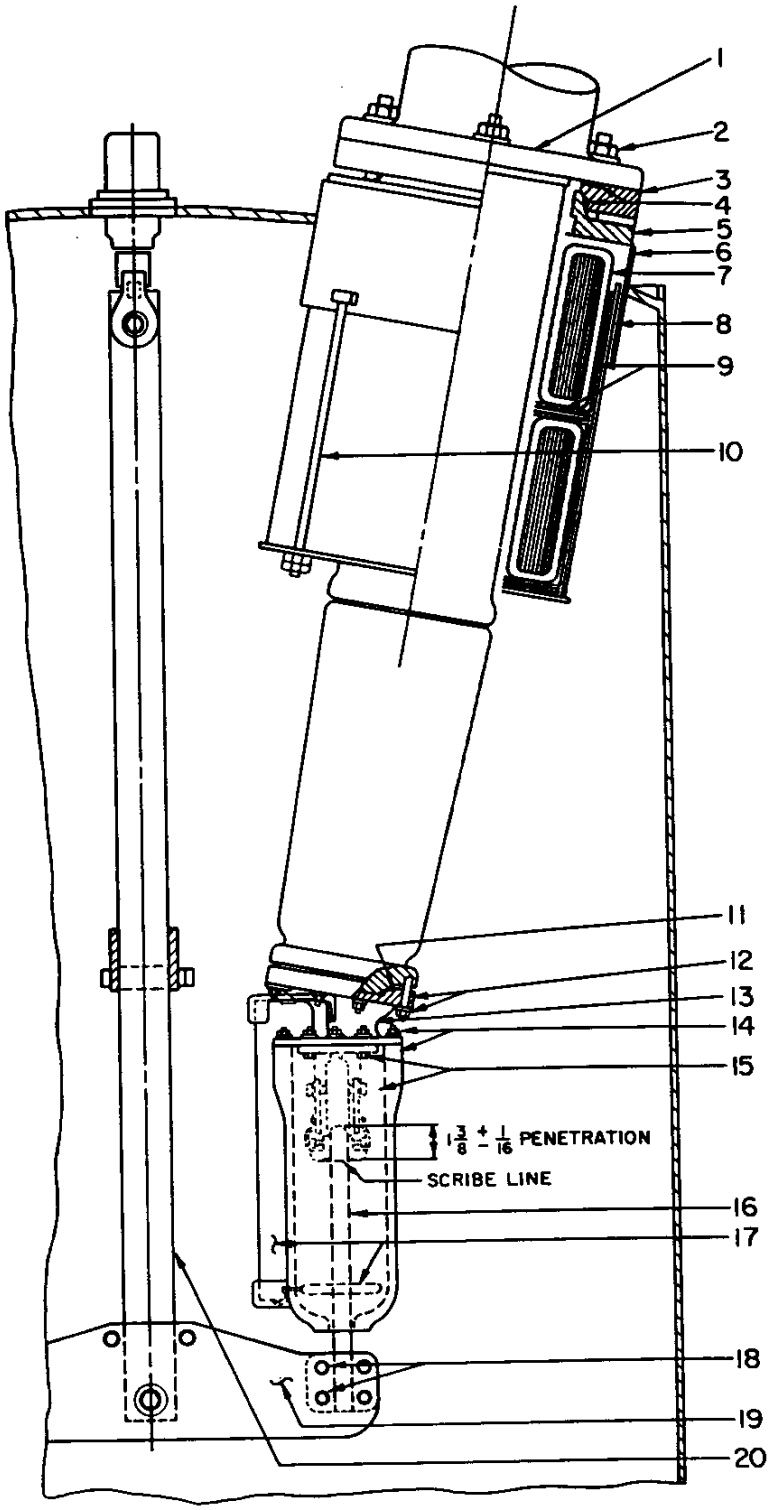

FIGURE 6

Lateral section—corona shields removed—through a pole of a typical AHJ breaker.

1. Bushing flange
2. Bushing mounting nuts
3. Adapter ring between bushing and breaker flanges
4. Gaskets recessed in adapter ring
5. Bushing casing flange with spherical surface for meeting adapter flange
6. Bushing casing
7. Current transformer
8. Current-transformer pocket
9. Packing liner and washers
10. Stud for holding current-transformer pocket
11. Spherical contact surface on bushing terminal
12. Stud nuts
13. Mounting casting with check valve for normal flow of contact cooling oil (check valve closes during fault interruption)
14. Interrupter chamber with mounting studs
15. Stationary contact shoe cluster mounted with cap-screws
16. Contact blade with arc-resistant tip and open core for cooling oil
17. Resistor (connected at lower end to resistor contact in interrupter chamber)
18. Bolts for clamping contact blade in crosshead
19. Crosshead
20. Liftrod

