Type OA-3 Operating Mechanism
Installation, Operating, and Maintenance Instructions

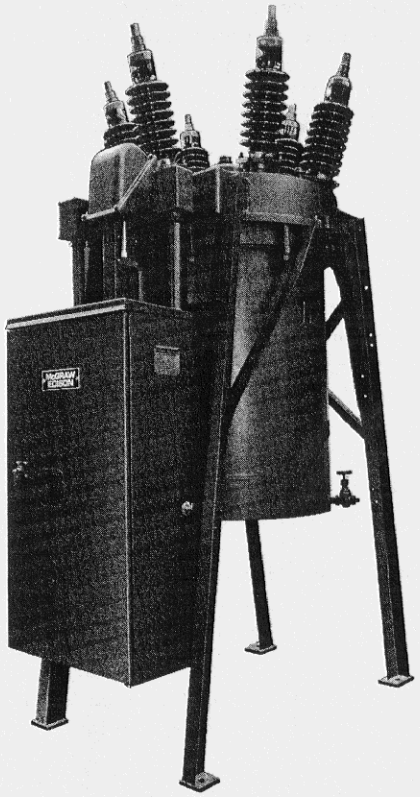

FIGURE 1
Type OA-3 hydraulic operating mechanism in cabinet on Type CF-37 breaker.

CONTENTS

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 Group sales engineer.

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I. GENERAL

The Type OA-3 mechanism, Figure 1, is a hydraulically closed, mechanical device that operates an oil circuit breaker at high speeds. An accumulator, with compressed nitrogen behind a floating piston, stores enough energy for five successive full-speed closures. The hydraulic fluid, being nearly incompressible, virtually provides a value-controlled mechanical linkage between the accumulator and the main operating piston. A system of levers with a holding latch couples the piston to the breaker and holds it closed. Opening energy is provided by springs in the breaker that are charged during the closing operation. The Type OA-3 mechanism is equipped for manual or electrical operation.

These instructions provide installation, operation, and maintenance information for the Type OA-3 operating mechanism. Proper adherence to these instructions is necessary to ensure continued satisfactory service. For detailed information not given in these instructions, refer to the drawings supplied with the specific equipment. Refer to applicable manuals for instructions on the breaker itself and other component parts.

II. SHIPMENT AND ACCEPTANCE

The operating mechanism is shipped assembled on the breaker. After a full series of factory tests, to check operation with the breaker, it is positioned and blocked as required for breaker shipment.

The accumulator is shipped with a normal precharge of gas. The oil-pressure system is shipped with slightly over the precharge pressure (precharge pressure plus 10 strokes of the hand pump, i.e., approximately 6 cu in.), to balance pressure on the accumulator piston seals. *(Maintain this pressure at all times* when the breaker is not in service or under test.) The sump tank is usually shipped empty and must be filled to normal level with suitable hydraulic fluid.

Auxiliary devices shipped in the compartment normally include a hand pump handle, a maintenance-positioning wrench, and the tripping pin for the latching mechanism.

One full set of instructions, including wiring diagrams, packaged in a protective envelope, is stored for shipment in each breaker compartment.

Immediately upon receipt of a breaker shipment, preferably before unloading, a thorough inspection should be made for damage or evidence of rough handling. A check should be made of the housing interior. Check the shipping memorandum for possible shortage. Should there be evidence of loss or damage, notify and file a claim at once with the carrier. Notify McGraw-Edison Power Systems Division, Canonsburg, Pa 15317.

III. HANDLING AND STORAGE

The breaker should be handled only with the mechanism in the shipping condition, as described in the previous section and in the breaker instructions.

Energize the heater circuit, using a temporary supply, if the permanent supply cannot be promptly provided. This will prevent moisture condensation and resulting damage. See the wiring diagram for heater circuit connections and specified voltage.

CAUTION: Do not energize any control or operating circuit until compliance with related later instructions and separate breaker instructions. This is to prevent personal injury or damage to equipment.

IV. INSTALLATION AND PREPARATION

The mechanism is mounted and tested on the breaker before shipment. Since it is shipped mounted and mechanically complete, there is no actual installation work required. However, certain checks must be thoroughly performed.

It is necessary to fully understand sections V and VI on the mechanism and its operation, before any attempt is made to energize the hydraulic system. Also, operation of the breaker must be understood, and specified checks made, before the mechanism is actuated.

CAUTION: All safety precautions herein, and contained in the breaker instructions, must be strictly observed. Although the mechanism was designed with the safety of personnel foremost in mind, the operating power and speed make careful work habits a necessity.

1. Electrical Connections

Diagrams supplied with the equipment show proper electrical connections to the mechanism. If permanent heater connections cannot be made promptly, a temporary supply should be provided, as previously stated, so that condensation of moisture in the cabinet can be prevented.

CAUTION: Mechanism operating circuits should not be closed until called for in both the breaker and these mechanism instructions.

2. Miscellaneous Parts

The hand pump handle and the maintenance-operating wrench are stored in holders in the compartment.

The breaker is shipped with the mechanism tripping pin 11, Figure 7, removed and taped to tripping lever 3. This pin is normally removed for certain checks on the breaker, so may be left out until this work is completed.

The breaker mechanism is mechanically blocked for shipment, as in Figure 8. No attempt should be made to remove this blocking, which requires operating pressure, until review of section VI and compliance with preparational steps of breaker instructions.

3. Hydraulic Fluid

Since the sump tank is usually shipped empty, it must be lowered and filled to the level marked "ACCUMULATOR EMPTY." Although the accumulator is shipped with a pressure slightly above the precharge value, the small amount of fluid (only about 6 cu in.) necessary to so charge the accumulator is insignificant.

Section VII contains further references for filling the sump tank and a list of acceptable fluids. The initial supply is shipped in a container along with the breaker.

