Type WSA Air Circuit Breaker: Installation—Maintenance

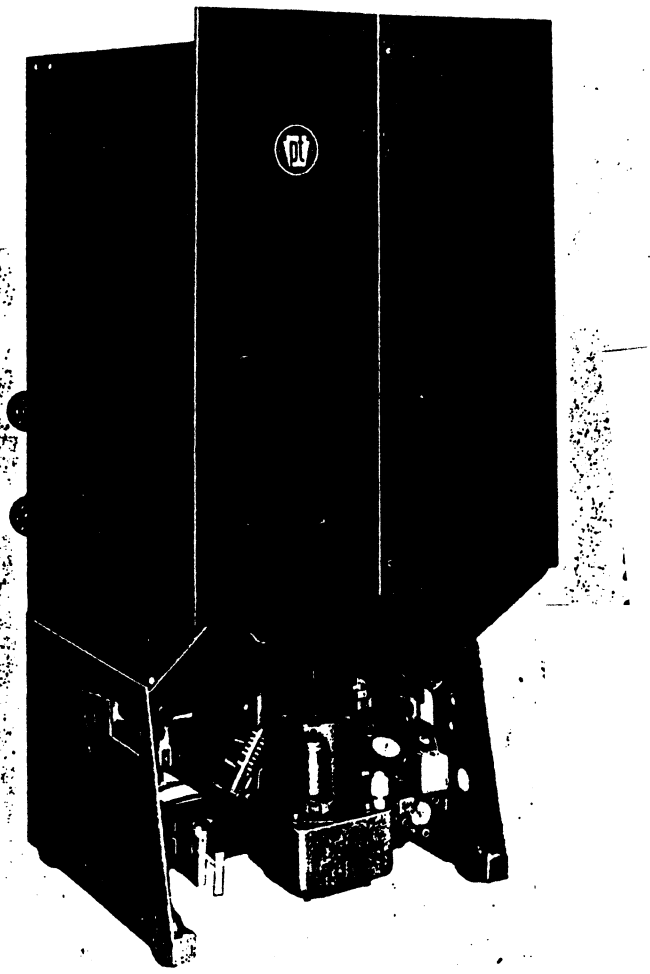


FIGURE 1
Front view of 15 kv air circuit breaker

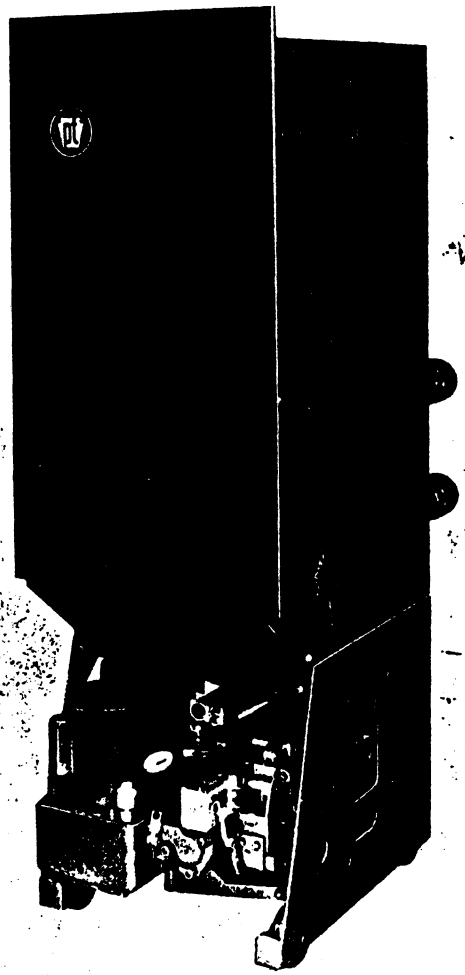


FIGURE 2
Front view of 5 kv air circuit breaker.

CONTENTS

I. GENERAL

The Type WSA magnetic-blowout air circuit breaker, Figures 1 and 2, is a three-pole, electrically operated, horizontal-drawout unit, specifically designed as a removable element of metalclad switchgear. The circuit breaker is equipped with a device necessary for positioning the unit in its cubicle, and with all interlock devices necessary for safety to operating personnel. The drawout feature allows it to function as a disconnecting switch, for complete isolation from the high-voltage circuit. Interchangeability between units of similar rating and control, provides maximum flexibility for inspection and maintenance.

The Type WSA circuit breaker is manufactured to meet the standard class ratings for indoor oilless-type circuit breakers from 5 kv, 150 mva, 1200 amps continuous to 15 kv, 500 mva, 2000 amps continuous. The rating of each circuit breaker is stamped on a nameplate that is fastened to the breaker frame. Control voltages and other necessary information also appear on this nameplate.

Many advanced features have been incorporated in the design to provide dependable, low-maintenance service, even under difficult switching conditions.

- —Positive, high-speed, shock-free operation, with generous reserve energy to close against heavy fault currents.
- —Stored energy mechanism provides four full-power closing operations after complete loss of auxiliary power, to meet emergency switching requirements.
- —Minimum power drain on control circuits.
- —Reduced arcing time on low-current, low-power-factor interruptions, aided by high-energy puffer.
- —Long life with minimum maintenance, because of short arcing times and shock-free operation.
- —Rugged construction throughout, to withstand heavy short circuit stresses.
- —Locked-on barrier assembly.
- —Complete interlock system, providing maximum safety for operating personnel.
- —Tilt-back arc chutes, for easy inspection of contacts.

II. SHIPMENT AND ACCEPTANCE

The circuit breaker unit is shipped in three main crates:

a. Main frame, mechanism, and contacts
b. Three arc chutes with lifting yoke
c. One set of interphase barriers

Immediately upon receipt, all crates should be inspected for any evidence of damage or rough handling. Report of damage should be made to Pennsylvania Transformer Division, McGraw-Edison Company, Box 330, Canonsburg, Pennsylvania; and a damage claim should be filed promptly with the carrier.