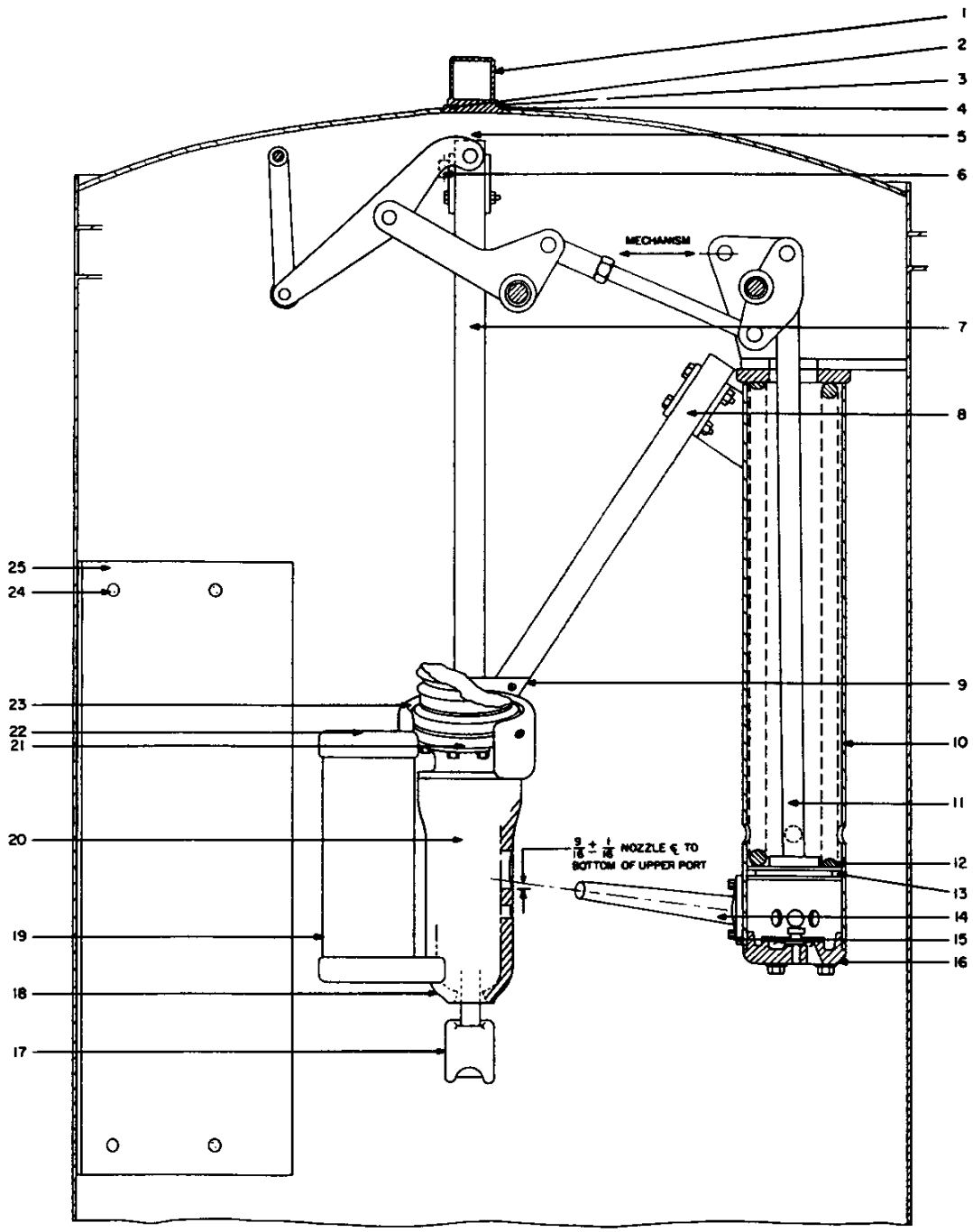

FIGURE 7

Longitudinal section—mechanism incomplete—through a pole of a typical AHJ breaker

1. Sealed hydraulic shock absorber
2. Hole fitted with ⅜-in. pipe plug
3. Shock-absorber gaskets
4. Shock-absorber shims
5. Space between shock absorber and liftrod in closed position (adjusted at factory with shims to 1/16 to ⅛-in. with breaker in latched-closed position)
6. Fitting for time-travel analyzer rod (10-32 tap)
7. Liftrod
8. Guide rod and bolted clamp
9. Sliding joint on guide rod for guiding liftrod
10. Cylinder containing opening spring, piston, and piston rod
11. Piston and piston rod
12. Opening spring
13. Piston rings
14. Jet nozzle aimed to inject oil into interrupter chamber port (one of two in ball-and-socket mountings)
15. Nozzle flange with bolts for clamping ball-and-socket mounting
16. Cylinder endplate with intake check valve
17. Crosshead
18. Connection between resistor element and probe in interrupter chamber (located in corona shield)
19. Resistor
20. Interrupter chamber
21. Resistor bracket
22. Corona shields at both ends of resistor
23. Corona shield around fittings at top of interrupter chamber
24. Spanner nuts
25. Tank liner

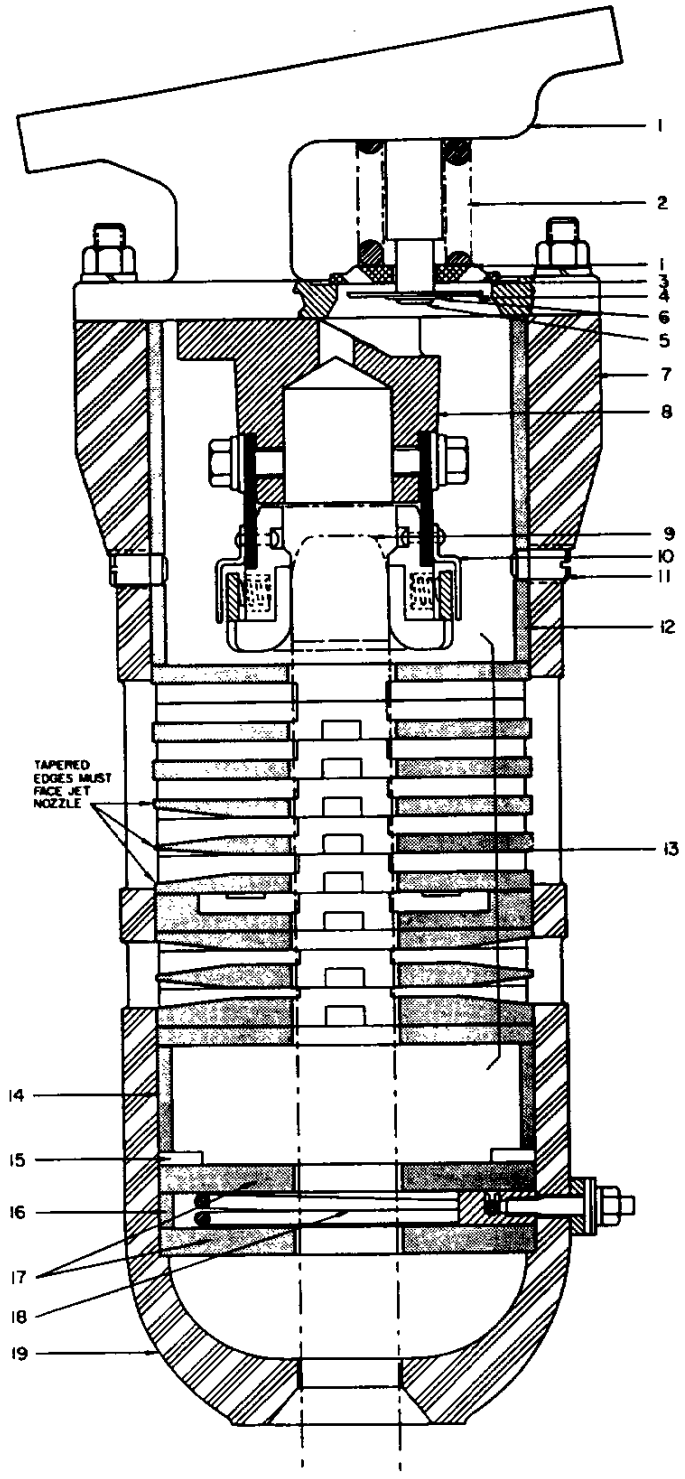

FIGURE 8

Section through the stationary contact and interrupter assembly of a typical AHJ breaker.

