INSTRUCTION BOOK

Pneumatic Operating Mechanism Type AA-10 for Oil Circuit Breakers

Westinghouse Electric Corporation

I. B. 33-125-C3A

INSTRUCTIONS

Pneumatic
Operating Mechanism
Type AA-10
for
Oil Circuit Breakers

October, 1953

WESTINGHOUSE ELECTRIC CORPORATION

Switchgear Division • East Pittsburgh Plant, East Pittsburgh, Pa.

I. B. 33-125-C3A

MH-721-A

Printed in U.S.A.

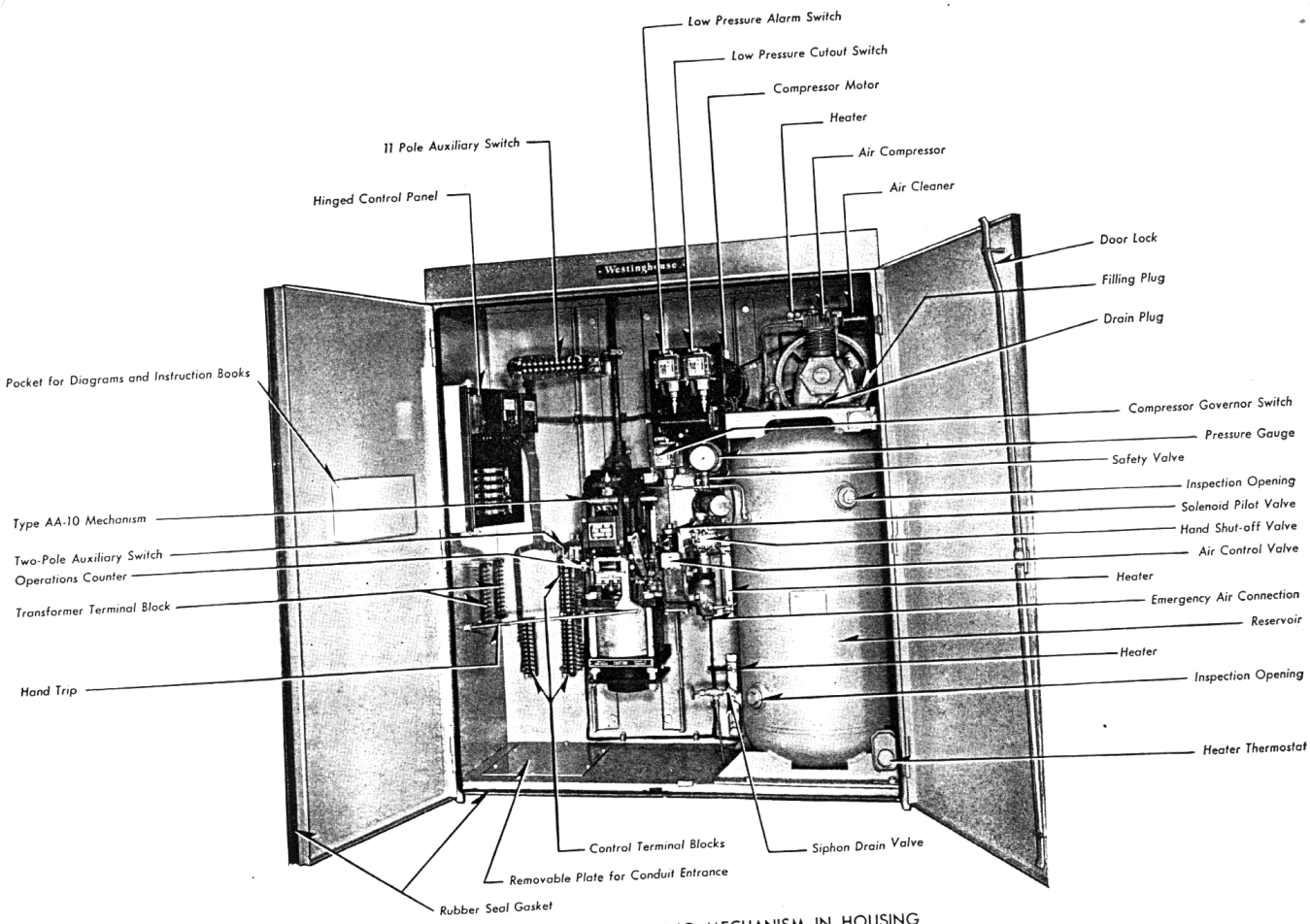


FIG. 1—AA-10 OPERATING MECHANISM IN HOUSING

INTRODUCTION

Type AA-10 circuit breaker operating mechanism is closed by compressed air, opened by springs, and is both electrically and mechanically trip free. Since the closing energy is derived from compressed air which can be stored up in a reservoir over a relatively long period of time with a low current consumption by means of a motor driven compressor, the mechanism is especially suited to applications where it is desired to eliminate large batteries required for solenoid mechanisms, or where fast reclosing is required.

CONTENTS

CONTENTS—Continued

DRAWINGS

PUBLICATIONS

Pneumatic Operating Mechanism—Type AA10

PART I—RECEIVING, HANDLING, AND STORAGE

Each mechanism and its associated equipment is tested at the factory and should be in good condition when received. Inspection should be made immediately to see that no damage has occurred in shipment. If injury is evident, or indication of rough handling is visible, a claim for damage should be filed at once with the carrier (Transportation Company), and the nearest Westinghouse Sales Office notified promptly.

Unpacking should be done carefully to prevent damage, and all parts should be checked with the shipping list to insure against leaving any parts in the packing material. The mechanism should be accompanied by the proper identification tag and this instruction book.

Be sure to remove the blocks and wires which were used to hold moving parts, mechanism triggers and latches in place during transit.

If the mechanism is not placed in service immediately, it should be kept in a clean dry place, protected from corrosion and moisture. This may be accomplished by closing the mechanism housing and energizing the space heaters provided in it. This procedure is recommended even if it requires the use of a temporary wire circuit to the heaters. In case this is impracticable, all machined parts, especially on the latching surfaces of the latch and rollers should be coated with grease or some rust inhibiting material. Additional protection may be obtained by the use of silica gel, activated alumina or similar dehydrating agents. Two or three small bags of the material should be hung in the mechanism housing near the parts requiring protection. It should be remembered that complete protection may not be provided in spite of all of the above precautions and periodic inspections should be made to determine the condition of the apparatus.

PART II—DESCRIPTION

GENERAL

Included within the dust tight sheet metal housing are the following pieces of apparatus which combined are designated as a complete operating mechanism:

(1) An air compressor, air storage reservoir and the necessary attachments and accessories for controlling the air supply.

(2) A pneumatic mechanism consisting of the air cylinder and piston, a lever system for connecting the piston to the pull rod of the breaker, and a system of latches for rapidly disengaging the breaker pull rod from the piston, a holding latch for maintaining the mechanism and breaker closed.

(3) A control panel to provide the necessary relays and interlocks for remote electrical control.

(4) A number of accessories essential to the proper functioning of the unit such as a trip magnet assembly, control valve, auxiliary switches, a latch check switch, space heaters, thermostat, fused knife switches for the establishing and protection of the electrical circuits, and terminal blocks for terminating all wiring where it will be readily accessible for connections on installation. See Fig. 1.

COMPRESSOR AND AIR SYSTEM

The unit is available with two sizes of air supply systems. For applications on the smaller breakers, the unit will consist of a 60 gallon reservoir, and a single stage (illustrated Fig.1) or two stage compressor depending on the normal operating pressure. For applications on the larger breakers, the unit will have an 80 gallon reservoir, and a two stage compressor with intercooling between the low pressure and high pressure cylinders. A pressure governor switch regulates the pressure in the storage reservoir. The pressure governor operates to start the compressor as soon as the pressure in the reservoir has dropped to a predetermined value, depending on the size of the circuit breaker to which the mechanism is applied, and stops the compressor as soon as the pressure has been raised to a 15 lb. per sq. in. differential above the starting pressure. The pressure governor switch pressure settings are shown on the mechanism nameplate for each application. Power to operate the compressor is furnished by a 230/115 volt, single phase motor through a "V" belt drive. Unless the order specifically specifies differently, the motors when shipped will be connected for 230 V. a-c to prevent damage to the motor from overvoltage. D.C. or 3 phase motors may be supplied for special applications.

The reservoir tank fulfills the requirements of State Inspection Codes and all equipment is manufactured under A. S. M. E. requirements with close inspection. A safety valve is supplied to prevent the pressure from building up to a dangerous level, should the pressure governor switch fail to cut off the compressor motor.

At a pressure slightly above the minimum satisfactory operating pressure, a low pressure cut-off switch operates to open the closing circuit, thus preventing the mechanism from attempting to operate the breaker when there is insufficient air pressure to complete the operation. A seal-in interlock on the closing relay is wired in parallel with this low pressure cut-off switch so that should the low pressure cut-off switch open its contacts during a closing operation, the breaker will complete the closing operation. The minimum setting of the low pressure cut-off switch is set high enough above the actual minimum to insure enough air to complete the closing operation. The setting of all pressure switches and safety valves are made at the factory and should not need changing.

If anything should go wrong with the compressor or air equipment so that normal pressure is not maintained, a low pressure alarm switch is provided that can be used to sound an alarm at the substation indicating that the pressure is only slightly above the setting of the low pressure cut-off switch.

A hand shut off valve is provided in the air piping between the reservoir and the pneumatic mechanism that can be used as a safety measure to prevent accidental operation while working around the mechanism.

The schematic diagram for the air system is shown on drawing 57-J-365. This diagram together with the control diagram, the various position figures, and the explanation of the mechanism operation should give a more complete understanding of the overall operation. The low pressure alarm and cut-off switches are connected to the mechanism side of the hand shut-off valve as an added safety feature, so that it is impossible to energize the closing control when the hand shut-off valve is closed. If an emergency source of air supply is available in case the compressor is out of service, it may be connected by removing the 1½″ pipe plug provided in the piping between the hand shut-off valve and the control valve as indicated on Fig. 1.

PNEUMATIC MECHANISM AND CONTROL

The Type AA-10 is electrically trip free at all times and is mechanically trip free whenever there is air pressure in the main closing cylinder. The determination of whether the mechanism functions trip free or non trip free is accomplished pneumatically and is called selective tripping. Figs. 3, 4 and 5 illustrate and supplement the following description.