III. UNPACKING, MOVING, STORAGE

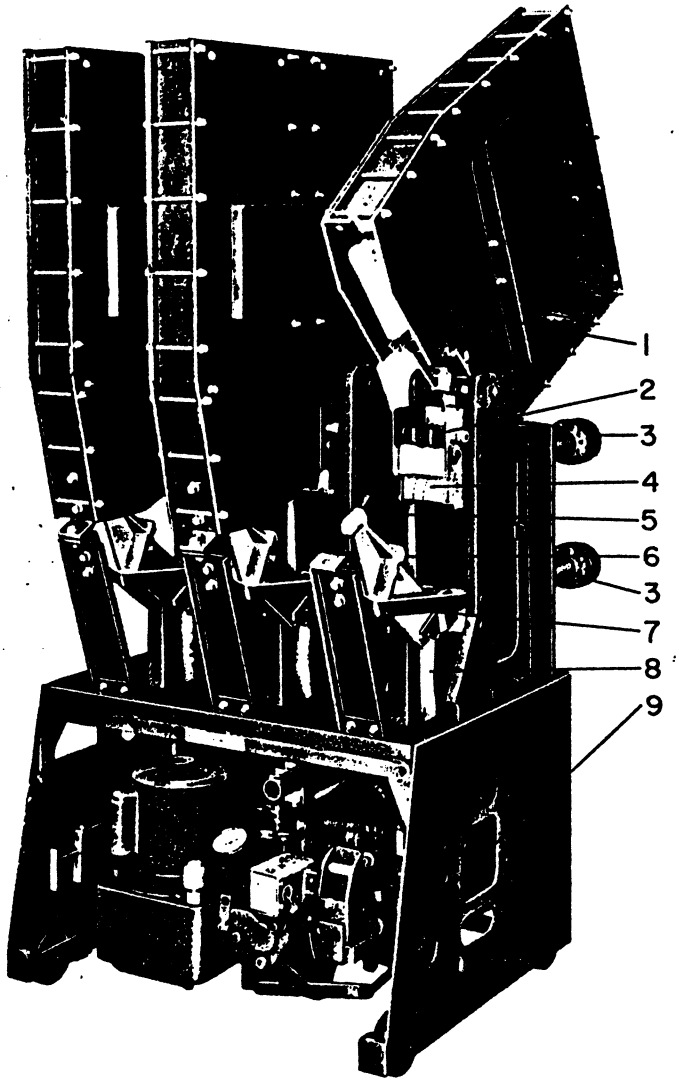
It is advisable to unpack the circuit breaker as soon as practical, so that no difficulty will be experienced when filing a claim for damage not evident upon receipt. Instructions are stenciled on each crate to indicate the proper opening procedure. The arc-chute crate in particular shoud be opened as prescribed on the crate. See Figures 3 and 4 for general identification of breaker parts.

1. Uncrating Mechanism and Frame

The breaker frame is banded to the skid that forms the base of the crate. The top and four sides form a cover that is nailed at the base. To uncrate the breaker, first remove the nails around the base and lift off the cover portion. Then remove the straps that fasten the base to the breaker frame. The breaker may now be lifted from the skids with a crane, by utilizing the lifting holes located in the side of the frame. A spreader bar should be used to avoid damage to the bushings. A *steady line is needed* from the lifting hook around the top center bushing, to keep the breaker from tilting, when being lifted without the arc chutes in place.

2. Uncrating Arc Chutes

The three arc chutes are shipped in one crate. For shipping reasons, the arc chutes are positioned upside down in



1. Arc-chute assembly
2. Stationary arcing contacts
3. Main disconnect contacts
4. Stationary main contacts
5. Moving arcing contacts
6. Moving main contacts
7. Connection for arc-chute runner
8. Puffer tube
9. Hydraulic operator

FIGURE 3

Front view of air circuit breaker with barrier assembly removed and arc chute pivoted back.

the crate. To facilitate easy removal of the arc chutes, it is necessary that the complete crate be turned over, so the skid is on top before opening. The skid portion of the crate may then be removed, exposing the three arc chutes in their normal upright position. A lifting yoke, included with the shipment, can be slipped over the extended bolt at the top center of each arc chute. A light-duty hoist or fork-lift truck may be used to lift the arc chute directly from the crate, when ready for installation.

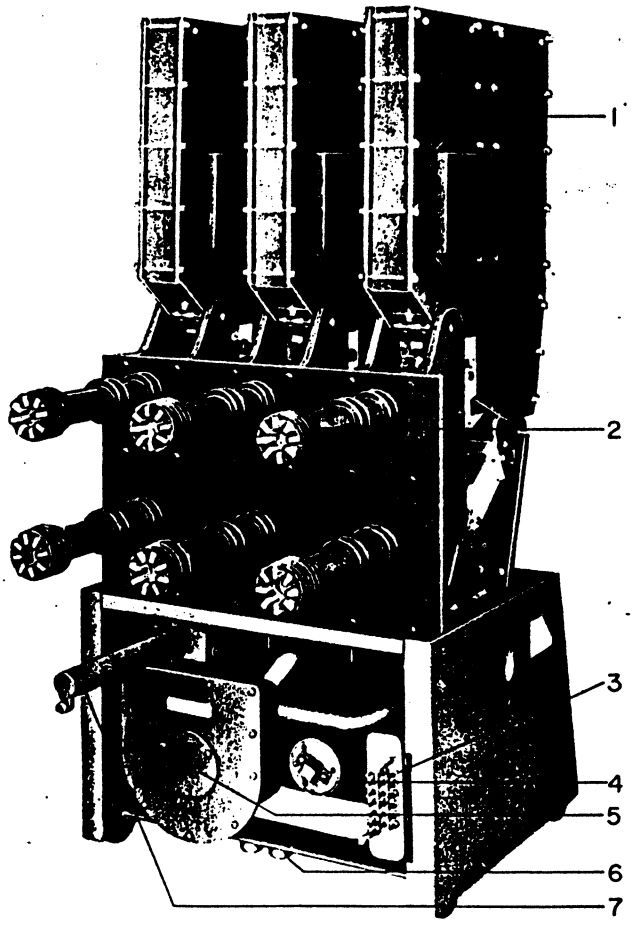
NOTE: The required assembly hardware is packaged in the respective crate.

3. Uncrating Interphase Barriers

No special instructions are needed, but care should be exercised in uncrating the interphase barriers.

4. Handling

A single-wheel dolly, Figure 5, is furnished for maneuvering breakers while removed from indoor or Safe-T-Aisle metalclad switchgear. For breakers of outdoor switchgear, an adjustable-height truck, shown in Figure 6, is furnished.



1. Arc-chute assembly
2. Primary disconnecting contacts
3. Secondary disconnecting contact plug in withdrawn position
4. Hydraulic accumulator
5. Puffer cylinder head with access opening to piston
6. Centering guide rollers
7. Cranking-in device in fully extended position

FIGURE 4

Rear view of air circuit breaker with barrier assembly removed.

5. Storage

Since the circuit breaker is an indoor device, it is very important that all parts be stored in a clean, dry place of moderate temperature. Particular care should be taken to prevent entry of foreign material into the arc chutes. It is advisable to keep the arc chutes in their shipping crate until time for installation on the breaker unit.

IV. PRESERVICE ASSEMBLY AND CHECKS

This section outlines a recommended procedure for assembling and checking operation of the breaker prior to installation. Also, the descriptive sections of this instruction manual, VI. BREAKER and VII. MECHANISM, should be thoroughly understood, before proceeding with the installation. Figure 9 identifies major breaker parts.

FIGURE 5

Breaker for indoor metalclad switchgear handled with dolly.

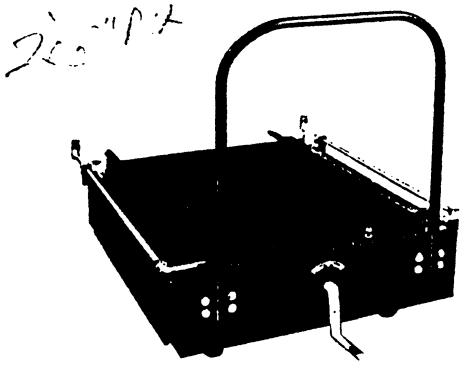
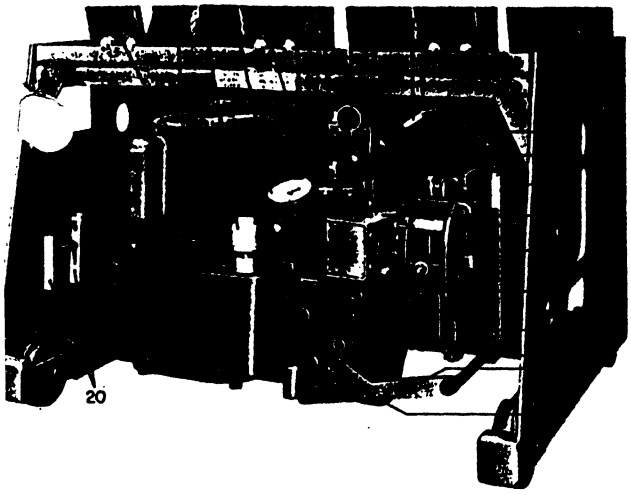


FIGURE 6

Truck for handling breakers of outdoor metalclad switchgear.



