APPARATUS DEPARTMENT

CANADIAN GENERAL ELECTRIC COMPANY LIMITED

PETERBOROUGH—ONTARIO

750 (1/65) P&SS

BELL SUB

1171B

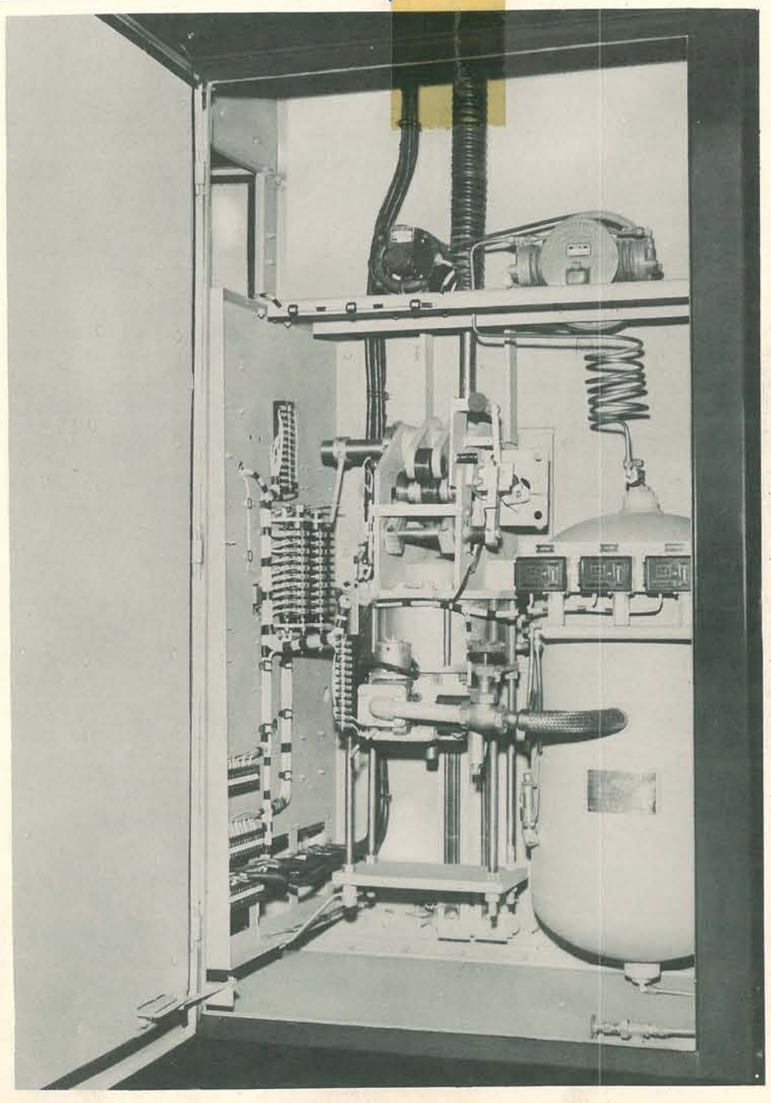
INSTRUCTIONS 371-03 MAP - 15 AND 15A [redacted]

PNEUMATIC OPERATING MECHANISM

FOR POWER CIRCUIT BREAKERS

TYPE KSO AND KLO

PLS. RETURN TO SHOP FILES



CANADIAN GENERAL ELECTRIC COMPANY LIMITED

CONTENTS

OUTLINES AND DIAGRAMS

PNEUMATIC OPERATING MECHANISM

TYPES MAP-15, MAP-15A

INTRODUCTION

The MAP type mechanism is a pneumatically operated mechanism for outdoor oil circuit breakers. The MAP-15 and 15A are used on floor mounted breakers type KSO rated 115 KV, 138 KV and 161 KV. The MAP-15A is also used on floor mounted breakers type KLO rated 230 KV.

MAP-15A is designed for high speed operation during the circuit breaker interruption of faults and high speed reclosing, its characteristic being the result of a simple rugged linkage design having low friction bearings.

The MAP mechanism is pneumatically trip-free and with its control equipment is electrically trip free and non pumping when closed on short circuits.

The mechanism and associated air operating equipment is enclosed in a weatherproof housing designed for mounting at the front of the breaker framework. DC voltage is required for the control circuit and batteries are recommended for this source. A-C voltage is recommended for the compressor motor and required for the heater circuits.

Since the control circuit requires very low operating currents, the necessity for large storage batteries or rectifiers used with solenoid mechanism is eliminated. The mechanism and accessories will operate at the standard CSA voltage ratings.

Proper Installation and Maintenance are Necessary for Continued Satisfactory Operation. The following instructions will provide information for placing the mechanism and breaker in service and for the necessary maintenance. It should be kept in mind that the illustrations shown in this instruction book are for illustrative purposes and may not always be an actual picture of the equipment being furnished. For final information always refer to the drawings that are furnished separately with the equipment. For additional instructions on the circuit breaker, refer to the Breaker Instruction Book.

RECEIVING HANDLING & STORAGE

Each mechanism is carefully inspected and packed by workmen experienced in the proper handling and packing of electrical equipment. Immediately upon receipt of a mechanism an examination should be made for any damage sustained during shipment. If injury or rough handling is evident, a damage claim should be filed at once with the transportation company and the manufacturer notified promptly.

Remove the crating or boxing carefully and check all parts against the packing list to make certain that no parts have been overlooked while unpacking. Always search the packing material for hardware that may have loosened in transit.

If the mechanism cannot be installed in the proper location immediately and it is necessary to store the equipment, it should be kept in a clean dry place protected from mechanical injury. Machined parts should be heavily coated with grease to prevent rusting and if stored for any length of time, periodic inspection should be made to see that corrosion has not taken place and to insure good mechanical condition. If possible, the space heater should be energized to prevent moisture condensation inside the mechanism housing. The control valve and compressor heaters must be disconnected during this time.

DESCRIPTION

The type MAP pneumatic operator consists of an air cylinder and piston with the associated mechanism and control equipment. The unit is designed to operate outdoor oil circuit breakers with provision for closing opening, trip free and reclosing operations. The MAP mechanism is built in two basic forms, the MAP-15 and 15A. The MAP-15A has a magnetic latch which gives a faster opening time, and it also has an auxiliary valve to return the mechanism operating piston for high speed reclosing. In other respects the two forms are identical in operation.

Control voltage and pressure ranges are given on the nameplate. The compressor motor operating voltage is either AC or DC.

INSTALLATION

During the installation of the mechanism it is necessary to make reference to the Instruction Book for the oil circuit breaker that it operates.

The mechanism and housing are shipped attached directly to the supporting framework or tank of the oil circuit breaker. The mechanism is installed and properly adjusted when received. The trip latches are wired during shipment and the fastenings should be removed after the breaker has been set in position. Shipping braces on the compressor motor should also be removed.

CAUTION: This mechanism is designed only for electrical closing when in use. ***NEVER ATTEMPT MANUAL CLOSING WITH THE BREAKER IN SERVICE,*** for under such conditions, sufficient closing force and speed cannot be applied.

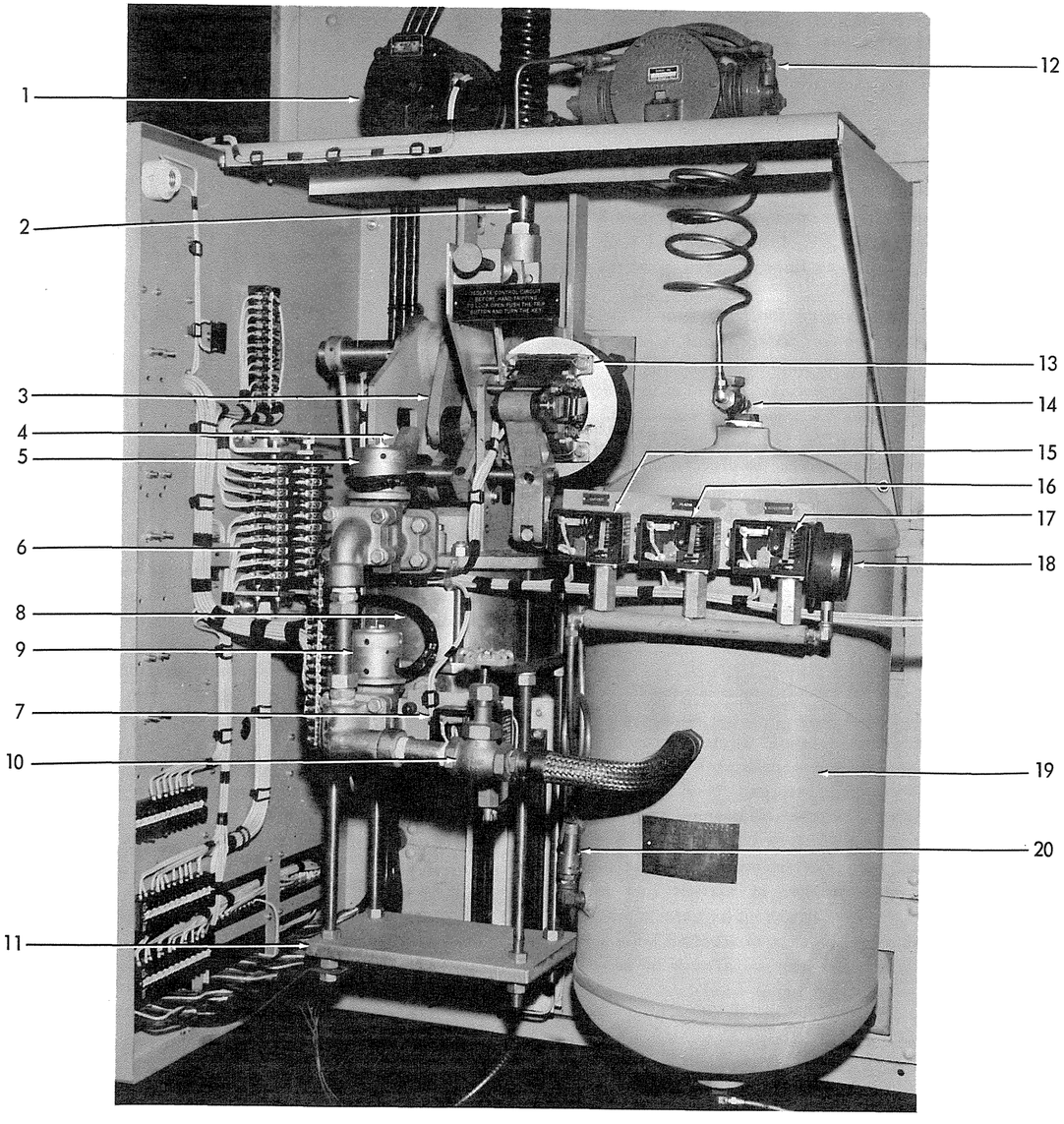


FIG. 1
MAP MECHANISM

1. Motor
2. Breaker Operating Rod
3. Main Output Crank
4. Latches
5. Auxiliary Control Valve
6. Auxiliary Switches
7. Pressure Transfer Switch
8. Operating Cylinder
9. Main Control Valve
10. Air Supply Valve
11. Jack Support
12. Compressor
13. Magnetic Trip Latch
14. Check Valve
15. Pressure Cut Off Switch
16. Pressure Alarm Switch
17. Pressure Governor Switch
18. Air Gauge
19. Air Receiver
20. Safety Valve

MOUNTING

If the mechanism and housing is shipped separately, or the unit has been removed from the breaker for shipment then it is necessary to fasten the mechanism and housing in position.

The breaker tank or framework to which the operating mechanism is to be mounted should first be plumb. This procedure is described in the Breaker Instruction Book. The mounting bolt holes in the mechanism housing and on the breaker framework or tank should be aligned after which the bolts can be installed and the housing bolted up tightly. The operating rod between the mechanism output crank and the breaker bell crank should be installed. The length of the operating rod can be adjusted by means of couplings on the ends to obtain breaker adjustment as described in the Breaker Instruction Book.

CONNECTIONS

After the mechanism has been mounted electrical connections can be made. Before proceeding, precautions should be taken to insure that all leads to be connected to the mechanism are de-energized.

All control wires should be run in conduit wherever it is practicable. Control wires must be run separately and remote from high tension leads and not in the same duct or parallel to high tension leads, unless distance separating the two sets of wiring is sufficient to prevent possible communicating between them as a result of short circuits.

Control wiring of adequate size should be used so that with operating current flowing to the operating mechanism the voltage across the terminals of the mechanism will be within the limits specified as standard for the range of control voltage.

Use the proper connection diagram for each individual job for testing and making connections. The mechanism is wired completely at the factory to terminal boards mounted on the control panel in the mechanism house. Incoming conduits can be terminated in a removable plate in the housing floor directly under the terminal boards. This plate can be drilled to suit any conduit requirements. It is recommended that all conduits entering the mechanism housing be sealed off at their entrance to the housing.