1. Contact and interrupter support assembly with valve
2. Spring
3. Check valve
4. Washer
5. Valve guide
6. Retainer ring
7. Interrupter assembly with baffles and resistor contact
8. Contact shoe cluster (8 shoes) and support casting
9. Contact blade
10. Contact shoe
11. Nonmetallic collar-locking screw
12. Collar
13. Baffles pinned into assembly
14. Spacer
15. Shims
16. Spacer
17. Baffles
18. Resistor contact
19. Interrupter chamber

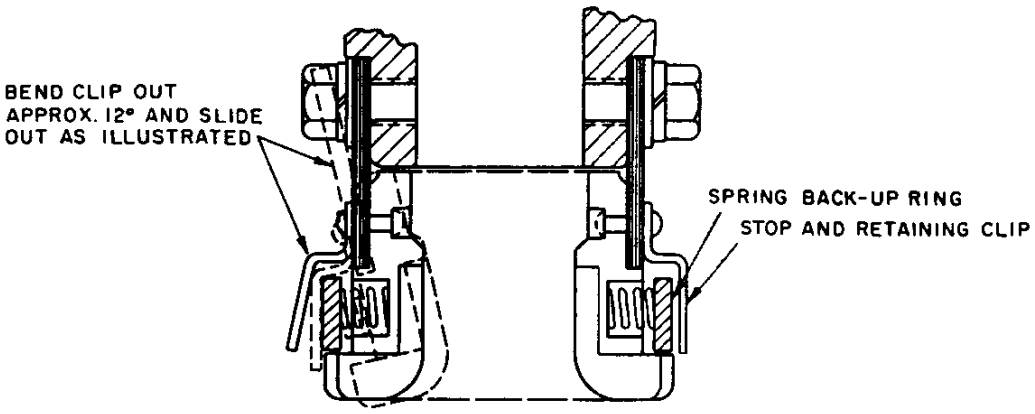

FIGURE 9
Procedure for removing an individual shoe from an AHJ contact shoe cluster.

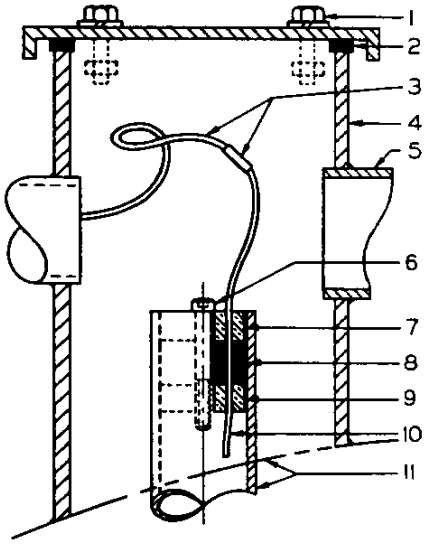

FIGURE 10
Seal details in the junction box for bushing current secondary leads in an AHJ breaker.

1. Cover bolt
2. Gasket on cover
3. Compression connector on typical lead
4. Terminal box
5. Interpole conduit
6. Compression box
7. Multi-hole washer (extra holes plugged)
8. Neoprene sealing plug
9. Threaded plastic compression disc
10. Leads to bushing current transformers
11. Conduit in breaker cover

MAINTENANCE

Remove the breaker from service at least once a year to inspect contacts and interrupter chamber baffles. Make sure the contacts are in good current-carrying condition and the interrupter chamber baffles are not worn.

Depending on the number and severity of interruptions to which the breaker is subjected, it may be necessary to inspect the breaker more often than once a year; for example, the breaker should be inspected thoroughly after it has interrupted five full-rated or 15 medium to heavy faults.

If breaker operation is infrequent, it is recommended that the breaker be opened and closed several times every six months to maintain the contact in good current-carrying condition.

Keep complete records of all out-of-service inspections and all maintenance work performed.

Safety Precautions

Observe all safety precautions in *Service Information S290-52-1, Type OA-4 Operating Mechanism Instructions,* as well as those throughout these instructions.

The operating mechanism red and green maintenance-positioning valves must be used during the performance of some of the maintenance steps. Refer to *Service Information S290-52-1, Type OA-4 Operating Mechanism Instructions,* for the proper use of these valves. When accumulator pressure is not required in the operating mechanism for maintenance operation checks, drain the accumulator or discharge the accumulator pressure to assure safe working conditions. When it is necessary to use the operating mechanism, stay clear of all moving parts.

If oil has been removed from the tanks, do not fast-operate the breaker; it must be slow-operated only.

The power and speed of AHJ-54 and AHJ-60 breakers in operation make observation of all safety precautions extremely important.

Materials

- Clean, lint-free rags.
- Insulating oil.
- Lubricants:

Sliding surfaces (such as pins and rods): —40 to +130 F temperature-range oil such as Keystone no. 4062, Standard (California) RPM Handy Oil, or Texaco Capella AA;

Ball bearings and roller bearings: Shell Oil Company Aeroshell no. 14 grease.

1 Open the breaker and remove the breaker from service.

2 Perform maintenance checks on the operating mechanism *before* making any maintenance checks on the oil circuit breaker.

Refer to—and follow—Service Information S290-52-1, Type OA-4 Operating Mechanism Instructions.

3 Remove the oil from the three tanks.

4 Open the three tank manholes, being careful not to damage the door gaskets.

5 Make sure all external tank fasteners are tight.

6 Perform maintenance checks on the entrance bushings.

Refer to—and follow—Service Information S315-10-1, Type PA Apparatus Bushings Instructions.

A If a bushing must be replaced, refer to *Bushings* in the Parts Replacement section.

Make this replacement before proceeding to the next maintenance step.

7 Check the bushing current transformers visually to make sure the leads are intact.

NOTE: If a change in—or addition to—bushing current transformers is desired, refer to Bushing current transformers in the *Parts Replacement* section and *Service Information S290-80-2, Type OE Bushing Current Transformer Instructions.*

Make this change or addition before proceeding to the next maintenance step.

Safety Precaution

Current-transformer secondaries not connected to relays, instruments, or meters must be short-circuited and grounded at the terminal blocks in the operating mechanism cabinet.

8 Using clean, lint-free rags and insulating oil, clean the interiors of the three tanks and the tank liners.

Do not rub in the residue—it might be conductive.

9 Make sure water has not leaked into the tanks.

A If there is evidence of water leakage, determine the cause of the leakage.

Correct this condition before proceeding to the next Maintenance step.

10 Using clean, lint-free rags and insulating oil, clean the liftrods and the guide rods.

Do not rub in residue—it might be conductive.

11 Make sure all internal tank fasteners are tight.

12 Using the operating mechanism red maintenance-positioning valve, slow-close the breaker, allowing it to settle on the latch with no overtravel.

13 Check liftrod linkage measurement T (Figure 4):

A Place a square against each liftrod with the blade of the square touching the lever hub as shown in Figure 4.

B With a non-carbon, grease-base pencil, mark each liftrod directly across from the lever hub.

C Using the operating mechanism green maintenance-positioning valve, slow-open the breaker.

D Measure from the non-carbon mark on each liftrod to the center of pin 16 (Figure 4).

- AHJ-54 breakers: Measurement T should be 11 3/16 in. ± 1/4 in.
- AHJ-60 breakers: Measurement T should be 12 3/16 in. ± 1/4 in.

E If measurement T is not within the tolerance specified, refer to *Liftrod linkage* in the Adjustments section.

Correct this condition before proceeding to the next maintenance step.

14 Check liftrod stroke (Figure 5):

A Using the operating mechanism green maintenance-positioning valve, slow-open the breaker.

B Holding a square on the non-carbon mark made on each liftrod, measure the distance from the top of the scale to the underside of the lever hub.

- AHJ-54 breakers: Stroke measurement should be 18 in. ± ¼ in.
- AHJ-60 breakers: Stroke measurement should be 20 in. ± ¼ in.

C If the stroke measurement is not within the tolerance specified, refer to *Liftrod stroke* in the Adjustments section.

Correct this condition before proceeding to the next maintenance step.