. Pump motor
. Fluid sump
. Filler cap and vent
. Fluid pressure gage
. Closing solenoid
. Auxiliary switch
. Operation counter
. Cranking-in-device handle opening
Breaker main contact position indicator
Manual trip bar
Maintenance closing valve
12. Maintenance opening valve
13. Interlock position indicator
14. Pressure switch
15. Latch mechanism
16. Manual hand pump lever
17. Trip solenoid
18. Interlock lever system
19. Maintenance interlock valve
20. Manual disconnecting lever and interlock for secondary circuit plug

FIGURE 7

ic operating mechanism from front of circuit breaker.

CAUTIONS:

a. Never connect the circuit breaker to a high-voltage circuit unless arc chutes and interphase barriers are in place.
b. Keep clear of moving parts of circuit breaker unless gage shows zero pressure and main contacts are open. Unlike a solenoid device, a stored energy mechanism may be operated at full speed, even though the breaker is not connected to a control circuit.

Checking Mechanism

The mechanism is filled with hydraulic fluid, adjusted, l tested before shipment from the factory; hence, no ther adjustments should be necessary. The following pro- ure, referring to Figure 7, is intended as a general check, ore the mechanism is placed in service.

Setting interlocks for test procedure:

a. Set cranking-in mechanism in extended position by depressing manual trip bar to position "2," then inserting crank and turning it counterclockwise until solid stop is felt.
b. Withdraw crank, being careful not to rotate it. Check to see that manual trip bar can be depressed to approximately ¼ inch beyond position "3," before it bottoms.

Return trip bar to position "1."

:cking vent and hydraulic fluid level in sump:

a. Check to see that pressure gage indicates zero pressure. If not, open closing valve 11 (9, Figure 10), to bleed off the pressure. Reclose *hand tight.*
b. Unscrew fill-vent plug and *remove sealing tape* from vent holes.
c. Measure fluid level in sump. It should be approximately 1½ inches below top machined surface of sump casting. If too low, replenish with suitable hydraulic fluid (per XI. MAINTENANCE) and replace filler plug.

3. Checking accumulator precharge pressure:
   a. Connect motor terminals to suitable voltage supply. See specific wiring diagram (Figure 12 is typical) for proper connections to secondary contact block and for proper voltage (usually 115 volts a-c).
   b. Check OPEN and CLOSE positioning valves. They should be closed (clockwise) *hand tight.*
   c. Energize motor. Pressure gage needle should rise suddenly to precharge pressure, then continue to rise slowly. The precharge pressure should be according to curve, Figure 8.

   NOTE: If voltage supply is not available, hand pump may be used.

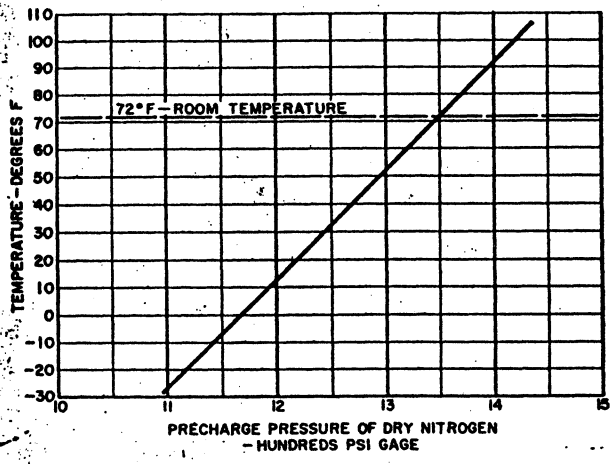


FIGURE 8

Pressure-temperature curve for accumulator precharge.

4. Checking motor cut-off pressure:
   a. Allow motor to run until it cuts off automatically at 3000 psi, plus or minus 100 psi. This should take approximately 1½ minutes. Cut-off pressure is independent of temperature.
   b. Motor may restart three or four times to recharge accumulator as pressure drops off. This is normal, being due to cooling of the accumulator gas, which heated during compression.
5. Operating breaker with manual positioning controls:
   a. Depress manual trip bar beyond position "3" and hold.
   b. Depress maintenance valve plunger as far as it will move (about one inch) and hold.
   c. Release manual trip bar. It should return to position "3," capturing maintenance valve plunger in depressed position.
   d. Open positioning closing valve (Figures 7 and 11). Breaker will move slowly to closed position. Motor pump should recharge accumulator. Hand pump may be used.

   NOTE: Contact alignment may be checked at this time.

e. Close the closing valve and open the opening valve. Breaker will move slowly to open position. Repeat these operations as desired.

NOTE: Contact engagement and penetration may be checked at this time.

6. Operating breaker manually at normal speed:
   a. Depress manual trip bar beyond "3," allowing maintenance plunger to snap out, thus alloving return of trip bar to position "1."
   b. Depress closing armature momentarily. Breaker should close at full speed.
7. Operating breaker electrieally:
   a. Connect secondary contact block to suitable control circuit with flexible test jumper, or by putting breaker in TEST position in cubicle.
   b. With pressure above 1900 psi, close and open breaker electrically with control switch.

2. Checking Contacts

The contacts are aligned and adjusted for proper engagement at the factory (see IX. ADJUSTMENTS) and should require no further attention. However, it is desirable to check the following points after shipment:

a. Contacts should be clean and bright, and free of any lubricants that might collect dust.
b. All moving contacts should be reasonably well centered horizontally with respect to stationary contacts. Off center ⅛ inch is satisfactory.
c. When closing, the arc contacts of the three phases should "make up" within ⅜ inch of simultaneously.
d. Depression of the main contacts should be 3/16 inch minimum to ⅜ inch maximum.

3. Installing Arc Chutes

The arc chutes are most easily installed with a small hoist, although the 5-kv chutes may be handled by two men. If the arc-chute crate is opened, as described in III. UNPACKING, the individual arc chutes may be lifted directly from the crate to their position on the breaker.

The lifting yoke, supplied with each shipment, may be slipped over the extended bolt in the top of each arc chute and retained with nuts. The saddle on the arc chute at 6, Figure 9, is straddled over the round arc chute hinge pin between the arc chute supports. Four cap screws with lockwashers secure the arc chute clips to the hinge. The capscrew heads tighten against the hinge. Flexible shunt strap 5 should be connected.

Before tightening front hold-down bolts 20, it is advisable to tilt the arc chutes back, one at a time, to inspect for damage or foreign material. Blow out the chutes with *dry* compressed air to remove foreign material.