ADJUSTMENTS

Although the mechanism has been adjusted and tested at the factory, it is advisable to check all of the following points as well as those listed under FINAL INSPECTION to be sure that no change has occurred during shipment and installation. No adjustments should be altered unless this inspection indicates it is necessary.

Use manual operation for all preliminary inspection. After the mechanism is connected to the breaker, operate it slowly to see that the operation is smooth throughout the closing and opening stroke, that no binding occurs, and that no excessive play is noticeable between parts. Electrical operation should be attempted only after it is certain that all mechanism adjustments are made correctly and that the oil circuit breaker is correctly adjusted according to its instructions.

PIPING

For normal mechanism operation, open fully the air supply valve (10) Fig. 1 between the air receiver and the main control valve (9). The manifold line is connected directly to the air receiver at all times. We thus have the pressure alarm switch (16), the pressure cut-out switch (15), the pressure governor switch (17) and the pressure gauge (18) furnished with a direct line, without valve, to the air receiver. Refer to Figs. 2 and 4 for schematic piping diagrams.

Compressor

The compressor should not require adjustment, but its operation should be checked as described in the section of Maintenance.

Breaker Operating Rod

The length of the operating rod is adjusted to obtain the correct front crank setting as described in the Breaker Instructions. Its length can be adjusted by turning the rod, as it has right and left hand threads at the lower and upper ends respectively.

Take care when assembling an operating rod to see that both ends are engaged in the couplings an equal amount in order to have sufficient length of rod in each coupling. Tighten all the locking bolts securely after adjustments are completed.

Magnetic Trip Latch MAP-15A

The magnetic latch is adjusted so that the pole pieces of the latch holding magnet (3) Fig. 7 obtain a good seat with the trip armature (6). If necessary, shim the magnet in or out. See that the surfaces which come in contact are smooth and free from rust or accumulated particles. The contact surface may be checked by taking an impression between the holding surfaces using tissue paper and carbon paper.

If the mechanism linkage is raised off the latches with the maintenance closing device so that it exerts no back pressure on the magnet, the magnet should require a direct pull of 600 to 800 pounds to release the armature. When the mechanism linkage is pulling against the magnet, a direct force of 300 to 400 pounds should be required to release the armature.

In any checking of the magnet, the absolute criterion, is whether the breaker will trip in the desired length of time and close consistently without latch failures.

MAP–15 MECHANISM

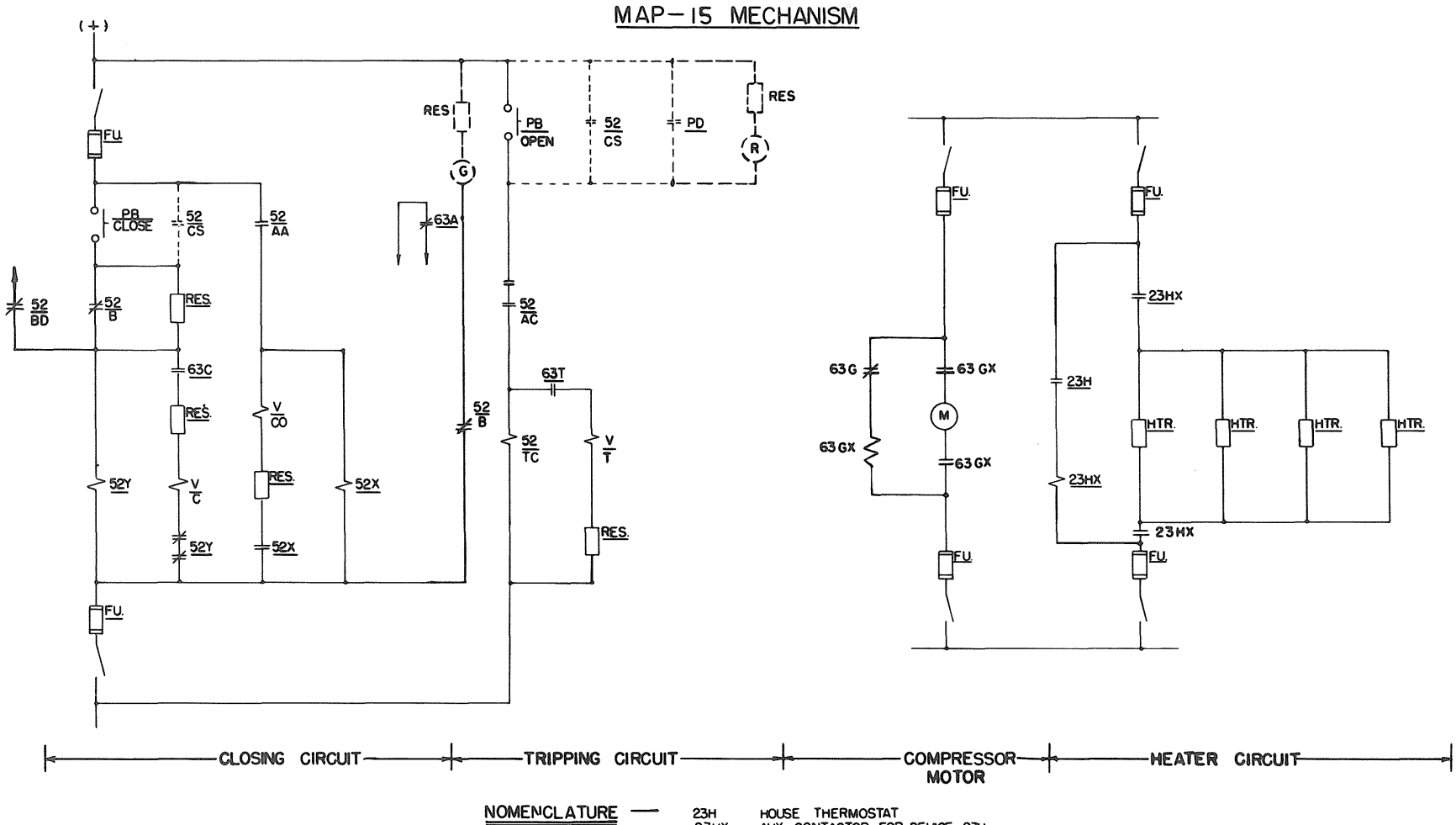


FIGURE 3

NOMENCLATURE —

23H	HOUSE THERMOSTAT
23HX	AUX. CONTACTOR FOR DEVICE 23H
52	AC CIRCUIT BREAKER
52/A	BREAKER AUX. SWITCH– CLOSED WHEN BREAKER CLOSED
52/B	BREAKER AUX. SWITCH– CLOSED WHEN BREAKER OPEN
52/AA	CUT-OFF SW. CLOSES WHEN PISTON IN UPPER POSTION
52/AC	AUX. SW. FOR OIL CIRCUIT BRKR. TRIP CIRCUIT
52/BD	OIL CIRCUIT BREAKER RECLOSING SW.
52/TC	OIL CIRCUIT BREAKER TRIP COIL (SMALL COIL AT FRONT OF HOLDING MAGNET)
52 X	CUT-OFF RELAY
52 Y	ANTI-PUMP RELAY
52 CS.	CONTROL SWITCH FOR DEVICE 52
63 A	PRESSURE ALARM
63 C	PRESSURE CUT-OFF OPENS FOR LOW PRESSURE
63 G	PRESSURE GOVERNOR
V/C	MAIN CONTROL VALVE COIL
V/T	TRIP WINDING VALVE COIL
V/CO	CUT-OFF VALVE COIL
63T	PRESSURE TRANSFER SWITCH
M	AIR COMPRESSOR MOTOR
HTR.	HEATER
RES.	RESISTOR
FU.	FUSE
63GX	AUX. CONTACTOR FOR DEVICE 63 G
PB	PUSHBUTTON
PD	PROTECTIVE DEVICE

MAP–15A MECHANISM

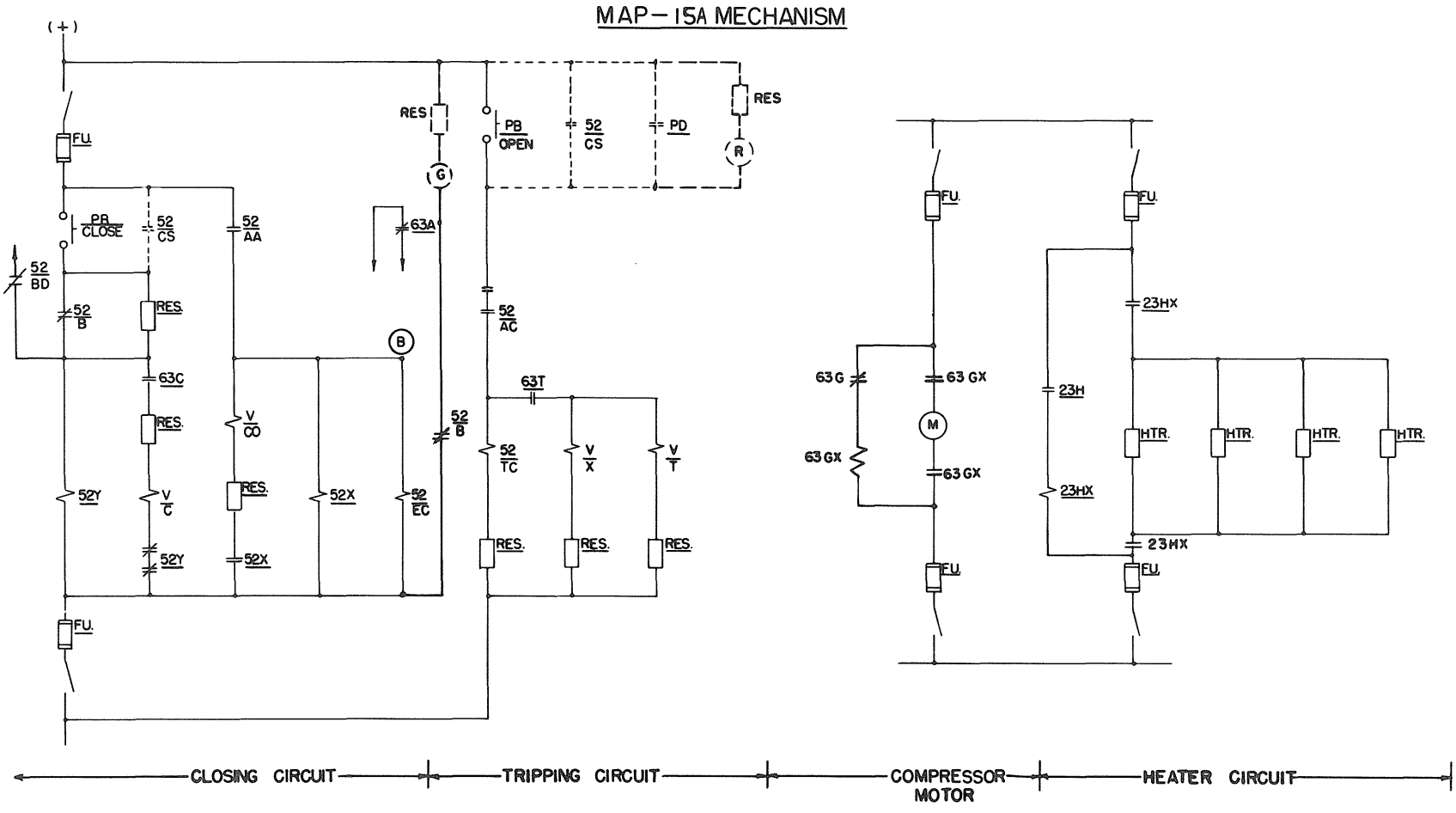


FIGURE 5

NOMENCLATURE —

23H	HOUSE THERMOSTAT
23HX	AUX. CONTACTOR FOR DEVICE 23H
52	AC CIRCUIT BREAKER
52/A	BREAKER AUX. SWITCH– CLOSED WHEN BREAKER CLOSED
52/B	BREAKER AUX. SWITCH– CLOSED WHEN BREAKER OPEN
52/AA	CUT-OFF SW. CLOSES WHEN PISTON IN UPPER POSTION
52/AC	AUX. SW. FOR OIL CIRCUIT BRKR. TRIP CIRCUIT
52/BD	OIL CIRCUIT BREAKER RECLOSING SW.
52/TC	OIL CIRCUIT BREAKER TRIP COIL (SMALL COIL AT FRONT OF HOLDING MAGNET)
52 X	CUT-OFF RELAY
52 Y	ANTI-PUMP RELAY
52 CS.	CONTROL SWITCH FOR DEVICE 52
52/EC	OIL CIRCUIT BREAKER EXCITING COIL (LARGE COIL AT REAR OF HOLDING MAGNET)
63 A	PRESSURE ALARM
63 C	PRESSURE CUT-OFF OPENS FOR LOW PRESSURE
63 G	PRESSURE GOVERNOR
V/C	MAIN CONTROL VALVE COIL
V/T	TRIP WINDING VALVE COIL
V/CO	CUT-OFF VALVE COIL
V/X	AUXILIARY CONTROL VALVE COIL
M	AIR COMPRESSOR MOTOR
HTR.	HEATER
RES.	RESISTOR
FU.	FUSE
63T	PRESSURE TRANSFER SWITCH
63GX	AUX. CONTACTOR FOR DEVICE 63 G
PB	PUSHBUTTON
PD	PROTECTIVE DEVICE