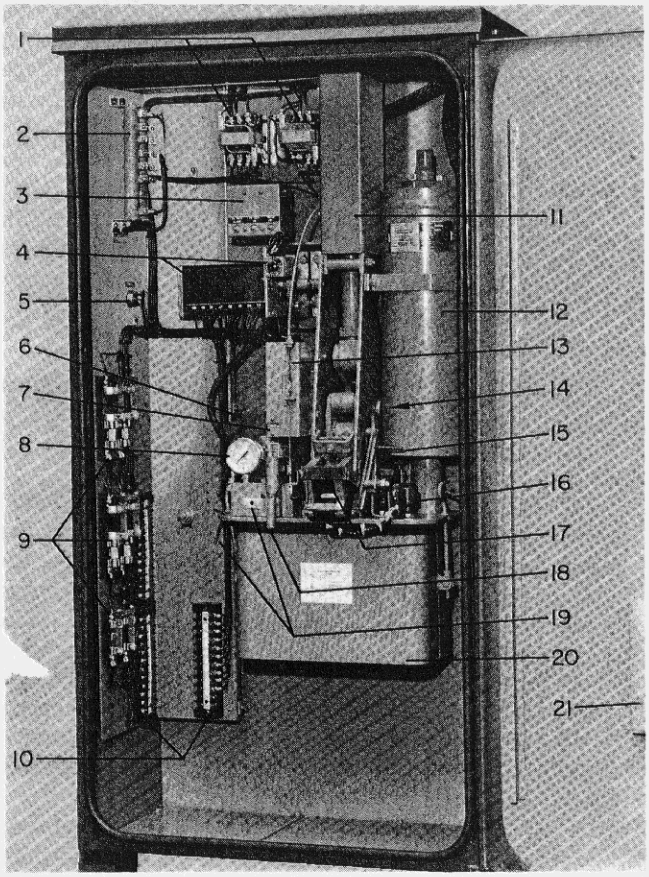
When the sump tank is filled and in place, and after related preliminary work has been done, the breaker mechanism should be slow-closed and slow-opened several times to purge the hydraulic system of air. This may be done when the breaker is checked. It is advisable to make a final check of fluid level.

4. Precharge Pressure

The precharge pressure required in the accumulator, according to section VII, is 1625 psi at 60 F. The precharge pressure registers on the gage the first moment after pumping is started. The gage suddenly jumps to the precharge value and the accumulator piston starts to move. Subse-

quently, the gage moves slowly. Check the value at the point of speed change, as pressure is hand pumped.

CAUTION: Do not pump more than 10 strokes of the hand pump after reaching precharge pressure in the hydraulic system, until the mechanism and the breaker are prepared for mechanical operation as described in related instructions. This is a safety measure to prevent unintentional breaker operation.



1. X and Y control relays
2. Resistors, trip and close
3. Pressure relay
4. 10-stages of a and b, and db auxiliary switch
5. Thermostat for space heaters behind panel
6. Hydraulic pump motor
7. Operation counter
8. Pressure gage
9. Fused switches in control and auxiliary power circuits
10. Terminal blocks for external circuits
11. Breaker pull rod
12. Accumulator, held by clamping band
13. Cable to external tripping handle, right side
14. Hydraulic operator linkage with closing and tripping mechanism
15. Hand closing lever (press to close)
16. Breather for sump tank
17. Hand tripping lever (lift to trip)
18. Lever for hand pump, extension stored on door
19. Maintenance-positioning valve, wrench in storage
20. Sump tank with clamps designed for use as lowering handles
21. Pocket on door for record

FIGURE 2

Type OA-3 mechanism with typical auxiliary devices in weatherproof cabinet. Arrangement is typical for type CF breaker; others are equivalent but equipment is rearranged.

5. Final Preparation

Inspect all relays and remove any blocking that may have been placed in them for shipping purposes.

No preoperational preparation, other than the above, should be necessary. All adjustments, made and checked at the factory, should remain unchanged. The mechanism receives an operational check-out during preparation of the breaker for service. Mechanism operation should be coordinated with breaker check-out requirements.

CAUTION: The breaker should be solidly anchored in final position, before any operation is attempted.

V. DESCRIPTION AND FUNCTION OF PARTS

A Type OA-3 operating mechanism with typical auxiliary facilities in its weatherproof cabinet is shown in Figure 2. Major parts are identified for reference purposes.

Described in this section are the basic operating principles and functions of the mechanism and its auxiliaries. These should be clearly understood before proceeding with any checkout or adjustment of the breaker.

1. General Principles of Operation

The Type OA-3 is a mechanical operating mechanism which is capable of opening and hydraulically reclosing a breaker in 20 cycles. Energy for five closures is stored by compressing nitrogen gas in an accumulator. Opening energy is stored in breaker springs during closure.

By means of a system of valves, a piston and a mechanical linkage, motion is transmitted to close the breaker and store energy in the opening springs. Refer to Figures 3 and 4 to follow the sequence of operation described below.

To close the breaker, the pilot valve is opened by energizing the closing solenoid, or by operating the manual close lever. This releases pressure behind the relay valve. Hydraulic pressure from the accumulator then operates on the face of the relay valve, thus drives it open and allows hydraulic pressure to be applied through the differential control piston to the closing piston. Simultaneously, pressure is applied to the latch valve piston, hydraulically loading the latch. Since the differential control piston has a larger exposed area on the lower end, it is forced up, sealing off the exhaust ports.

At the end of a closing operation, the main piston completes its upward stroke, and either de-energization of the closing solenoid, or release of the manual trip lever causes the pilot valve to reset, followed by the relay valve. Resetting is delayed approximately 15 cycles to permit positive hydraulic action, when closing is hand started. The breaker, under the influence of its opening springs, then settles onto its mechanical latch by driving hydraulic fluid out through the throttling clearance of the latch valve. The breaker is trip-free during this action.

If the latch is released at any time during the closing stroke (a trip-free operation), the latch valve piston is driven upward. This opens the latch valve, and allows the pressure in the control duct to exhaust to the sump. Pressure above the differential control piston now drives it downward, sealing off the high-pressure hydraulic supply, and opening the exhaust ports. The breaker then is free to trip under the influence of the opening springs.