15 Check the effective length of the pullrods.

NOTE: After being in service for some time, the pullrods may stretch, causing out-of-tolerance differences in the three breaker poles.

A Using the operating mechanism red maintenance-positioning valve, slow-close the breaker, allowing it to settle on the latch with no overtravel.

B Starting with pole 1 and working back through poles 2 and 3, measure from the back of link bearing hub 26 (Figure 4) to the near side of the pump piston rod as shown in Figure 4.

- Effective length of pullrod: Measurement should be 7/16 in. ± 1/16 in.

C If the effective length of any one of the pullrods is not within the tolerance specified, refer to *Effective length of pullrods* in the Adjustments section.

Correct this condition before proceeding to the next maintenance step.

16 Check to make sure the locknuts and washers holding the pullrod sections to the linkages are tight.

17 Check liftrods 20 (Figure 6) and contact blades 16 (Figure 6) visually to make sure they are vertical and, therefore, parallel to one another.

A If a liftrod or a contact blade is not vertical, refer to *Liftrod and contact blade verticality* in the Adjustments section.

Correct this condition before proceeding to the next maintenance step.

18 Remove resistors 19 (Figure 7) which are anchored in place by brackets 21 at the top and the corona shields at the bottom.

Do not remove the brackets; to do so may change the interrupter chamber alignment.

A Clean the resistors by flushing them with insulating oil.

19 With a non-carbon, grease-base pencil, mark the location and position of each interrupter chamber so that, after being removed, it can be returned to its original location and position.

20 Remove the nuts from the mounting studs holding interrupter chambers 14 (Figure 6) in place.

21 Remove the interrupter chambers.

22 With a caliper inserted through the top of each assembled interrupter chamber, check the round center holes of baffles 13 (Figure 8) for elongation caused by erosion.

A If the elongation in any baffle exceeds 1/8 in., refer to *Interrupter chamber baffles* in the Parts Replacement section.

Correct this condition before proceeding to the next maintenance step.

23 Make sure the arc-resistant sintered alloy on the end of each blade and the end of each shoe in contact shoe clusters 15 (Figure 6) is at least 1/8 in. thick.

A If the contacts are only slightly eroded, refer to *Contact blade and shoe contacts* in the Adjustments section.

Correct this condition before proceeding to the next maintenance step.

B If the arc-resistant sintered alloy on the end of a shoe in a contact shoe cluster is less than 1/8 in. thick, refer to *Contact shoes* in the Parts Replacement section.

Correct this condition before proceeding to the next maintenance step.

24 Check contact blade alignment:

A Using the operating mechanism red maintenance-positioning valve, slow-close the breaker completely.

(1) Make sure the contact blades enter the stationary contact shoe clusters on center, making the clusters spread evenly with equal distance between the shoes.

(2) If the contact blades do not enter the stationary contact shoe clusters on center, refer to *Contact blade alignment* in the Adjustments section.

Correct this condition before proceeding to the next maintenance step.

NOTE: Pressure of the individual shoes in each contact cluster is controlled by a compression spring that requires no checking or adjustment.

25 Using the operating mechanism green maintenance-positioning valve, slow-open the breaker.

26 Check contact blade penetration:

A Make a scribe mark 1 1/8 in. from the tip of each contact blade as shown in Figure 6.

B Using the operating mechanism red maintenance-positioning valve, slow-close the breaker, allowing it to settle on the latch.

C Check the scribe mark.

- The scribe mark should be even with the ends of the contact shoes ± 1/16 in.

D If contact blade penetration is not 1 1/8 in. ± 1/16 in., refer to *Contact blade penetration* in the Adjustments section.

Correct this condition before proceeding to the next maintenance step.

27 Using the operating mechanism green maintenance-positioning valve, slow-open the breaker.

MAINTENANCE (continued)

28 Reinstall interrupter chambers 14 (Figure 6) in their original locations and positions.

A Make sure the interrupter chambers are vertical and coaxial with the contact blade.

B Make sure the exhaust ports in the interrupter chambers face outward toward the tank wall on one side and inward toward the jet nozzles on the opposite side.

C Make sure the nuts on the mounting studs are tight.

29 Check the horizontal and vertical positioning of jet nozzles 14 (Figure 7):

A Horizontal: Make sure the centerline of each jet nozzle aligns with the center of its exhaust port (Figure 7).

NOTE: The centerline of each jet nozzle can be determined by the straightedge projection on the tapered outside face.

B Vertical: Make sure the center of each jet nozzle is directed toward the upper exhaust port at a level 9/16 in. ±1/16 in. from the bottom of the upper port as shown in Figure 7.

C If the jet nozzles are not properly positioned horizontally and/or vertically, refer to *Jet nozzle positioning* in the Adjustments section.

Correct this condition before proceeding to the next maintenance step.

30 Using the operating mechanism green maintenance-positioning valve, slow-open the breaker.

31 Check the electrical resistance of liftrods 7 (Figure 7) and guide rods 8 (Figure 7).

NOTE: Both liftrods and the guide rods are made of organic insulating material and, when not immersed in dry oil, they can absorb moisture.

A Conduct a megger test over the full length of each liftrod and the full length of each guide rod from the clevis at the top of the liftrod down to crosshead 17 (Figure 7).

- Electrical resistance of both the liftrods and the guide rods must be at least 10,000 megohms.

B If the electrical resistance of a liftrod or a guide rod is less than 10,000 megohms, refer to *Electrical resistance of liftrods and guide rods* in the Adjustments section.

Correct this condition before proceeding to the next maintenance step.

32 Check to make sure all the interrupter parts and the tank liners are dry.

A If all the interrupter parts and the tank liners are not dry, refer to *Interrupter parts and tank liners* in the Adjustments section.

Correct this condition before proceeding to the next maintenance step.

NOTE: To avoid absorption of excess moisture and to keep insulating values high, do not expose any insulating part to air with a relative humidity of over 50%.

33 Check to make sure all insulation—organic and inorganic—is clean.

NOTE: Contaminants on insulating parts facilitate electrical breakdown.

A Clean insulation with insulating oil and clean, lint-free rags.

34 Conduct a top-of-bushing, terminal-to-terminal resistance test on each of the three breaker poles (Figure 2).

NOTE: Resistance test results indicate the current-carrying condition of the breaker, *not* its ability to interrupt faults.

Electrical Resistance Level	Electrical Resistance* microohm
Normal	120±25
Caution	220
Service limit	250

*Measured externally—terminal to terminal—with the breaker closed. Resistance values must be maintained below the caution level.

A If resistance test values are 220 microohms or higher, refer to *Top-of-bushing, terminal-to-terminal resistance* in the Adjustments section.

Correct this condition before proceeding to the next maintenance step.

NOTE: Because the contacts clean themselves when the breaker is operated, resistance values may run high if the breaker has not been operated for several months.

35 Make sure all electrical connections throughout the contact assembly are intact.

36 Using the operating mechanism green maintenance-positioning valve, slow-open the breaker.

37 Check the interiors of the three tanks to make sure they are thoroughly clean and dry.

38 Check all three manhole door gaskets to make sure they are in good sealing condition.

A If a gasket has been damaged, replace it, cementing it into the groove in the flange.

