



DESCRIPTION • OPERATION • MAINTENANCE
INSTRUCTIONS

Oil Circuit Breaker
OPERATING MECHANISM

Type CAS-6

**RETURN
TO
Westinghouse Electric Corp.
DIST. INCH. & SERVICE DEPT.
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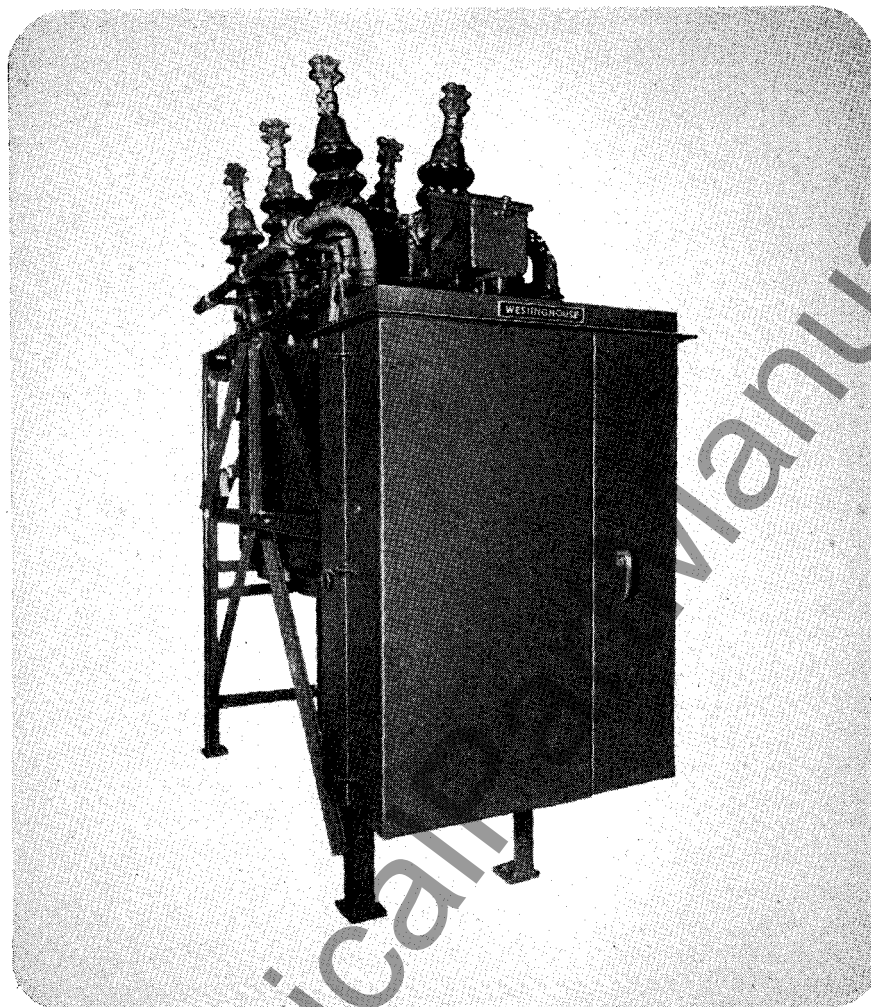
WESTINGHOUSE ELECTRIC CORPORATION
SWITCHGEAR AND CONTROL DIVISION

EAST PITTSBURGH PLANT

EAST PITTSBURGH, PA.

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An oil circuit breaker operated by the Type CAS-6 operating mechanism is closed by compressed air and opened by springs. It is pneumatically trip-free on automatic operation and mechanically trip-free on hand closing. The usual application for this mechanism is for high-speed reclosing duty, but it is sometimes used for eliminating the large batteries required for a solenoid mechanism.

DESCRIPTION

Type CAS-6 operating mechanism (See Figs. 1 and 2) is equipped with a single coil shunt trip, an exhaust magnet valve (electrically coupled to the trip coil), an intake magnet valve (may also be operated manually by pushing down on the magnet armature), an automatic throttle, a ten-pole auxiliary switch, a two-pole auxiliary switch, an operation counter, a control panel, an air compressor with

storage tank and pressure switches, thermostatically controlled heaters, and an all steel weatherproof, outdoor housing which completely encloses all of the above equipment.

The breaker operating rod is connected through a link (to allow for lateral motion) to the main piston. The automatic lever is held closed by the automatic latch at the left end. The non-automatic lever (for