An auxiliary hydraulic circuit, Figure 6, permits slow admission of hydraulic fluid into the main cylinder for maintenance slow closing. The breaker drifts open due to leakage when the valve is closed.

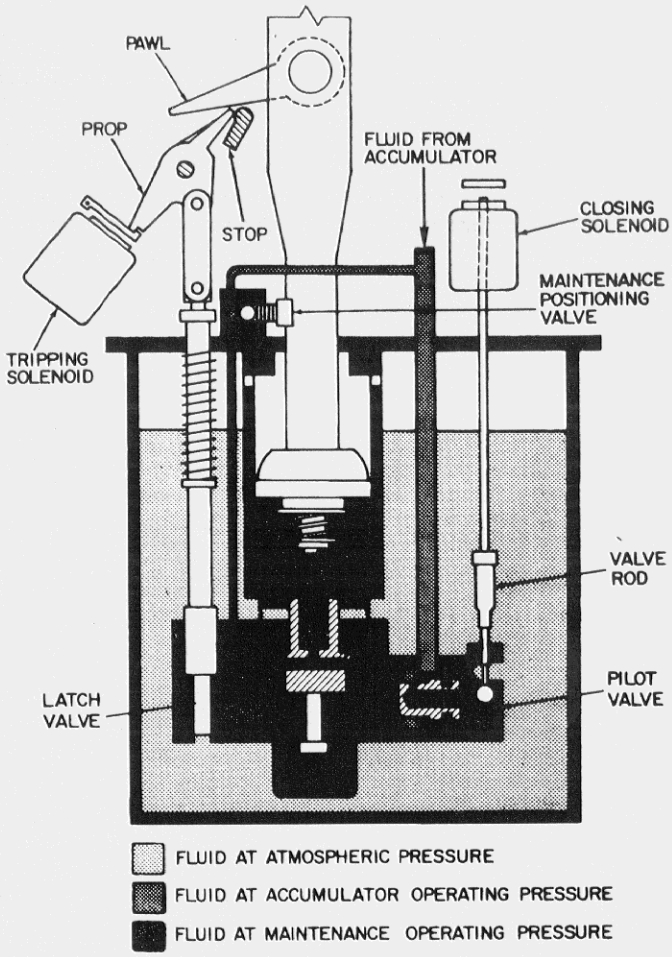


FIGURE 6

Schematic showing mechanism slowly closing, using maintenance-positioning system.

out is complete, its contacts close and stay closed until the breaker is closed, either by electrical or manual means. The device is then reset mechanically. It does not affect the closing time when the breaker is manually closed, nor does it reduce a longer time value set on another relay.

Supplementary instructions may be needed and are furnished for special control or relaying devices. The variety of available devices is too great for coverage by these general instructions.

VI. OPERATION AND SAFETY BLOCKING

During normal service, all control operations described in section V are performed electrically. These may be initiated manually or by relays. That is, a solenoid is energized to operate the pilot valve that admits fluid under pressure for closing, and a solenoid releases the mechanism and latch valve to permit tripping. These solenoids are actuated according to the particular control scheme.

For servicing the breaker, the mechanism can be opened or closed manually at normal or slow speeds. It can be blocked against unintentional operation.

1. Safety Precautions

As previously stated, it is extremely important that procedures for manual operation and safety blocking are clearly understood and carefully followed. The speed and power of a breaker mechanism make careful work habits essential, to prevent equipment damage and for personal protection.

(1) Electrical closing and tripping circuits should be opened, before any manual operations are performed, or work is done on the breaker.

(2) The tripping pin is removed, as described in VI-5, to prevent accidental tripping from such causes as bumping the tripping lever.

(3) While working around moving parts of the mechanism or the breaker, the mechanism should be mechanically blocked open or closed, as described later in this section.

(4) The accumulator must be drained before any work is done on the hydraulic system. Draining the system is a good precaution when any work is done with the breaker open.

Open the pump supply circuit. Next, open the maintenance-positioning valve slightly, but not sufficiently to move the breaker. The fluid will bleed out past the latch valve. Lifting the latch valve to the position shown in Figure 4 will speed fluid release. This can be done with a screwdriver, while the prop is unlatched. As previously stated, it takes only about one minute for the pump to restore closing pressure, when desired.

2. Normal-speed Operation

Manual closing and tripping levers are identified by items 8 and 3 of Figure 7. With adequate pressure (1825 psi minimum) in the hydraulic system, these devices will initiate and complete full-speed operation of the breaker.

If power is not available for the motor-driven pump to provide necessary pressure for full-speed closing, the hand pump may be used. As stated previously, when starting from zero, approximately five minutes of pumping with full strokes is required to obtain minimum operating pressure. Stored energy in breaker springs is always adequate for opening.

When the breaker is operated electrically, an attempted closure with less than minimum required pressure is blocked by the low pressure switch. Since this switch is not effective when hand operating the pilot valve, it is necessary to check gage pressure.

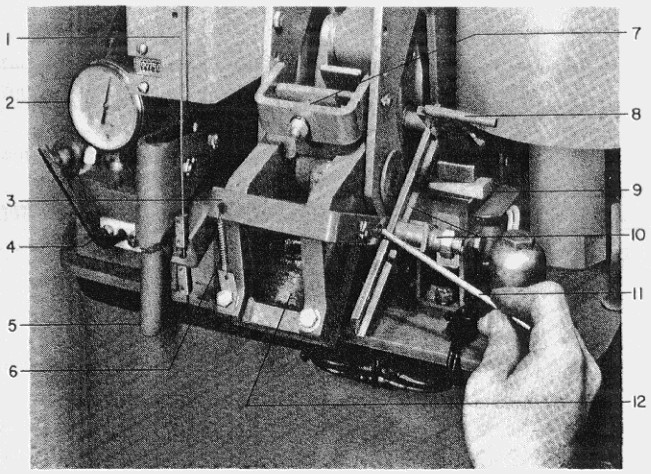
CAUTION: Fast operations, without oil in the breaker tank, are restricted. Therefore, the mechanism should not be fast operated, except in compliance with breaker instructions.