39 Coat all three manhole door gaskets with grease to prevent them from sticking.

40 Bolt the three manholes closed, pulling up the bolts in small increments progressively around the door until metal-to-metal contact is obtained.

41 Fill each tank with tested oil through the filter-press opening in the tank cover (Figure 2) or through the drain valve to the point indicated on the oil-level gage.

Refer to—and follow—PTI S-266, Oil Circuit Breaker Insulating Oil and Oil Handling, for testing the oil.

Safety Precaution

Never fast-operate the breaker until after the hydraulic jet cylinders have been filled with oil as outlined in step 42.

A Allow four hours for the oil to deaerate before energizing the breaker, especially if the tanks are filled from the top.

B After the oil has been deaerated, check each oil-level gage.

C If deaeration has reduced the oil volume, add more oil to the point indicated on the oil-level gage.

42 Using the operating mechanism maintenance-positioning valves, slow-close and slow-open the breaker three times to fill the hydraulic jet cylinders.

43 Recheck each oil-level gage.

A If necessary, add more oil to the point indicated on the oil-level gage.

44 Using the manual closing lever, fast-close the breaker, letting it latch closed.

45 Using the manual trip lever, fast-open the breaker.

46 Repeat the fast-closing and fast-opening operations twice.

47 Connect a temporary two-pushbutton station with open and close buttons close enough together to coordinate the electrical control of the breaker.

Refer to—and follow—the connection diagrams that accompany the breaker.

48 Using the temporary electrical controls, perform 10 full closing and opening operations, ending with a closing operation.

NOTE: If the OA-4 operating mechanism cuts out on low pressure during these operations, allow time for the pressure to return to normal before resuming the electrical control check.

49 Perform time-travel tests (if required).

A Remove the pipe plug from hole 2 (Figure 7).

B Insert a Cincinnati analyzer rod in hole 2.

NOTE: Fitting 6 (Figure 7) on each liftrod has a 10-32 tapped hole for the analyzer rod.

C Record direct readings of contact speed/motion characteristics.

D Remove the analyzer rod.

E Replace the pipe plug in hole 2 (Figure 7), sealing the plug in the hole with thread compound.

50 Check all painted surfaces, making sure they are clean.

A Retouch the paint where necessary for appearance and complete protection.

51 Place the breaker and the operating mechanism in the following service-ready condition:

A Pump motor switch closed and accumulator charged;

B Red closing and green opening maintenance-positioning valves closed;

C Breaker open;

D Heaters in operating mechanism cabinet energized.

Safety Precaution

Main (load) connections should not impose more than a 100-lb maximum cantilever pull on the bushings. Forces may be caused by expansion, contraction, wind loading, or foundation movement.

52 Record maintenance work performed in permanent file.

A Record the operation counter registration.

B Record pertinent facts regarding the condition of the breaker.

ADJUSTMENTS

Safety Precaution
The oil circuit breaker must be out of service before making any adjustments.

Keep complete records of all adjustments made.

1 Liftrod linkage.

If liftrod linkage measurement T is not within the tolerance specified:

A Using the operating mechanism red maintenance-positioning valve, slow-close the breaker, allowing it to settle on the latch.

B Remove pin 26 (Figure 4).

NOTE: The only load on pin 26 is the weight of the liftrod and the fittings.

C Loosen nut 18 (Figure 4).

D Lengthen or shorten the link between the lift crank and the drive crank.

NOTE: Dimension T includes the 1-in. blade of the square held against the lever hub as shown in Figure 4.

E Tighten nut 18 (Figure 4).

F Replace pin 26 (Figure 4).

2 Liftrod stroke.

Liftrod stroke is affected by the centerline-to-centerline measurement of pin 4 (Figure 4) and bellcrank and pivot pin 5 (Figure 4), liftrod linkage measurement T, and the effective length of the pullrods.

If the liftrod stroke measurement is not within the tolerance specified:

A Using the operating mechanism red maintenance-positioning valve, slow-close the breaker, allowing it to settle on the latch with no overtravel.

B Check the distance from the centerline of pin 4 (Figure 4) to the centerline of bellcrank and pivot pin 5 (Figure 4).

- This measurement should be $1\frac{13}{16}$ in. $\pm \frac{1}{16}$ in.

C If this measurement is not within the tolerance specified, lengthen or shorten vertical pullrod 1 (Figure 4):

(1) Using the operating mechanism green maintenance-positioning valve, slow-open the breaker.

(2) Remove the four 1½-in.-long, ⅜-11UNC capscrews that hold endplate 16 (Figure 7) in place.

(3) Block the load in each breaker pole by placing a section of pipe below piston 11 (Figure 7) in the lower end of cylinder 10 (Figure 7).

NOTE: Recommended blocks are square-cut, 4¾-in.-long sections of 5-in. standard pipe.

All three poles must be blocked. Blocking a single pole to handle the load of all three poles is not adequate.

(4) Replace endplate 16, but temporarily substitute 2-in.-long bolts for the capscrews in order to relieve the linkage of the opening-spring load.

NOTE: These bolts are used as jackscrews to remove the load from an individual section of linkage.

(5) With the pipe blocks and the temporary bolts in place, but leaving some space above the endplate to permit positioning an individual pole, eliminate the load on the linkage sections.

(6) Using the operating mechanism maintenance-positioning system, remove the load from the operating mechanism.

(7) Remove pin 4 (Figure 4).

(8) Loosen nut 2 (Figure 4).

(9) Screw rod end 3 (Figure 4) to the right or to the left as required to lengthen or shorten vertical pullrod 1 (Figure 4).

(10) Reinstall pin 4 (Figure 4).

(11) Tighten nut 2 (Figure 4).

D Recheck liftrod linkage measurement T.

NOTE: Any change in the centerline-to-centerline measurement of pin 4 (Figure 4) and bellcrank and pivot pin 5 (Figure 4) will affect liftrod measurement T.

(1) If liftrod linkage measurement T is not within the tolerance specified, refer to *Liftrod linkage* in the Adjustments section and correct this condition.

E Recheck liftrod stroke.

NOTE: Any change in the centerline-to-centerline measurement of pin 4 (Figure 4) and bellcrank and pivot pin 5 (Figure 4) will affect liftrod stroke.

(1) If liftrod stroke is still not within the tolerance specified, check the effective length of the pullrods as outlined in Item 3, Effective length of pullrods, in the Adjustments section.

F Recheck liftrod linkage measurement T to make sure that any change made in the effective length of the pullrods has not altered liftrod linkage measurement T.

G Recheck liftrod stroke to make sure it is within the tolerance specified.

3 Effective length of pullrods.

If the effective length of a pullrod is not within the tolerance specified:

A Using the operating green maintenance-positioning valve, slow-open the breaker.

B Remove the four 1½-in.-long, ⅜-11UNC capscrews that hold endplate 16 (Figure 7) in place.

C Block the load in each breaker pole by placing a section of pipe below piston 11 (Figure 7) in the lower end of cylinder 10 (Figure 7) to relieve the linkage of the opening-spring load.