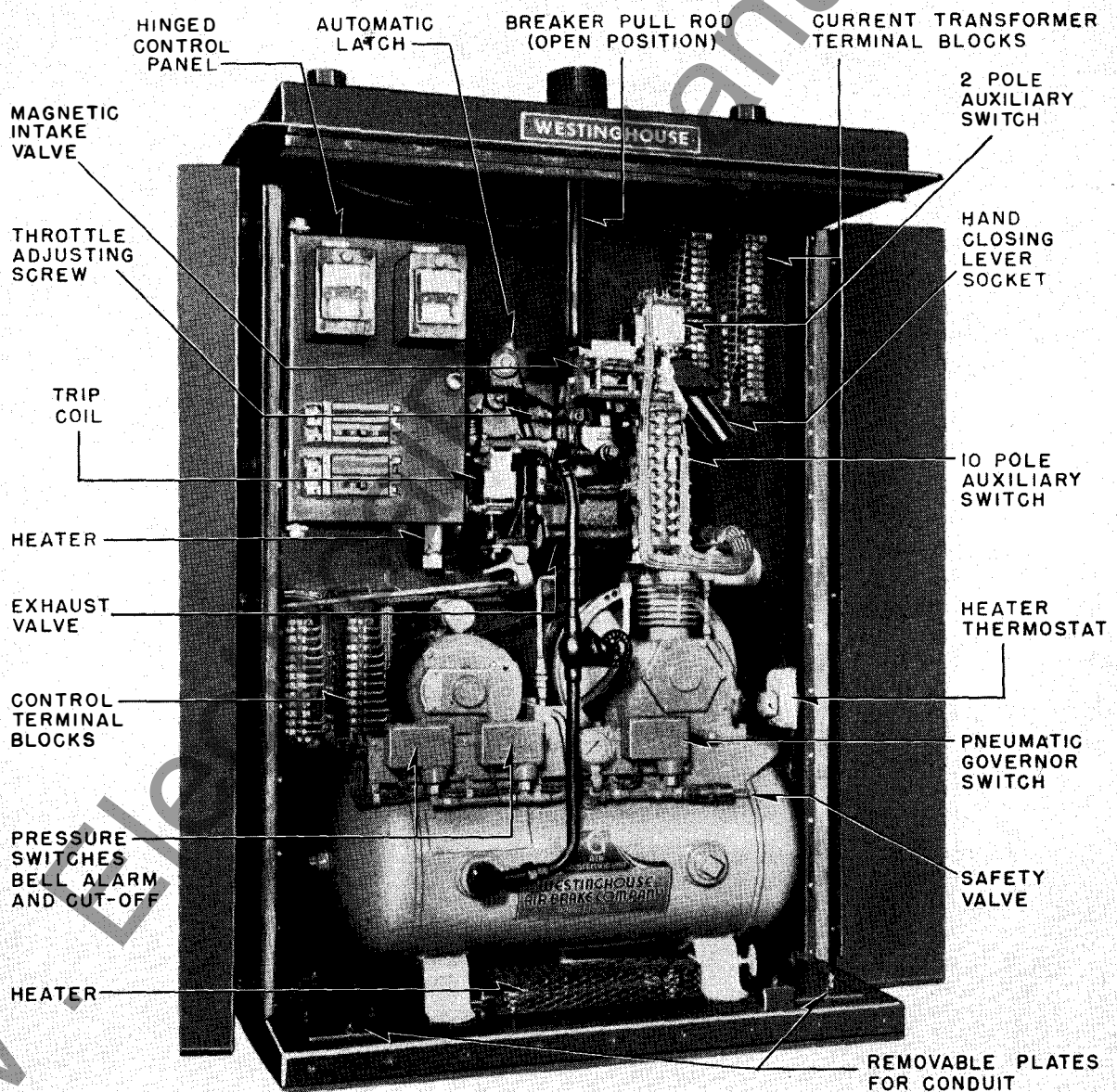


FIG. 1. Type CAS-6 Operating Mechanism in Housing.

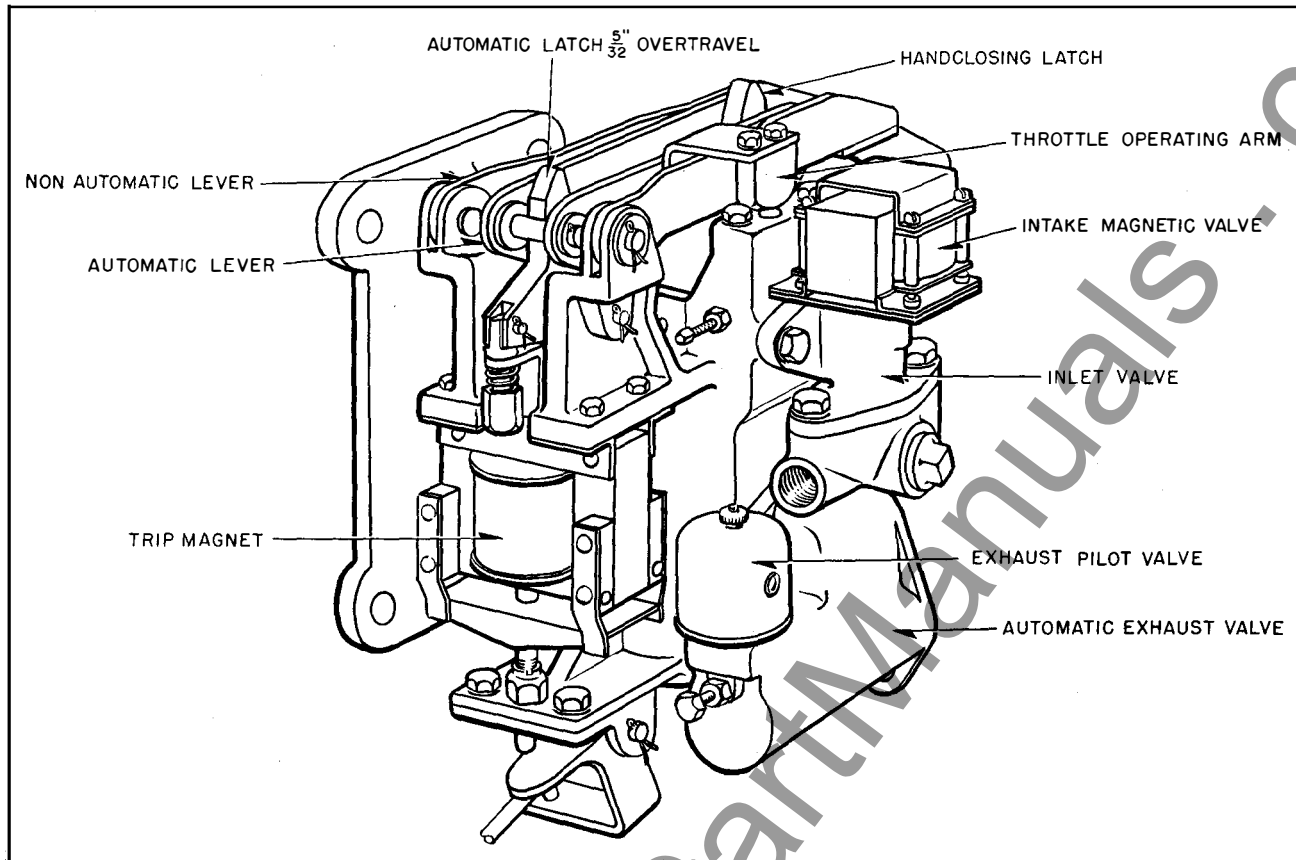


FIG. 2. Type CAS-6 Operating Mechanism.

hand closing) is pinned to the mechanism frame at the left end and pinned to the automatic lever at the right end; the two levers are held closed at the right end by the hand closing latch. For normal automatic operation, the mechanism operates as a single lever mechanism and is pneumatically trip-free. The non-automatic lever comes into play only to make the mechanism mechanically trip free on hand closing.

The mechanism and its associated equipment is substantially constructed, and all vital parts such as pins, pistons, valves, etc., are made of corrosion-resisting materials to insure satisfactory performance over a long period of time. A 350-watt space heater is energized continuously, winter and summer, in order to keep the temperature inside the mechanism housing a few degrees above the outside temperature, thus preventing condensation of moisture inside the housing. A second 350-watt heater operated by thermostatic control to cut in at low temperatures is suitably located to reduce the danger of moisture freezing around the valves of the mechanism and compressor. If the equipment has been out of service, the compressor should not be started in freezing weather without first making sure that

the heaters have been on long enough to thaw out valves, etc. Otherwise the compressor may develop dangerously high cylinder pressures. The compressor may be disconnected by opening the AB breaker in the motor circuit, leaving the heaters energized.