3. Slow-speed Positioning

The breaker may be moved slowly, and held at any point with maintenance-positioning valve 19, Figure 2, also identified in the schematic drawing of the system, Figure 6. Such an operation is performed with closing pressure in the hydraulic system. The hex-socket wrench that fits maintenance-positioning valve, as shown at 4, Figure 7, is used for slow operation of the breaker.

Slight opening of the maintenance-positioning valve will cause the breaker to slowly move toward closed position. Fluid introduced through the valve will, at the same time, bleed out of the system past the latch valve. Therefore, the breaker will drift open if the maintenance-positioning valve is closed. The breaker can be held at any desired position or degree of closure by finding a balance point between the rate of fluid being valved into and bleeding out of the system.

CAUTION: If trip pin 11, Figure 7, is not removed, the breaker will trip at high speed, if it is moved to closed position and then is allowed to begin drifting open. This is because trip-free sliding link 10 will actuate the latch.



1. Cable to external tripping pull handle
2. Pressure gage
3. Tripping lever (raise to trip breaker)
4. Maintenance-positioning wrench inserted to operate valve
5. Hand pump lever (extension handle removed)
6. Bias spring on trip lever
7. Latch frame adjustment
8. Closing lever (lower to close breaker)
9. Hardwood wedge to block closing, inserted between armature and core of closing solenoid
10. Trip-free sliding link and friction ball assembly
11. Tripping pin being removed from tripping lever (pin pointing at hole)
12. Tripping solenoid

FIGURE 7

Mechanism in the open position with closing solenoid blocked and with tripping pin being removed.

4. Blocking In Open Position

The circuit to the closing solenoid should first be opened, to block closing. Operation of the pilot valve, which admits fluid to the system for fast closing, is positively blocked by raising the closing lever and inserting a hardwood wedge 9, Figure 7, between the armature and the core of the closing solenoid. This prevents manual operation by the closing lever, as well as backup assurance that the breaker cannot be closed electrically.

This blocking will prevent only fast operation. The breaker can still be slow-closed by means of the maintenance-positioning valve.

Complete blocking requires that the hydraulic system be drained. The system must be drained, as discussed in VI-1, if the work planned would otherwise endanger personnel.

5. Blocking In Closed Position

For such checks as contact-penetration measurements, it is necessary to come in close proximity to the breaker moving contacts. Safe practice for such purposes requires that the mechanism be positively blocked closed.

The circuit to the tripping solenoid must be opened. Also, tripping pin 11, Figure 7, is removed. Removal of this pin, which is held in place with cotter pins, prevents accidental tripping by moving the trip lever.

A further precaution which should be taken is the insertion of a mechanism blocking rod, as shown in Figure 8. The ⅞-inch diameter steel rod used to block the breaker for shipment is suitable for this purpose. The mechanism is placed in the latched-closed position to insert the rod.

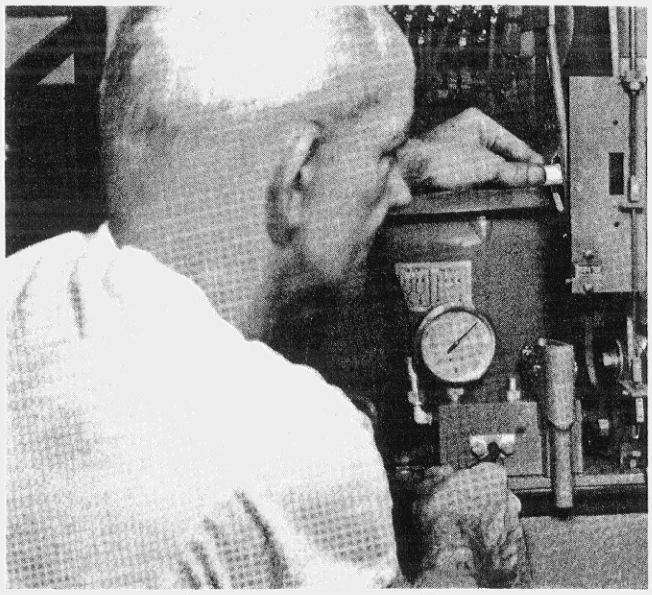


FIGURE 8

Rod being inserted in mechanism to block breaker closed.

CAUTION: Should the mechanism in some way be tripped with the rod in position, breaker contact parts will drop instantly approximately 1¼ inches, before being stopped by the rod. The mechanism would then have to be slow-closed to remove the blocking rod.

When it is desired to slow-open a mechanism that is latched closed, it is necessary to lift and hold the pawl off of the prop, until it lowers past the point of engagement, as follows: In latched position, the pawl, Figure 6, is held under pressure against the prop. Also, it is spring-held to the stop. After freeing the pawl by fully closing the breaker with the maintenance-positioning valve, pry it clear of the prop with a screwdriver inserted behind the pawl. While the pawl is held in this position, slow-open the mechanism by partially closing the maintenance valve. The pawl will, as the mechanism opens, assume the position shown in Figure 6.

VII. REFERENCE DATA AND ADJUSTMENTS

Data on precharge gas pressure, on fluid level, and on mechanism adjustments is included in this section. This reference information is pertinent to sections IV INSTALLATION and VIII MAINTENANCE.

Mechanical adjustments required for the operating mechanism are rare, and no change of adjustment should be made unless operating symptoms indicate maladjustment. However, it is recommended that simple adjustment checks be made to ensure that the original adjustments have not slipped or changed because of wear. These checks should be made at the time of installation and at times of periodic maintenance. Adjustments not described in this manual should be left alone, unless advice is secured from the factory.

CAUTION: Carefully follow safety precautions described throughout mechanism and breaker instructions. Most important instructions will be found in section VI on operation and safety blocking.