NOTE: Recommended blocks are square-cut, 4¾-in.-long sections of 5-in. standard pipe.

All three poles must be blocked. Blocking a single pole to handle the load of all three poles is not adequate.

D Replace endplate 16, but temporarily substitute 2-in.-long bolts for the capscrews.

NOTE: These bolts are used as jackscrews to remove the load from an individual section of linkage.

E With the pipe block and the temporary bolts in place, but leaving some space above the endplate to permit positioning an individual pole, eliminate the load on the linkage section to be adjusted.

F Using the operating mechanism maintenance-positioning system, remove the load from the operating mechanism.

G To shorten the pullrod in pole 1:

(1) Loosen spanner nut and lockwasher 8 (Figure 4).

(2) Remove all shims and retainer rings.

(3) Remove bearing pin 24 (Figure 4).

(4) Screw the rod section into rod end 7 (Figure 4) (it has a righthand thread) until the effective length of the pullrod is 7/16 in. ± 1/16 in.

(5) Reinstall all shims and retainer rings in their original positions.

(6) Tighten spanner nut and lockwasher 8 (Figure 4).

H To shorten the pullrods in poles 2 and 3:

(1) Straighten the star lockwasher and loosen nuts 1 (righthand and lefthand) at both ends (Figure 5).

(2) Facing pole 1, turn the rod section clockwise until the effective length of the pullrod is 7/16 in. ± 1/16 in.

(3) Tighten star lockwasher and nuts 1 (righthand and lefthand) at both ends (Figure 5).

I Remove the temporary bolts and endplate 16 (Figure 7).

J Remove the pipe block from below piston 11 (Figure 7).

K Replace endplate 16 and the four 1½-in.-long, ⅜-11UNC capscrews.

L Tighten the four capscrews.

4 Liftrod and contact blade verticality.

If a liftrod is not vertical:

A Make sure the breaker is level.

- If the breaker is not level, correct the condition.

B If the breaker is level, but the liftrod is not vertical, make sure guide rod 8 (Figure 7) has not shifted slightly due to movement of the guide rod in clamp 8 (Figure 7).

- If the guide rod has shifted, correct the condition.

If a contact blade is not vertical:

A Using the operating mechanism green maintenance-positioning valve, slow-open the breaker.

B Loosen the blade clamps at the bottom of contact blade 16 on crosshead 19 (Figure 6).

C Straighten the blade.

D Tighten the blade clamps at the bottom of the blade on crosshead 19 (Figure 6).

5 Contact blade alignment.

If a contact blade does not enter the stationary contact shoe cluster on center, making the cluster spread evenly with equal distance between the shoes:

A Using the operating mechanism green maintenance-positioning valve, slow-open the breaker.

B Loosen contact cluster mounting capscrews 15 (Figure 6), allowing the cluster to self-center.

C Tighten the contact cluster mounting capscrews.

D Slow-operate the breaker to check contact blade alignment.

If a contact blade enters the stationary contact shoe cluster on center when the interrupter chamber is removed, but binds while passing through the interrupter chamber when the chamber is in place:

A Using the operating mechanism green maintenance-positioning valve, slow-open the breaker.

B Change the angle of interrupter chamber 14 (Figure 6) slightly by shifting the position of the entire assembly on spherical contact surface 11 (Figure 6) by loosening and tightening opposite stud nuts 12.

NOTE: This minor change in angle only will not appreciably change the position of the stationary contact shoe cluster.

C Slow-operate the breaker to check contact blade alignment.

If more than a minor adjustment is required for contact structure alignment, overall adjustments must be made. To align the contact assembly:

A Using the operating mechanism green maintenance-positioning valve, slow-open the breaker.

B Loosen all bushing mounting bolts 2 (Figure 6) except those in line with the desired direction of movement of the contact assembly.

C Rock the vertical axis of bushing adapter ring 3 (Figure 6) in small increments by loosening and tightening opposite mounting bolts.

NOTE: If necessary, bushing flange 5 (Figure 6) can also be shifted slightly because of the hole tolerance for the mounting bolts.

D Tighten all bushing mounting bolts.

E Compensate for any angular change of the bushing by making an opposite—and equal—angular change of the contact assembly which is held to spherical contact surface 11 by stud nuts 12 (Figure 6):

(1) Adjust stud nuts 12 to return the interrupter chamber mounting flange to the horizontal position.

NOTE: When the interrupter chamber mounting flange is horizontal, contact blade 16 will be parallel with liftrod 20 (Figure 6).

F Slow-operate the breaker several times to check alignment.

ADJUSTMENTS (continued)

6 Contact blade penetration.

If contact blade penetration is not 1⅜ in. ± 1/16 in.

A Using the operating mechanism red maintenance-positioning valve, slow-close the breaker, allowing it to settle on the latch.

B Loosen bolts 18 (Figure 6) on crosshead 19 (Figure 6).

C Shift the contact blade up or down as required to match the scribe mark on the blade and obtain a penetration of 1⅜ in. ± 1/16 in.

D Tighten bolts 18 on crosshead 19 (Figure 6).

7 Contact blade and shoe contacts.

To dress slightly eroded contact blade and shoe contacts:

A With the breaker open, mark the location and position of each interrupter chamber 14 (Figure 6) with a non-carbon, grease-base pencil so that each chamber can be returned to its original location and position.

B Remove the nuts from the mounting studs holding the interrupter chamber.

C Remove the interrupter chamber.

D Dress the contacts lightly with a fine file.

NOTE: Be very careful not to drop any filings in the tank.

E Reinstall each interrupter chamber in its original location and position.

F Reinstall the mounting stud nuts that hold the interrupter chamber in place.

8 Jet nozzle positioning.

If the centerline of a jet nozzle does not align with the center of its exhaust port (horizontal alignment) or if a nozzle center is not directed toward the exhaust port at a level 9/16 in. ± 1/16 in. from the bottom of the upper port (vertical alignment) as shown in Figure 7:

A Loosen the ball clamp at bolts 15 (Figure 7).

B Move the jet nozzle horizontally or vertically until the proper alignment is achieved.

C Tighten the ball clamp at bolts 15 (Figure 7).

9 Electrical resistance of liftrods and guide rods.

If the electrical resistance of a liftrod or a guide rod is less than 10,000 megohms:

A Using the operating mechanism green maintenance-positioning valve, slow-open the breaker.

B Heat the tank air to a value about 20 C (36 F) above ambient temperature.

NOTE: Space heaters may be used, but care must be taken to prevent heating the insulating materials to a temperature over 100 C (212 F). Air circulation through available openings must be provided.

10 Interrupter parts and tank liners.

If all interrupter parts and tank liners are not dry:

A Heat the tank air to a value about 20 C (36 F) above ambient temperature.

NOTE: Space heaters may be used, but care must be taken to prevent heating the interrupter parts and the tank liners to a temperature over 100 C (212 F). Air circulation through available openings must be provided.

11 Top-of-bushing, terminal-to-terminal resistance.

If the top-of-bushing, terminal-to-terminal resistance test values of any of the breaker poles are 220 microohms or higher:

A Using the operating mechanism green maintenance-positioning valve, slow-open the breaker.