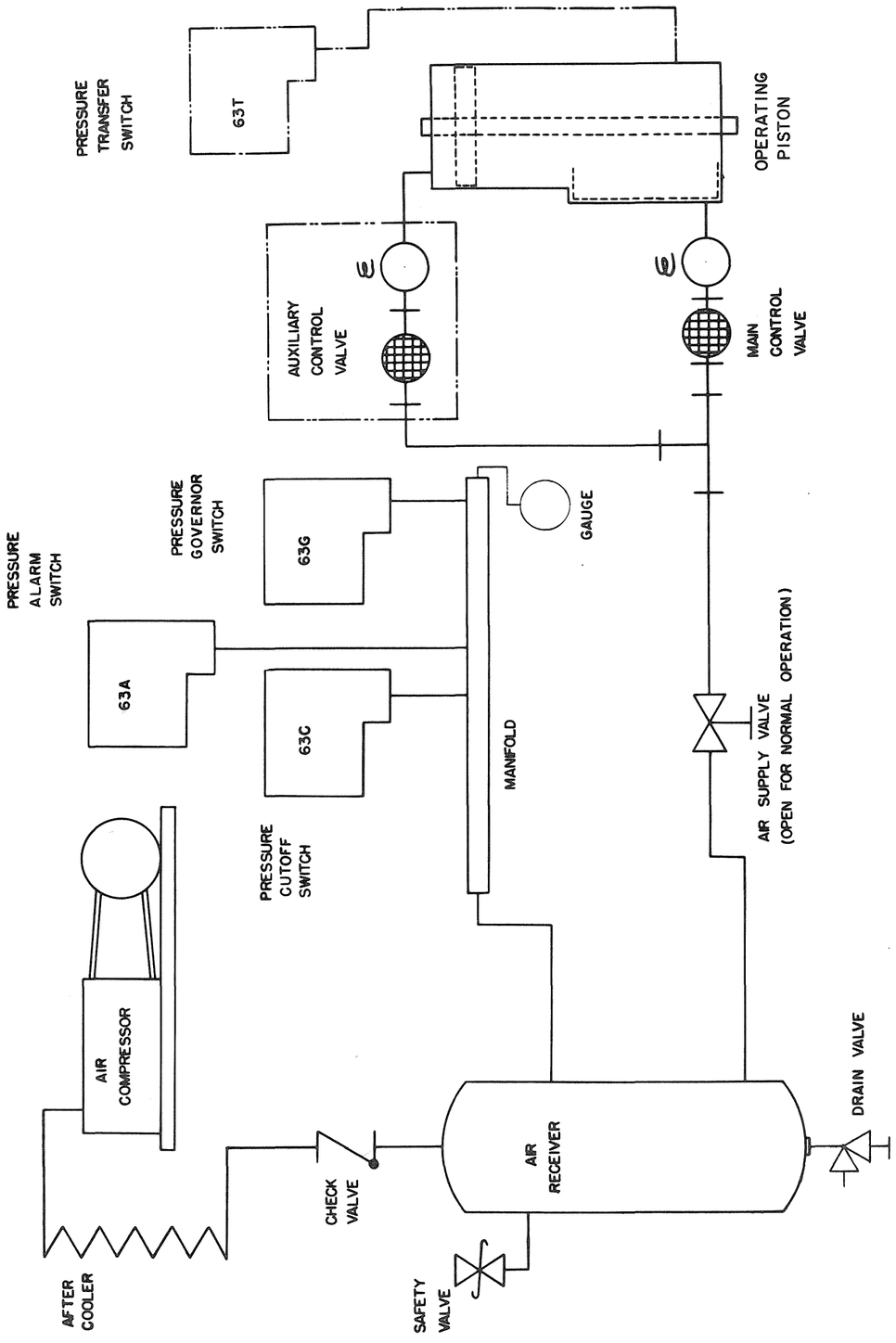


FIG. 2 MAP 15 SCHEMATIC PIPING DIAGRAM (AS SHOWN – WITHOUT AUXILIARY CONTROL VALVE & PRESSURE TRANSFER SWITCH)

FIG. 4. MAP 15A SCHEMATIC PIPING DIAGRAM (AS SHOWN – WITH AUXILIARY CONTROL VALVE & PRESSURE TRANSFER SWITCH)

Latch Wipe

To check the amount of latch wipe, center the maintenance closing device under the piston plunger (21) Fig. 6 and (20) Fig. 7 and slowly jack the mechanism closed until the upper limit of the stroke is reached. The jack should not be forced upward beyond this position because straining of the supporting structure may result from carelessly overtravelling the full stroke. There will then be clearance between the latches and the trip rollers. Hold back the trip latches (9) and place a little bearing blue on their ground surface where they engage the trip rollers (7). Then allow the trip latches to rotate into position under the trip rollers. Open the release valve on the jack slowly allowing the rollers to rest fully on the latches, then jack the mechanism closed far enough to be able to rotate the latches back for a measurement of wipe. There will be a fairly wide line on the latch faces where the rollers rested (as evidenced by the rubbing off of the bearing blue). The amount of wipe is determined by measuring from the edge of this line nearest the roll-off edge of the latch to the beginning of the radius of the roll-off edge.

The trip rollers (7) should bear upon the ground surface of the latches (9) at a point .03" minimum from the face of the latch. This adjustment can be varied by changing the number of shims in back of the magnet frame (3) of Fig. 7 in the MAP-15A. For the MAP-15 mechanism adjustment of latch wipe is obtained by shimming the latch arm stop (6) of Fig. 6. It is to be noted that the edge of the latch is slightly ground to protect the trip rollers (7).

Latch Clearance

Referring to Figs. 6 and 7 clearance of not less than 1/32 plus 1/32 minus 0 inch is required between the latch faces (9) and the trip rollers (7) when the piston (23) Fig. 6 and (22) Fig. 7 is in its extreme upper position in the cylinder. This has been adjusted during assembly by providing a suitable number of thin shims (22) Fig. 6 and (21) Fig. 7 upon the piston's upper face. Because the piston plunger (21) Fig. 6 and (20) Fig. 7 slides within the piston, this clearance cannot be checked by the use of the maintenance closing jack for the piston will remain in the bottom of the cylinder. Therefore, at this point, it will be necessary to operate the mechanism electrically at normal operating pressure.

When checking this clearance, the breaker is closed electrically except that the piston is held in its upper position. This may be done by inserting a piece of thin insulation of paper between the contacts of the piston cut-off "aa" switch (10) to prevent cutting off the control valve until the latch clearance has been quickly checked. After clearance readings have been taken by means of a feeler gauge inserted between the latches and the trip rollers, the paper is withdrawn whereupon the "aa" contacts make, the control valve closes, the piston resets, and the breaker is held closed when the trip rollers engage the latch faces.

If this latch clearance is incorrect, the cylinder must be dropped to add or remove shims.

Piston Cut-Off Switch "aa"

The piston cut-off switch (10) Fig. 6 and 7 is adjusted to allow .03 inch clearance between the switch plunger and its operating bar (31) when the piston is in its upper position. This setting insures positive contact. As in the case of the latch clearance, pneumatic operation is required to make this check. The switch cut-off, therefore, must be delayed by the insertion of paper between the cut-off switch contacts as already described.

Reclosing Switch "bd"

This switch (1) Fig. 6 and 7 functions to complete the closing circuit as the breaker opens for a reclosing operation. It is operated by a cam attached to the output crank shaft which compresses the switch plunger to a point where the switch contacts will have full wipe.

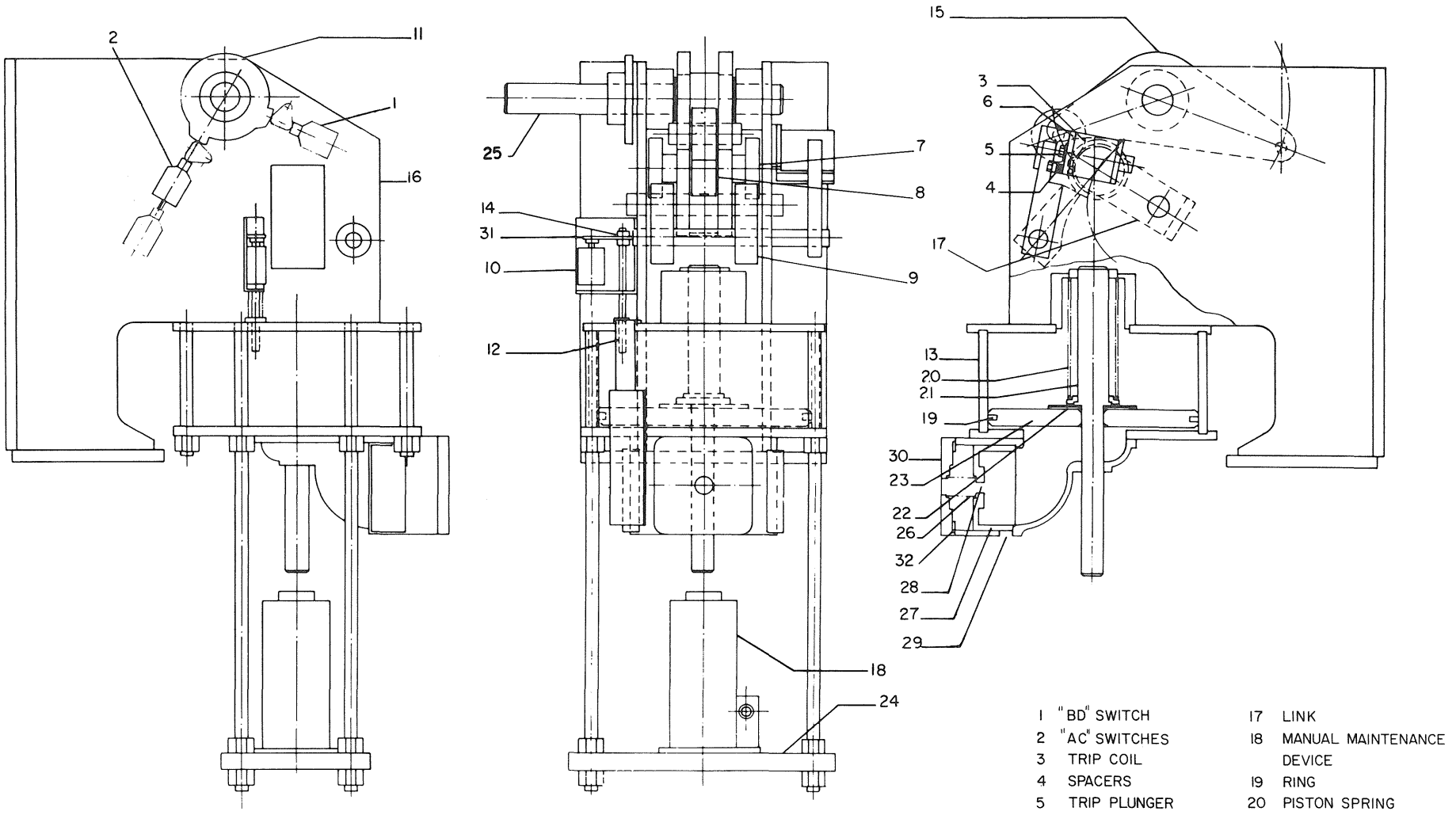
The reclosing cycle must be set-up so that the breaker contacts open at least halfway before they start to reclose. The point at which they start to reclose is determined by the operating pressure, the breaker opening speed and by the setting of the "bd" switch, which initiates the reclosing circuit. The operating pressure is given on the mechanism nameplate and the proper opening speed is given in the Breaker Instruction Book. The "bd" switch has been properly adjusted at the factory, but if it must be changed, it is necessary to determine, by analyzer curves, the proper adjustment to guarantee the breaker contacts opening at least halfway before reclosing.

"ac" Switch

This switch (2) Fig. 6 and 7 is adjusted to interrupt the trip coil circuit early enough so as to allow the protective relays time in which to open their contacts before the breaker recloses. It must make early enough to complete the trip free circuit in case the breaker closes in on a fault. In the breaker open position the contacts of the "ac" switch will have full contact break. With the breaker in the closed position the "ac" switch will have full wipe. The "ac" switch is operated by a cam which rotates with the output crank.