1. Accumulator Precharge

Construction of the hydraulic accumulator is illustrated by Figure 9. The piston is shown in the approximate position

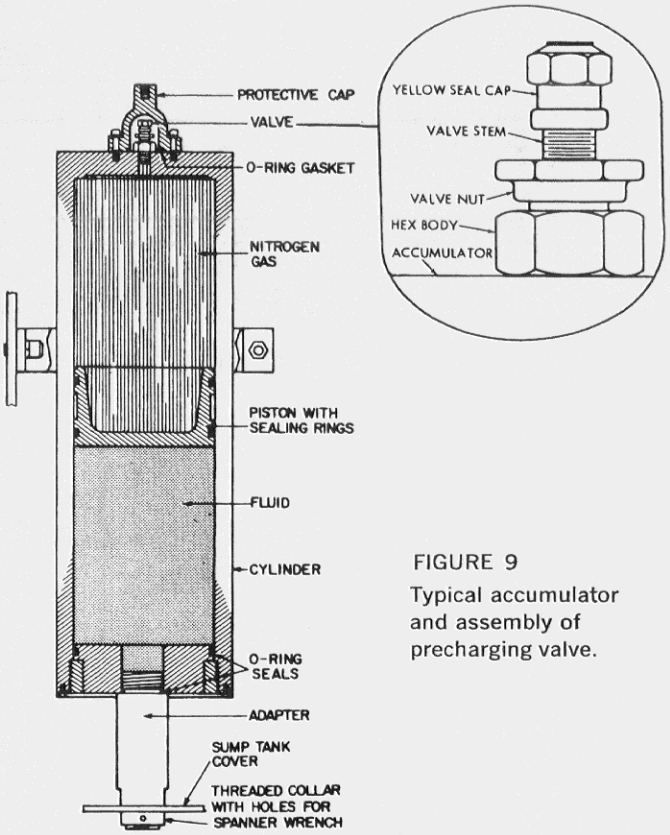


FIGURE 9
Typical accumulator and assembly of precharging valve.

of full fluid pressure. At zero fluid pressure, it would rest on the bottom of the cylinder, with the precharge pressure of dry nitrogen above.

Operating pressures are discussed in VII-3 on pressure-switch settings. For proper operation, the accumulator precharge pressure has been established as 1625 ±25 psi at 60 F. Precharge pressure is checked and adjusted with specified nitrogen gas, as described below.

(1) Precharge Pressure Measurement

To check the precharge pressure, the breaker is taken out of service and left open, the pump circuit is opened and the fluid is exhausted from the system by slightly opening the maintenance-positioning valve, as described in VI-1-(4). Tape the bulb of a thermometer to the accumulator tank, at about the vertical midpoint.

With zero fluid pressure, and maintenance-positioning valve closed, operate the hand pump. The gage at first will show marked increase in fluid pressure with each stroke. When rapid pressure increases suddenly stop, the gage reading is the precharge pressure. The reason for this is that the lift-off pressure of the floating piston in the accumulator has been exceeded, and slow filling of the accumulator with fluid is taking place, thus further compressing the gas.

At the break point in pressure change, the pressure should be 1625 ±25 psi, adjusted for temperatures according to the chart, Figure 10.

(2) Precharge Pressure Adjustment

If precharge gage pressure, corrected for temperature, is not within 25 psi, it must be adjusted. A tolerance above nominal is preferred. Instructions refer to Figure 7.

(a) Remove the cover cap from the accumulator valve. Care must be taken not to damage the o-ring gasket.

(b) Remove the yellow sealing cap from the valve.

(c) Connect a nitrogen gas supply provided with gage and control device.

(d) Turn the valve nut counterclockwise (2½ turns maximum) until the valve stem moves downward and opens the valve.

(e) Use the gas control device to add or release nitrogen until the desired pressure is established.

(f) Turn the valve nut clockwise until the valve stem rises and the valve reseats. Tighten the valve nut securely, but not excessively tight.

(g) After removing the gage and gas control device, place a drop of light oil on the valve stem.

(h) Tighten the yellow seal cap one-half turn beyond hand tight. Replace the accumulator valve cap.

NOTE: While nitrogen charging equipment is in place, its pressure gage may be used to check the pressure gage for the hydraulic system. The difference in gage readings should not exceed 25 psi.

(3) Nitrogen Gas Specifications

Use only nitrogen gas meeting these specifications:

Minimum purity	99.9%
Maximum oxygen	0.1%
Maximum hydrogen	0.0%
Maximum moisture	0.0012%

2. Hydraulic Fluid

Fluid (special oil) in the hydraulic system should not need replacement, unless it has been contaminated. The level

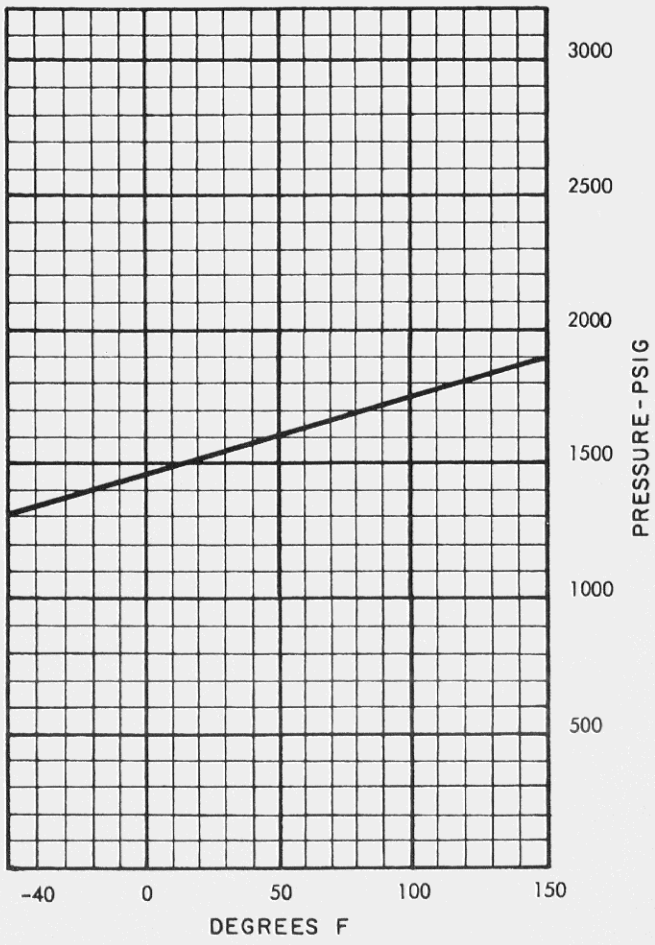


FIGURE 10
Precharge pressure variation with temperature.

is checked against markings inside the sump tank, identified as item 20, Figure 2.