The air supply equipment consists of a 150-pound air compressor with a storage tank and automatic control. A pneumatic governor is set to maintain the pressure in the storage tank at a certain normal value; the compressor motor is started when the pressure falls 10 pounds below this value. The normal pressure may be set anywhere from 150 pounds on down, depending on the particular breaker with which the mechanism is to be used. Large breakers will, of course, require higher pressure to close, while it is desirable to limit the pressure to a lower value on smaller breakers in order to prevent undue slamming.

The air compressor is equipped with a $\frac{1}{2}$ hp, single-phase, 60-cycle, 115/230 V a-c motor. The motor (and heaters, also 115/230 V) are connected for 230 volts when shipped in order to prevent damage to the motor from over-voltage unless 115-volt connection is specified. The air system is suitable

for at least five operations without recharging. The system will charge from atmospheric pressure to 150 pounds in approximately 25 minutes. The pressure will build up to normal after the motor has been started by the pneumatic governor (10 pounds below normal) in two to three minutes. The storage tank fulfills all requirements of State Inspection Codes, and all equipment is manufactured under A.S.M.E. requirements with close inspection.

If anything should go wrong with the compressor or air equipment so that normal pressure is not maintained, a pressure switch is available to sound an alarm at the substation when the pressure reduces to about 15 pounds above the lowest pressure at which the breaker will operate satisfactorily. At a pressure a little higher than the minimum satisfactory operating pressure, another pressure switch operates to open the circuit to the closing relay, thus preventing the mechanism from attempting to operate the breaker when there is insufficient air pressure to complete the operation.

A safety valve is supplied on the storage tank which will pop off at approximately 15 percent above the normal operating pressure. This prevents the pressure from building up to a dangerous level if the pneumatic governor fails to cut off the compressor motor. The settings of all pressure

switches and safety valves are made at the factory and should not be changed.

A 10-pole and a 2-pole type W rotary auxiliary switch, each independently adjustable and mechanically connected to operate with the breaker contacts, are included. Contacts not used for breaker control may be used for signal lights, interlocking, and other control circuits.

RECEIVING 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 to see that no damage has occurred in shipment. Unpacking should be done carefully to prevent damage, and all parts should be checked with the shipping list so as not to leave any parts in the packing material. The mechanism should be accompanied by the proper identification tag and this instruction book.

If the mechanism is not placed in service immediately, it should be kept in a clean dry place, protected from corrosion and moisture. It would also be well to apply a coating of grease or some rust-inhibiting material on pins and bearings, and especially on the latching surfaces of the latch and trigger.

OPERATION

Before operating the mechanism for the first time, remove all tags, instruction books, etc., from the housing, read instructions and file for ready reference. Remove blocking from relays, wire on latches, and all other material used for shipping purposes. Before operating compressor, make sure that it is filled with a good grade of SAE No. 30 engine oil (SAE No. 20 for winter conditions), that the belt and flywheel are free from all foreign material, and that the drain valve at the bottom of the storage tank is closed. In freezing weather, allow the space heaters to remain energized several hours before operating the compressor. Also read the Westinghouse Air Brake Co. installation and maintenance leaflet accompanying each compressor unit before operating.

Operate the mechanism with the hand closing lever as described in the following paragraph before operating it with air to make sure that all moving parts of the mechanism and breaker are free.

The mechanism may be opened slowly by hand by holding down on hand closing lever and releasing hand closing latch at right end of mechanism, then carefully raising the hand closing lever.

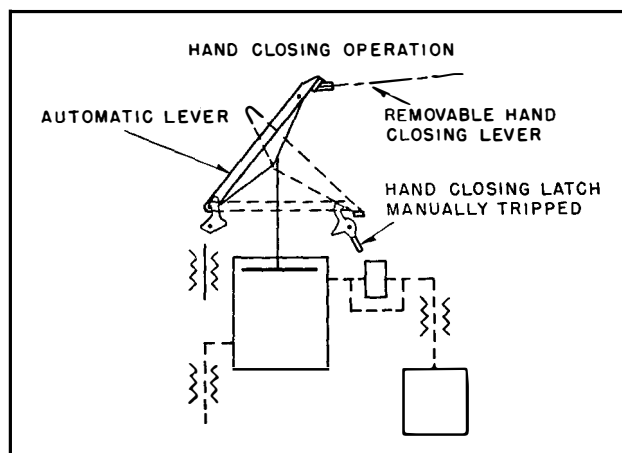


FIG. 3. Mechanism Levers in Position for Hand Closing.