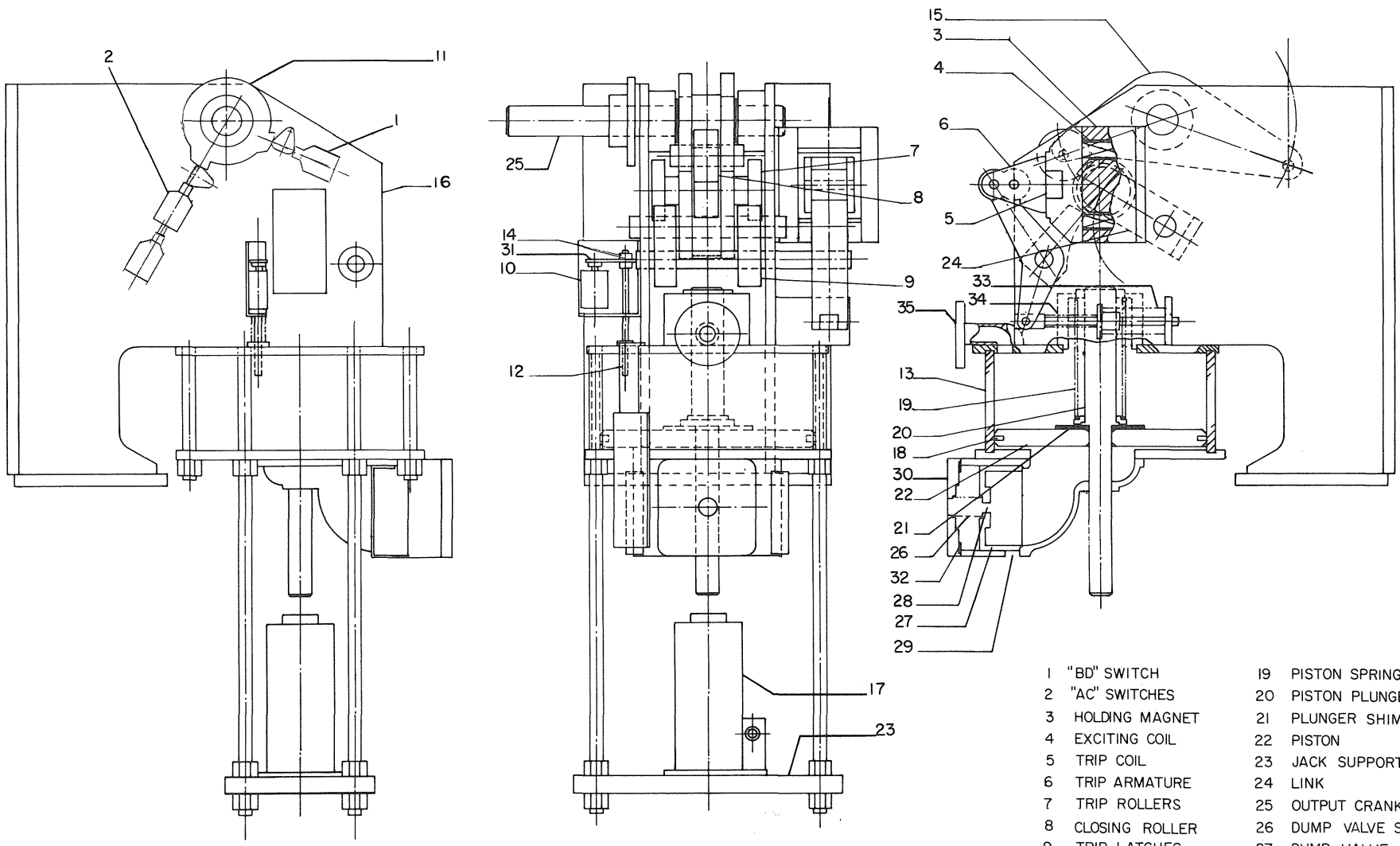
Note that on reclosing breakers, the "ac" switch must interrupt the trip circuit before reclosing can be initiated and hence it must not be set too far from the breaker closed position.

In all cases, the factory settings are to be preferred.



1 "BD" SWITCH
2 "AC" SWITCHES
3 TRIP COIL
4 SPACERS
5 TRIP PLUNGER
6 LATCH ARM STOP
7 TRIP ROLLERS
8 CLOSING ROLLER
9 TRIP LATCHES
10 CUTOFF SWITCH "AA"
11 CAM
12 CUTOFF SWITCH OPERATING ROD
13 CYLINDER
14 ADJUSTING SCREW
15 OUTPUT CRANK
16 FRAME
17 LINK
18 MANUAL MAINTENANCE DEVICE
19 RING
20 PISTON SPRING
21 PISTON PLUNGER
22 PLUNGER SHIMS
23 PISTON
24 JACK SUPPORT
25 OUTPUT CRANK SHAFT
26 DUMP VALVE SPRING
27 DUMP VALVE
28 ORIFICE
29 EXHAUST PORTS
30 MOUNTING FOR MAIN CONTROL VALVE
31 OPERATING BAR
32 BUFFER

FIG. 6 MAP-15 MECHANISM



1 "BD" SWITCH
2 "AC" SWITCHES
3 HOLDING MAGNET
4 EXCITING COIL
5 TRIP COIL
6 TRIP ARMATURE
7 TRIP ROLLERS
8 CLOSING ROLLER
9 TRIP LATCHES
10 CUTOFF SWITCH "AA"
11 CAM
12 CUTOFF SWITCH OPERATING ROD
13 CYLINDER
14 ADJUSTING SCREW
15 OUTPUT CRANK
16 FRAME
17 MANUAL MAINTENANCE DEVICE
18 RING
19 PISTON SPRING
20 PISTON PLUNGER
21 PLUNGER SHIMS
22 PISTON
23 JACK SUPPORT
24 LINK
25 OUTPUT CRANK SHAFT
26 DUMP VALVE SPRING
27 DUMP VALVE
28 ORIFICE
29 EXHAUST PORTS
30 MOUNTING FOR MAIN CONTROL VALVE
31 OPERATING BAR
32 BUFFER
33 BUFFER SPRING
34 HOLDING SPRING
35 AUXILIARY VALVE CONNECTION

FIG. 7 MAP 15A MECHANISM

Main Control Valve

The main control valve will not require adjustment before placing the breaker in service. However, the proper polarity of the three coil windings should be checked. This should be done as described under MAINTENANCE-CONTROL VALVE. The section on OPERATION-CONTROL VALVE should be read first to insure understanding of the principles of operation of the valve.

In addition, if a variable voltage is available, the valve may be checked for operation at the minimum voltage as shown on the mechanism nameplate.

Auxiliary Control Valve

This is an additional control valve used on the MAP-15A only, for high speed reclosing. This valve will not require adjustment before placing the breaker in service. However, if a variable voltage is available, the valve may be checked for operation at the minimum voltage.

Auxiliary Switch SB-1

This switch is set at the factory for proper adjustment and the position of its contacts agrees with the connection diagram. The adjustable connection link will give a small variation of their position but anything more will require disassembly and a change of rotor position. See Instruction Book.

Anti-Pump Relay and Cut-Off Relay Type HGA

If a variable voltage is available, the minimum pickup of these relays may be checked, otherwise, it will be sufficient to note that it operates at normal voltage. Complete information on this relay will be found in its Instruction Book.

Thermostat and Heaters

Check the operation of the thermostat and heaters. The thermostat on the control panel should be set at 40° F. See the OPERATION and MAINTENANCE sections for further information.

Closing Dashpot Fig. 8

If the mechanism has been shipped with its breaker it should not be necessary to make any other adjustments other than checking the oil level. This level should be even with the fill hole when the piston is in the up position (circuit breaker open). There is no closing dashpot on MAP-15 & MAP-15A mechanisms supplied on KSO breakers at 5000 MVA and above and on KLO breakers.

The dashpot should be inspected at least once a year to see that it is clean and free of any sludge or dirt and that the oil level is at the correct height. When adding oil to the dashpot use #10C Transil.

A fill hole (marked "Oil Filler" on Fig. 8) is provided to serve the dual purpose of an oil gauge and fill hole. With the plug removed from this hole, oil should be added until it runs out the hole. This should be done with the piston in the extreme up position.

When the mechanism is shipped separately from the breaker, as for supply mechanisms, it will be necessary to adjust the length of operating rod (3) by either clockwise or anti-clockwise rotation. First set the breaker so that the contact tip of the blade and rod is within 9" from the full closed position. This is the minimum adjustment which allows the cam (4) to engage the closing roller (6) as late as possible in the closing stroke. The rod (3) may then be adjusted in successive steps until a proper closing curve is obtained. After a satisfactory curve has been obtained, tighten the set screw (2) in the upper and lower couplings.

Pressure Switches (Fig. 9)

The MAP-15 and MAP-15A are equipped with four pressure switches: Pressure Governor, Pressure Alarm, Low Pressure Cut-out and Pressure Transfer. Each is provided with independent adjustment for setting its cut-in and cut-out points and which can be checked and calibrated if necessary with the system pressure slowly increasing or decreasing according to the function of the switch. The compressor charges slowly enough for making the increasing pressure check; while the drain valve may be opened slightly to bleed the system slowly for checking the decreasing pressure points. To check these switches allow the pressure to slowly increase or decrease and observe the pressures at which the switch opens and closes.

The opening and closing points should be in accordance with the requirements shown below for each different switch application. When observing the pressure gauge reading it is advisable to gently tap the gauge to be sure the needle is operating freely.

These four switches (63G, 63A, 63C and 63T) shown on piping and wiring diagrams, Figs. 2 and 4, are all of the same type, their differences being only in their adjustment and electrical connections. The governor switch (63G) and alarm switch (63A) are normally closed to provide for closing contacts on falling pressure. The cut-out switch (63C) and transfer switch (63T) are normally open to provide opening contacts on falling pressure.

The operating point of the switches on falling pressure is determined solely by the range adjustment.

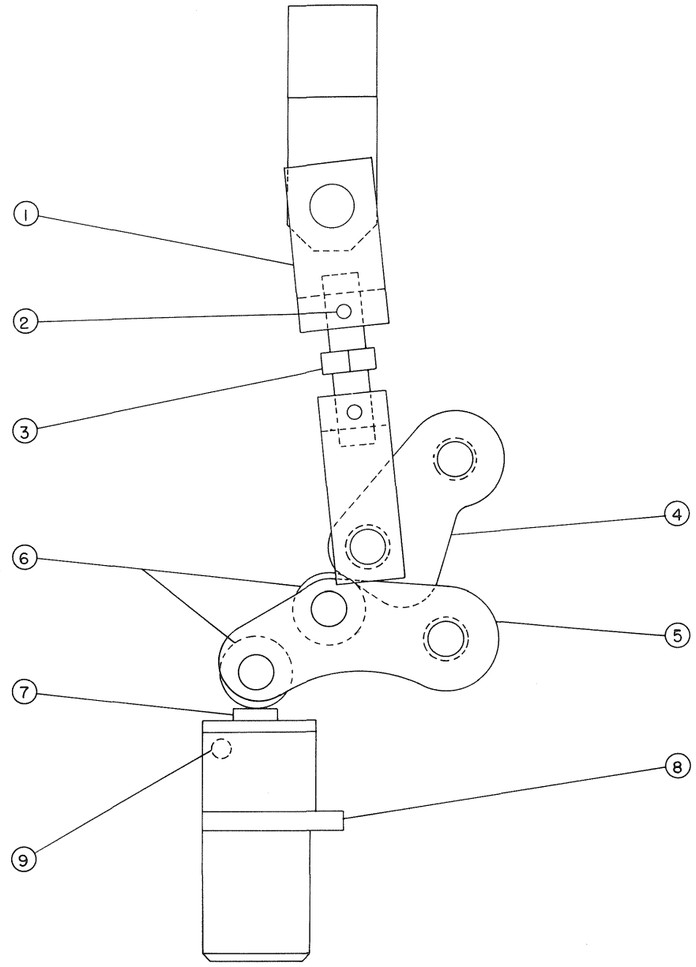


FIG. 8. CLOSING DASHPOT

1	COUPLING	5	CRANK
2	SET SCREW	6	ROLLER
3	ADJUSTABLE OPER^{G}-ROD	7	PISTON
4	CAM	8	DASHPOT
		9	OIL FILLER

The operating point of the switches on rising pressure is determined by the differential setting, in conjunction with the range adjustment, since rising pressure operation occurs at a pressure above the falling operation point equal to the amount of the differential setting.

All switches are to be adjusted for approximate minimum differential setting.

Pressure Governor Switch 63G Fig. 9

This switch functions to close its contacts and start the air compressor whenever the pressure decreases "a" P.S.I. below normal (see table below).

Accordingly, with the pressure slowly falling, set the range adjustment screw (3) on top of the switch so that its contacts close below normal pressure at the values stated in the table below:

Type	"a" P.S.I.	"b" Contact Closes At
KSO - up to 5000 MVA	10	8 to 10 P.S.I.
KSO - over 5000 MVA and KLO	15	13 to 17 P.S.I.

With the pressure slowly rising, the contacts should open within plus or minus 1 percent of normal pressure. This can be adjusted by very slightly turning the differential adjustment screw (4) located on the switch.

Pressure Cut-Off (63C) Fig. 9

This switch functions as a low pressure interlock to open the mechanism closing control circuit should the pressure fall to the minimum pressure shown on the operating range on the breaker nameplate.