After installing the three arc chutes, operate the breaker contacts slowly, by means of manual positioning controls, per IV-1-5 above, to observe possible interference.

4. Installing Interphase Barriers

Since the interphase barrier assembly protects operating personnel from contact with the live parts of the circuit breaker, it is necessary to install it before putting the breaker into service.

The interphase barriers are shipped completely assembled and need only to be placed on breaker and fastened in position. The 15 kv barriers are in two parts, held together with two bolts which must be removed for easier handling.

Place the barrier asembly on the breaker frame (left side first on a 15 kv breaker). Then tighten hold-down bolts through the frame angle. Rebolt together the two halves of 15 kv assemblies.

V. INSTALLATION

When the circuit breaker is assembled, complete with arc chutes and interphase barriers, it is ready for installation in the cubicle. For a description of the switchgear insertion facilities, see section VIII.

Before inserting the breaker to DISCONNECT position:

a. Check primary disconnect contacts for cleanliness and freedom of movement.
b. Check to see that breaker is open, that cranking mechanism is fully extended, and that manual trip bar 10, Figure 7, can be depressed the ¼ inch beyond position "3."

1. Placing Breaker in DISCONNECT Position:
   a. Depress manual trip bar beyond position "3" and roll breaker into cubicle until cranking-in device contacts rear of cell.
   b. Release manual trip bar. It should return to position "1," locking the breaker in DISCONNECT position.
2. Placing Breaker in TEST Position (Optional):
   a. Release secondary contact carriage latch at left of mechanism, pull handle and turn to left until it stops. Then push carriage to limit. Physical location of breaker in cubicle remains unchanged. Breaker may now be operated electrically.
3. Placing Breaker in OPERATE Position:
   a. Depress manual trip bar to position "2," tripping breaker if closed, and insert crank.
   b. Turn crank *clockwise* to draw breaker into cubicle, until crank meets a solid stop. (First 1/3 turn raises the protective shutter without moving the breaker.)
   c. Remove crank and allow manual trip bar to return to position "1." Breaker is in OPERATE position.

VI. BREAKER—GENERAL DESCRIPTION

The breaker unit consists of a steel and insulation structure which carries the bushings, contact assembly, arc chutes, cranking-in system with interlocks, secondary control contacts, auxiliary devices, and hydraulic, stored-energy operating mechanism.

Figure 9 identifies the basic parts of the bushing, contact and arc-chute portion of the breaker.

1. Normal open condition:
   The positions of the drive mechanism and moving-contact parts are illustrated by Figure 9.
2. Sequence in closing breaker contacts:
   a. High-pressure hydraulic fluid from hydraulic control unit flows into left side of drive cylinder 30.
   b. Piston moves to right, compressing opening spring 31, and rotating main drive shaft 28 to close contacts of the three poles.
   c. Arc contacts 18 and 19 touch first.
   d. Main contacts 21 and 22 touch, and compress contact springs.

e. Latch prop 29 engages latch surface on main shaft.
f. Piston 30 reaches end of cylinder and stops smoothly, due to shock-absorbing action.
g. Oil pressure is cut off and latch prop 29 holds breaker closed.

3. Sequence in opening breaker and interrupting circuit:
   a. Latch linkage (not shown) releases latch prop 29, allowing opening spring to move piston to left, rotating main shaft 28 clockwise to open contacts.
   b. Main contacts part, shifting current to arc contacts.
   c. Arc contacts part, forming power arc.
   d. Blast of air, created by puffer 31, flows through insulating tube and nozzle 26, and is directed across contacts.
   e. Arc moves upward into arc chute, impinging on runners 8, 11, and 17.
   f. Interrupter block 15 extinguishes portion of arc-shunting blow-out coil 10, forcing full arc current through coil.
   g. Powerful magnetic field drives arc upward into spaced, slotted interrupter plates 12, lengthening and cooling the arc to extinction.
   h. Piston 30 reaches end of drive cylinder where shock-absorbing action decelerates mechanism and contacts to smooth stop.

VII. MECHANISM—GENERAL DESCRIPTION

The operating mechanism is a hydraulic, stored-energy device, functioning in the following manner to close the circuit breaker:

a. The motor-driven hydraulic pump initially forces hydraulic fluid into the pressure storage chamber (hydraulic accumulator previously charged with gas according to the pressure-temperature curve, Figure 8), until the fluid occupies approximately 50 per cent of the original volume. The 50 per cent reduction in gas volume increases the pressure in the chamber to 3000 psi.
b. A valved system admits a portion of the hydraulic fluid to a drive piston, which closes the breaker contacts as previously described.

The mechanism may be operated in several ways, to drive the circuit breaker contacts.

a. Full-speed closing, electrical: Opening (pilot) valve actuated electrically by closing magnet.
b. Full-speed closing, manual: Opening pilot valve operated by hand, deflecting closing-coil clapper.
c. Full-speed opening: Trip latch operated either electrically or manually.
d. Maintenance (slow speed) opening: Special positioning valve operated by hand.
e. Maintenance (slow speed) closing: Special positioning valve operated by hand.

Figure 10 is a simplified schematic diagram of the hydraulic system, referred to for describing the operation of the mechanism. The pictorial representation of the various valves and other fittings do not necessarily show their actual construction, but rather show their location and function in the hydraulic circuit.

1. Normal position—ready to close:
   a. Breaker contacts are open.
   b. Accumulator 15 is fully charged to 3000 psi.
   c. Hydraulic system is pressurized up to pilot valve 3, relay valve 11, positioning valve 9, hand pump check valve 1, and high-pressure relief valve 7.
   d. Opening latch is set, holding latch valve 5 in position shown.

   NOTE: Latch valve 5 may assume position shown in Figure 10, whenever opening latch is tripped. It does so during trip-free opening, and momentarily during normal opening when latch is tripped.

2. Normal closing:
   a. Pilot valve 3 is opened, manually or by closing-coil magnet.
   b. High-pressure fluid from accumulator flows past the pilot valve through the latch valve 5 and into pilot line 6, to relay valve piston on top of relay valve 11.

1. Primary disconnect contacts: Multiple finger contact cluster with stainless steel garter springs and retainers, free-floating assembly for alignment with contact studs in cubicle
2. Bushing stud (contact cluster removed): Hollow copper
3. Bushing: Epoxy-filled glass sleeve
4. Bushing and chute supports and barriers: Glass-reinforced epoxy
5. Flexible connecting strap to rear arc runner
6. Arc-chute hinge
7. Hinge plate
8. Rear arc runner
9. Magnet core: Laminated transformer-quality steel
10. Blow-out coil: Connected in series between center runners
11. Center arc runners
12. Interrupter stack: Spaced ceramic interrupter plates with tapered offset slots
13. Glass-polyester insulating side sheets
14. Magnet pole-piece: Laminated transformer-quality steel
15. Interrupter block of blow-out coil
16. Ceramic arc-shield plate
17. Front arc runner: Connected to lower bushing terminal
18. Stationary arc contacts: Silver-alloy contact surface for arc resistance
19. Movable arc contacts: Arc-resistant silver-alloy contact surface
20. Interrupter hold-down bolt
21. Stationary main contacts: Multiple-finger type with "blow-on" current path, generous wiping action, silver-alloy contact surfaces
22. Moving main contact: Silver-alloy surface
23. Connection from hinge block to front arc runner
24. Retainer key: Maintains hinge-contact-pressure adjustment and retains push-rod pin
25. Hinge contact: Silver-alloy contact washers held between contact arms and hinge terminal by hinge bolt and spring washers
26. Puffer tube and nozzle: Insulating tube (one tube for each pole) for directing puffer-generated air blast across contacts
27. Operating rod: High-strength insulating material, threaded at lower end to provide adjustment for contacts
28. Main operating shaft: Drives three push-rods and auxiliary devices
29. Opening latch prop, and prop-latch notch on main drive shaft: Holds mechanism closed
30. Hydraulic drive cylinder: Drives the breaker mechanism
31. Opening spring in puffer cylinder

FIGURE 9
Schematic drawing of breaker.