Main Frame and Cylinder

The mechanism is built up around the main frame which serves to support and enclose the levers, latches and triggers that provide the releasable connection between the closing piston and the breaker pull rod. The cylinder is attached to and supported on the main frame by four bolts, and consists of a non ferrous seamless tube clamped between the top plate which is part of the frame and the bottom plate.

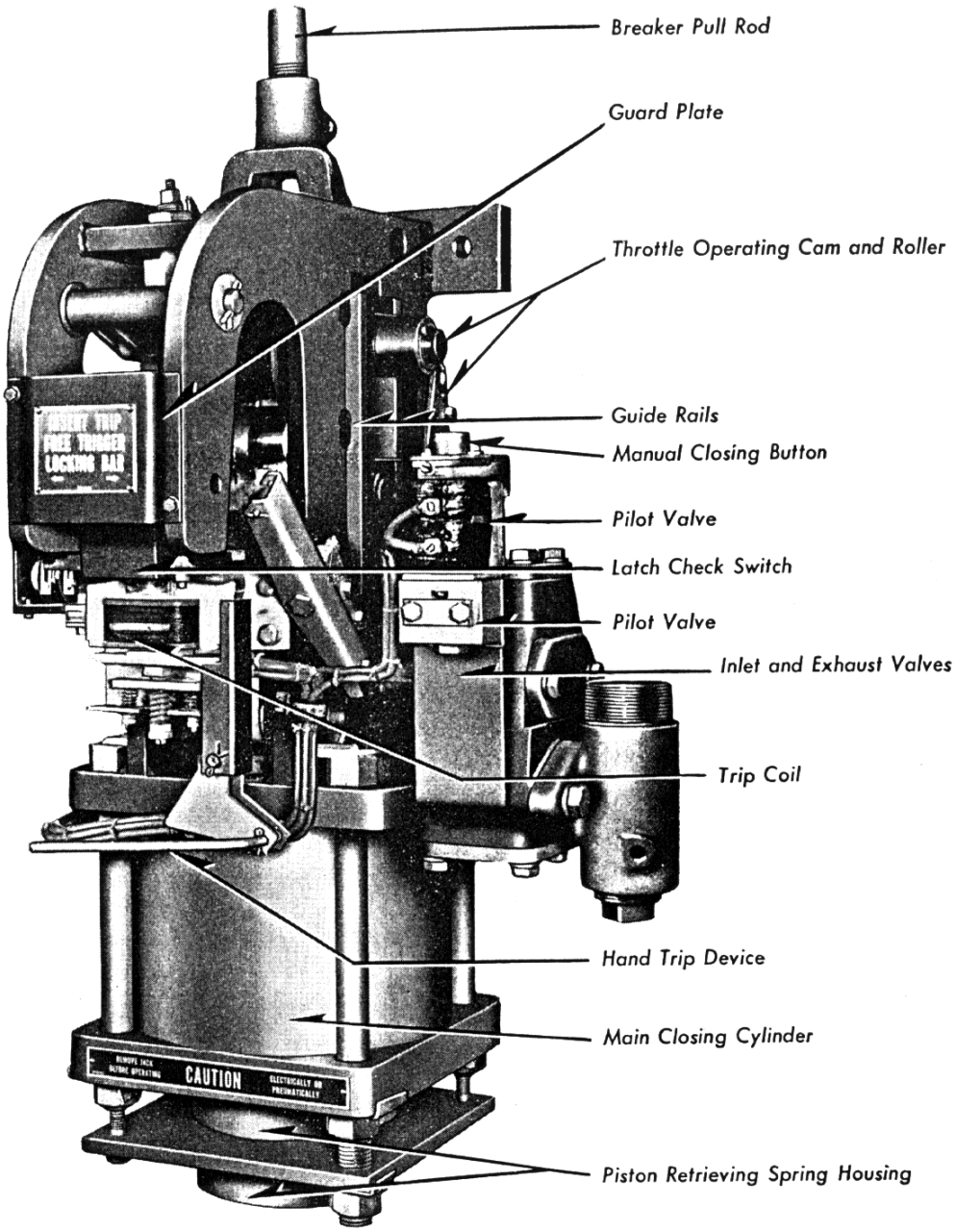


FIG. 2—TYPE AA-10 MECHANISM

Closing Piston Snubber

There are two concentric rings of rubber sandwiched between a recess in the top side of the bottom plate and a steel piston stop ring. These steel plates and the ring are given a corrosion resistant protective finish. This "sandwich" serves to absorb some of the final shock caused by the rapidly moving piston reaching the end of its travel. To decelerate the piston before engaging this resilient stop, a collar on the underside of the piston closes off a concentric, close fitting opening in the bottom plate as the mechanism approaches the closed position Fig. 4. This traps a small volume of air between the underside of the piston and the end of the cylinder providing pneumatic dashpot action.

Retrieving Spring Assembly

Immediately below the bottom plate and clamped to it by extensions on two of the bolts

holding the cylinder assembly to the main frame is the spring housing which supports and encloses the two heavy retrieving springs. These springs, which are compressed during the closing stroke, supply the force required to rapidly retrieve the piston to the open position whenever the mechanism is tripped.

Closing Piston Assembly

The main closing piston which is cast from a non ferrous alloy is screwed on and locked to the piston rod at approximately its mid point. The lower end of the piston rod is threaded to receive the hand closing jack. An adjustable packing gland around the piston rod, plus a gasket between the mechanism frame and cylinder combined with two piston rings on the main closing piston minimize the air losses during closing operations. The cross-head, which is located on the upper end of the piston rod, carries two pins: The upper pin "E" which is supported by roller bearings at either end, is engaged by the holding latch when the mechanism is in the closed position; the lower pin "B" serves to attach the closing lever to the piston rod, and extensions of this pin carry a roller at either end which travel between guide rails on the frame.

Lever System

The piston is connected to the breaker pull rod rod-end through the closing lever and thrust link which are joined with pin "C". The rod end and thrust link are joined by pin "A". The ends of this pin carry rollers which are guided between two rails and provide straight line motion of point "B". As long as point "C" is restrained to maintain the relative position of A-C-B as shown in Figs. 3 and 4, the movement of the piston will be transmitted to the breaker pull rod. If at any time during the closing operation or after the mechanism is closed, the restraint on point "C" is released, the linkage A-C-B will open up allowing the breaker pull rod and the closing piston to move independently of each other. This provides essentially the mechanically trip free function. The balance of the parts are required to make it possible to control at will the release or retention of the connection between the closing piston and the breaker, and also to reduce the load present at point "C" to a load on the trigger that will make possible low tripping effort. The intermediate link, which is connected to the thrust link and closing lever at one end by pin "C" and at the other end to the mid point on the trip-free lever by pin "D", transfers the load on "C" to the trip free lever. This creates a tendency for the trip free lever to rotate clockwise about the trip free lever fulcrum pin bearings. The trip free fulcrum pin is supported at either end in roller bearings.

Trip Free Trigger

The trip free trigger, which is positioned approximately tangential to the roller on the trip free lever and which is free to rotate on needle bearings about the trigger fulcrum pin, provides the final releasable means for controlling the fixation of point "C". The end of the trigger in engagement with the roller on the trip free lever is shaped in such a manner that there is a slight tendency for the trigger to rotate counter-clockwise whenever there is a load on the breaker pull rod. In addition to this moment the trigger is spring biased to the latched position as shown in Figs. 3 and 4. A stop on the trip free lever positions the end of the trigger accurately in respect to the roller insuring definite engagement.

To insure against the possibility of the shock incident to closing causing the trip free trigger to release the trip free lever prematurely, a spring biased catch is provided that engages the trip free trigger in the latched position. Normally there is no load on the catch, however the catch must be released prior to tripping the trip free trigger. An arm on the catch is interposed between the trip rod and selector bar which insures the prior release of the catch.

To insure positive latching with early cut-off of the closing air at the end of a closing operation, a spring biased catch, similar to the catch used in conjunction with the trip free trigger, is provided that engages the non trip-free trigger as the trigger moves up behind the roller on the main holding latch. Normally there is no load on the catch, however the catch must be released prior to tripping the non trip-free trigger. This release is accomplished by having an arm on the catch, extend over immediately behind the catch on the trip-free trigger. Thus as the trip rod rises, it rotates both catches out of the way before the selector bar attempts to disengage either trigger.

Trip Free Lever Stop

The trip free lever accelerates rapidly to a relatively high speed in retrieving from the position shown in Fig. 5 to the open position Fig. 3. To stop this rapidly moving lever, a resilient stop is provided. The body of the stop is screwed into a cross bracing member of the main frame to provide adjustment of the stop. The resilient feature consists of a rubber plug totally enclosed in a steel housing. The outside diameter of the rubber is slightly smaller than the inside diameter of the housing which provides a relatively slow build up of resisting force until the plug has been deformed to fill the inside of the enclosure. The resisting force then builds up very rapidly to bring the trip free lever to rest.

Holding Latch and Trigger

In order to maintain the mechanism and breaker in the closed position after the closing air has been shut off, a sturdy holding latch, fulcrumed to the frame on roller bearings and spring biased toward the latched position is provided to engage pin "E" in the cross head. To provide for non-trip free operation, which is required in order to realize high speed reclosing the nose of the latch is machined so that the breaker load at pin "E" creates a moment in a counter-clockwise direction on the latch. The latch is restrained in the latched position shown in Fig. 4 by the non trip free trigger, which is fulcrumed on needle bearings on the trigger fulcrum pin, and engages a needle bearing roller carried on the latch. The trigger is spring biased to the latched position shown in Fig. 4. The trigger stop pin serves to position the non trip free trigger in the latched position and also limits the overtravel of both the non trip free trigger and the trip free trigger in the tripped position.

Trip Magnet Assembly

The trip magnet assembly is located on the underside of the frame directly under the selector bar. The trip rod is screwed into and locked to the trip armature. The upper end passes up through the stationary "E" frame to disengage the triggers, and the lower end extends down through a clearance hole in the resilient stop plate and carries a "kick-off" spring. The "kick-off" spring serves to force the armature away from the stationary core immediately after the trip coil is de-energized to insure rapid resetting of the triggers. $\frac{1}{32}$" thick copper rivets on the underside of the pole faces creates a $\frac{1}{32}$" air gap between the armature and pole faces which also speeds up the retrieving of the armature.