Accordingly, with the pressure slowly falling the range adjustment screw on top of the switch should be set so that the switch "a" contacts open within plus or minus 1% of minimum pressure. Then, with pressure slowly rising, the contacts should close above the point of opening at a value stated in the table below:

Type	"a" Contacts Close
KSO - up to 5000 MVA	8 to 12 P.S.I.
KSO - over 5000 MVA and KLO	13 to 17 P.S.I.

Pressure Alarm Switch (63A) Fig. 9

This switch operates and is adjusted just like 63G except that its contact should be adjusted to close at 13 to 17 P.S.I. above the minimum operating pressure, as listed on the breaker nameplate. Its contact should open 13 to 17 P.S.I. above the point of closing.

Pressure Transfer Switch (63T) Fig. 9

This switch is pneumatically connected to the lower end of the mechanism operated cylinder and functions to close its contacts whenever there is pressure on the main cylinder. The contacts should be adjusted to close at 45 psi and open at 30 psi. The exact calibration is not important but the switch should be set as low as possible to get positive action.

Accordingly, with slowly rising pressure the contacts should close from 13 to 17 psi above the point of opening. This requires both range and differential settings on the switch to be near the minimum.

If it is desired to carefully check the switch operation, it will be necessary to remove it from the cylinder to a source of controlled air pressure, since the mechanism cylinder pressure cannot be measured or controlled accurately.

Final Inspection

After the mechanism has been installed with all mechanical and electrical connections completed, make the following inspection test:

1. See that the mechanism is properly set up and securely fastened to the breaker framework.
2. Review the following adjustments:
   a) Compressor oil level and belt tension.
   b) Operation of the pressure switches.
   c) Latch wipe – .03 min. from face of latch.
   d) Latch clearance – .030 in. to .063 in.
   e) Piston cut-off switch "aa" set for positive wipe.
   f) Reclosing "bd" switch.
   g) "ac" switch.
   h) Anti-pump and cut-off relay type HGA.
   i) Thermostat set at 40 F and all heaters functioning.
3. Check that all bolts, nuts and screws are properly tightened and that all washers and cotter pins are in place with cotter pin ends effectively bent over.
4. Inspect all wiring for damage during installation work, check terminal connections for loose screws, and test for possible grounds or short circuits.
5. See that all bearing surfaces and the cylinder are properly lubricated. (Refer to OPERATION and MAINTENANCE).
6. Operate the mechanism electrically and check the following points:
   a) Closing, opening, reclosing, and trip-free times.
   b) Minimum trip voltage.
7. See that all points where the surface of the paint has been damaged during installation are repainted immediately.

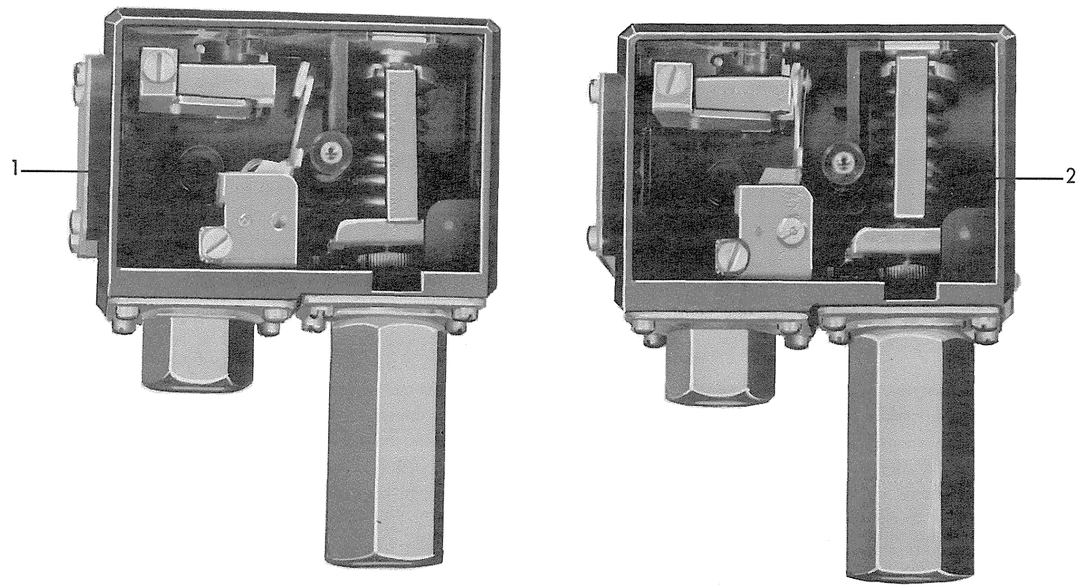


FIG. 9
PRESSURE SWITCH

1. Pressure Switch – Normally Open Contact – 63C & 63T.
2. Pressure Switch – Normally Closed Contact – 63G & 63A.
3. Range Adjustment Screw.
4. Differential Adjustment Screw.

OPERATION

Closing

In closing, the operation of the control switch energizes the main control valve closing coil V/C and the anti-pump relay coil (Y). The relay has a time delay pick-up which allows the pilot armature of the control valve to travel its complete stroke and be sealed in by the magnetic pole piece before the relay picks up and opens its normally closed contacts. This opens the control valve closing coil V/C circuit. Even if the closing control switch is released before the operation is completed the valve will remain magnetically sealed open permitting the operation to be completed.

The instant the control valve opens (refer to Fig. 6 and 7) high pressure air enters the chamber in front of the dump valve piston (27) which is already in the forward position due to the action of spring (26) and blocking the three cylinder exhaust ports (29). The air then passes through orifice (28) in the dump valve and enters the cylinder (13) under the piston (23) of Fig. 6 and (22) of Fig. 7. As the piston and plunger (21) Fig. 6 and (20) Fig. 7 are forced upward by the increasing air pressure in the cylinder the piston plunger engages the closing roller (8) forming a toggle with the links and output crank (15). This rotates the output crank and closes the breaker by pulling down the coupling fastened to the operating rod.

When the piston reaches its maximum position as determined by the shims (22) Fig. 6 and (21) Fig. 7, the rod (12) forces the plunger of the piston cut-off switch "aa" upward thereby permitting the switch to close. Thus the coil of the HGA cut-off relay is energized thereby closing its contacts. The V/CO cut-off coil of the control valve then becomes energized thus shutting off the air. At the same time the latch (9) rotates under the roller and holds the mechanism in the closed position.

When the pressure on the control valve side of the dump valve piston (27) falls, due to an exhausting through the ports of the control valve, the piston is forced back into the extreme left position. This uncovers the three cylinder exhaust ports (29) which permits the air in the cylinder to escape rapidly to atmosphere. The springs (20) Fig. 6 and (19) Fig. 7 can then return the piston (23) Fig. 6 and (22) Fig. 7 to its normal position.

As mentioned previously in "Adjustments", the MAP-15A mechanism is equipped with a magnetic trip latch. When the piston reaches its uppermost position and the "aa" switch is closed as mentioned above for the MAP-15 mechanism, the latches (9) rotate under the rollers (7) but are in this case held by the magnetic latch and holding the mechanism in the closed position. The exciting coil winding of the magnetic latch is energized as long as the "aa" switch is closed.

If the control switch should be held closed or if for any other reason the closing control circuit remains energized the contacts of the anti-pump relay, which will then be open, will prevent the V/C winding of the main control valve coil from again being energized until the control switch is released. This prevents any pumping of the mechanism.

NORMAL TRIPPING

Normal Tripping

Normal tripping is a trip operation actuated after the breaker has been closed for a period of time long enough for the breaker parts all to have returned to an "at rest" or normal breaker closed position. The pressure under the operating piston must be so low that the pressure transfer switch has opened its contacts to prevent operation of the main control valve coil (V/T). Thus only the breaker trip-coil (52/TC) is energized on a straight trip operation.

MAP-15

The mechanism trip coil (52/TC) is energized by the protective relay or control switch contacts. The trip coil plunger (5) Fig. 6 strikes the trip latch (9) out from under the roller. The opening springs in the breaker then cause the breaker to open.

MAP-15A

The breaker trip coil (5) Fig. 7 is embedded in the face of the magnetic latch in such a way that it sets up a flux, when energized, which shifts the permanent magnet flux through an air gap path instead of through the armature. The mechanism pulls the armature away, revolving the trip latches, and allows the breaker to open.

Pneumatically Trip-Free

A trip-free operation occurs when the breaker is closed on a fault, or if the control switch is held in the trip position after a closing operation is initiated.

The mechanism is pneumatically and electrically trip-free when the "ac" switch is closed. This switch functions to interrupt the trip coil circuit after a tripping impulse and does not close until the breaker contacts are only a few inches from fully closed. Hence, a trip-free operation cannot occur except when the mechanism is close to the fully closed position. Such an operation will now be described.

Assume that the breaker has been given a closing impulse followed by a continuous tripping voltage.

Fig. 10 MAP-15

The energizing of the main control valve solenoid winding V/C Fig. 10 causes the control valve (A) to open, blocking off the exhaust port (B) and admitting high pressure air to the dump valve (C) which due to the action of its return spring is in the extreme right position and blocking exhaust ports (D). The high pressure air then passes through hole (E) in the dump valve and is admitted into the cylinder under the main mechanism piston. The piston is forced upward, moving the linkage toward the breaker closed position. When air enters the cylinder, the pressure transfer switch 63T closes its contacts and hence the V/T circuit is set up in readiness for a trip free operation.

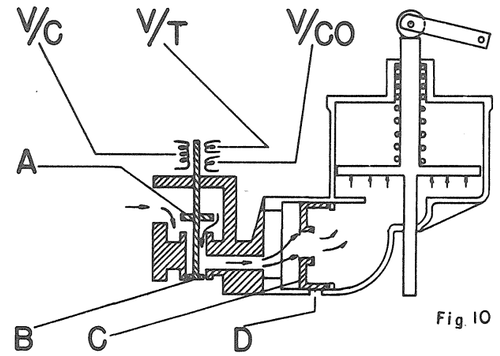


Fig. 10

Fig. 11 MAP-15

When the mechanism is sufficiently closed to operate the "ac" switch, the breaker trip coil 52/TC and the control valve V/T winding are energized. The V/T coil immediately closes the control valve which cuts off the supply of high pressure air and opens exhaust port (B). The small quantity of air trapped between the control valve and the dump valve is released through (B). The high pressure air under the mechanism piston quickly forces the dump valve (C) back to the left, uncovering exhaust port (D).

Fig. 12 MAP-15

The air under the piston is released through port (D) producing the sharp report characteristic to these mechanisms. The piston returns to the at-rest position by spring pressure and load of mechanism and the breaker contacts open.

Assume that the breaker has been given a closing impulse followed by a continuous tripping voltage.

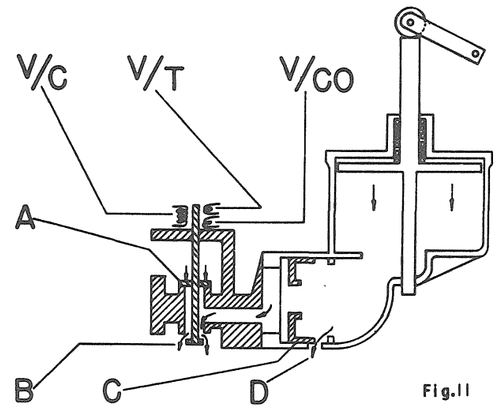


Fig. 11

Fig. 13 MAP-15A

In general the operation of the MAP-15A is the same as that described for the MAP-15 under Fig. 11. When air enters the cylinder the pressure transfer switch (63T) closes its contacts and hence the V/X and V/T circuits are set up in readiness for a trip free if required.

Fig. 14 MAP-15A

When the mechanism is sufficiently closed to operate the "ac" switch the breaker trip coil 52/TC, the main control valve V/T winding and the auxiliary control valve V/X winding are simultaneously energized. The V/T winding immediately closes the main control valve (A) which cut off the supply of high pressure air and opens exhaust port (B). The small quantity of air trapped between the main control valve and the dump valve is released through (B) and the high pressure air under the mechanism piston quickly forces the dump valve to the open position, uncovering the exhaust port (D).