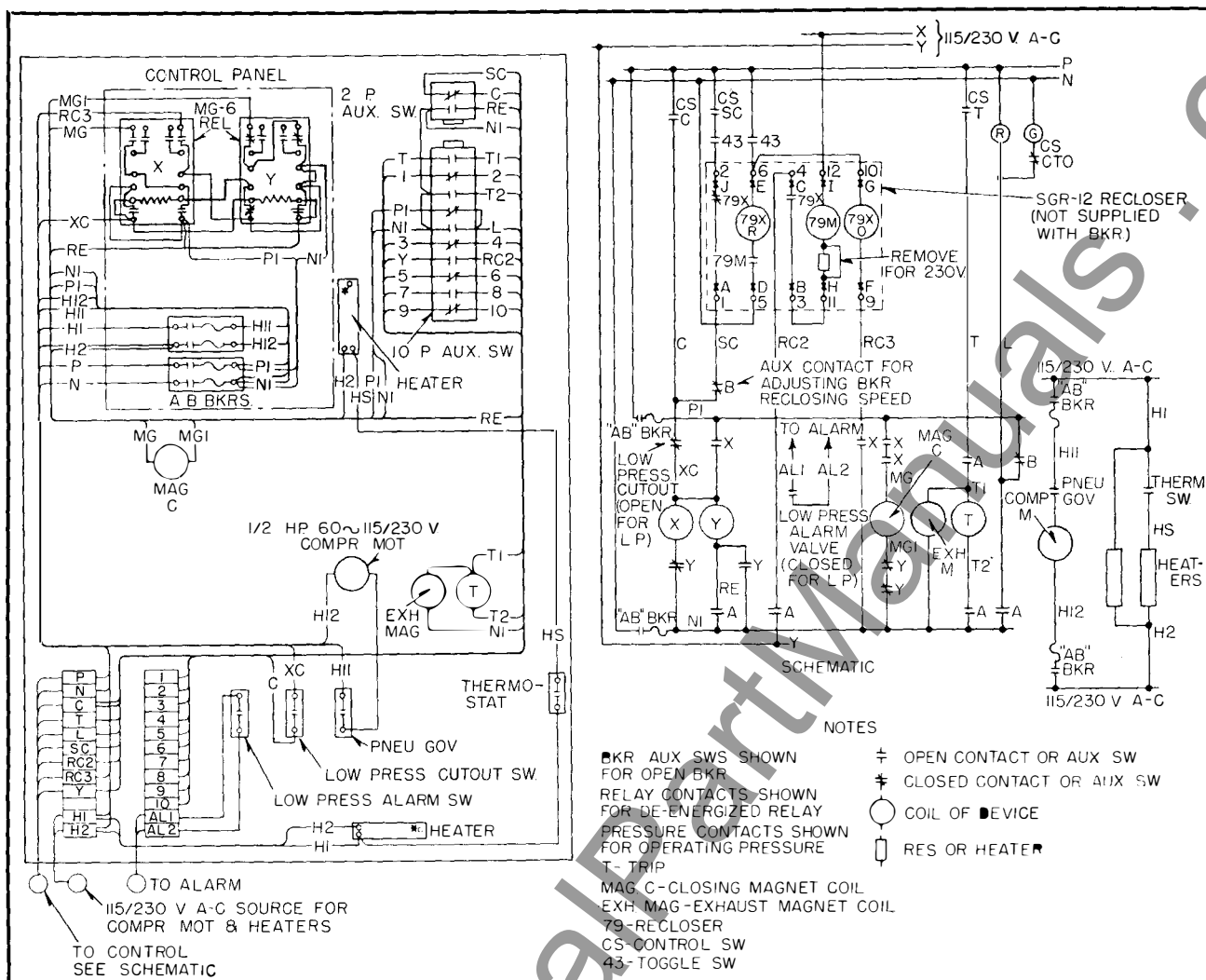


FIG. 4. Wiring and Schematic Diagrams.

Caution: Always make sure that the air valve between storage tank and mechanism is closed before using hand closing lever or before working on mechanism. Also be sure to remove hand closing lever before operating the mechanism electrically.

Hand Closing Operation. Refer to Fig. 3. With the mechanism in the normal open position as shown by the dotted lines, the removable hand closing lever is inserted in its socket at the right end of the mechanism. By releasing the hand closing latch manually, the hand closing lever may be pushed upward (carrying the non-automatic lever) until the automatic latch is engaged at the left end of the mechanism as shown by the solid lines. In this position the hand closing lever is coupled to the breaker and is ready to close. If the breaker is to be closed on a live line, the closing operation

should be executed in a single positive sweep. If the breaker should happen to be closed on a fault, the automatic latch is free to operate, so that the breaker is mechanically trip-free and opens as described under "Simple Opening".

Simple Closing. Fig. 4 shows a typical X-Y control scheme used for straight closing or re-closing operations. For straight closing, the X relay coil is energized through the control switch on the switchboard and its contacts in turn energize the intake magnet valve. The latter opens, permitting high pressure air from the storage reservoir to pass into the mechanism cylinder where it forces the piston down, closing the breaker contacts. When the breaker is closed, the Y relay coil is energized through an "A" contact on the breaker auxiliary switch. At this time two Y relay contacts in the magnet valve circuit and one in the X relay coil

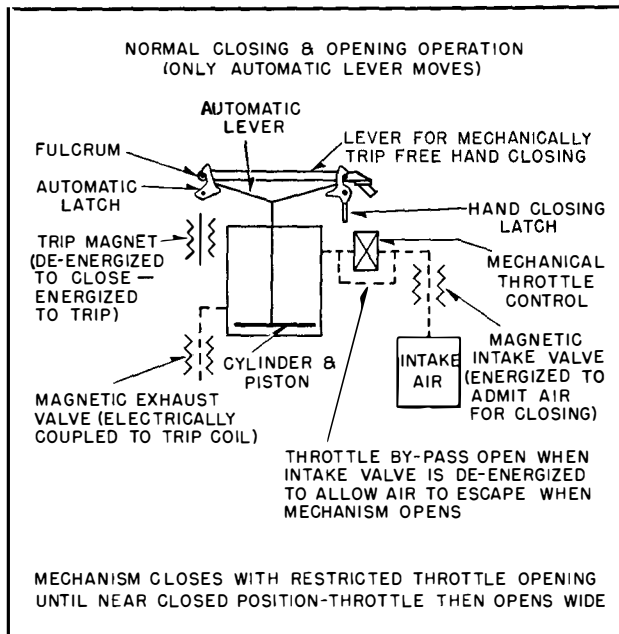


FIG. 5. Schematic Diagram of Normal Closing and Opening Operation.

circuit are opened, thus de-energizing the magnet coil and the X relay simultaneously. A fourth Y relay contact connected in parallel with the "A" auxiliary switch closes when the Y relay is energized, providing an anti-pumping seal-in connection for Y relay.

Figure 5 shows schematically the position of the various mechanism parts in the closed position and indicates the functions of the various assemblies.

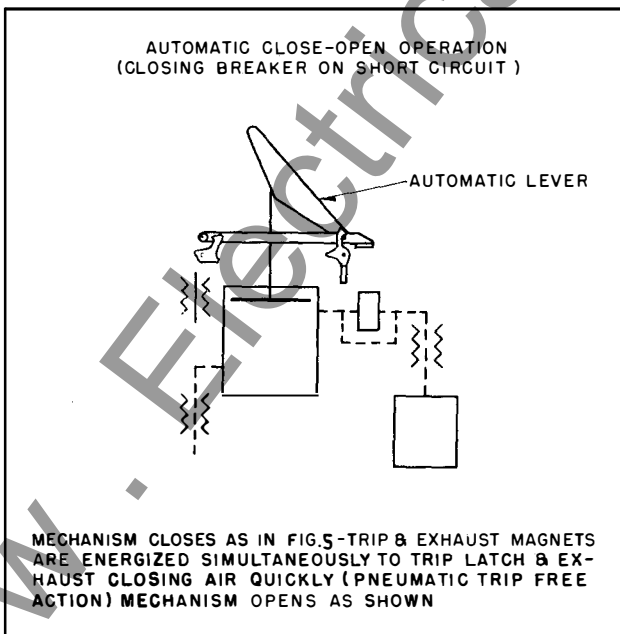


FIG. 6. Schematic Diagram of Close-Open Operation.