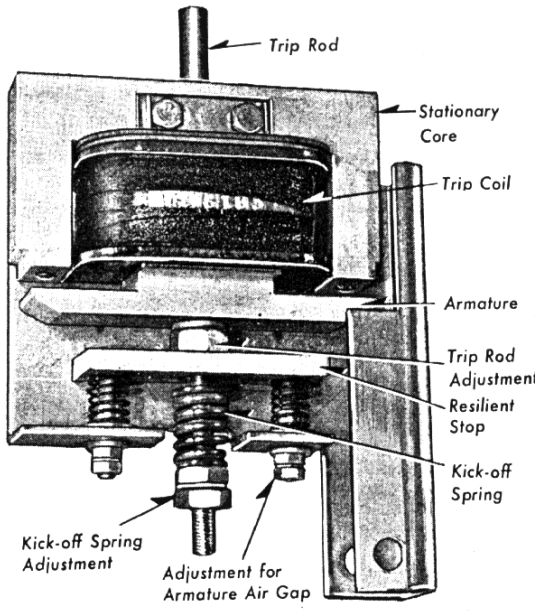


FIG. 6—TRIP MAGNET ASSEMBLY

Trip Selector

In order to realize the benefits of short reclosing times made possible by non trip free operation, and still retain the advantages of fast tripping times obtained by mechanical trip free operation when closing in against a fault, it is desirable to be able to choose between trip free and non trip free operation. This is called "selective tripping" and is accomplished pneumatically as follows:— Reference Figs. 16-17. The selector bar, which passes at right angles to the planes of the two triggers and is interposed between the trip rod and the triggers has a boss on its upper edge so arranged that the length of the flat upper surface is greater than the spacing between the triggers. Thus the selector bar is always in a position to trip one or both triggers for any position of the selector bar. When the selector bar is over to its extreme left hand position, Fig. 17 the boss is directly under the non trip free trigger and a "valley" is under the trip free trigger. When the selector bar is moved over to its extreme right hand position,

Fig. 16 the boss is directly under the trip free trigger and has been moved free of the non trip free trigger. The chamfer on the left hand end serves to prevent the selector bar from accidently interfering with the triggers during the transfer motion. The position of the selector bar is determined by a spring bias that selects the non trip free trigger except when there is air pressure in the closing cylinder. A selector piston located in the control valve on the cylinder side of the inlet valve is connected through a linkage with the selector bar so that whenever the inlet valve is open, the selector piston will shift the selector bar over to the right and select the trip free trigger for tripping. With the inlet valve closed, the spring bias on the linkage returns the selector bar to its normal position for tripping from the non trip free trigger.

Control Valve

Due to a wide range of functions which the mechanism may be called on to perform, there

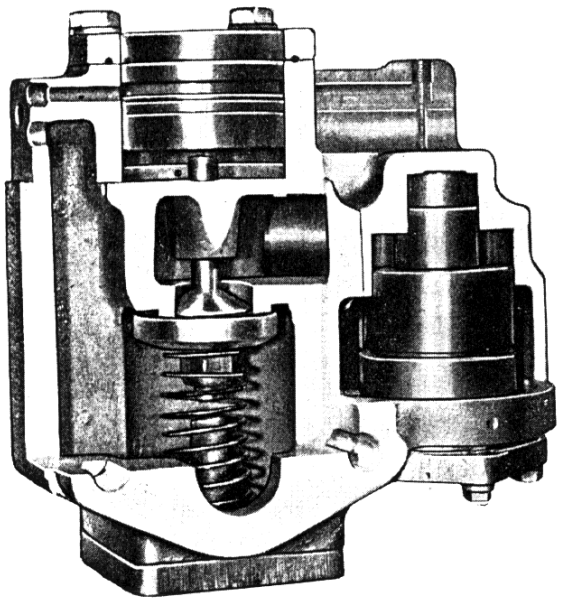


FIG. 7—AA-10 CONTROL VALVE
(with high speed exhaust)

are several combinations required in the control valve assembly as follows:

(1) For the majority of breakers, which have a comparatively light starting load, a throttle and adjustable by-pass are required (Fig. 8A-14-15).

(2) For the largest breakers this feature is omitted.

(3) For all breakers where immediate multiple reclosures are required, a fast acting exhaust valve is incorporated (Fig. 8).

(4) Where only one reclosure is required, a slow acting "poppet" type of exhaust, which allows the pressure to leak down to a low value before exhausting is permissible (Fig. 8B).

(5) To provide for selective tripping as described previously in detail, a selector piston (Fig. 17) is required to operate the selective tripping. It is possible that some applications may require a combination of all of these features except that either (3) or (4) will be used but not both at the same time. A valve including a throttle and by-pass, a selector piston, and the fast acting exhaust valve will be described. For particular applications where some of the features may not be required nor included, their function as described here after may be passed over or even blocked out if it is felt desirable to avoid confusion on the part of maintenance personnel who may be using the instruction book for reference.

The control valve combines both the inlet and exhaust functions in a single compact unit and is controlled by a single electro pneumatic pilot valve as illustrated in Figs. 8 to 10, 8A to 9B.

Certain illustration liberties were taken in Figs. 8A, 9A and 9B especially in respect to the shape and arrangement of the by-pass and throttle piston to facilitate the illustration and understanding of the valve construction and functioning.

The pilot valve is double acting i.e.: when the inlet seat is closed, the exhaust ports are open (Fig. 8), and vice versa (Fig. 9). The pilot valve inlet has a lapped-in metal to metal seat and is spring biased closed. The valve is opened either by energizing the pilot valve coil or by manually operating the pushbutton on top of the coil which in both cases moves the pilot valve plunger down. The valve remains open only while the coil is kept energized or the button held down. As soon as the coil is de-energized or the button is released, the spring bias closes the inlet seat and opens the exhaust seat.

The main inlet valve has a metal reinforced neoprene rubber disc seat to insure positive seating and dependable service. The valve is held tightly closed by a spring bias and the air pressure acting on the underside of the seat. The valve is opened by a separate piston which is located directly above and opens the valve by forcing down the valve stem.

The small hole (a) through the bottom of the inlet valve cylinder into the air passage to the main closing cylinder, and the small bleeder hole (b) through the side wall of the valve body near the bottom of the same cylinder serve to regulate the back pressure inherently present under the piston due to leakage around the valve stem and the inlet valve piston. The inlet valve piston has a piston ring to keep the leakage to a minimum and insure obtaining full control air pressure above the piston for positive action.

The fast exhaust valve consists of a freely floating piston which is maintained in the closed position by gravity when there is no air pressure through the control valve. The valve seat is undercut to provide access for the air pressure in the main closing cylinder to act on the underside of the exhaust valve piston seat. The piston on top of the valve has a larger area than the exposed area of the valve seat. Thus when the control air is admitted above the exhaust valve piston, there is a preponderance of force to maintain the valve closed. Whenever the control air is exhausted from above the piston, the closing air, acting on the exposed surface of the valve seat, creates a preponderance of force upwards to open the valve. Since the exhaust valve only has to retain the air during the short interval while the mechanism is closing, a metal to metal seat is satisfactory. The four holes through the step on the piston serve the dual purpose of:

(1) Preventing air being trapped in the space above the step on the piston when the valve opens and

(2) Preventing a build up of pressure in this space due to leakage of control air past the piston.

An air passage between the top sides of the inlet and exhaust valve pistons is connected with the pilot valve between its inlet and exhaust ports. This arrangement permits a single pilot valve to control the opening and closing of both the inlet and exhaust valves.

For control valves employing the slow exhaust, the air passage for the control air connecting the inlet and exhaust valves is omitted.

The slow exhaust valve consists of a poppet type valve, with a metal to metal seat, spring biased to the open position. The adjustable spring bias is set so that the valve will be forced closed whenever the air pressure in the cylinder which acts on top of the valve seat is at or above the actual minimum operating pressure.

The arrangement of the by-pass and throttle as illustrated in Figs. 8A, 9A and 9B does not conform exactly to the actual physical arrangement of the valve, but the deviations were considered necessary in order to illustrate the continuity of air flow. There are two parallel air passages between the inlet valve and the closing cylinder:

(a) One via the small port directly under the by-pass adjusting screw, and

(b) The other a much larger passage via the throttle piston. The larger passage is so arranged that the throttle piston, which is spring biased closed, can close off this path completely leaving only the restricted opening via the by-pass port as a connection between the inlet valve and the cylinder. The by-pass adjusting screw provides a means of regulating the flow of air through the by-pass port.

The position of the throttle piston is regulated by the throttle cam lever, which in turn is controlled by the position of the breaker as illustrated in Figs. 14-15. For the start and early part of the closing operation, the breaker load is relatively light for most breakers. In order to prevent the breaker lift rod from attaining unnecessarily high velocities during this lightly loaded portion of the closing stroke, with a corresponding drop in pressure in the closing cylinder, the flow of air is restricted by having the throttle piston closed and the air forced to reach the cylinder via the by-pass port. Shortly before the breaker contact load is picked up, the large passage through the valve is opened up to provide maximum air flow to meet the rapid increase in load which the mechanism is called on to close. The opening of the throttle piston is accomplished by a roller on the breaker pull rod rod-end pin engaging a cam on the throttle lever during the closing movement of the

mechanism. The position in the closing stroke where the throttle opens can be set for early or late opening by shifting the position of the cam plate on the throttle lever.

The main components of the valve are made of a non-ferrous alloy. All moving parts such as valve stems and pistons are chromium plated to minimize galling and insure trouble free performance.

Opening the small pilot valve either manually by means of the pushbutton on top of the pilot valve coil, or by energizing the coil, admits high pressure air above the inlet and exhaust valve pistons simultaneously. The inlet valve piston is forced down opening the inlet valve and the air from the storage reservoir is free to flow via the by-pass port into the main cylinder. The exhaust valve is held closed by the preponderance of force created downwardly on the valve by virtue of the control air acting on the larger area of the piston versus the closing air acting on the exposed surface of the valve seat (Fig. 9). Afer the mechanism has traveled sufficiently for the rod end roller to engage the throttle cam plate, the throttle piston is opened (Figs. 9B-15).