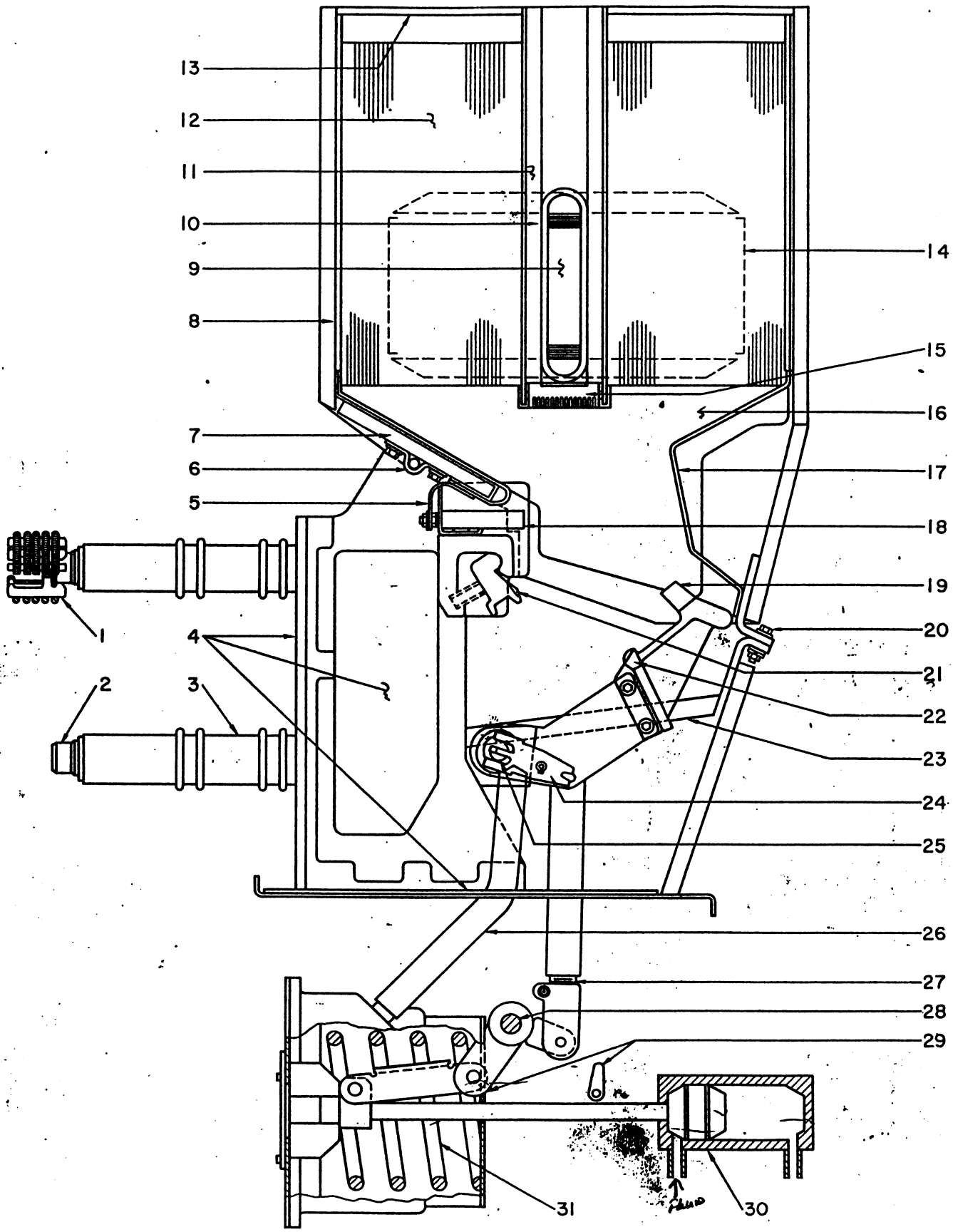


FIGURE 9
(Caption and item descriptions are on left page.)

c. High pressure in pilot line attempts to force latch valve 5 to open to sump (valve is held closed to sump by breaker opening latch) and causes relay valve piston to move down from position shown.
d. Relay valve piston closes the line from right of cylinder to sump and admits high-pressure fluid from accumulator to cylinder, past the maintenance valve head 16.
e. Pressure in right side of cylinder forces piston toward left, closing the main contacts and compressing opening spring 17. Fluid on left side of piston is forced through exhaust passage to sump.
f. As piston approaches left end of cylinder, tapered boss 18 on piston enters exhaust passage, restricting fluid flow, decelerating mechanism and contacts.
g. When piston reaches end of cylinder, pilot valve 3 mechanically and hydraulically is reset to original position, opening pilot line to sump, relieving pressure on back side of main piston 18.
h. Loss of pressure in pilot line allows relay valve 11 to stop flow of fluid from accumulator and open right side of cylinder to sump, also relieves opening force on latch valve.
i. Loss of pressure in cylinder allows piston to move slightly to right, but motion is stopped by mechanical latch, which holds breaker in closed position.
j. Loss of fluid from accumulator has reduced pressure, and pressure switch starts pump motor to recharge accumulator. System has returned to normal position (Figure 10), except that piston is left side of 19. Contacts are closed and mechanism is latched.

3. Normal opening:
a. Mechanical trip latch is released, manually or by tripping magnet.
b. Opening spring moves piston to right, driving contacts open. Hydraulic fluid on right side of cylinder was exhausted previously through relay valve.
c. As piston reaches right end of cylinder, tapered boss 18 enters exhaust passage, restricting fluid flow, and decelerating mechanism and contacts smoothly.

4. Trip-free opening:

Valves are in the same position as for normal closing (Figure 10), except when tripping is initiated. The latch valve 5 then temporarily assumes the up position. This relieves the pilot-line pressure, causing the relay valve 11 to open the drive-cylinder pressure line to the sump, releasing all pressure behind piston 18. The opening spring then opens the breaker at full speed.

5. Maintenance positioning to close:
a. Maintenance valve 16 is closed manually. Interlock bar releases latch so that latch valve is free to move. This prevents the appearance of high pressure in the pilot line, so relay valve piston is inoperative.
b. Closing positioning valve 9 is opened manually, slowly admitting high-pressure fluid to cylinder.
c. Piston moves to left, closing breaker, speed depending on amount and speed valve 9 is opened.