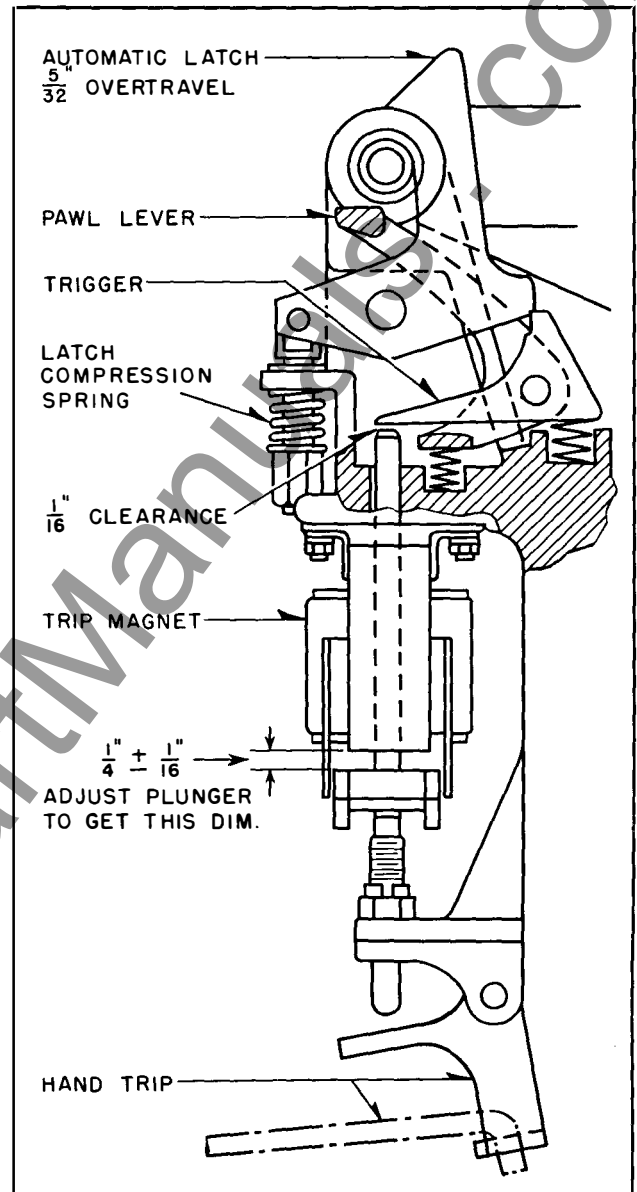


FIG. 7. Detail View of the Latch Assembly in the Closed Position.

The main piston of the mechanism is connected to the automatic lever and the breaker vertical pull rod through a link which provides for lateral motion of the lever. Fig. 6 shows the position of the levers when the mechanism is open. In closing, the piston moves down, the automatic lever rotates downward about the right hand end until the roller at the left hand end of the lever strikes the sloping face of the automatic latch (see Fig. 7), forcing it to rotate clockwise about its fulcrum pin as the lever moves further down. Further motion of the lever also forces the pawl lever down, freeing the trigger, which rotates in a counter-clockwise direction, and as the roller clears

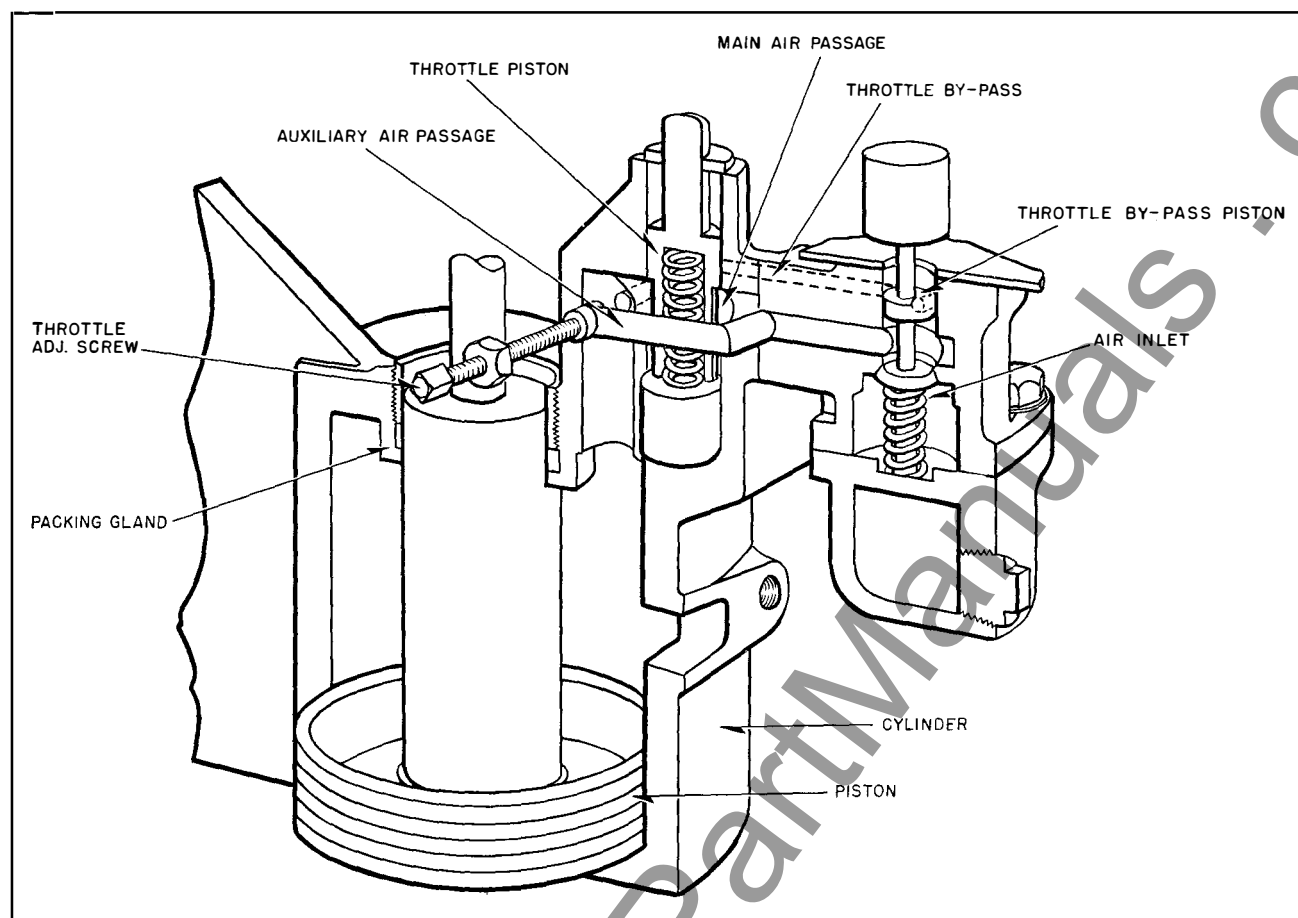


FIG. 8. Section View Showing Air Passages.

the nose of the latch and the latch snaps into place, the trigger engages it and locks it in the closed position. Fig. 7 shows the detail of the latch assembly in the closed position. The flow of air to the mechanism cylinder during the first part of the closing stroke is restricted by a throttling device built into the mechanism. This limits the flow of air to the piston while the accelerating spring and closing load is relatively light, preventing excessive slamming. The throttle is automatically opened near the end of the stroke so as to enable the mechanism to exert maximum closing force at the time it picks up the contact and final accelerating spring load as well as the load imposed by the flow of short circuit current through the breaker contacts.