Closing the pilot valve by either releasing the manual pushbutton or de-energizing the pilot valve coil opens up the exhaust ports and closes off the inlet seat. This allows the control air above the inlet and exhaust pistons to exhaust down to atmospheric pressure which causes two actions to take place practically simultaneously:

(1) The inlet valve closes under the combined action of the valve spring and the pressure differential across the valve seat, and

(2) The exhaust valve opens due to the shift in preponderance of force upwardly on the valve, since the only force now is created by the closing air acting on the exposed surface of the valve seat. (Fig. 10). This opens up a large and direct passage from the main closing cylinder to the atmosphere and results in a very rapid "dumping" of the closing air.

For control valves employing the slow exhaust, the function described above is essentially correct except that the exhaust valve closes as soon as the air admitted to the cylinder builds up to a pressure sufficient to overcome the spring bias, and remains closed following the closing of the inlet valve until the air leakage out of the cylinder drops the pressure sufficiently to permit the spring bias to overcome the air pressure on the top side of the valve seat.

The selector piston shown in Figs. 16-17 is located on the main cylinder side of the inlet valve in order that the piston will be responsive to the air pressure conditions in the closing cylinder. The piston and stem are two separate pieces to facilitate disassembly and assembly without removing the valve casting from the mechanism. The spring bias for positioning them in the retrieved position is on the selector lever. Whenever the inlet valve is open, the admission of air to the closing cylinder simultaneously puts air pressure on the selector piston which overbalances the spring bias and shifts the selector linkage.

The slow exhaust assembly shown in Fig. 8B, is used in place of the piston and valve seat of the fast exhaust. Due to differences in machining of the control valve body, the two types of exhaust are not interchangeable without replacing the complete control valve assembly.

Control Scheme

To provide for remote and semi-automatic control of the admission of air to the mechanism, and the cutting off of the air at the end of a closing operation, a control panel is included as part of the standard equipment. The steel panel which is located on the left hand side of the sheet metal housing in order to provide the maximum unrestricted working space around the mechanism, is mounted on hinges enabling the panel to be swung out providing convenient access to the wiring on the rear. The equipment on the standard panel includes a closing relay, a cut-off relay, and three fused knife switches. Referring to Diagram 16-C-4200, the closing relay designated as "X" and the cut-off relay designated as "Y" are pictured in the de-energized position. The arrangement of the two relays as shown provides an electrically trip-free, non-pumping device and is commonly designated as an X-Y control scheme.

The electrically trip-free feature is provided by inserting an auxiliary switch contact designated as "aa" in the cut-off relay coil circuit, and a circuit opening contact of the cut-off relay in the closing relay circuit. The auxiliary switch known as the cut-off switch is mounted on the pneumatic mechanism and connected by a switch operating lever to an extension of the

cross-head roller pin. Thus the position of its contacts are determined by the position of the mechanism closing piston. On a closing operation, as the mechanism approaches the closed position, the "aa" switch makes up its contact energizing the cut-off relay coil, and this in turn opens the cut-off relay contact in the closing relay coil circuit, which returns the closing relay to the de-energized position. Simultaneously the two normally closed cut-off relay contacts in the pilot valve coil circuit open. To provide the non-pumping feature, a normally open cut-off relay contact is connected in parallel with the cut-off switch "aa" contact, and another normally open cut-off relay contact is connected in parallel with the low pressure cut-off and latch check switches. If the mechanism and its connected load fail to remain closed due to some mal-functioning part such as a broken latch, as soon as the mechanism has dropped open far enough to re-open the cut-off switch "aa" contacts, the cut-off relay contact in parallel with the "aa" contact remains closed maintaining the closing circuit "locked out". The closing circuit will continue to be "locked out" until the operator releases the control switch de-energizing the control circuit.

For those special applications where multiple immediate reclosures are required, the 2 pole cut-off switch is replaced with a 5 pole switch which permits two "bb" switch contacts to be inserted in the pilot valve coil circuit in series with the cut-off relay contacts. The "bb" contacts open the pilot valve coil circuit, resulting in faster cutting off of the closing air by eliminating the pickup time of the cut-off relay. This speeds up the retrieving action of the mechanism levers and triggers and makes possible faster successive reclosing times. Leaving the cut-off relay contacts in the circuit retains the anti-pumping feature.

Low Pressure Cut-Out Switch

To insure against the mechanism attempting to close when there is insufficient air pressure in the reservoir to complete the operation, a low pressure cut-out switch, located in the air supply system between the inlet valve and the reservoir and on the mechanism side of the shut-off valve, has its contact connected in the closing circuit. The low pressure cut-out switch contact is normally closed, but opens before the critical operating pressure is reached.

To further insure against a possible faulty operation due to the low pressure cut-out switch opening its contacts during a closing operation, a "make" contact of the closing relay is provided in parallel with the low pressure cut-out switch. As soon as the closing relay is energized, the "make" contact "seals itself in" and insures the admission of air to the mechanism to complete the closing operation. This "seal-in" contact also insures the completion of any closing operation once started, even though the operator might release the control switch before the mechanism has had time to complete the operation.

If the breaker is closed on a fault, and the operating pressure is near the lower limit, the low pressure cut-out switch contacts may open momentarily just after the breaker reaches the closed position. Should this occur while the operator is still maintaining the control switch closed, and after the cut-off relay has caused the "X" seal in to drop out, the breaker would reclose. Employing a normally open cut-off relay contact in parallel with the low pressure cut-off switch insures against this faulty operation.

Additional contacts of the closing relay are situated in the intake pilot valve coil circuit to provide additional adjustment in the closing or reclosing time. Should it be desirable to speed up the reclosing time beyond the adjustment provided in the adjustable contact fingers on the 2 pole or 5 pole switch, a connection between "Y" and "MAG" on 16-C-4200 can be made which eliminates the "X" relay pick-up time. Two contacts of the cut-off relay are also placed in this same circuit in order to speed up the de-energizing of the intake valve at the conclusion of the closing stroke as much as possible, and thus minimize the consumption of the stored compressed air per operation.

One of the fused knife switches on the control panel is provided to take the power off from the control circuit locally during maintenance periods and also provide overload protection. Another fused knife switch is provided for the same reason for the compressor motor circuit. The third fused knife switch is provided in the heater circuit.

Reclosing Adjustment Switch

Reference diagram 16-C-4200. For reclosing duty, besides the addition of a reclosing relay

such as the Type SGR-12 shown, an auxiliary switch indicated as "bb" on the diagram and located in the circuit from the recloser to the control relays is required. This switch which is normally open when the mechanism is closed, is capable of adjustment so that the point in the opening stroke at which it makes up its contact can be varied. The setting of this switch controls the amount of opening of the breaker before reclosing and consequently determines the reclosing time. The "bb" contact is located on the 2 pole or 5 pole auxiliary switch and has adjustable finger contacts for varying the switch setting.

Latch Check Switch

Reference diagram 16-C-4200. To insure that the mechanism is completely retrieved and the trip free trigger is fully engaged before any closing or reclosing operation (2nd or 3rd Reclosure on multiple reclosing) is attempted electrically, an auxiliary switch indicated as LCH (latch check) on the diagram and located in the circuit between the closing circuit at the mechanism and the lead coming from the point of remote control is provided. This switch is operated mechanically by an extension on the trip free trigger and is normally closed except while the trigger is disengaged.

For applications where the Type AA-10 mechanism is used for multiple reclosing duty, the switch determines the reclosing time by requiring that the energizing of the closing circuit be delayed until the mechanism is fully retrieved and the trigger reset following the tripping out of the breaker.

ACCESSORIES

Auxiliary Switches

In addition to the 2 pole or 5 pole cut-off switch, a 11 pole auxiliary switch with independently adjustable contacts is provided for use in interlocking, indicating, alarm and trip circuits. The 11 pole switch is connected to the vertical pull rod and hence indicates the position of the connected load or breaker.

Operation Counter

An operation counter is mounted on the cut-off switch, and is operated by the switch operating arm. The counter records on the opening stroke.

High Speed Switch

A high speed switch is available on special request which mounts on the mechanism housing back and is operated from the vertical pull rod.

Heaters

Three heaters are provided in the mechanism housing. One of these heaters is to be energized continuously winter and summer to maintain a temperature differential between the inside and outside in order to prevent undesirable moisture condensation within the housing. The other two heaters, thermostatically controlled, are suitably located to provide better heat distribution in colder weather.

Hand Closing Device

A removable ratchet type jack hand closing device, which attaches to the lower threaded end of the piston rod and is supported by the underside of the spring housing, is provided for closing the mechanism and its connected load during adjustment of the breaker. This device is not to be used for emergency manual closing of the breaker on a live line. If it is considered desirable from a safety stand-point while workmen are inside the breaker tank to insure against accidental opening of the breaker, a pin is provided which may be inserted through two holes in the side plates on the frame. The pin passes immediately behind the two catches and just above the tail section on the trip free trigger and prevents accidental tripping of the mechanism and consequently unintentional opening of the breaker. *This pin must be removed before putting the breaker back in service.*

PART III—OPERATION

AA-10

Closing

Starting with the mechanism and breaker in the open position (Fig. 3) with the trip free trigger engaged to restrain the trip free lever, closing the control switch energizes the closing relay "X" and inturn the pilot valve coil "MAG", reference 16-C-4200, which admits compressed air stored in the reservoir to the closing cylinder. The trip-free trigger by restraining the trip free lever maintains the trust link and closing lever in the relative position shown in Fig. 3 which effectively connects the closing piston to the breaker pull rod. When the breaker is nearly closed, the "aa" auxiliary switch contacts close energizing the cut-off relay "Y" which simultaneously (1) opens its "Y" contacts in the pilot valve coil circuit initiating the shutting off of compressed air to the closing piston, (2) opens its contact in the closing relay circuit causing the "seal-in" contacts "X" to open and (3) closes the "seal-in" "Y" contact in parallel with the "aa" switch and the "Y" contact in parallel with the low pressure switch to maintain the control relays locked out until the control switch is released. The point where the "aa" switch makes up its contact is so near the end of the closing stroke, that the mechanism and breaker continue on in to the fully closed position before the closing air is actually shut off. As the mechanism reaches the fully closed position (Fig. 4), the holding latch engages the cross-head pin and the non trip-free trigger engages the roller on the holding latch, keeping the mechanism and breaker closed. The closing air in the cylinder is exhausted and the selector bar shifts back to its normal position setting up the non trip free trigger for the next tripping operation.