(1) One check is made by carefully lowering the sump tank with pressure up to normal cutoff value. First, block closing per VI-5. Lower the tank. Clamping screws are designed to serve as lowering handles.

Allow sufficient time for drip-off of the mechanism. The level should be within ± ¼ inch of the line marked ACCUMULATOR CHARGED. Too low a level may indicate leakage of gas from the accumulator.

(2) A second check is made with the hydraulic system discharged. The sump tank must be in place to start this check. Open the pump motor circuit, discharge the system VI-1-(4), then lower the tank.

Allow several minutes for the system to drain. The level should be within ± ¼ inch of the line marked ACCUMULATOR EMPTY.

Add fluid specified below if the level is below the tolerable values. If the level is as much as ¾ inch below the mark, leakage of lines outside the tank is indicated. Temperature will not significantly change the level.

NOTE: A minute trace of red (the fluid color) around a fitting does not necessarily constitute a leak. If leaking when under pressure, fluid will be sufficient to wet the finger.

(3) Hydraulic Fluid Specifications

A hydraulic fluid other than the following should not be used, without Pennsylvania approval.

Shell Oil Company—Aeroshell Fluid No. 4
Standard Oil Company of California—RPM Aviation Hydraulic Oil No. 2
Texaco, Incorporated—Texaco Aircraft AA Hydraulic Oil
Humble Oil and Refining Co., Esso Div.—Univis J-43

3. Pressure Switches

The 3-circuit pressure-operated relay 3, Figure 2, consists of a common, nonadjustable, pressure element and three microswitches. Settings are adjusted by positioning the switches. The switches are identified as the *pump-motor control* (for opening the motor supply circuit), the *low-pressure cutout* (for opening the closing-coil circuit when pressure is excessively low), and the *low-pressure alarm* (for closing an external alarm circuit). The alarm contacts have a noninductive d-c rating of 10 amps at 125 v or 3 amps at 250 v, and an a-c rating of ¼ hp at 125 v. The pump motor control and low-pressure cutout switches are rated for their specific applications.

Each pressure switch has a front-accessible screw with locknut, that is turned clockwise for decreasing the operating pressure. Pressure differential, close to open, is nonadjustable. Operating adjustments are checked as follows:

(1) Motor Control Setting

Open the motor supply circuit; lower the pressure about 500 psig by slightly opening the maintenance-positioning valve; reclose the motor circuit and allow the pumping to continue until pressure-switch opening.

Refer to the oil circuit breaker mechanism nameplate for cutoff pressure. It is preferable that settings be on the high side, and that a pressure switch be reset if it operates near the low limit, since the operating point is most likely to change downward.

(2) Low-pressure Cutout Setting

Connect a voltmeter or indicating lights to terminals of the low-pressure cutout switch, as determined by reference to the specific wiring diagram. Bleed pressure, by slightly opening the maintenance-positioning valve, until the cutout switch operates.

Refer to the oil circuit breaker mechanism nameplate for pressure at which the cutout switch should open. A setting on the high side is preferable.

(3) Alarm Circuit Setting

Proceed as with the low-pressure cutout switch. The circuit-closing valve is 1850 ±50 psig. The value is arbitrary, and may be changed as required.

(4) Differential Operating Limits

As stated, there is no adjustment of operating differential, which is the psig difference from the setting when reversing the directions of the above pressure changes. The rated differential is shown on the pressure-switch nameplate, but the outside acceptable limit is considered to be 400 psig. Pressure switches should not be field repaired. See section VIII-2 and VIII-3 for replacement.

4. Over-pressure Relief Valve

The pressure-relief valve is a capsule unit placed in the valve-and-pump block, Figure 11. It is sealed at the bottom with an o-ring gasket, and is held in place with a screw and lock nut. It is necessary to withdraw the valve to adjust the screw, since its casing will otherwise turn when turning the screw. Tightening the screw increases the operating pressure.

Refer to the oil circuit breaker mechanism nameplate for pressure at which the relief valve should open. For a check, it is necessary to bypass the motor cutoff switch by running a temporary supply directly to the pump motor. See the wiring diagram. Allow the pump to run until steady state pressure is reached, i.e., when valve bleedoff and pump input balance.

5. Pilot Valve Rod

When the closing solenoid, Figures 3 and 4, is energized, the armature, which has a return spring, is moved through most of its stroke, before it strikes the pilot valve rod with a hammer blow, thus actuating the valve ball. The remainder of the motion opens the valve approximately 1/16 inch. The considerable added force normally required for this last

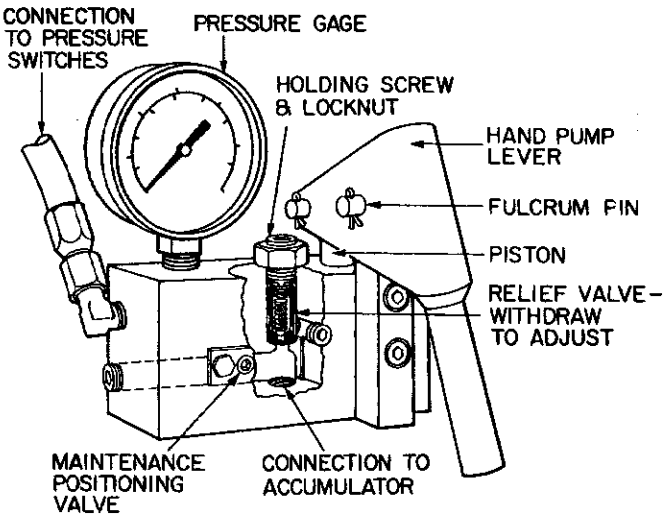


FIGURE 11

Valve and pump block, showing details of relief valve.