6. Maintenance positioning to open:
a. Closing positioning valve 9 is closed.
b. Opening positioning valve 10 is opened manually, allowing fluid in cylinders to escape to sump.
c. Opening spring forces piston to right, opening breaker.

VIII. AUXILIARIES—GENERAL DESCRIPTION

The circuit breaker, being a removable unit in metalclad switchgear, is equipped with a complete cranking-in device for moving the breaker into and out of its cubicle. An interlock system insures proper and safe operation.

1. Cranking-In Device

The circuit breaker may be placed in three operating conditions inside the cubicle:

1. OPERATE: Breaker is connected to main primary circuit and secondary control circuits. Mechanism is free to operate at normal speed, but maintenance (slow) operation is not possible.
2. DISCONNECT: Breaker is disconnected from primary and secondary circuits, and protective shutter isolates breaker from high-voltage terminals in cubicle. Both normal (full velocity) and maintenance operations, only by manual control, are permitted.

1. Hand-pump intake valve and output check valves
2. Hand pump: Pumps fluid to pressure required for emergency or maintenance operation.
3. Pilot valve: Poppet valve, actuated by closing coil; initiates closing operation by admitting high-pressure to pilot line
4. Line metering limit valve: Functions to close pilot valve hydraulically
5. Latch valve: Controls flow of pilot fluid between pilot valve, relay valve, and sump; held closed to sump by breaker opening latch
6. Pilot line: Connection between pilot valve and relay valve
7. High-pressure relief valve (setting change requiring disassembly): Spring-loaded poppet valve, protects system against excessive pressure
8. Low-pressure valve (actuated from high-pressure line, *setting not to be changed):* Poppet valve exhausts pilot line fluid to sump if accumulator pressure falls too low for safe operation
9. Closing positioning valve: Hand operated to close breaker slowly
10. Opening positioning valve: Hand operated to open breaker slowly
11. Relay valve: Pilot operated poppet valve, controls flow of fluid from accumulator to drive piston; operates only with pressure in pilot line
12. Motor-driven pump: Pumps hydraulic fluid from sump into accumulator
13. Pressure switch: Dual-element switch controls pump motor; prevents electrical closing when pressure is too low
14. Pressure gage: Scaled 0-4000 psi
15. Hydraulic accumulator: Compressed gas behind floating piston, hydraulic fluid on opposite side under equal pressure
16. Maintenance valve: Hand operated for maintenance purposes
17. Opening spring in puffer cylinder
18. Tapered boss at end of piston: Slows operating speed at end of stroke by gradually blocking fluid passage
19. Main drive cylinder: Piston drives breaker mechanism
20. Low-pressure reset valve

FIGURE 10

Schematic diagram of hydraulic mechanism fluid-control system, shown with breaker in tripped position.

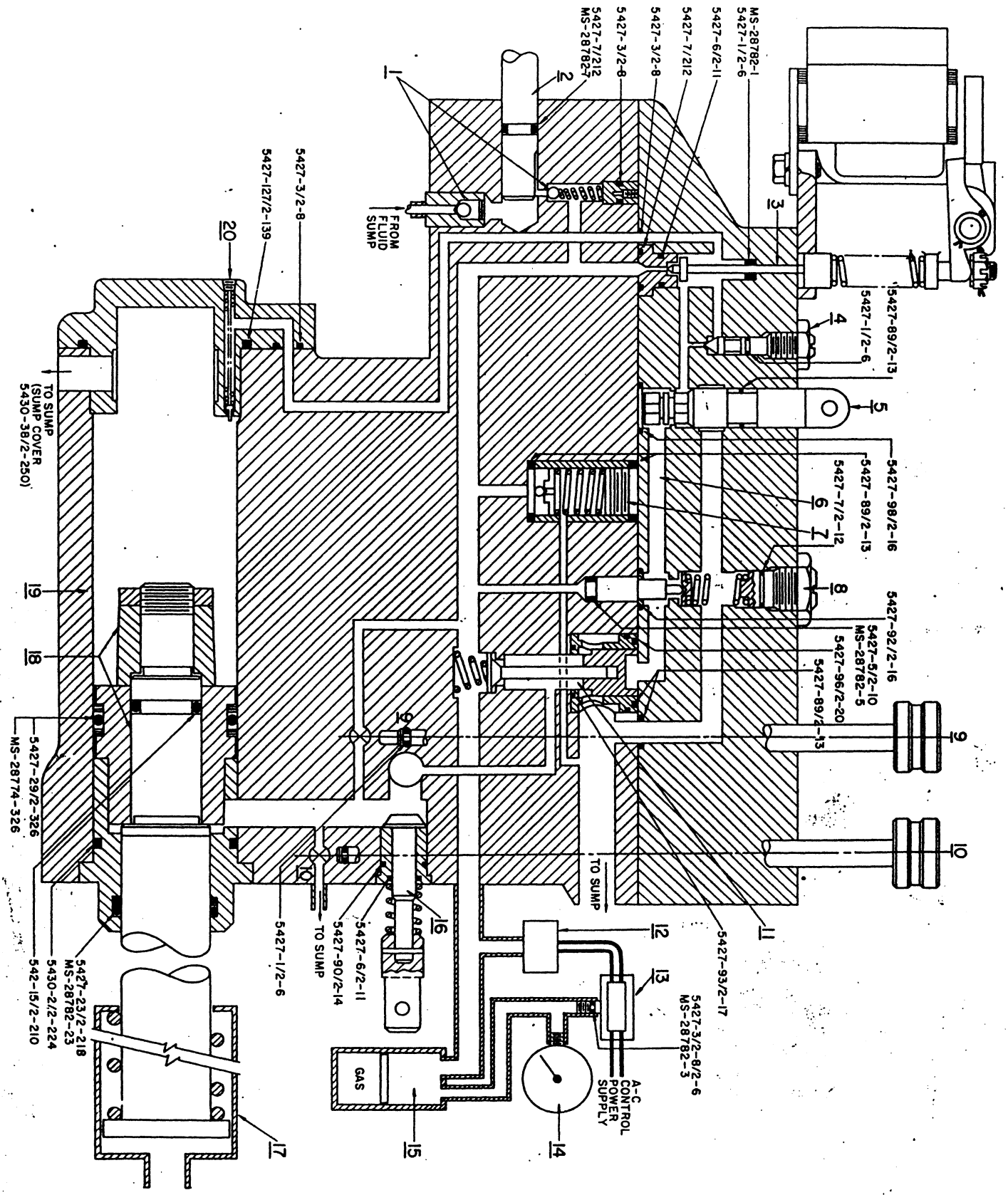


FIGURE 10
(Caption and item descriptions are on left page.)

@ 1700 psi 525 opens

@ 1900 psi 525 closes

@ 3000 psi ±100 5255 opens to cut off motor

secondary disc:

5255 is @ pins 16 & 18 (115v AC)
(motor runs to build pressure)

525 is @ pins 1
and with 52B @ pin 4
forms the close ckt according to A.I.
but pins 4 & 12, also, close the brks ← ?
this situation cannot occur in the cubicle
due to the Y relay;
it occurs artificially on the open floor, only.