Opening

Starting with the mechanism in the closed position (Fig. 4), when the control switch or protective relay energizes the trip coil circuit, the trip rod on the moving armature of the trip magnet disengages the non trip free trigger which has been restraining the holding latch to keep the breaker closed. Since the trip free trigger remains in engagement with the trip free lever, the piston remains connected to and is retrieved with the breaker to the open position (Fig. 3). The two strong retrieving springs under the piston help to accelerate the piston and hence contribute partially to the opening speed of the breaker.

Close-Open

Starting with the mechanism in the open position (Fig. 3) as the air pressure builds up in the cylinder following opening of the inlet valve, the selector piston shifts the selector bar to set up the trip free trigger ready for tripping. Tripping the mechanism by the protective relay as the breaker contacts touch, (Fig. 4) disengages the trip free trigger which releases the trip free lever. A projection on the side of the trip free trigger, engages the non trip free trigger moving it clear of its engagement with the roller on the holding latch, as the trip free trigger clears the roller on the trip free lever. The horn on the trip free lever maintains the trigger in the released position until the mechanism is fully retrieved. Release of the restraint on point "C" allows it to rotate about pin "B" which rotates the trip free lever clockwise until points "A" and "C" are opposite each other horizontally. As pin "A" in the breaker rod end continues toward the full open position, point "C" moves to the right which reverses the rotation of the trip free lever (Fig. 5). Going back to nearly the beginning of the trip free action, as soon as the closing lever starts to rotate about pin "B" the "kicker", which is a part of the closing lever, forces the holding latch out of engagement with the cross head pin, which insures unimpeded retrieving of the closing piston to the open position as soon as the closing air has been exhausted. As the closing air is exhausted, the selector bar shifts back to its original position. As the mechanism moves from the extreme trip-free position Fig. 5 to the open position Fig. 3 point "C" now rotates about point "A" which is a fixed center due to the breaker having reached the full open position. For the early part of the retrieving stroke, the trip free lever will again rotate clockwise until points A-C-D are in a straight line. As soon as the piston has retrieved far enough for point "C" to get above the line between A-D, the trip free lever reverses motion and rotates very rapidly back to the relatched position on Fig. 3. The resilient trip

free lever stop provides sufficient overtravel of the trip free lever to permit the trip free trigger to snap into position under the trip free lever roller.

Open-Close

Starting with the mechanism in the closed position Fig. 4, with no air pressure in the closing cylinder, the selective tripping causes the mechanism to trip from the non trip-free trigger when the protective relays energize the trip coil. As soon as the mechanism has opened sufficiently to close the "bb" contact on the 2 pole or 5 pole auxiliary switch, the closing circuit is energized admitting high pressure air on top of the piston. This retards and then reverses the direction of the mechanism and breaker and the mechanism recloses the breaker as in a normal closing operation.

Should the fault still exist that caused the protective relay to trip the mechanism the first time as the mechanism recloses the breaker, the mechanism will function as described in detail under the description of the CLOSE-OPEN section, and the breaker and mechanism will return to the open position. Due to the lockout feature of the Type SGR-12 relay, the mechanism must be closed by the operator before another reclosing operation can be performed.

PART IV—INSPECTION—MAINTENANCE—ADJUSTMENT

Since operating conditions vary so greatly from one area to another and even between installations in the same locality, it is difficult to recommend any time interval for inspection and maintenance. The important consideration in this respect is that a regular schedule is established and maintained in order that the condition of the equipment is known, and any deficiencies corrected before they can develop into a serious condition. The circuit breaker is highly dependent upon the proper functioning of the mechanism. Therefore, it should always be kept in good condition.

Service Manuals I.D.I. 9352-1 and 9352-3 of the Westinghouse Air Brake Co. made a part of this instruction book, contains a complete description of the compressor unit with recommendations for inspection and maintenance.

MAINTENANCE

Caution

When working around the mechanism or breaker, CLOSE the hand valve between the reservoir and mechanism and open the control circuit at the control panel so that accidental operation of the intake valve or closing contactor will not cause the breaker to close unexpectedly. As a further safety precaution, it is recommended that the pushbutton on top of the pilot valve be held down to exhaust the high pressure air between the hand shut off valve and the control valve.

Keep the area immediately below the spring housing free whenever operating the mechanism, as the lower end of the piston rod protrudes through the opening in the spring housing when the mechanism is in the closed position.

For applications where the fast exhaust valve is used and the normal operating pressure is 250 psi or above, an exhaust tube connected to the under side of the exhaust valve and passing through the bottom of the housing is used to carry the exhausted air safely to the outside of the housing. For lower operating pressures, the air is exhausted directly out of the exhaust valve into the housing. In either case, personnel should keep clear of the area immediately below the exhaust whenever the mechanism is operated pneumatically.

Personnel should be cautioned to keep all tools and especially their hands outside of the side plates of the frame whenever the mechanism is in the closed and latched position. This is especially true of the space immediately in front of the trip free lever, as this lever travels at a very fast speed and could result in serious injury if this precaution is not observed.

In order to be sure of the mechanisms good condition and check its readiness for satisfactory operation, especially in applications where the mechanism is not called on to operate for extended periods of time, several operations should be made at each inspection period.

Latches and Triggers

The latch is made of hardened steel machined to shape with the latching surfaces ground smooth after hardening. The triggers are cast from a tough high strength nonferrous alloy with corrosion resistant stellite inserts at the latching points. The engaging surfaces of the latches and triggers may be polished with fine emery cloth if they become dirty. DO NOT ATTEMPT TO GRIND THE SURFACES NOR CHANGE THEIR ANGLE. Apply a thin film of rust inhibitor to the latch and rollers on the engaging surfaces. This inhibitor should be carefully selected to be free-flowing at all anticipated temperatures, non-hardening, and self-healing (does not completely wipe off in one operation). The latching surfaces should be examined at every inspection to make sure that they are not gummed up.

If while adjusting the breaker contacts, it becomes desirable to open the mechanism slowly with the hand closing device after the mechanism has been closed and latched, pull the mechanism slightly into the overtravel position to take the load off from the latch and then while holding the hand trip knob in the tripped position, reverse the jack and back out the breaker. The hand trip knob can be released as soon as the latch starts to back off from the crosshead pin.

The needle bearings are packed with Westinghouse Grease #1022-1, an all purpose grease and shouldn't require repacking.

The grease on the roller guides should be examined periodically for contamination with dust or other foreign matter and if this condition is evident, the old coating should be washed off with a solvent and a new coating of grease applied.

Since the acme threads on the lower end of the piston rod and the mating threads in the jack body are very heavily loaded on some of the largest breakers, a special heavy duty grease is supplied for use with the jack. It is recommended that the threads be relubricated liberally with this grease after a maximum of 4 closing and opening operations.

AIR LEAKAGES

Overall

A good overall check for air leaks in the air supply system is to make a "leak test." Observe the loss in pressure on the pressure gauge over a sufficiently long time in order to determine the rate of pressure drop. When checking leakage, allow the system to cool for about 2 hours before reading pressures if the reservoir has just been filled from atmospheric pressure, otherwise a pressure drop of a few pounds will be observed due to contraction of the air on cooling. When the mechanisms leave the factory, the air system will not lose more than two or three pounds per square inch per hour, but there is no need for alarm if the leakage exceeds this figure somewhat, unless it becomes progressively worse.

As a protective measure before the mechanism assembly leaves the factory, the air cleaner is removed and the compressor run for several minutes while atomized oil is drawn in through the air intake. Therefore when the breaker is first put into service, this oil may show up either in the air exhausted from the control valve or in the air discharge from the reservoir whenever the condensate is blown out. Evidence of oil at these points is normal and expected and should not be cause for alarm.

Inlet Valve

The first place to check for leaks is the pilot valve. Cover one of the two exhaust ports, that come out of either side of the housing directly under the coil, with a finger and apply a soap solution over the other port. Leakage here is generally due to dirt particles on the valve seat. "Cracking" the valve several times by pressing on the pushbutton momentarily will generally serve to dislodge the dirt and make the valve seal properly. However if this proves unsuccessful, the inlet valve can be removed for inspection by unscrewing the hex head plug on the bottom side of the housing. In replacing the valve, make sure that the small valve stem enters the hole in the end of the plunger before replacing the plug.

Checking for leaks past the main inlet valve can be accomplished easily for the valve assembly employing the "fast exhaust". Apply a soap solution over the bleeder hole through the right hand side of the valve body. If a leak is detected here, after having previously determined that the pilot valve is tight, it indicates that the main inlet valve is not sealing properly. The quickest method and one that generally is successful is to "crack" the valve

by bumping the pushbutton on the pilot valve several times. The valve can be removed for inspection of the rubber disc seat by removing the cover on the underside of the valve body. For valve assemblies using the "slow exhaust", it is necessary to first remove the exhaust assembly from the valve body and either close off the exhaust by tightening up the nut on the lower end of the valve stem and then reassembling the exhaust assembly in the valve body or otherwise sealing of the exhaust opening before checking for a leak through the bleeder hole.

If the leak is not connected with the control valve, all air connections including the safety valve should be checked with soap solution.

ADJUSTMENTS

Pressure Gauge

It is advisable to check the pressure gauge with a master gauge to verify the correctness of the indication before checking the pressure switch adjustments.

Pressure Switches

The settings of the pressure switches should be checked against the values stamped on the mechanism nameplate at each regular inspection period. *Governor Switch.* Pressures higher than normal will cause the breaker to slam hard on closing, while pressures lower than normal reduce the reserve capacity stored in the reservoir. If the pressure gauge reading at the time the compressor has just completed recharging the reservoir indicates that the switch is not cutting off at the proper pressure, it may be corrected with adjustment of the slotted knurled stud on top of the switch. The screw on the left hand side of the case under the removable front cover controls the differential. For best switch operation, the differential should be adjusted so that the compressor starts 15 lbs. below the cut-off pressure. *Low Pressure Cut-Off Switch.* Too low a setting of the low pressure cut-off switch, nullifies the purpose of the switch: i.e. to prevent the mechanism from attempting to close when there is insufficient air to complete the operation. Too high a setting would result in the switch opening prematurely and thereby cut down the number of operations unnecessarily that are possible from a fully charged reservoir.