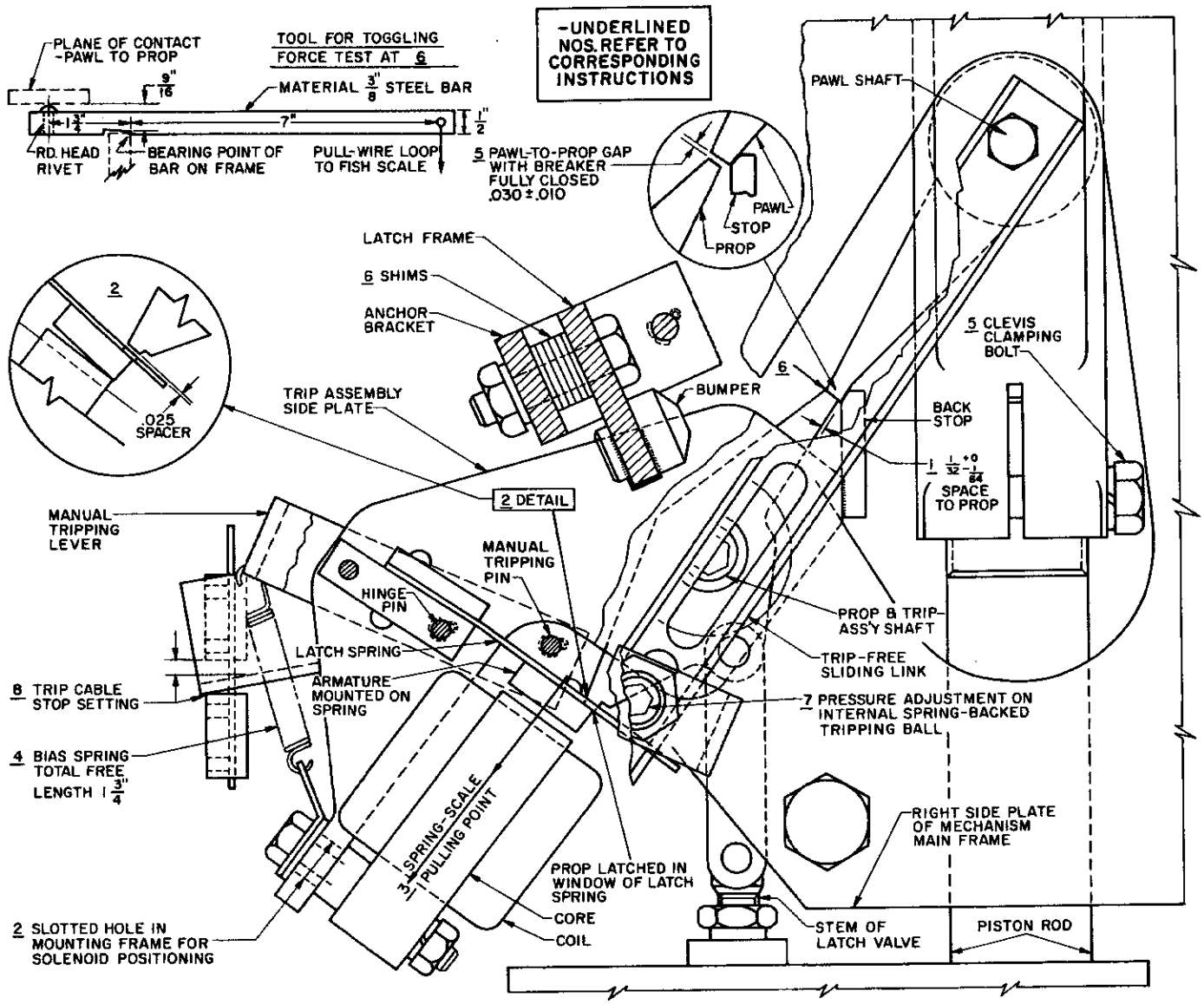


FIGURE 12

Latching mechanism checks and adjustments. Underlined item numbers refer to corresponding paragraphs of instructions.

portion of the motion must overcome both the valve ball return spring and the hydraulic pressure. Valve-spring pressure alone is small, but enough to feel as the closing lever is hand actuated.

Valve rod length is adjusted at 8, Figure 5, requiring lowering of the sump tank. Depress the closing lever to a point where the valve rod starts to move the valve ball. Mark the point on the side of the armature, using a scribe. Depress the lever to the limit and again mark the armature position. There should be approximately 1/16 inch between lines. Retighten the adjustment lock nut, before making a final check.

The closing solenoid should operate the pilot valve under full system pressure, applying a following minimum voltage:

Nominal	Minimum
48 v d-c	36 v d-c
125 v d-c	90 v d-c
250 v d-c	180 v d-c

Should the operation at minimum voltage not be positive, the above value (1/16 inch) for valve movement may be on the high side, necessitating a recheck and reduction.

6. Latching Mechanism

Instructions for checking and adjusting the latching and tripping mechanism refer to parts of Figure 12. *The following underlined paragraph numbers correspond to item reference numbers of the figure.*

1 Prop-To-Stop Clearance

Clearance between the prop and its back stop should be 1/32 inch, when the latch is pushed tight against the spring. Clearance limits may be checked by using a .030-inch feeler as a "no-go" gage, and a .015-inch feeler as a "go" gage. Clearance is originally adjusted by filing the stop, and should not require change. Note that the pawl normally is held against the stop by spring pressure.