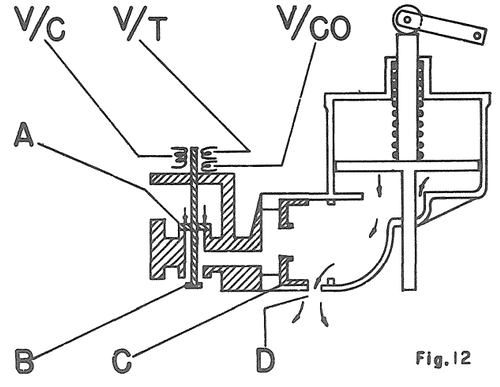


Fig. 12

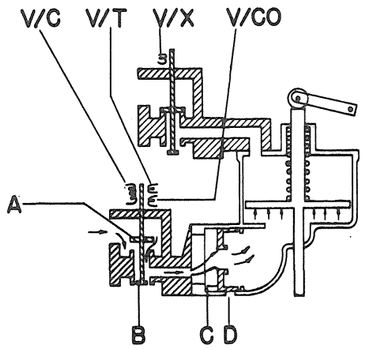


Fig.13

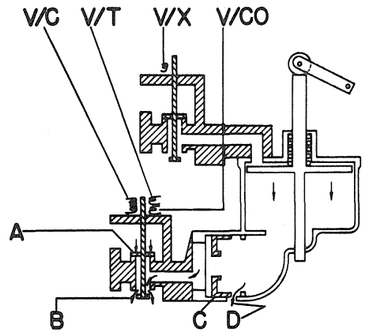


Fig.14

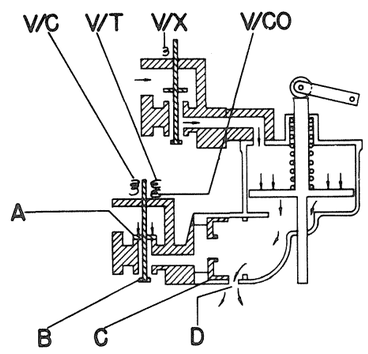


Fig 15

Fig. 15 MAP-15A

At the same time the V/X winding opens the auxiliary control valve, admitting high pressure air to the upper side of the mechanism piston which rapidly forces the piston down and the air is exhausted through port (D).

RECLOSING MAP-15

When the trip coil (3) Fig. 6, is energized the armature removes the latch (9) from under the trip roller (7) allowing the output crank (15) and the cam (11) to rotate counter-clockwise until the "bd" switch operates. When the "bd" switch is closed, it energizes the closing circuit causing the valve to open and the piston plunger to rise and engage the closing roller of the linkage before the breaker has completely opened. Refer to "Adjustments" for setting this switch in order to vary the reclosing time.

RECLOSING MAP-15A

The "bd" switch contacts are made, as described in the reclosing for the MAP-15. The pressure transfer switch has been placed in series with the auxiliary control valve V/X coil and the main control valve coil V/T winding so that during a normal opening operation there will be no air pressure on top of the piston to increase the reclosing time during subsequent reclosure. However, when the breaker contacts again make, there will be air under the piston and subsequently the pressure transfer switch will be closed. Then when the "ac" switch makes, the circuit is set up for a trip-free operation should the protective relay operate again because the fault which caused the original trip still persists.

Refer to "Adjustments" for setting the switch in order to vary the reclosing time.

MAIN CONTROL VALVE

This control valve Fig. 16 is a pilot operated valve equipped with a solenoid coil consisting of three windings. Winding (V/C) is in the breaker closing circuit for opening the pilot valve. Winding (V/CO) is in the air cut-off switch circuit and closes the valve by neutralizing the permanent magnet in the pole piece of the valve. Winding (V/T) is in the breaker trip-free circuit and operates in a similar manner to the V/CO winding.

The operation of the valve is such that when the valve is connected with air flowing from the air receiver to the valve as indicated by the arrow, pressure builds up in the chamber above the main piston (13) due to leakage around the piston and through the bleed hole in the top of the piston. When the V/C winding (7) is energized, it raises the pilot armature (10), opening the pilot valve and permits the air in the upper

1. Washer Shim
2. Upper Coil Frame
3. Spring
4. Spacer
5. Set Screw
6. Valve Cutoff Coil (V/CO)
7. Valve Closing Coil (V/C)
8. Valve Trip-Free Coil (V/T)
9. Lower Coil Frame
10. Pilot Armature
11. Gasket
12. Spring
13. Piston and Exhaust Valve
14. Heater
15. Plunger
16. Retaining Plate
17. Shims
18. Permanent Magnet
19. Pole Piece
20. Pilot Armature Pin
21. Valve Body
22. Pilot Valve Seat
23. Exhaust Port

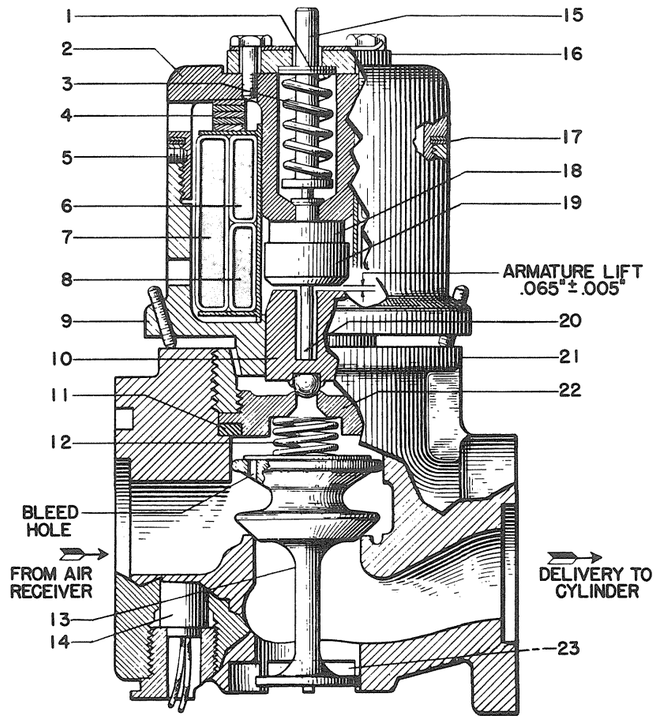


FIG-16 Main Control Valve

chamber above the piston to pass out faster than it is coming in. The pressure differential lifts the main piston (13). The armature reaches the pole piece (19) where it is held by the permanent magnet (18) which has been soaked by the closing coil (V/C).

The valve remains open until the air in the mechanism cylinder forces the mechanism piston up allowing the latches to reset and closing the cut-off switches. Closing the cut-off switches energizes the the V/CO winding (6) of the main control valve coil, which sets up an opposing force to the lines of force about the permanent magnet. This neutralizes the holding force sufficiently to allow the kickoff spring (3) to push the armature from the pole piece, which closes the pilot valve.

Closing the pilot valve permits the pressure to build up again in the upper chamber. When the pressure is sufficient, the piston moves down, closing the valve and cutting off the air. The exhaust valve, being part of the main piston, moves down uncovering the exhaust ports. This permits the air trapped between the control valve and dump valve to bleed out allowing the pressure in the cylinder to force the dump valve open, exhausting the air from the cylinder.

When used with the MAP-15 and 15A mechanisms the V/T winding (8) in the control valve solenoid coil is in the protective relay circuit and in parallel with the mechanism trip coil whenever there is pressure in the cylinder below the mechanism piston. The operation of this winding is the same as that of the V/CO winding except that it is energized simultaneously with the trip coil and does not have to wait until the breaker is fully closed before closing the valve. The function of this coil is to quickly cut off the valve if the mechanism is closed on to a fault current causing the mechanism to trip-free and permit the breaker to open. To assure fast trip free operation, the de-energizing force of the winding is sufficient to over-ride the force of the closing V/C winding in the event it is still energized during a trip free operation.

The proper relative polarity of the three windings in the coil must always be maintained because of the permanent magnet-type of design.

See section "Maintenance-Control Valve" for further information.

1. Washer Shim
2. Upper Coil Frame
3. Spring
4. Spacer
5. Set Screw
6. Valve Coil (V-X)
7. Spacer
8. Pole Piece
9. Lower Coil Frame
10. Pilot Armature
11. Gasket
12. Spring
13. Piston and Exhaust Valve
14. Heater
15. Plunger
16. Retaining Plate
17. Shims
18. Pilot Armature Pin
19. Valve Body
20. Pilot Valve Seat
21. Exhaust Port

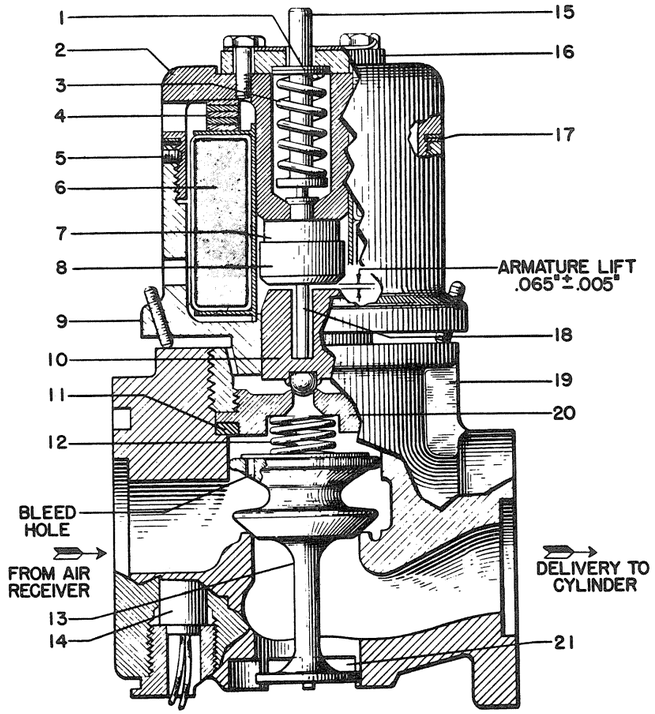


FIG-17 AUXILIARY CONTROL VALVE

AUXILIARY CONTROL VALVE (MAP-15A)

The auxiliary control valve Fig. 17 is a pilot operated valve equipped with a solenoid coil consisting of a single winding (V/X) which opens the pilot valve. The winding is connected in parallel with winding V/T of the main control valve and in series with the contacts of the pressure transfer switch. The pressure in the cylinder below the piston operates the pressure transfer switch to allow the energizing of the valve coil when the predetermined pressure exists and the "ac" switch on the mechanism is closed. The valve functions when the breaker is closed on a fault to give maximum speed of opening.

The opening of the pilot valve allows the piston and exhaust valve (13) to function exactly the same as described under MAIN CONTROL VALVE. Air from this control valve is admitted to the mechanism cylinder above the piston. This forces the piston down rapidly so that it will not retard the opening operation of the breaker when closed in on a fault current.

EXCITING COIL

The exciting coil (4) Fig. 7 for the magnetic latch is assembled in the magnet frame and is connected in the circuit through the "aa" mechanism cut-off switch. Each time the mechanism cut-off switch closes, the exciting coil is energized to recharge the permanent magnet. This restores the magnetic flux to full strength just prior to closing and insures holding the trip armature closed. The lead of the exciting coil designated "B", should always be connected to the (+) polarity.

COMPRESSOR PANEL

On this panel which is located at the front of the air receiver are mounted the following devices (see piping and wiring diagrams Figs. 2 and 3 for the MAP-15 and Figs. 4 and 5 for the MAP-15A).

1. Low pressure cut-off switch (63C) which opens to prevent closing the breaker when the pressure falls below a predetermined value.
2. Pressure Alarm Switch (63A) which closes when the pressure falls to within 10 percent of the point where the (63C) switch opens. The purchaser may connect this switch in a signal alarm circuit.
3. Pressure governor switch (63G) which controls the pressure in the air receiver.

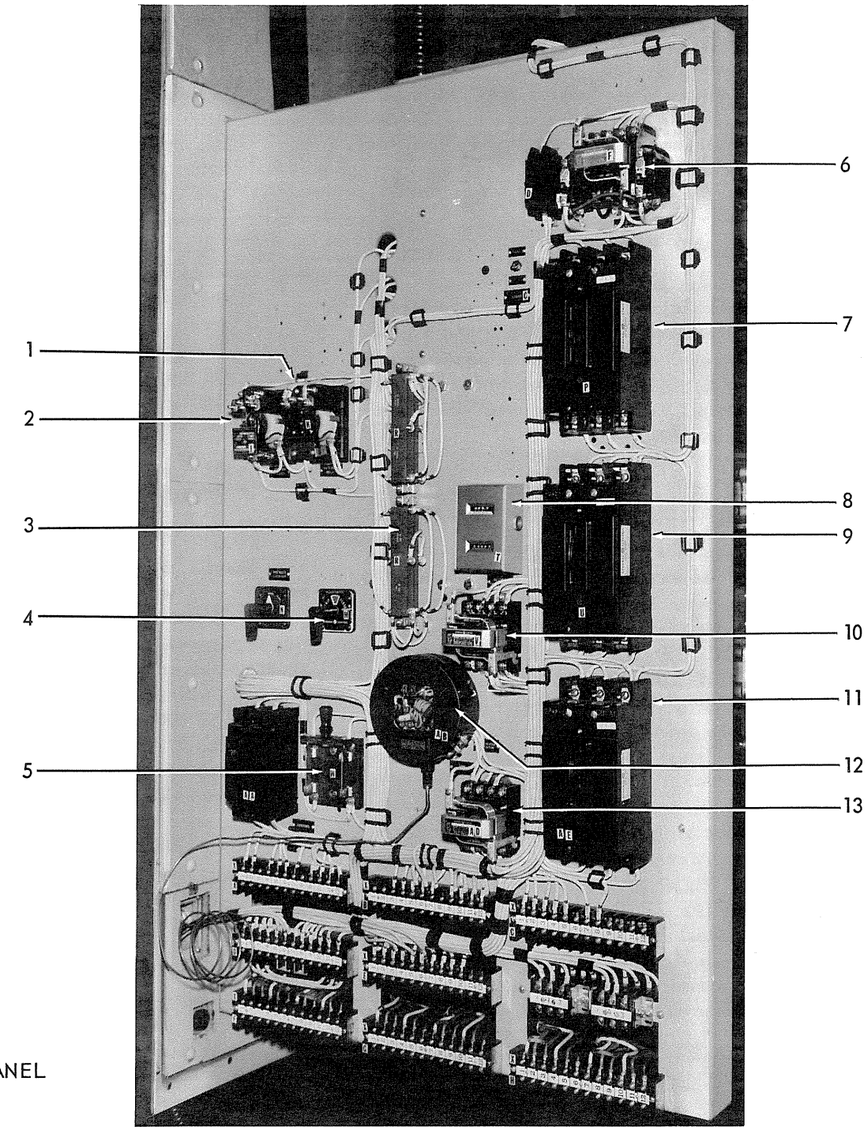


FIG. 18
CONTROL PANEL

1. Cut-off Relay
2. Anti-pump Relay
3. Resistors
4. Breaker Control Switch
5. Main Control Switch
6. Motor Starter
7. Motor Switch
8. House Thermostat
9. House Heater Switch
10. House Heater Aux. Contactor
11. Tank Heater Switch
12. Tank Thermostat
13. Tank Heater Aux. Contactor

CONTROL PANEL

The control panel is located on the inside of the mechanism house (Fig. 18). On it are mounted the knife switches for the house heaters, tank heaters and the control. The HGA relays, contactors and thermostat for the house and control valve heater are also mounted on this panel.