The governor switch is normally set to start up the compressor at a pressure well above the operating pressure of the cut-out switch, thus the cut-out switch is not normally called on to operate except in the event the compressor is out of operation. Since this switch may remain idle over long periods, its readiness to operate in an emergency should be checked at each inspection period. *Low Pressure Alarm.* The low pressure alarm switch is intended to give a warning to the operator in the event that the compressor fails to recharge the reservoir. Therefore in order to forestall erroneous indication of the alarm, the setting of the alarm switch should be checked. *Safety Valve.* To insure against overloading the compressor unit or damage to the mechanism and breaker from operating at excessive pressures in the event of failure of the governor switch to cut off the compressor, the safety valve is set to open at 110 to 125 percent of normal pressure. To verify the safety valve setting, place a jumper across the governor switch contacts and allow the compressor to operate beyond the normal cut-off pressure.

Tripping

The latch and triggers on this mechanism do not require delicate adjustment and therefore no adjustment is provided.

An adjustment for the overtravel of the trip free lever is provided and should be checked occasionally. With the mechanism in the open position Fig. 3, there should be approximately $\frac{1}{32}$" clearance between the trip free lever roller and the stellite tip on the trip free trigger to insure positive resetting of the trigger. More clearance than is necessary at this point will impose severe hammering of the trip free lever roller and the trigger when the closing air is admitted to the cylinder. Adjustment of this clearance is made by turning the resilient stop housing in or out of the strut on the main frame. The small nut on the upper end of the steel follower stem, should be finger tight only, to insure against putting any initial compression on the rubber bumper.

The air gap for the trip armature should be approximately $\frac{3}{16}$". This adjustment is made by varying the height of the resilient stop Fig. 6. For maximum tripping speed, the length of the trip rod should be just long enough to release the trip free lever when the armature air gap

is 1/32". This adjustment has been made at the factory and should not require changing. It can be changed however, if it is found necessary by loosening the lock nut on the underside of the armature and screwing the trip rod either in or out of the armature. If adjustment is found necessary recheck free travel of trip armature before picking up "kick-off" spring as described below.

The "kick-off" spring on the lower end of the trip rod serves to speed up the retrieving of the armature after the trip coil is de-energized. When the armature is sealed in against the pole faces of the magnet, this spring should be compressed about 1/16". Thus for an armature air gap of 3/16", the gap between the underside of the resilient stop bar and the top of the kick off spring should be 1/8". If it is ever necessary to change this factory set adjustment, be sure to keep the trip rod from turning in respect to the armature, by holding the trip rod with a screw driver while loosening and tightening the kick off spring adjusting nuts.

Overtravel

The overtravel of the closing piston should be approximately 1/8". There is no adjustment of the overtravel, but it should be checked to determine that it exists, as it is essential in order to allow time for the latch to snap into place. Furthermore if it is not present, it may indicate that the lift rod stops in the breaker pole unit are engaging too much ahead of the overtravel stop on the mechanism. To check the overtravel with the mechanism in the closed position, hold down the pushbutton on the inlet valve, and observe the travel of the cross-head roller pin.

Throttle and By-Pass

There is only one adjustment provided on the throttle (for those mechanisms where a throttle is supplied) and that is to vary the position in the closing stroke of the mechanism where the throttle is opened up. This adjustment is made by shifting the location of the cam plate on the throttle lever.

The by-pass is fully closed when the threads on the by-pass adjusting screw are flush with the lock nut.

The by-pass is fully open when the by-pass adjusting screw is backed off 8 full turns from the closed position.

A taper on the lower end of the by-pass adjusting screw provides a metering adjustment to the flow of air for positions between the closed and open position. The setting of the by-pass has been determined at the factory and shouldn't normally require further attention.

PART V—TROUBLE SHOOTING SUGGESTIONS

In case unsatisfactory operation develops, the following are suggested points to check in order to isolate the trouble.

A. If the mechanism fails to close the breaker.

1. Check to see that the correct control voltage is available.
2. Check the closing relay to see that it closes its contacts.
3. Check the inlet valve coil circuit.
4. Check the pressure of the air in the reservoir to see that it agrees with the normal pressure given on the nameplate.
5. Check the position of the hand shut off valve between the reservoir and the mechanism.
6. Check the admission of air to the main closing cylinder by observing whether the mechanism starts to close when the button on the pilot valve is bumped and also that there is a momentary discharge from the exhaust, when the button on the pilot valve is released.
7. Check the four studs that clamp the cylinder to the frame and the 3 bolts that fasten the control valve to the frame to make sure that both are clamped securely.
8. Check the breaker stops to make sure there is no interference.
9. Check to see that the trip free trigger is reset properly. Two things to look for if the trigger does not reset are (1) The trip free lever stop being set too low thus limiting the travel of the trip free lever

and (2) The breaker traveling too far in the open position so that the main closing piston hits the top plate thus preventing the retrieving springs from resetting the trip free lever.

B. If the mechanism closes the breaker, but fails to keep it closed.

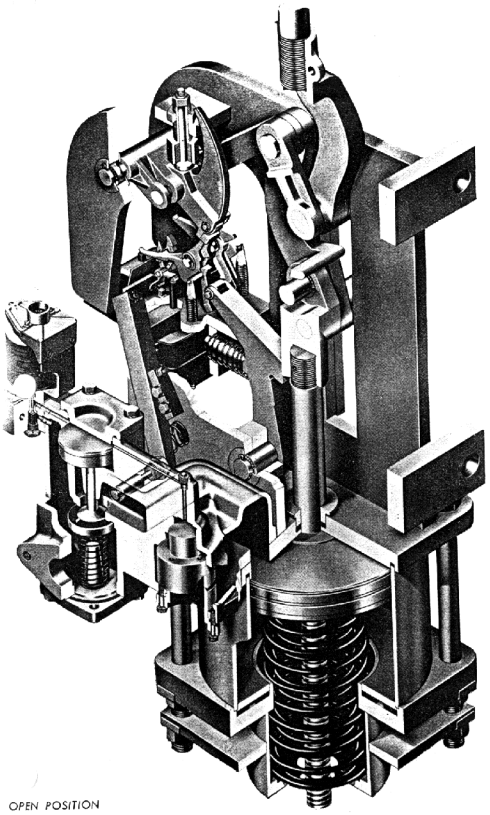
1. Check the minimum operating voltage of the cut-off relay and increase it if it is too low.
2. Check the 2 pole or 5 pole switch contacts to see if they are closing too soon, so as to cut-off the air to the cylinder before the mechanism is closed and latched.
3. Close the mechanism by means of the pushbutton on top of the pilot valve and observe the over travel between the roller on the cross-head pin. This should be about $\frac{1}{8}$" to allow the latch time to reset.
4. While the mechanism is in the overtraveled position of check #3, observe whether the end of the non trip-free trigger resets properly behind the roller on the holding latch.
5. If the non trip free trigger does not reset, close the mechanism with the hand closing jack to the overtravel position and (1) Check the clearance between the "Kicker" and the nose of the holding latch to make sure that the latch is free to move forward for its full travel and (2) check the movement of the non trip free trigger to make sure that it is free to rotate between the limits of the trigger stops.
6. Check the resetting of the trip free trigger to make sure that the upper end of the trigger is against the stop on the trip free lever, and that the trigger is in full engagement with the trip free lever roller.

C. If the mechanism fails to trip.

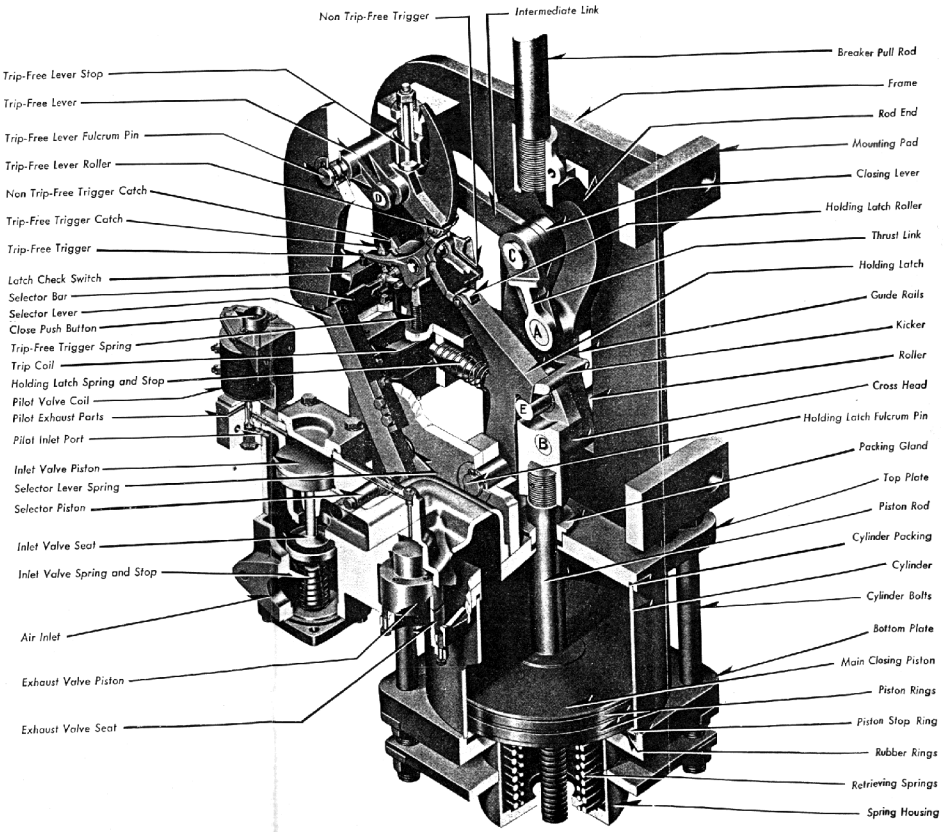
1. Check the voltage at the trip coil.
2. Check the terminals on the 11 pole auxiliary switch to be sure that they are making good contact.
3. Observe whether the trip rod rises when the control switch is moved to the position for tripping.
4. Put the hand closing jack on and take the breaker load off from the latch. Then raise the trip rod manually and observe whether the non trip free trigger is disengaged and the latch is free to rotate releasing the cross-head pin. Also check that the tripping armature seats up against the stationary armature.
5. Check the overlap of the trigger on the latch as in Section B-4 above.