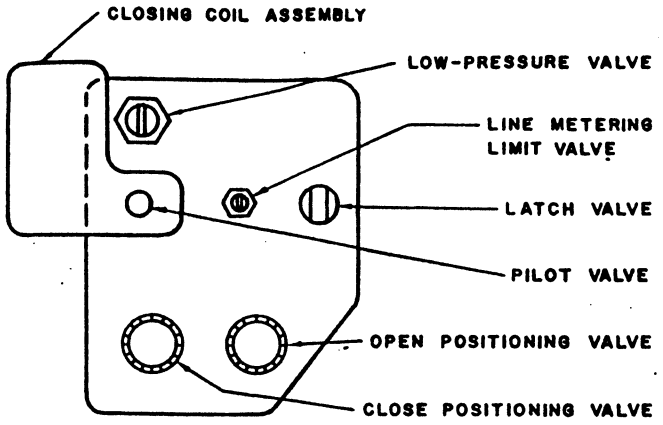


FIGURE 11
Arrangement of control valves.

3. TEST: Same breaker position in cubicle as DISCONNECT, except that secondary contacts are engaged manually to permit electrical operation.

The cranking-in device is basically a screw-type jack, operated by inserting a handcrank into a socket. Positive stops at both extremes of jack travel indicate when correct position of breaker in cubicle has been reached.

To engage the device on the breaker with the socket in the cubicle and to lift the protective shutter when the breaker is being inserted, the mechanism barrel has been made to rotate during the first one-third turn of the crank. In a reverse manner, the shutter is driven downward as the breaker is withdrawn.

2. Interlocking Facilities

An interlock bar coordinates the positions of the cranking-in device, manual trip bar, maintenance valve, and hand crank, with respect to breaker position in the cubicle. Its function is to insure that:

a. Breaker is tripped open while being drawn into or out of cubicle, or when crank is inserted.
b. Cranking-in device is in correct position before breaker can be inserted in cubicle.
c. Maintenance operation is permitted only when breaker is in DISCONNECT or TEST position.
d. Breaker cannot operate at normal speed while maintenance positioning controls are operative.

3. Control Facilities

In addition to the major components described, the standard circuit breaker unit has the following auxiliary devices:

1. Secondary contact block: The male section of an 18-point bayonet-type separable contact is mounted on a movable carriage. The carriage is normally locked in the retracted position and moves with breaker. It may be unlatched and extended to connect with the female contacts and complete the control connections, thus placing the breaker in TEST position.
2. Auxiliary switch: A 10-stage, two-break-per-stage auxiliary switch has each stage actuated by a rotating cam, positioned on a common shaft. Cams may be rotated about the shaft in 15-degree steps to change relative timing of contact operation. Five stages are normally used for breaker electrical control, leaving five stages for such purposes as auxiliary indicating lights and supervisory schemes.

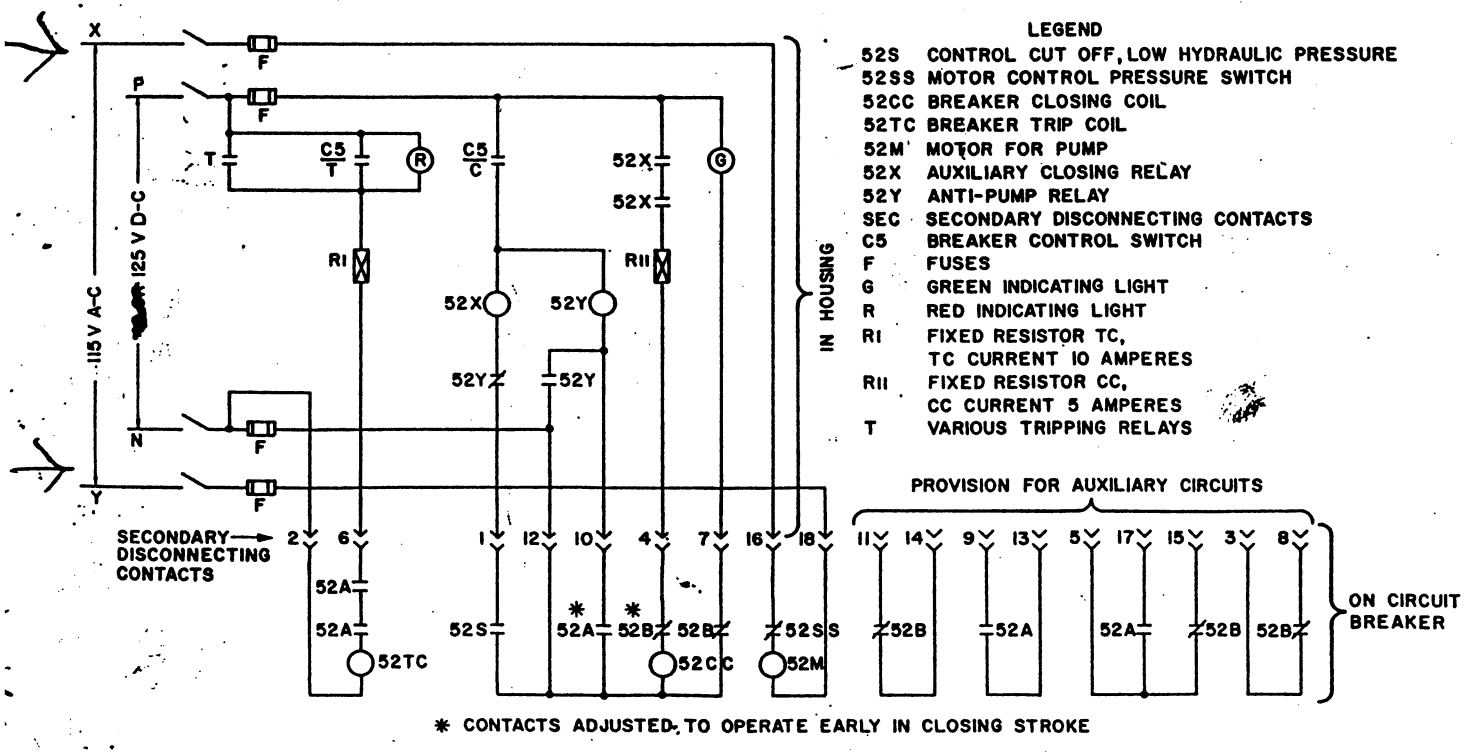


FIGURE 12
Typical schematic diagram of breaker electrical control system.

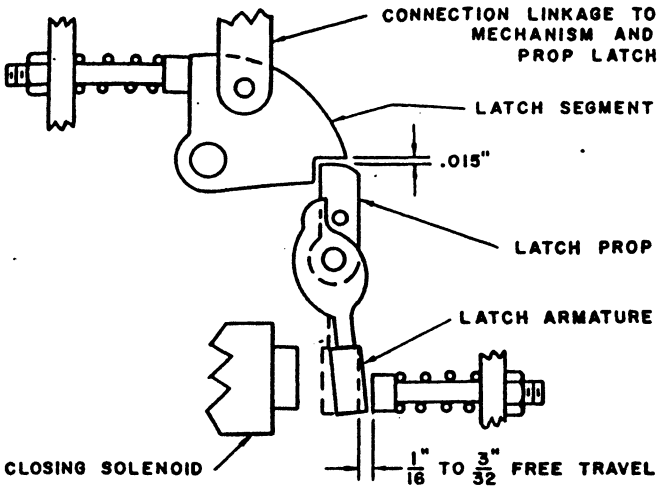


FIGURE 13
Schematic showing opening-latch adjustment.