THERMOSTAT AND HEATERS

One thermostat and three sets of heaters are in the operating mechanism house. The main and auxiliary control valve heaters (30W), the four 350 W house heaters are controlled by the thermostat on the control panel. Another thermostat in the mechanism house controls the 500 W tank heaters, if supplied. See wiring diagrams Figs. 3 and 5.

MAINTENANCE CLOSING DEVICE

The maintenance closing device consists of a hydraulic jack and handle which is used to assist in making adjustments. This is the only purpose of the device because it permits slow closing and opening. ***IT MUST NOT BE USED FOR CLOSING THE BREAKER ON A LOAD.***

To raise, turn the release valve firmly to the right by using the notched end of the jack handle. The ram of the jack must be centered on the mechanism piston plunger cap. Then insert the handle in the socket and raise by pumping.

To open the breaker slowly, as might be desired for checking adjustments, raise the piston plunger (21) Fig. 6 and (20) Fig. 7 until it lifts the trip rollers (7) off the latches (9). Then hold back the latches by means of the manual trip device and lower the mechanism slowly by turning the release valve on the jack to the left. The amount the valve is turned governs the speed at which the mechanism opens.

MAINTENANCE

The operating mechanism of an oil circuit breaker is a very important part and must have regular systematic inspection during which every part is looked over carefully. The frequency of inspections should be determined by each operating company on the basis of the service to which the operating mechanism is subjected. Operating experience will soon establish a maintenance schedule that will give assurance of proper mechanism condition. An annual inspection and maintenance program is desirable in addition to a visual inspection at more frequent intervals. These inspections should be coordinated with an inspection of the breaker parts for maximum convenience.

Precautions

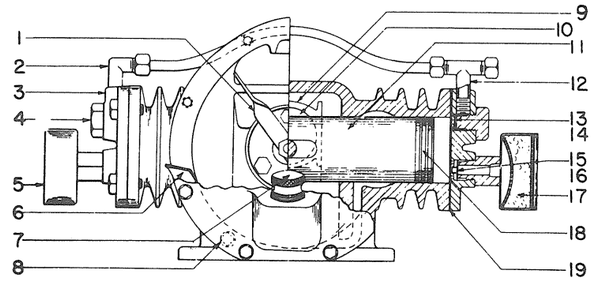
1. Be sure that all primary and secondary circuits have been opened before any inspection or maintenance is attempted.
2. After any adjustment is made in the mechanism, operate manually to check the adjustment before operating electrically.
3. Use the connection diagram accompanying the operating mechanism in all cases when testing and connecting the mechanism.
4. When making adjustments in the mechanism or the breaker, it is advisable to drain the air receiver.
5. When the pressure system must be exhausted for work on the mechanism or breaker, use the drain valve. Never use the manual relief on the safety valve.

PERIODIC INSPECTION

The mechanism should have a regular visual inspection, initially at one-week intervals until such time as frequency has been determined by local operating requirements. At this inspection, the condensate should be blown from the air receiver. The amount of water allowed to collect should not exceed one pint. This can be used as a guide to the necessary frequency of draining. The frequency is determined by existing atmospheric conditions and will vary greatly between seasons of the year and with different locations. Generally once a month should be sufficient.

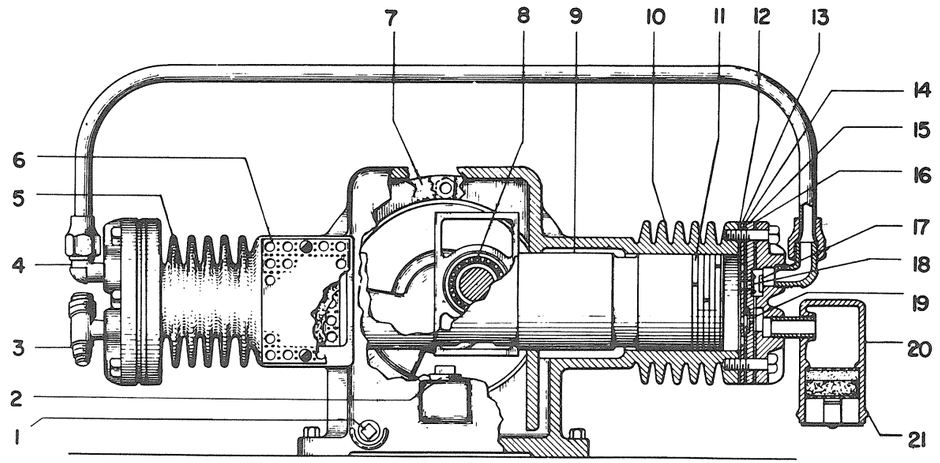
Check to make sure that the pressure is within the proper limits, and that the compressor and the heaters are functioning properly. The pressure may vary as much as 15 psi below normal, unless the breaker has just been operated, at which time lower pressures are not uncommon. Under normal conditions, the compressor should not operate more than 10 minutes every two hours. If it does, the system should be checked to determine the cause. If possible, a mechanism operation should be observed at least once every 2 or 3 months.

Check the tension on the compressor drive belts by pressing with the thumb against the centre of the belts with moderate pressure. The belts should deflect .26 to .50 inch. Adjust, if necessary, by loosening the motor mounting bolts and sliding the motor toward or away from the compressor. New belts will stretch slightly during the first few months of operation. Belts that are too loose will slip on the motor pulley and cause undue heating and wear. Tight belts will overload the bearings as well as the belts. ***CAUTION:*** De-energize the compressor motor circuit before proceeding the drive belt inspection or adjustment.



1. Oil Splasher
2. 90 Elbow
3. Cylinder Head
4. Exhaust Plug
5. Intake
6. Oil Cover Gasket
7. Oil Fill Plug
8. Oil Drain
9. Yoke
10. Eccentric Shaft
11. Piston
12. 'T' Fitting
13. Exhaust Valve
14. Exhaust Valve
15. Intake Valve
16. Intake Valve Spring
17. Intake
18. Piston Rings
19. Head Gasket

Fig. 19 Air Compressor



1. Drain Plug
2. Fill Plug
3. Tee Fitting
4. 90° Elbow
5. High Pressure Cylinder
6. Crank Case Breather
7. Cover Gasket
8. Yoke Bearing
9. Low Pressure Piston
10. Low Pressure Cylinder
11. Piston Rings
12. Valve Retainer Gasket
13. Valve Retainer
14. Valve Plate Gasket
15. Valve Plate
16. Head Gasket
17. Valve Stop
18. Exhaust Valve
19. Intake Valve
20. Air Intake
21. Air Strainer

Fig. 20 Air Compressor

ANNUAL MAINTENANCE

1. Change the oil in the compressor.
   Refill with Turbine Oil (see page 28*).
2. Compressor: The compressor filters should be checked. Each cotton filter pad is held between two screens, the outer one being retained in the funnel mouth by a snap ring. Removal of the intake funnels is necessary to inspect and clean the intake valve faces, and at such times the funnels with their filter units may be rinsed in carbon tetrachloride or other cleaning fluid. If gasoline must be used, take care that the filters are thoroughly dry before replacing and running the compressor so that all danger of fire hazard is removed. When excessively dirty, the cotton filters should be replaced, taking care to reassemble properly with the concave screens toward the compressor. Filters may be purchased or made up from cotton available locally.
3. Check Valve: Disassemble the check valve and immerse the parts in a cleaning fluid. If the disc seat is worn (three or four years should be the average life) the disc should be replaced. Remove the retaining nut and replace the disc with one of Buna-N rubber. After replacing the nut, prickpunch to lock it in place. Slight leakage may be present when replacement is made but the valve will soon seat itself and eliminate this leakage.
4. Main Control Valve: The main control valve used on MAP pneumatic operating mechanism has metal-to-metal seats throughout, giving an extended life with a minimum of maintenance. The component parts are precision machined, eliminating the need of a lapping operation. Even though the valve requires no lubrication, it is not expected that the moving parts will need replacement during the normal life of the equipment. The valve is tested at the factory to insure a maximum leakage rate of 150 cubic centimeters per minute.
   This amount of leakage should not produce an audible leak, and under normal conditions, the valve leakage will decrease with usage. If an audible leak should be detected, corrections may be made in the following manner:
   The stainless steel ball seat of the pilot armature (10) Fig. 16 has been carefully coined into the pilot valve seat (22). Slight leakage at this point may be corrected by recoining the seat. This may be done by removing the upper coil frame (2) and placing a .12 inch thick washer around the pilot armature pin (20) between the pole piece (19) and the pilot armature (10). Then force the ball into the seat, applying the pressure by screwing down the upper coil frame about .010 inch (between .12 to .26 of a turn). Remove the washer and recheck the valve for lift. This lift should be .065 in ± .005 in. and and shims (17) must be added or removed to obtain this. Adjust the pilot valve spring pressure by means of shims (1) to just prevent leakage (balance) at from 25 to 50 psi above the normal operating pressure.
   After the above steps have been taken, reassemble the valve and operate several times in order to improve seating. If this procedure does not stop the leak, it is recommended that the lower coil frame and pilot seat (9 and 22) and the pilot armature (10) be replaced.
   If leakage is detected on the main piston (13), repairs may be made in the following manner. Loosen the set screws and unscrew the lower coil frame (9) from the body (21). After removing the pilot valve seat (22) and the gasket (11), lift out the main piston and apply a small amount of fine grinding compound to it. Place a #10-32 screw in the top of the piston and lock with a nut. Reassemble the piston in the valve body and lap it in. Remove the piston and clean off all traces of grinding compound from the piston and valve body. Reassemble in the reverse order and test. Should the leak persist, it is recommended that the control valve be returned to the factory for repair.
   At normal maintenance periods, it is recommended that the set screws be loosened and the lower coil frame (9) tightened in order to insure a good seal at the gasket (11). Retighten the set screws.
   To change the main control valve coil, remove all set screws (5), disconnect the coil leads and then unscrew the upper coil frame (2). Assemble the new coil with the V-T winding (leads 1 and 2) at the lower end. Correct polarity of the leads must be maintained. This is indicated by numbers on tags attached to coil leads and corresponding numbers shown on the wiring diagram. After the new coil is assembled, it is imperative that it be checked in the following manner:
   With normal operating pressure in the air receiver, energize the control circuit by means of the local close switch on the panel. If the valve opens but fails to close after the cut-off switches make, check and interchange leads 3 and 4 (V-CO winding). To check winding V-T, put a paper between the contacts of the "aa" cut-off switch and, with normal air pressure in the air receiver, energize the control circuit. Then trip the mechanism with the control switch. If the valve fails to close, leads 1 and 2 (V-T winding) should be checked and interchanged.
5. Auxiliary Control Valve: Refer to Fig. 17. Access to the coil for changing and to the internal valve parts for inspection and repair is gained in the same manner as described above under "Main Control Valve". The pilot armature lift in the case of this valve is also .065 in ± .0005 in. and is measured and adjusted like the main control valve.