D. On Reclosing Duty, if the mechanism trips but fails to reclose.

1. Check the "bb" contact on the two pole switch to see that it is making good contact.
2. Check to make sure that the cut-off relay is not picking up prematurely and locking out the closing relay and the pilot valve coil. Advancing the setting of the "bb" switch contact too far will cause this to occur.

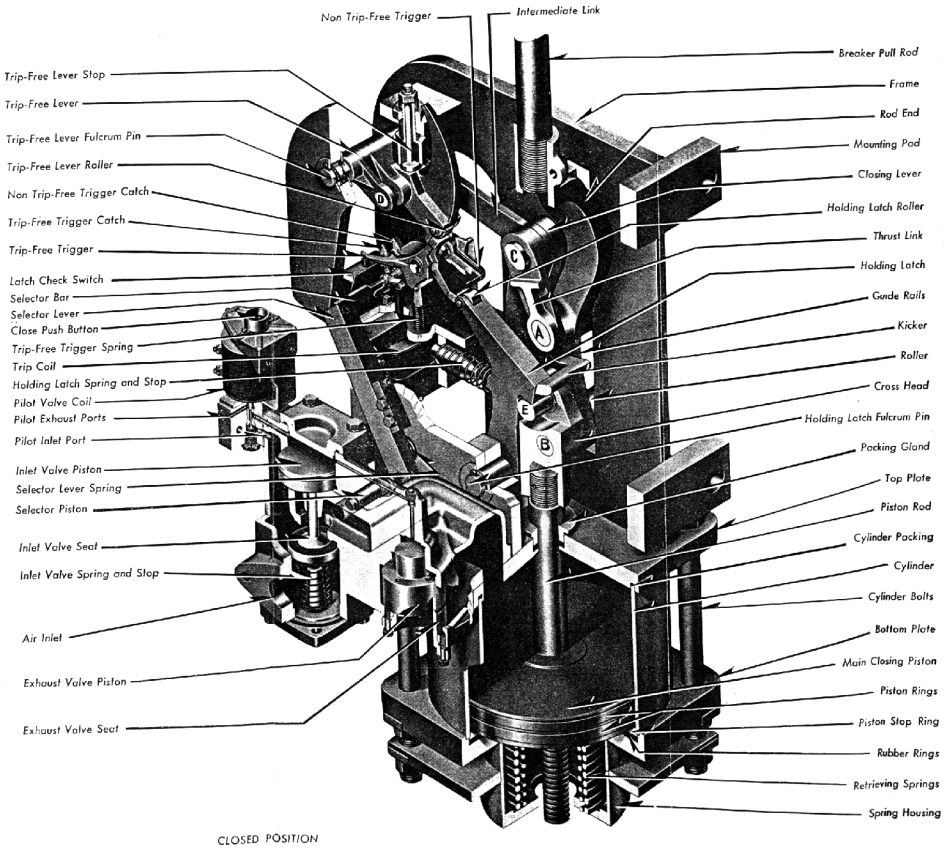


OPEN POSITION
FIG. 3

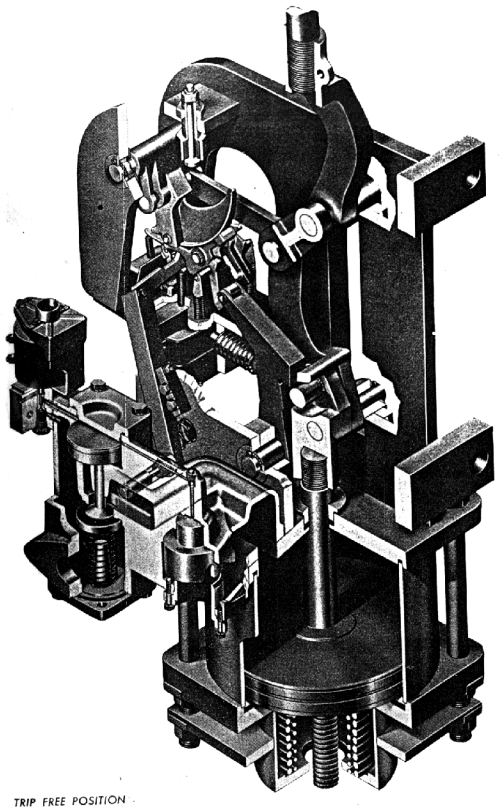


CLOSED POSITION
FIG. 4

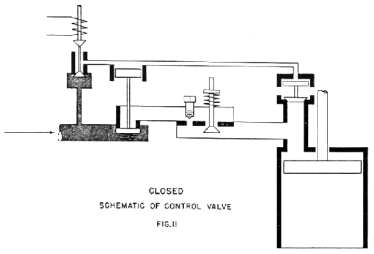
TRIP FREE F
FIG



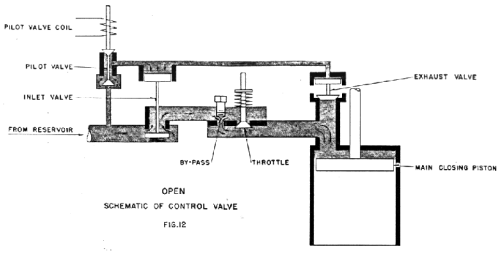
CLOSED POSITION
FIG. 4



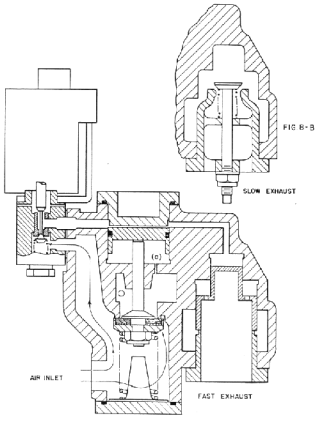
TRIP FREE POSITION
FIG. 5



CLOSED
SCHEMATIC OF CONTROL VALVE
FIG.11

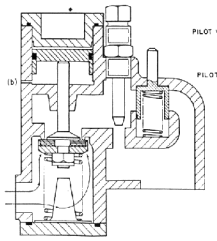


OPEN
SCHEMATIC OF CONTROL VALVE
FIG.12

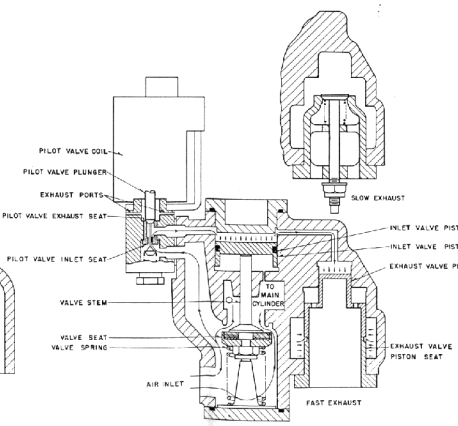


CLOSED
FIG. 8

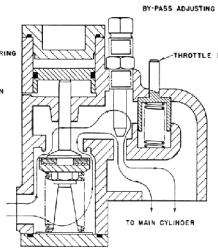
FIG. 8-B



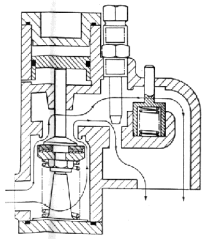
CLOSED
MECHANISM FULL OPEN
FIG. 8-A



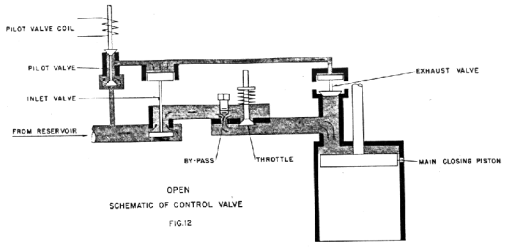
OPEN
FIG.9



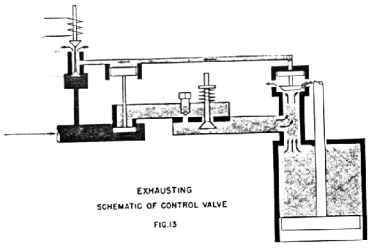
OPEN
MECHANISM IN EARLY PART OF CLOSING STROKE
FIG.9-A



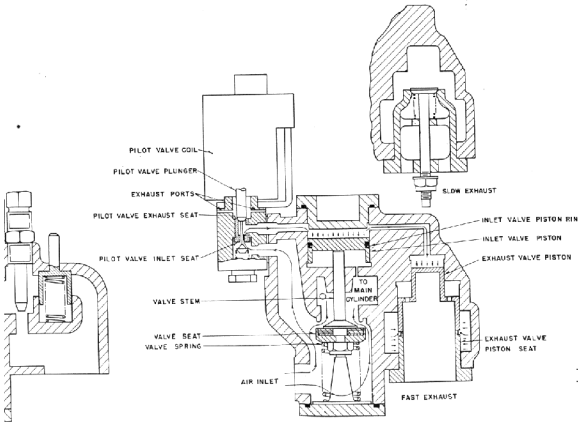
OPEN
MECHANISM NEARING END OF CLOSING STROKE
FIG.9-B



OPEN
SCHEMATIC OF CONTROL VALVE
FIG.12

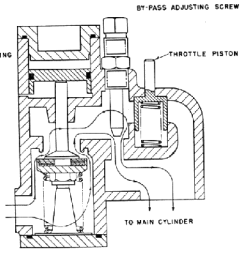


EXHAUSTING
SCHEMATIC OF CONTROL VALVE
FIG.13

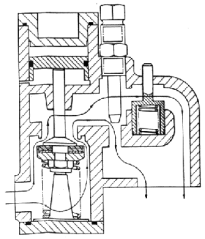