In Fig. 8 the passage from the air inlet of the magnet valve to the operating cylinder is shown with the throttle piston in the open position as it is at the end of the closing stroke. In this position, a small diameter section of the piston is in position

in the air passage, permitting free flow of air past this section of the piston to the top of the cylinder. When the mechanism is in the open position, the throttle piston is raised so that the lower enlarged section is in the main air passage, completely sealing it off.

The main air passage is supplemented by an auxiliary passage shown in Fig. 8 on the near side of the main passage, one end of which is partially closed by a throttle adjusting screw. This controls the amount of air admitted to the main cylinder during the first part of the stroke. The throttle piston is moved from the throttling position to the open position by a throttle operating arm attached to the automatic lever of the mechanism.

When the magnet coil is de-energized at the end of the closing stroke, the inlet valve and the throttle by-pass piston move up to the position shown in Fig. 8 and the latter uncovers exhaust ports (not shown) on the near side of the valve body, and throttle by-pass ports connecting to a throttle by-

pass passage through which the compressed air in the cylinder is exhausted to atmosphere.

Note: It is also possible to close the mechanism pneumatically by inserting a screwdriver under the intake magnet guard cover and using it as a lever to push down on the magnet armature.

Simple Opening. Starting with the mechanism in the closed position as shown in Figs. 5 and 7, the trip coil is energized either by turning the switchboard control switch to the trip position, or by the automatic action of protective relays. This causes the trip plunger to snap upward and strike the trigger. The trigger rotates clockwise about its fulcrum pin to release the latch which in turn is forced back by the roller on the operating lever under action of the breaker accelerating spring. As the automatic lever moves upward, it releases the pawl lever spring so that the pawl lever holds the trigger away from the latch in readiness for the next closing operation.

When the mechanism opens, the air at atmospheric pressure above the main piston would normally escape through the restricted throttle opening. However, the throttle restriction would be small enough in some cases to actually slow down the opening stroke due to the slow escape of the air trapped above the piston. To eliminate this possibility a throttle by-pass is provided, the openings of which are exposed by the throttle by-pass piston when the valve is in the closed position, thus insuring rapid escape of atmospheric air above the main piston.

Close-Open Operation—Pneumatic Trip-Free Action. If, at the time of closure, some condition exists which causes the trip circuit to be energized, the exhaust pilot valve coil will also be energized, simultaneously opening the exhaust pilot valve and permitting high pressure air from mechanism cylinder to act on the head of the exhaust valve piston. The latter is forced open as shown in Fig. 9 so that the high pressure air in the main cylinder is quickly exhausted to atmosphere. This permits the breaker to open quickly without disconnecting the breaker operating rods from the mechanism piston and lever.

This differs from the solenoid mechanism, with which it is necessary (due to sluggishness imparted to the mechanism core by the inductive circuit) to disconnect the breaker pull rod from the solenoid core by means of a trip-free lever in order to obtain adequate opening speed

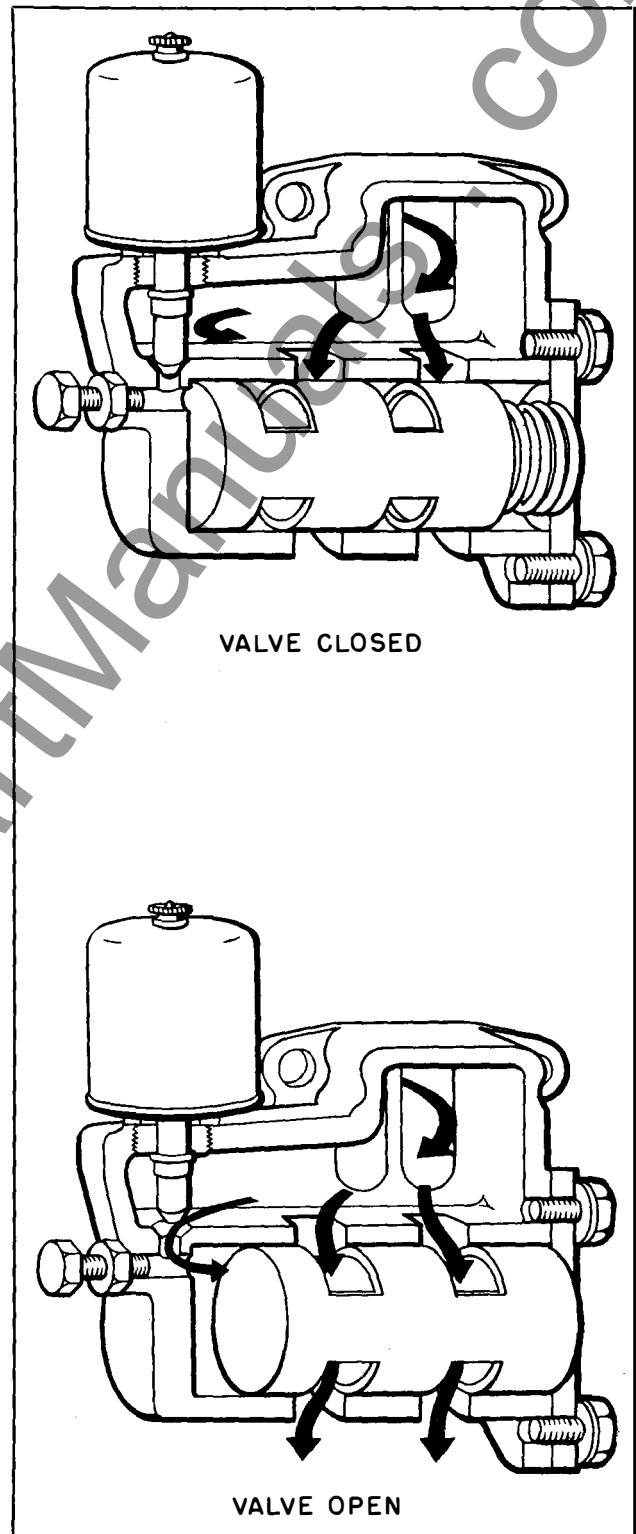


FIG. 9. View Showing Operation of Exhaust Pilot Valve.

when opening under such conditions. This action of the pneumatic mechanism is called pneumatically trip-free operation and by permitting direct con-