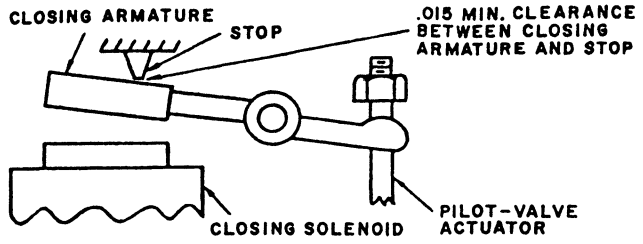


FIGURE 14
Schematic showing closing-armature adjustment.

3. Position indicator: Red and green decals on the auxiliary-switch drive lever clearly indicate open and closed positions of circuit breaker contacts.
4. Operation counter: Mechanical ratchet-type counter, actuated by auxiliary-switch linkage, registers each breaker opening.

IX. ADJUSTMENTS

The following instructions on adjustments are followed as needed for sections IV PRESERVICE CHECKS and XI MAINTENANCE.

Although the breaker is fully equipped with safety features, it is highly important to observe all precautions recommended throughout these instructions, while making adjustments.

1. Hydraulic fluid level: Fluid level should be 1½ inches below top machined surface of sump casting when accumulator pressure is zero. Replenish with Texaco AA Aircraft Hydraulic Fluid or Aeroshell #4.
2. Pressure switch—motor cut-off (14, Figure 7 and 13, Figure 10; also 52SS, Figure 12): Should cut motor off at 3000 psi, plus or minus 100 psi. Adjust by loosening lock nut and turning adjusting screw.
3. Pressure switch—low pressure closing cut-off (14, Figure 7 and 13, Figure 10; also 52S, Figure 12): Should open contacts when pressure drops to 1700 psi; closes contact when pressure rises to 1900 psi.
4. Opening latch clearance: See schematic, Figure 13.
5. Closing armature clearance: See adjustment schematic, Figure 14.
6. Accumulator precharge pressure: Should be according to curve, Figure 8. Check by starting with zero pressure and operating pump until initial pressure suddenly appears on gage. If too low, accumulator may be recharged with dry nitrogen. Refer to factory for instructions.
7. High-pressure relief valve (7, Figure 10): Factory set at 3400 psi. Cannot be adjusted without disassembly.
8. Low-pressure valve (8, Figure 10): Factory set. Do not change.
9. Contact engagement: Main contacts 21, Figure 9, should depress 3/16 to 3/8 inch when breaker is latched; may be adjusted by rotating push-rod 27, Figure 9, in clevis casting in half-turn increments.
10. Line metering limit valve (4, Figure 10): No adjustment required unless setting has been changed. Screw should be bottomed, then backed out 1/8 turn, and lock nut tightened.

X. TECHNICAL REFERENCE DATA

The following technical data will facilitate installation, adjustment and maintenance work:

1. Motor: One-third hp, 1725 rpm, 115/230 volts a-c, capacitor-start, induction motor, with built-in, self-resetting thermal cut-out.
2. Pump: Axial-piston type with strainer at intake.
3. Accumulator: Piston-type, precharged with dry nitrogen, half-gallon capacity.
4. Pressure switch: Piston-actuated type, working against calibrated spring; actuates two separately adjustable, single-pole, double-throw micro-switches.
5. Closing coil: Resistance—4 ohms. Current—5 amperes at normal voltage. Fixed series resistor is located in switchgear cubicle.
6. Opening (trip) coil: Resistance—2 ohms. Current—10 amperes at normal voltage. Fixed series resistor located in switchgear cubicle.
7. Hydraulic fluid: Texaco Aircraft AA Hydraulic Fluid (Texaco) or Aeroshell Fluid #4 (Shell).
8. Grease for anti-friction bearings: Keystone #84 HX, or equivalent minus 70 to plus 180 F lubricants.
9. O-ring seals: Buna-N material, for use with petroleum base hydraulic fluid.

XI. MAINTENANCE

Proper and timely maintenance is necessary to retain the maximum performance capability of the circuit breaker. The frequency of such maintenance depends mainly upon the degree of exposure to contaminating atmospheres and the severity of operating duty. It is good practice to inspect the breaker after a severe fault interruption near its maximum rating.

Inspection is convenient, due to the ease with which the breaker can be removed from the cubicle, the interphase barriers removed, and the arc chutes tilted back.

The mechanism has few adjustments, and a minimum of maintenance is required. All main bearing points have needle bearings permanently lubricated with proper grease. Do not lubricate latch surfaces.

Observe all precautions and procedures in section IV on preservice work.

Make checks per IX ADJUSTMENTS. Also, the following additional steps should be followed:

1. Primary disconnect contacts: Inspect for cleanliness, burning and freedom for self-alignment.
2. Main contacts: If excessive wear or burning is present, dress with fine sandpaper, being careful to control all dust particles.
3. Arcing contacts: Dress surface only in case of extreme burning.
4. Arc chutes: Wipe off excessive deposits on interior of insulating sheets and ceramic plates. Sand lightly if necessary. Check for broken ceramic parts.
5. Bushings and other insulating parts: Wipe with cloths moistened in a cleaning solution. Preferable kinds are neptane, Stoddard Solvent, or cleaner's naphtha, obtainable from most oil companies. *These are flammable liquids, no sparks and flame must be kept away.* Also, have good ventilation where they are used.
6. Secondary contacts: Check for burning and general cleanliness.
7. Auxiliary switches: Check for proper operation and for burning on contacts.

XII. SPARE PARTS

Although local experiences and practice will determine the parts and quantities to be secured for maintenance purposes, the following minimums are suggested.

Description	Part or Dwg. No.	Quantity of Parts* 1-5	6-20	Over 20
Contact—arcing, moving	32-6987	6	12	24
Contact—arcing, stationary	32-6999	3	6	12
Contact—main, moving	32-6987	1	2	4
Contact—main stationary fingers	A-910007	4	8	16
Primary disconnect fingers—1200A	32-7567	3	6	12
—2000A	32-7568	3	6	12
Secondary contact plug (male)	32-3424	1	2	4
Crank handle—15 kv	32-7542	1	1	2
— 5 kv	32-7541	1	1	2
Manual pump handle	31-11765	1	1	2
Arc chute—15 kv	34-1921	—	1	3
— 5 kv	34-1922	—	1	3
Pump motor	31-15022	—	1	2
Trip coil	32-5289	1	2	4
Closing coil	32-5288	—	1	2
Pump	31-15250	1	2	4
O-ring seals—sets	31-11976	1	2	4
Truarc rings—sets	31-15031	1	2	4
Pressure switch	33-7217	—	—	1
Pressure gage	31-15028	—	—	1
Accumulator	31-15027	—	—	1
Latch mechanism assembly	33-7157	—	—	1

*Suggested stock for number of breakers indicated.

Note: With over 20 breakers on the premises, a spare breaker should be considered, in addition to spare parts.

When ordering parts or when securing information regarding parts, supply the breaker rating and serial number.

Address the Service Department, Pennsylvania Transformer Division, McGraw-Edison Company, Box 330, Canonsburg, Pennsylvania.

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