6. Air Strainers: The air strainers which are bolted in the flanges of the control valves should be cleaned by rinsing in carbon tetrachloride or other cleaning fluid. This screen unit comprises two closely spaced screens of different mesh. When replacing, place the coarser mesh screen on the control valve side of the air line, to have it serve as a support for the finer mesh screen against the pressure flow.
7. Thermostat and Heater: The cut-in and cut-out points of the thermostat on the control panel should be checked if possible. If it is not possible to check the thermostat operation, it should be momentarily short circuited to check the operation of the heaters. Be sure to return the thermostat to the 40 F point if it is moved for checking.
8. Mechanism Linkage: Check the latch clearance and latch wipe as described under INSTALLATION ADJUSTMENTS. Operate the mechanism manually to make sure it operates freely.
9. Auxiliary Switches: Check the adjustment of the switches (aa, bd and ac) as described under Installation Adjustments.
10. Pressure Switches: Check the settings of the pressure switches as described under INSTALLATION ADJUSTMENTS. These switches do not require lubrication.
11. Compressor Rate: Check the time for the compressor to pump up to normal pressure from zero pressure. Without leakage this should be from 30 to 55 minutes. If the pump up time is excessive with only normal system leakage check the belt tension. If no external cause can be found, the compressor piston rings or valves or both may be sticking. New oil may free the parts but dis-assembly for cleaning will probably be required. See Figs. 19 or 20.
12. Leakage: Observe the rate of air leakage. It should not exceed 5 psi per hour with well seated control valves and check valve. A maximum leakage of 5 psi per hour will mean that the compressor runs approximately once every two hours. This is not excessive for the compressor. If leakage is excessive after the valves are well seated, the source should be located. A soap and water solution may be used on pipe and tube joints to show up leaks but must all be removed after checking.
13. Safety Valves: Check for leakage. Safety valves are emergency devices and are not normally desinged for manual operation or repeated testing. They are rarely airtight when new and seldom airtight after they have been popped or operated manually. System leakage, including the safety valve should not exceed 5 psi per hour. The valves require regrinding and recalibration by the valve manufacturer if leakage becomes excessive.
14. Closing Dashpot: Check the level of the oil in the mechanism closing dashpot as described on page 12.
15. Inspect the condition of painted surfaces and where necessary repaint immediately.
16. Maintenance Closing Device: The oil in the jack is a light-bodied, non-freezing type, and must be replenished occasionally. When it becomes necessary to replenish use Simplex Hydraulic Jack Oil, not alcohol or brake fluid. With the jack in its upright position and the ram fully lowered, the oil should be level with the hole for the oil filler screw.
17. Testing: The only way to completely check the operation of the mechanism (and the breaker) is by use of a time-travel recorder of the Cincinnati type. Owing to the high speeds encountered, a direct-reading type record is recommended. A routine check with an analyzer at regular inspection periods is the best guarantee of trouble-free operation.

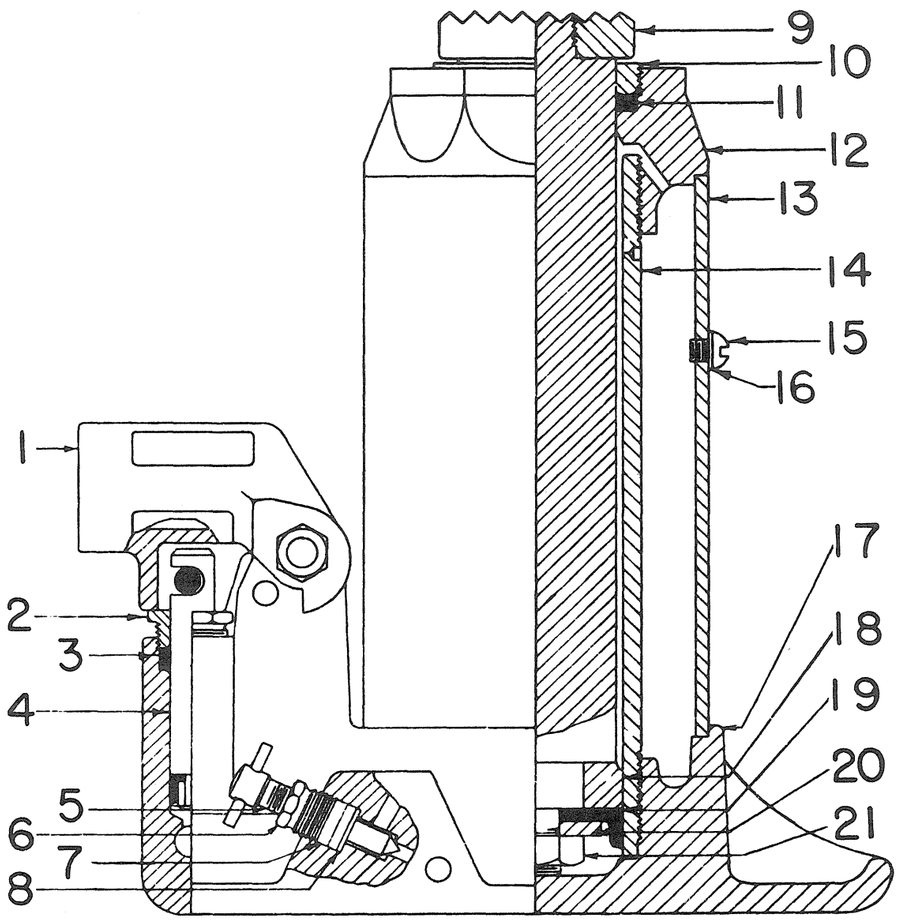
LUBRICATION

In order to maintain reliable operation, it is important that all circuit breakers and their mechanisms be properly lubricated at all times. During assembly at the factory all bearing surfaces, machined surfaces, and all other parts of the mechanism subject to wear have been properly lubricated using the best lubricants available for the service conditions. However, even the finest oils and greases oxidize to some extent with age, as evidenced by hardening and darkening in colour. Consequently, all lubricants should be renewed periodically.

Frequent operation of a mechanism causes the lubricant to be forced out from between the bearing surfaces. A simple lubrication will sometimes clear up symptoms of distress which might be mistaken for more serious trouble. It is also recommended that all mechanisms be operated at regular intervals to insure the user that the equipment has not become sluggish.

The correct period between maintenance lubrications depends to a great extent upon local conditions. Until a definite schedule has been worked out, the mechanism should be lubricated annually and also whenever it is overhauled, as outlined in the LUBRICATION CHART. Mechanisms in very highly repetitive service should be checked more often.

The LUBRICATION CHART shown on Page 28 gives complete information for lubricating the mechanism. One column shows the recommended annual lubrication which requires no disassembly. The other column, ALTERNATIVE LUBRICATION, outlines a procedure similar to that performed on the mechanism at the factory, but should be used only in case of a general overhaul or disassembly for other reasons, or if the operation of the mechanism becomes sluggish. The alternative method of lubrication, however, should be undertaken after five years of service.



1. Handle Socket
2. Packing Nut
3. Packing
4. Piston
5. Release Screw
6. Packing Nut
7. Release Packings
8. Washer
9. Ram Head
10. Ram Packing Nut
11. Ram Packing
12. Top Nut
13. Reservoir Nut
14. Ram Tube
15. Filler Screw
16. Fiber Washer
17. Base
18. Ram Spacer
19. Ram Cup
20. Cup Retainer
21. Cup Nut

Fig. 21 Maintenance Closing Device

Motor Bearings

Motors used on the MAP-15 and MAP-15A mechanisms have both sleeve and ball bearings. The sleeve bearing motors have hinged-lid oilers and should be oiled with standard #20 oil. The oiling required is 30 - 70 drops after the first year and after each 1000 hours of additional service. Ball bearing motors are shipped with sufficient grease for the initial operating period and should be regreased every three years.

Use GE Ball Bearing Grease, Spec. DQ6A2A3.

a) Clean grease fittings and free relief valves at lower end of bearings of hardened grease.
b) Grease motor at standstill only.
c) Use hand-operated gun only.
d) After greasing, allow motor to run about 10 minutes, and then wipe off grease escaping from relief valves.
e) If the spring grease relief fittings have been replaced by screw plugs, they must be removed when greasing the bearings.

CLEANING

Whenever cleaning is required, as indicated in the LUBRICATION CHART, the following procedures are recommended.

Sleeve Bearings

The pins should be removed and all old oxidized grease removed by immersion in clean petroleum solvent or similar cleaner. ***DO NOT USE CARBON TETRACHLORIDE.*** Wipe the pin and bearing clean, then apply a small amount of GE Lubricant D50H15 to the entire surface of the bearing just before reassembling.

Sealed Ball Bearings

Remove the bearings to be cleaned from the mechanism, take out the rubber seals, and place the bearings in a container of clean petroleum solvent. ***DO NOT USE CARBON TETRACHLORIDE.*** If the grease in the bearing has become badly oxidized, it may be necessary to use alcohol (the type used for thinning shellac) to remove it. Ordinarily, by agitating the bearings in the cleaning solution and using a stiff brush to remove the solid particles, the bearings can be satisfactorily cleaned. Do not handle the bearings with bare hands as deposits from the skin onto the bearings are inductive to corrosion. If the bearings are touched, the contamination can be removed by washing in alcohol. After the bearings have been thoroughly cleaned, spin them in clean, new, light machine oil until the cleaner or solvent is entirely removed. Allow this oil to drain off and then repack them immediately with GE Lubricant D50H15 being sure all metal parts are greased. Reassemble the seals.

CAUTION: If it becomes necessary to clean the bearings in alcohol (shellac thinner) be sure the alcohol is perfectly clean, and do not allow the bearings to remain in the alcohol more than a few hours. If it is desirable to leave the bearings in the alcohol for a longer time, an inhibited alcohol such as is used for anti-freeze should be used. Even then, the bearings should be removed from the alcohol within twenty-four hours. Esso Anti-Freeze and DuPont Zerone are satisfactory for this purpose. Precautions against the toxic effects of the alcohol must be exercised by wearing rubber gloves and by using the alcohol in a well ventilated room; excessive exposure to the fumes is sometimes unpleasant to personnel. Washing the bearings in light oil and draining should follow immediately, then apply the lubricant.

General Electric Lubricant D50H15 is available only in cartons containing twelve collapsible tubes of grease. This is a total of three pounds of grease to the carton. It is so packaged to insure cleanliness and to prevent oxidation.

RENEWAL PARTS

Recommendations

It is recommended that sufficient renewal parts be carried in stock to enable the prompt replacement of any worn, broken or damaged parts. A stock of such parts minimizes service interruptions caused by breakdowns, and saves time and expense. When continuous operation is a primary consideration, more renewal parts should be carried, the amount depending upon the severity of the service and the time required to secure replacements.

ORDERING INSTRUCTIONS

When ordering renewal parts, address the nearest General Electric Sales Office, specifying the quantity required, and describing each part by the catalogue number obtained from the Renewal Parts Bulletin.

It is also suggested that complete identification of the mechanism be furnished by supplying the information found on the mechanism nameplate and, if possible, the number of the requisition on which the mechanism was originally furnished.

Renewal parts which are furnished may not be identical to the original parts, since improvements are made from time to time. The parts which are furnished, however, will be interchangeable.

LUBRICATION CHART

PART	LUBRICATION AT ANNUAL MAINTENANCE PERIOD	ALTERNATIVE LUBRICATION (REQUIRES DISASSEMBLY)
Dump Valve	Do not oil or grease.	After removing from cylinder, clean and apply small amount of D50H15. Wipe most of it off leaving only a film.
Piston	About ¼ oz. of light machine oil, SAE 20, injected in oil fill hole.	Clean all surfaces and apply a thin coat of D50H15.
Piston Plunger	Wipe all visible surfaces clean and apply very thin coat of D50H15.	Clean all surfaces and apply a thin coat of D50H15.
Ground Surfaces (Latches, rollers, trip magnet faces, etc.)	Wipe clean and apply D50H15. Use very thin film on magnet faces.	Same as Annual Lubrication.
Sleeve Bearings (Mechanism & Breaker Linkage)	Very light application of light machine oil, SAE 20.	Clean as per instruction under LUBRICATION SLEEVE BEARINGS. Apply D50H15 liberally.
Compressor	Change oil. Refill even with the fill hole using oil as recommended.	Same instruction as Annual Lubrication.
Compressor Motor Ball Bearing	After cleaning grease fittings and freeing relief valves of hardened grease, with motor at standstill, grease with GE Ball-Bearing Grease, DQ6A2A3.	Same instructions as Annual Lubrication.
Sleeve Bearings	30-70 drops of #20 oil in oilers.	Repeat Annual Instructions every 1000 hours.
Sealed Ball Bearings (Trip Rollers and Trip Shaft)	No lubrication required.	Clean as per instructions under LUBRICATION-SEALED BALL BEARINGS. Repack with D50H15. Fill only 1/3 full.
Control Valves	No lubrication required.	No lubrication required.

* **Recommended Vendors – Vendor Type**

Imperial Oil Ltd.	– Terreso 52
B-A Oil Ltd.	– Britex 55
Shell Oil (Canada) Ltd.	– Turbo 33
Texaco (Canada) Ltd.	– Regal C
Sun Oil Co. Ltd.	– SW-931