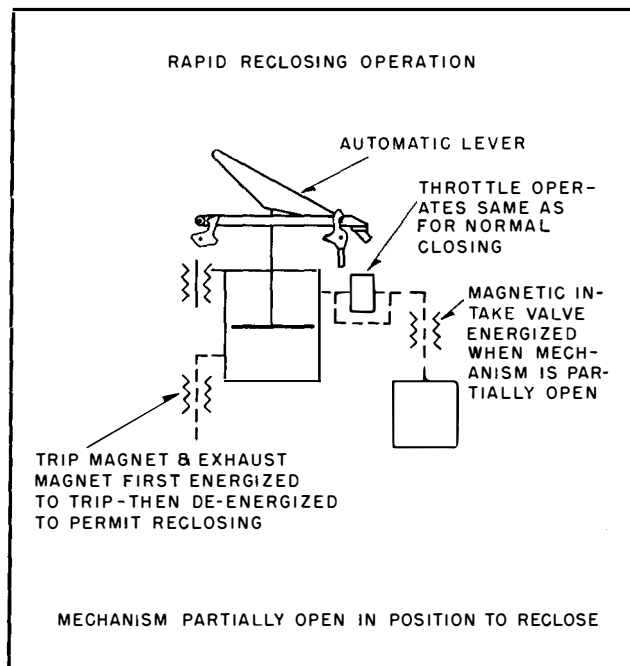


FIG. 10. Schematic Diagram of Rapid Reclosing Operation.

nection of the mechanism piston and lever to the breaker operating rod at all times makes the mechanism inherently suitable for high speed reclosing service.

Rapid Reclosing Operation. Fig. 4 shows a typical high speed reclosing set-up using the Westinghouse SGR-12 single-shot recloser, while Fig. 10 represents schematically the operation of the mechanism in this service. Start with the breaker in service in the closed position. When a fault occurs, the protective relay causes the breaker to trip in the manner previously described.

As the breaker begins to move toward the open position, the trip and exhaust coils are de-energized by the opening of the two series "A" (auxiliary switch) contacts shown in Fig. 4, leaving the mechanism ready for reclosure. Shortly after the two "A" contacts de-energize the trip-exhaust circuit, the "B" contact in the SC circuit closes, energizing the "X" relay through the reclosing relay and in turn the intake magnet valve. Air is then admitted to the top of the main piston as described under "Simple Closing" and quickly builds up enough pressure to arrest the opening stroke and start the breaker back to the closed position. The partial closing stroke is completed in the same manner as for straight closing. If the fault no longer exists on the line, the breaker will remain in the closed

position after opening and reclosing. If the fault still exists on the line, the protective relay will cause the breaker to trip again. The breaker will then trip free pneumatically as previously described and remain open, since the closing circuit through the recloser is broken following the reclosing operation.

The speed of breaker reclosing is determined primarily by the point in the opening stroke at which the air is admitted. This is controlled by the "B" (special) contact on the two-pole auxiliary switch shown in Fig. 4 which energizes the intake magnet valve (through "X" relay). It should not be necessary to disturb this contact since it has been properly adjusted at the factory.

For 69 kv breakers, when high speed reclosing in the order of 20 cycles is required, an attachment known as the Throttle Selector is used. This is a small latch arrangement which holds the throttle wide open until the breaker has completed more than half its full opening travel, after which the breaker movement releases the throttle to the limiting position ready for the next normal closing operation. However, on a reclosing operation, the wide throttle opening will reverse the breaker travel before it completes much more than half its full travel; thus the throttle is wide open for the entire reclosing stroke. In connection with the throttle selector, a spring-operated operation counter arrangement is used, so that the counter will operate on half stroke. Full breaker stroke will then take up the remaining travel by stretching the spring.

Adjustments. The mechanism, compressor, pressure switches, auxiliary switches, throttle, latches, etc., have been properly adjusted and tested with the breaker at the factory for satisfactory performance, and the timing has been checked. It should not be necessary to change any of these adjustments before placing in service.

A check on these adjustments, on periodic inspections, or if trouble is experienced, can be made very easily. Refer to Figs. 3 and 7. With the air and control voltage shut off and the breaker open, trip the hand closing latch manually and push the non-automatic lever toward the position shown. When the roller on the automatic lever is directly opposite the latch nose, check to see that the latch has at least $\frac{1}{16}$ inch travel remaining and is not jamming against the roller. If this travel is not obtained, it is an indication that the latch compression spring is going solid; this may be corrected by

loosening the castle nut which controls the spring compression.

A reasonable amount of compression on the latch spring is desirable in order to snap the latch into place quickly before the air supply is shut off or the automatic lever bounces open. However, too much latch spring compression may cause the breaker to be hard to latch and cut down the number of operations possible before re-charging the storage tank, or cause the latch to jam on the roller as indicated above. The normal compressed length for the latch spring is $1\frac{1}{16}$ inches (breaker closed and latched).

The $\frac{5}{32}$ inch overtravel dimension indicated at the automatic latch (see Fig. 7) is an important factor for good latch operation since it allows the latch time to snap into place. There is no adjustment for the $\frac{5}{32}$ inch overtravel; it is only necessary to make sure that this overtravel is taken up when the breaker closes. Motion should be stopped by the automatic lever striking the stop on the mechanism frame, and not by the main piston striking the bottom cylinder cover, or by the breaker lift rods striking their stops. This may be checked by holding a piece of cardboard over the automatic lever stop to see if it is marked by the lever when the breaker closes. The standard $\frac{1}{16}$ inch clearance on the breaker lift rod stops will take care of this (breaker closed and latched without overtravel).

With the breaker closed and latched, the trigger should be stopped from rotating counter-clockwise by the notch in the heel of the latch, thus getting about $\frac{1}{16}$ inch overlap at the latching point. With the breaker open, the trigger should clear the latch $\frac{1}{32}$ inch at the latching point. This is governed by the relation between the trigger spring and the pawl lever spring. The trigger spring is strong enough to snap the trigger into place quickly when latching, but not so strong that it increases the tripping load unduly.

The pawl lever spring must be strong enough to overcome the trigger spring in order to get the $\frac{1}{32}$ inch clearance at the latching point with the

breaker open. It is obvious that this clearance is necessary to prevent the latch from jamming into the trigger when the latch is forced back as the breaker closes. It is also necessary to maintain $\frac{1}{32}$ inch overtravel (vertical clearance at latching point between the latch and trigger). Much less than this would endanger jamming the latches, while much more would allow the trigger to pass completely under the latch.

Clearance between the trip plunger and trigger should be $\frac{1}{16}$ inch while the armature gap should be set at $\frac{1}{4}$ inch $\pm \frac{1}{16}$ inch. Both of these adjustments are controlled by the adjusting bolt under the trip armature.