SED
FULL OPEN
8-A

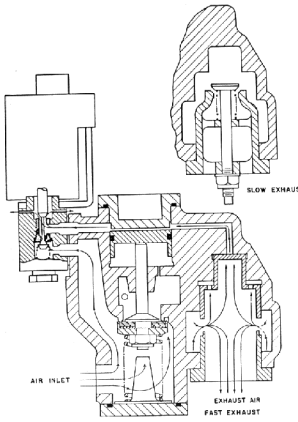
OPEN
FIG.9



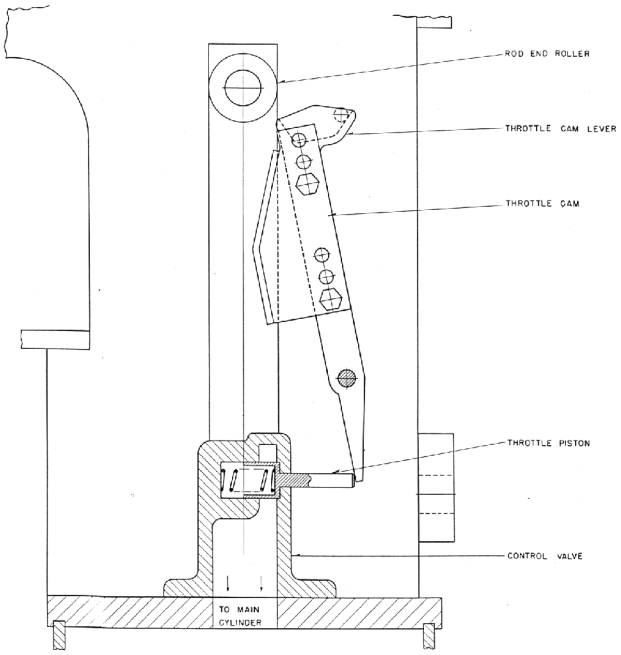
OPEN
MECHANISM IN EARLY PART OF CLOSING STROKE
FIG.9-A



OPEN
MECHANISM NEARING END OF CLOSING STROKE
FIG.9-B

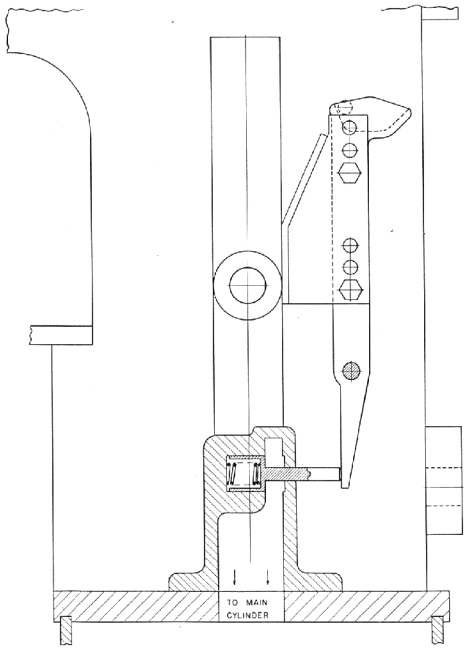


EXHAUSTING
FIG.10



MECHANISM OPEN-THROTTLE CLOSED

FIG 14



MECHANISM CLOSED-THROTTLE OPEN

FIG 15

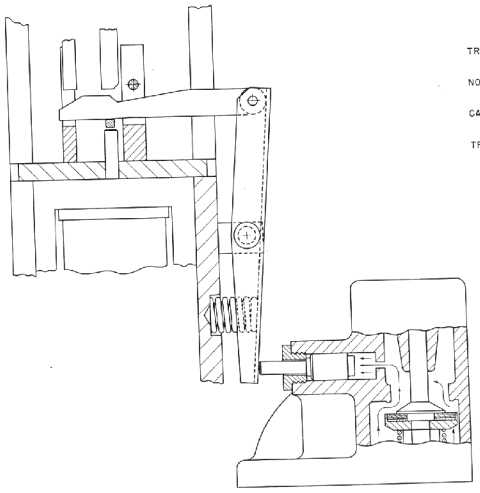


FIG.16

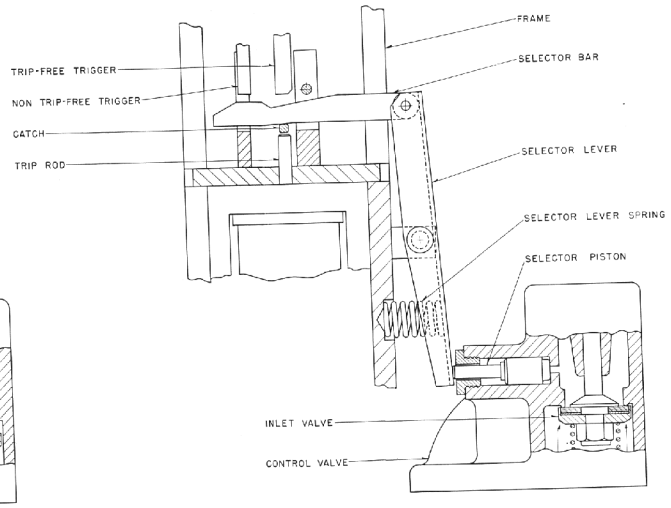
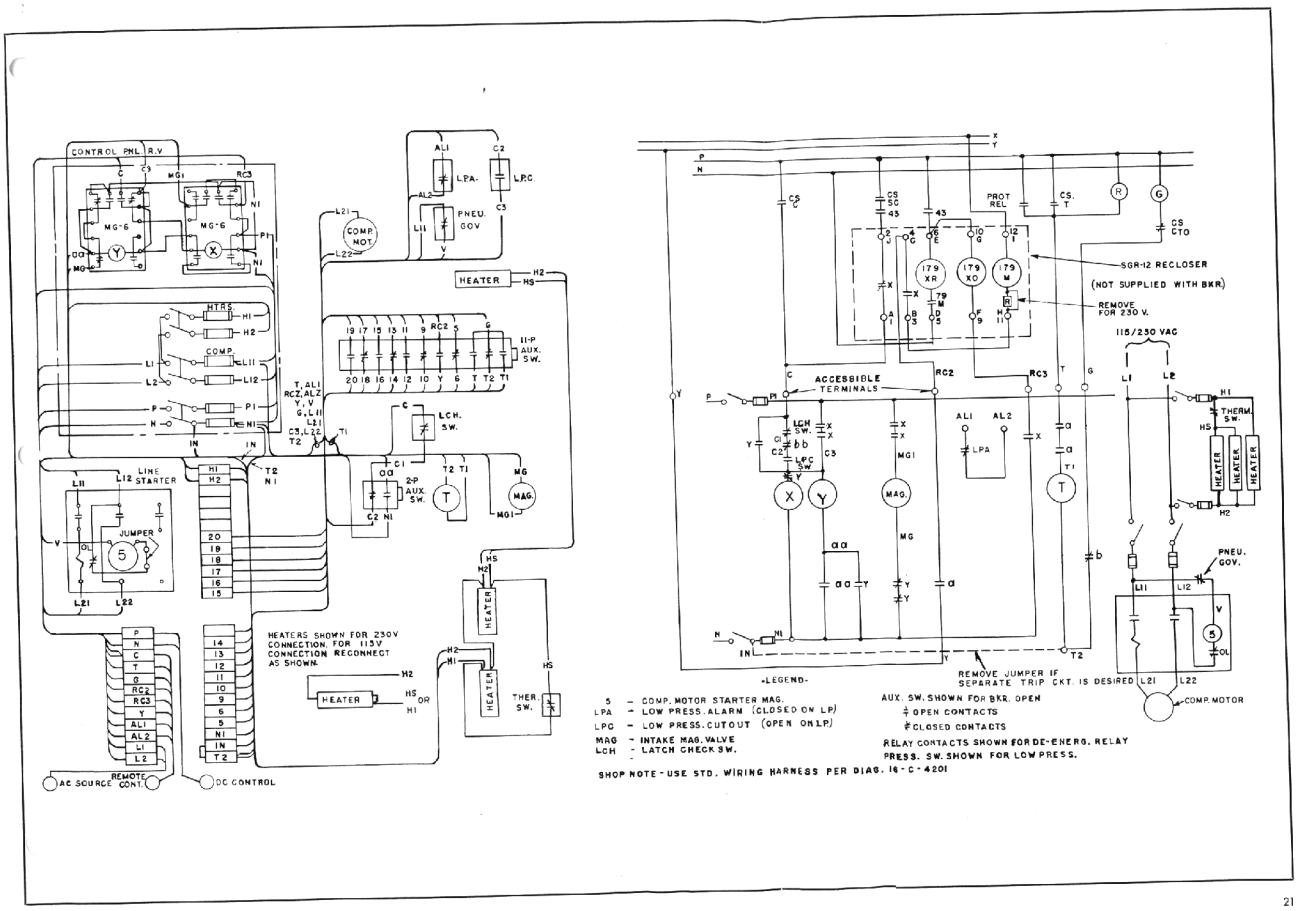

FRAME
SELECTOR BAR
TRIP-FREE TRIGGER
NON TRIP-FREE TRIGGER
CATCH
TRIP ROD
SELECTOR LEVER
SELECTOR LEVER SPRING
SELECTOR PISTON
INLET VALVE
CONTROL VALVE

FIG.17


CONTROL PNL R.V
MG-6
COMP. MOT.
PNEU. GOV
LPA.
LPC.
HEATER
HTRS.
COMP.
11-P AUX. SW.
LCH. SW.
2P AUX. SW.
MAG.
LINE STARTER
JUMPER
HEATERS SHOWN FOR 230V CONNECTION. FOR 115V. CONNECTION RECONNECT AS SHOWN.
THER. SW.
REMOTE CONT.
AC SOURCE
DC CONTROL
SGR-12 RECLOSER
(NOT SUPPLIED WITH BKR)
REMOVE FOR 230 V.
115/230 VAC
ACCESSIBLE TERMINALS
THERM. SW.
REMOVE JUMPER IF SEPERATE TRIP CKT. IS DESIRED
COMP. MOTOR
-LEGEND-
5 - COMP. MOTOR STARTER MAG.
LPA - LOW PRESS. ALARM (CLOSED ON LP)
LPC - LOW PRESS. CUTOUT (OPEN ON LP)
MAG - INTAKE MAG. VALVE
LCH - LATCH CHECK SW.
AUX. SW. SHOWN FOR BKR. OPEN
a OPEN CONTACTS
b CLOSED CONTACTS
RELAY CONTACTS SHOWN FOR DE-ENERG. RELAY
PRESS. SW. SHOWN FOR LOW PRESS.
SHOP NOTE - USE STD. WIRING HARNESS PER DIAG. 16-C-4201