B With a non-carbon, grease-base pencil, mark the location and position of each interrupter chamber so that, after being removed, it can be returned to its original location and position.

C Remove the nuts from the mounting studs holding interrupter chamber 14 (Figure 6) in place.

D Remove the interrupter chambers.

E Check the thickness of the arc-resistant sintered alloy on the end of each contact blade and the end of each shoe in each contact shoe cluster.

(1) If the arc-resistant sintered alloy on the end of a shoe is less than ⅛ in. thick, refer to *Contact shoe contacts* in the Parts Replacement section of these instructions and replace the contact.

(2) If the contacts are only slightly eroded, dress the contacts lightly with a fine file, removing only the high spots.

NOTE: Be very careful not to drop any filings in the tanks.

F Clean the tank to remove all filings so as not to contaminate the oil.

G Using the operating mechanism red maintenance-positioning valve, slow-close the breaker.

H Perform a top-of-bushing, terminal-to-terminal resistance test on each of the three breaker poles.

(1) If the electrical resistance measured externally (terminal to terminal) is 220 microohms or higher, redress the contacts.

I Reinstall the interrupter chambers in their original locations and positions.

J Reinstall the nuts on the mounting studs holding the interrupter chambers in place.

PARTS REPLACEMENT

Safety Precaution
The oil circuit breaker must be out of service before replacing any parts.

Refer to Supplement 1 to S290-30-1, Spare Parts List, for parts ordering data. Keep complete records of all parts replaced.

I Bushings.

Refer to—and follow—Service Information S315-10-1, Type PA Apparatus Bushings Instructions.

To replace a bushing:

A Using the operating mechanism green maintenance-positioning valve, slow-open the breaker.

B Remove resistor 19, bracket 21, and corona shields 22 (Figure 7).

C Remove the entire half-pole assembly by removing mounting stud nuts 12 (Figure 6) from the bushing bottom flange.

D Remove the damaged bushing by removing nuts 2 (Figure 6).

E Install the new bushing, using nuts 2 (Figure 6).

F Tighten nuts 2 (Figure 6).

G Reinstall the half-pole assembly, tightening stud nuts 12 (Figure 6) progressively around the bushing flange.

H Check contact blade alignment:

(1) With a non-carbon, grease-base pencil, mark the location and position of the interrupter chamber so that, after being removed, it can be returned to its original location and position.

(2) Remove the nuts on the mounting studs holding interrupter chamber 14 (Figure 6) in place.

(3) Remove the interrupter chamber.

(4) Using the operating mechanism red maintenance-positioning valve, slow-close the breaker.

(5) Make sure the contact blade enters the stationary contact shoe cluster on center, making the cluster spread evenly with equal distance between the shoes.

(6) If the contact blade does not enter the stationary contact shoe cluster on center:

a Loosen contact cluster mounting capscrews 15 (Figure 6), allowing the cluster to self-center.

b Tighten the contact cluster mounting capscrews.

c Slow-operate the breaker to check contact blade alignment.

I Check contact blade penetration:

(1) Using the operating mechanism green maintenance-positioning valve, slow-open the breaker.

(2) Make a scribe mark 1⅜ in. from the tip end of each contact blade as shown in Figure 6.

(3) Using the operating mechanism red maintenance-positioning valve, slow-close the breaker, allowing it to settle on the latch.

(4) Check the scribe mark.

- The scribe mark should be even with the ends of the contact shoes ±1/16 in.

(5) If contact blade penetration is not 1⅜ in. ±1/16 in.:

a Loosen bolts 18 (Figure 6) on crosshead 19 (Figure 6).

b Shift the contact blade up or down as required to match the scribe mark on the blade and obtain a penetration of 1⅜ in. ±1/16 in.

c Tighten bolts 18 on crosshead 19 (Figure 6).

J Reinstall interrupter chamber 14 (Figure 6) in its original location and position.

(1) Make sure the interrupter chamber is vertical and coaxial with the contact blade.

(2) Make sure the exhaust ports in the interrupter chamber face outward toward the tank wall on one side and inward toward the jet nozzle on the opposite side.

(3) Make sure the mounting stud nuts are tight.

K Slow-operate the breaker to check contact blade alignment when the interrupter chamber is in place.

(1) If the contact blade binds while passing through the interrupter chamber:

a Using the operating mechanism green maintenance-positioning valve, slow-open the breaker.

b Change the angle of interrupter chamber 14 (Figure 6) slightly by shifting the position of the entire assembly on spherical contact surface 11 (Figure 6) by loosening and tightening opposite stud nuts 12.

NOTE: This minor change—in angle only—will not appreciably change the position of the stationary contact shoe cluster.

c Slow-operate the breaker to check contact blade alignment.

(2) If more than a minor adjustment is required for contact structure alignment:

a Using the operating mechanism green maintenance-positioning valve, slow-open the breaker.

b Loosen all bushing mounting nuts 2 (Figure 6) except those in line with the desired direction of movement of the contact assembly.

c Rock the vertical axis of bushing adapter ring 3 (Figure 6) in small increments by loosening and tightening opposite mounting bolts.

NOTE: If necessary, bushing flange 5 (Figure 6) can also be shifted slightly because of the hole tolerance for the mounting bolts.

d Tighten all bushing mounting bolts.

PARTS REPLACEMENT (continued)

e Compensate for any angular change of the bushing by making an opposite—and equal—angular change of the half-pole assembly which is held to spherical contact surface 11 by stud nuts 12 (Figure 6):

- Adjust stud nuts 12 to return the interrupter chamber mounting flange to the horizontal position.

  NOTE: When the interrupter chamber mounting flange is horizontal, contact blade 16 will be parallel to liftrod 20 (Figure 6).

f Slow-operate the breaker several times to check alignment.

L Reinstall resistor 19, bracket 21, and corona shields 22 (Figure 7).

2 Bushing current transformers.

Refer to—and follow—Service Information S290-80-2, Type OE Bushing Current Transformers Instructions.

To replace a bushing current transformer:

A Using the operating mechanism green maintenance-positioning valve, slow-open the breaker.

B Remove resistor 19, bracket 21, and corona shields 22 (Figure 7).

C With a non-carbon, grease-base pencil, mark the location and position of the interrupter chamber so that, after being removed, it can be returned to its original location and position.

D Remove the nuts on the mounting studs holding interrupter chamber 14 (Figure 6) in place.

E Remove the interrupter chamber.

F Cut the secondary leads on each side of splice 3 (Figure 10) in the junction box.

NOTE: Before cutting the secondary leads, make sure they are marked on the load side.

G Pull the cut leads back to the current transformer.

H Loosen the compression bolt and tap it to free the plug (Figure 10).

I Remove seal 8 (Figure 10) at the entrance to the junction box.

J Pull on the compression bolt to free the sealing parts (compression washer, plug, and threaded disc), Figure 10.

K Remove holding nuts on stud 10 (Figure 6).

L Lower current-transformer pocket 8 (Figure 6) over the bushing.