It has already been pointed out that the breaker reclosing time is primarily determined by the "B" contact setting in the SC circuit (see Fig. 4) which is a special contact on the two-pole auxiliary switch. Other factors affecting the reclosing time are: the pressure setting of the pneumatic governor, the throttle setting, and the breaker accelerating spring setting.

The spacers under the throttle operating arm of the automatic lever (see Fig. 8) should be selected so that there is a $\frac{1}{32}$ inch clearance at the throttle piston seat with the mechanism over-traveled. This clearance would be approximately $\frac{1}{8}$ inch with the breaker in the latched position. The setting of the throttle adjusting screw is determined at the factory by starting with it completely shut off and then backing off until positive closing operation is obtained throughout the air pressure range. Opening the passage any wider will not increase the number of operations per tank of air, and will cause the breaker to close unnecessarily hard.

The normal operating pressure and pressure differential is determined by the governor setting. The cut-off (top) pressure should be set to agree with the marking on the mechanism nameplate and the differential should be adjusted for 10 pounds. The adjusting screw at the right on top of the switch, controls the cut-off point, while the screw at the left controls the differential.

MAINTENANCE

Caution: When working around the mechanisms or breaker, close the hand valve between the compressor and mechanism and open the control circuit at the control panel so that accidental operation of the magnet valve or contactor will not cause the breaker to close unexpectedly.

It is desirable to inspect the mechanism and compressor at regular intervals and be sure of its condition by making several operations, particularly at first if not familiar with pneumatic mechanisms. It is necessary to keep moving parts, particularly the latch and switches, clean and free from foreign matter or rust. Note that the space heater which is energized continuously (winter and summer) will minimize rusting. It is also desirable to make one or more close-open operations of the breaker in order to make the exhaust valve operate. Otherwise the breaker may be in service a number of years before closing on a fault and causing the exhaust valve to operate.

The automatic latch and trigger are made of high-grade steel machined to shape, with the latching surfaces ground smooth after hardening. The engaging surfaces of the latch and trigger may be polished with fine emery cloth if they become dirty. Apply a thin film of rust inhibitor to the latch and trigger where the latch hooks over the roller, and where the trigger engages the latch. 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). A light graphite lubricant is suggested, or other material with similar properties. The latching surfaces should be examined at every inspection to make sure that they are not gummed up.

Important: Do not attempt to grind the latching surfaces or change their angle.

If the low pressure switch available for operating a low pressure alarm in the station is used, there should be no danger that air pressure will not be available at all times. However, the compressor and mechanism should be checked occasionally for maintenance of pressure. When in good shape, the air system will not lose more than two or three pounds per hour (mechanism not operating), but there is no need for alarm if the leakage exceeds this figure somewhat, unless it becomes progressively worse.

The first place to check for air leaks is the intake valve on the mechanism; a few operations of the breaker may dislodge any foreign material which may be lodged at the valve seat. If this does not cure the leak, all air connections and joints should be checked with soapy water. Then if the leak still persists, it may be necessary to re-grind the intake valve to its seat. However, this valve has been carefully ground to its seat before leaving the factory, and this operation will rarely be necessary.

The main cylinder must be reasonably free from leaks in order not to lose power at the end of the closing stroke. To this end, the main piston has been provided with rings, and the piston shaft has a packing gland where it passes through the top of the cylinder casting. The packing gland may be easily tightened, but this should not be necessary for long periods of time since the packing material is rather solid. Too much tightening here will, of course, tend to put a drag on the breaker when opening. The cylinder leaks may be observed by energizing the closing circuit with the "Y" (cutoff) relay blocked (breaker in the closed position), or by operating the intake valve manually. If the mechanism is in good condition, a small amount of air may be felt at various points by an exploring hand, but an unusual amount should be investigated. If the mechanism overtravels when the air is applied in this manner, it is a reasonably good indication that the leaks are not excessive. These leaks are present only when the mechanism operates; the air is sealed off positively by the intake valve at all other times.

The throttle piston should be inspected for free operation. It is returned to its restricting position by a spring and if the piston becomes jammed in the open position, the breaker would slam excessively in closing.

An instruction leaflet from the Westinghouse Air Brake Co. is supplied with each compressor unit; it should be used in conjunction with this instruction book for overall maintenance of the mechanism and compressor unit.

If there is any trouble in operation, the mechanism should be taken out of service at once and put into proper condition. The circuit breaker is highly dependent upon the proper functioning of the mechanism which should therefore be kept in good condition at all times.

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INSTRUCTIONS

PREPARATION OF TYPE CAS-6 MECHANISMS OF LARGE OIL CIRCUIT BREAKERS FOR COLD WEATHER SERVICE

Faulty operation of the CAS-6 mechanism used to open and close large oil circuit breakers in below-freezing weather may result from improper lubrication and/or packing of the mechanism closing piston rod. During extreme cold periods the lubricant may congeal and prevent free movement of the piston rod through the packing gland. In some cases the breaker opens but will not reclose; in others, the breaker will trip on fault but will not drop out completely. This condition can be prevented by the following cleaning and maintenance operations performed just prior to the winter season.

- (1) Clean the piston rod with light lubricating oil or WEMCO C oil to cut the deposit on the rod. A light film of this oil may be left on the rod for lubrication if the oil selected will not stiffen excessively at the low temperatures anticipated or a more generous coating of WEMCO C oil may be used.
- (2) Investigate piston packing gland to make certain that it is correctly packed. This packing gland (identified in Figure 8 of I.B. 33-125-2A) should be loose enough for the rod to move freely through it. The quantity of the gland packing should not be so great that in the closed position the pin holes at the top of the piston rod overlap the packing and tend to chew it up, thus increasing the friction. If the packing seems excessive in quantity or pressure or otherwise in need of replacement, the following is an outline of the procedure recommended:
 - (a) Make mechanism safe by opening control circuit and shutting off air at the hand shut-off valve.
 - (b) With the pneumatic operating mechanism in the open position, raise the packing gland nut by unscrewing.
 - (c) Remove all of the old packing gland material.
 - (d) Wash the shaft with a suitable solvent to remove any sticky deposit on the shaft.
 - (e) Install 3/16" round asbestos rope graphited twisted packing material as supplied by Anchor Packing Co., Garlock Packing Co., Goodall Rubber Co. or equivalent so that two complete turns are used.

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- (f) Replace the packing gland nut reasonably tight so that a fairly good air seal is obtained without adding undue friction loading on the shaft.
- (g) Lubricate piston rod and packing with a liberal application of WEMCO C oil.

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November 12, 1951

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