2 Prop-To-Latch Gap

The solenoid core is positioned by means of slots in its

mounting frame. The core is set parallel to the armature, when the prop latch is in the latch-spring window. The latch recesses as far as the armature.

Spacing from the prop to the latch spring, with the spring depressed and the armature touching the core, as shown in the detail, is set with a spacer to .025 inch.

3 Unloaded-Latch Pulling Effort

When the latch is unloaded, that is when the mechanism is in overtravel position and the pawl is off the prop, the effort required to trip the latch is 8 to 12 lbs.

Pull may be measured with a wire loop placed centrally over the armature (back of the rivets) as shown, then using a spring scale. The solenoid is removed for this check. Adjustment is made by bending the spring. After making an adjustment, the spring should be backbent slightly to relieve internal stresses and stabilize the adjustment. Recheck the adjustment.

4 Bias Spring

The bias spring will have the proper low tension when the *free length* measures 1¾ inches between bearing points of terminal loops.

5 Pawl-To-Prop Gap

To assure that the pawl and prop will properly engage and latch the breaker in the closed position, the clearance between the pawl and prop, when the breaker is at the fully closed position, must be .030 ±.010 inch.

Adjust the clearance by removing the pin through the clevis, loosening the clamping bolt, and screwing the piston rod in or out. A quarter turn changes the gap .026 inch. The joint is pinned at the factory, and normally needs no adjustment.

6 Loaded-Latch Moving Effort

With above adjustments made, check for the 105 ±10 lbs effort required to move the latch and pawl through toggle under loaded (breaker closed) condition. An adjustment change according to the following instructions will require a recheck of above adjustments 2 and 5.

The pawl normally rests against the stop, due to spring pressure. (The prop is clear of the stop.) For this check, it is necessary to have a clearance from pawl to stop. Clearance is obtained by moving the mechanism to overtravel position, inserting behind the pawl a shim of 1/32 inch, lowering the pawl back on its prop, then removing the shim.

Measurement is made with a tool such as illustrated in the detail on Figure 12. It is used as a lever with its fulcrum on the right side plate of the mechanism frame, to find the pressure needed to force the prop and pawl through toggle. Insert the tool through the opening in the side plate, position the tool so that bearing points are as indicated in the sketch, then hook a fish scale in the wire loop and pull until the pawl and prop toggle. Note that the dimensions of the tool result in a 4-to-1 mechanical advantage and spring scale multiplier.

Effort is changed by adjusting the number of shims 6 under the latch frame anchor bracket. This changes the displacement of the contact point with respect to a line through centers of the pawl and prop bearings. Removing shims will shift the bearing center of the prop and thus increase latch load and moving effort.

With moving effort thus adjusted, tripping effort, measured by the method described under item 3 should be 18 to 30 lbs.

The mechanism should trip under loaded-latch condition with a minimum voltage applied to the trip coil, as follows:

Nominal	Minimum
48 v d-c	28 v d-c
125 v d-c	70 v d-c
250 v d-c	140 v d-c

To operate positively at minimum voltage, the unloaded latch pulling effort, item 3 above, may have to be adjusted to the minimum 8-lb value.

7 Ball-Trip Pressure

Trip-free action depends on the proper setting of spring pressure on the drag ball at the coupling point between the manual trip lever and the sliding link. The ball causes drag only when not in the slots of the sliding link.

Turn the set screw out until the internal spring is fully relaxed, then tighten by ¼-turn increments until the breaker is trip free. Further compress by ½ turn and tighten the lock nut.

This trip-free setting is checked by slow-closing the breaker until the ball moves into the short slot, or is on the bridge, then allowing the breaker to start drifting open. The latch should release and the breaker should fast-open.

8 Trip-Cable Stops

The top stop collar on the manual trip cable is set ⅛ inch above the arm on the trip lever, while the trip lever is raised and the manual trip pin is resting lightly on the latch spring. With the trip lever released and down, the lower stop collar is set so it just touches the arm on the trip lever.

When the mechanism is equipped with a 169 switch, a stop collar (not shown on the drawing) must be set to actuate the switch before the latch is released by the manual trip lever.

VIII. MAINTENANCE AND SPARE PARTS

It is recommended that the mechanism receive routine maintenance coordinated with breaker maintenance, or as service conditions warrant. Detailed records will provide a guide to local requirements. A complete overhaul each five years is recommended.

Refer to section VII for general data and instructions on adjustments. Also, refer to other instructions and drawings furnished on the mechanism and breaker.

A small stock of maintenance parts is recommended. Later instructions herein describe procedures for replacement of certain parts. Special instructions can be secured from the factory, if needed.

CAUTION: Carefully follow safety precautions described throughout mechanism and breaker instructions. Most important instructions will be found in section VI on operation and safety blocking.

1. Routine Maintenance

Seldom is there need to lower the sump tank or dismantle any part of the mechanism during routine servicing. Periodic maintenance primarily consists of a general cleanup, checks for leaks and simple checks of adjustments.

It is advisable to make general checks on the condition of the pressure system (gas and fluid) more frequently than at overall maintenance periods. Checks without removal from service are outlined below.

Item Description	Specification Part Number	Quantity per Installation
Opening coil, with resistor—		1 each
48-v d-c	Coil: FA-10403 and Resistor: E-30332	
125-v d-c	Coil: FA-10403 and Resistor: E-30332	
250-v d-c	Coil: FA-10403 and Resistor: E-30473-E	
Closing coil—		1 each
48-v d-c	Coil: FA-11179 and Resistor: E-30332	
125-v d-c	Coil: FA-11179 and Resistor: E-30332	
250-v d-c	Coil: FA-11179 and Resistor: E-30473-E	
X or Y relay coil—	Refer to the oil circuit breaker order.	1 each relay
Pressure switch, 3-unit assembly	FC-10298	1 each
Pressure line, valve block to pressure switches	FA-3381-E	1 each

MEMORANDUMS

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