M Install new bushing current transformer.

Refer to—and follow—Service Information S290-80-2, Type OE Bushing Current Transformers Instructions, for

(1) polarity marks;

(2) wiring and connections;

(3) short-circuiting at the terminal block.

N Reinsert—and tighten—holding nuts on stud 10 (Figure 6).

O Replace sealing parts (compression washer, plug, and threaded disc) in the conduit and the leads.

P Pass new leads through the seal and tighten.

NOTE: The leads on current transformers are long enough to reach through the junction box. Slack should be sufficient to make new compression-type lead connections.

Q Reinstall interrupter chamber 14 (Figure 6) in its original location and position.

(1) Make sure the interrupter chamber is vertical and coaxial with the contact blade.

(2) Make sure the exhaust ports in the interrupter chamber face outward toward the tank wall on one side and inward toward the jet nozzle on the opposite side.

(3) Make sure the mounting stud nuts are tight.

R Reinstall resistor 19, bracket 21, and corona shields 22 (Figure 7).

3 Interrupter chamber baffles.

The left and right interrupter chambers are designed opposite hand.

To replace a baffle in an interrupter chamber:

A Using the operating mechanism green maintenance-positioning valve, slow-open the breaker.

B With a non-carbon, grease-base pencil, mark the location and position of the interrupter chamber so that, after being removed, it can be returned to its original location and position.

C Remove resistor 19 (Figure 7).

NOTE: Do *not* remove bracket 21 (Figure 7).

D Remove the nuts on the mounting studs holding interrupter chamber 14 (Figure 6) in place.

E Remove the interrupter chamber.

F Remove collar-locking screws 11 (Figure 8) to release collar 12 which holds the baffles in place.

G Remove baffles 13 and 17 (Figure 8).

NOTE: Baffles 13 are doweled together.

H Remove the lower baffles one at a time, marking each baffle and its location and position so that it can be returned to its original location and position.

I Remove the eroded baffles.

NOTE: Although it is necessary to replace only those baffles that are eroded, it is frequently more practicable to replace the entire set of baffles.

J Replace the eroded baffles with new ones.

K Reassemble the baffles in their original locations and positions in the interrupter chamber.

L Reinstall the interrupter chamber in its original location and position.

(1) Make sure the interrupter chamber is vertical and coaxial with the contact blade.

(2) Make sure the exhaust ports in the interrupter chamber face outward toward the tank wall on one side and inward toward the jet nozzle on the opposite side.

(3) Make sure the mounting stud nuts are tight.

M Reinstall resistor 19 (Figure 7).

4 Contact shoes.

To replace contact shoes in the contact shoe cluster:

A Using the operating mechanism green maintenance-positioning valve, slow-open the breaker.

B With a non-carbon, grease-base pencil, mark the location and position of the interrupter chamber so that, after being removed, it can be returned to its original location and position.

C Remove resistor 19 (Figure 7).

NOTE: Do *not* remove bracket 21 (Figure 7).

D Remove the nuts on the mounting studs holding interrupter chamber 14 (Figure 6) in place.

E Remove the interrupter chamber.

F Remove the contact shoes to be replaced as shown in Figure 9:

(1) Remove the capscrew.

(2) Bend the retaining clip out about 12 degrees.

(3) Move the contact shoe to the position shown by the dotted line in Figure 9.

(4) Catching the small spring, remove the contact shoe from the cluster.

G Install the new contact shoe and spring in the cluster:

(1) Bend the retaining clip out about 12 degrees.

(2) With the new contact shoe and spring in the position shown in Figure 9, insert the shoe in the cluster.

(3) Bend the retaining clip back in place.

(4) Replace the capscrew, torquing it to 20 ft/lb.

H Using the operating mechanism red maintenance-positioning valve, slow-close the breaker until contact blade 16 (Figure 6) is about to enter contact shoe cluster 15 (Figure 6).

I If the contact blade is on center with the contact shoe cluster, close the breaker completely.

J If the contact blade does not enter the contact shoe cluster on center, making the cluster spread evenly with equal distance between the shoes:

(1) Loosen contact cluster mounting capscrews 15 (Figure 6), allowing the cluster to self-center.

(2) Tighten the contact cluster mounting capscrews.

(3) Slow-operate the breaker to check contact blade alignment.

K Check contact blade penetration:

(1) Using the operating mechanism green maintenance-positioning valve, slow-open the breaker.

(2) Make a scribe mark 1⅜ in. from the tip end of each contact blade as shown in Figure 6.

(3) Using the operating mechanism red maintenance-positioning valve, slow-close the breaker, allowing it to settle on the latch.

(4) Check the scribe mark.

- The scribe mark should be even with the ends of the contact shoes ± 1/16 in.

(5) If contact blade penetration is not 1⅜ in. ± 1/16 in.:

a Loosen bolts 18 (Figure 6) on crosshead 19 (Figure 6).

b Shift the contact blade up or down as required to match the scribe mark on the blade and obtain a penetration of 1⅜ in. ± 1/16 in.

c Tighten bolts 18 on crosshead 19 (Figure 6).

L Reinstall interrupter chamber 14 (Figure 6) in its original location and position.

(1) Make sure the interrupter chamber is vertical and coaxial with the contact blade.

(2) Make sure the exhaust ports in the interrupter chamber face outward toward the tank wall on one side and inward toward the jet nozzle on the opposite side.

(3) Make sure the mounting stud nuts are tight.

M Slow-operate the breaker to check contact blade alignment when the interrupter chamber is in place.

(1) If the contact blade binds while passing through the interrupter chamber:

a Using the operating mechanism green maintenance-positioning valve, slow-open the breaker.

b Change the angle of interrupter chamber 14 (Figure 6) slightly by shifting the position of the entire assembly on spherical contact surface 11 (Figure 6) by loosening and tightening opposite stud nuts 12.

NOTE: This minor change—in angle only—will not appreciably change the position of the stationary contact shoe cluster.

c Slow-operate the breaker to check contact blade alignment.

(2) If more than a minor adjustment is required for contact structure alignment:

a Using the operating mechanism green maintenance-positioning valve, slow-open the breaker.

b Loosen all bushing mounting nuts 2 (Figure 6) except those in line with the desired direction of movement of the contact assembly.

c Rock the vertical axis of bushing adapter ring 3 (Figure 6) in small increments by loosening and tightening opposite mounting bolts.

NOTE: If necessary, bushing flange 5 (Figure 6) can also be shifted slightly because of the hole tolerance for the mounting bolts.

d Tighten all bushing mounting bolts.

e Compensate for any angular change of the bushing by making an opposite—and equal—angular change of the half-pole assembly which is held to spherical contact surface 11 by stud nuts 12 (Figure 6):

- Adjust stud nuts 12 to return the interrupter chamber mounting flange to the horizontal position.

NOTE: When the interrupter chamber mounting flange is horizontal, contact blade 16 will be parallel to liftrod 20 (Figure 6).

f Slow-operate the breaker several times to check alignment.

N Reinstall resistor 19 (Figure 7).

MAINTENANCE LOG

Date Checked	Adjustment	Comment