I.B. 33-125-1A

DESCRIPTION • OPERATION • MAINTENANCE

INSTRUCTIONS

PNEUMATIC OPERATING MECHANISM

Type CAS-8

for

Oil Circuit Breakers

WESTINGHOUSE ELECTRIC CORPORATION
SWITCHGEAR DIVISION
EAST PITTSBURGH PLANT • EAST PITTSBURGH, PA.

SUPERSEDES I.B. 33-125-1

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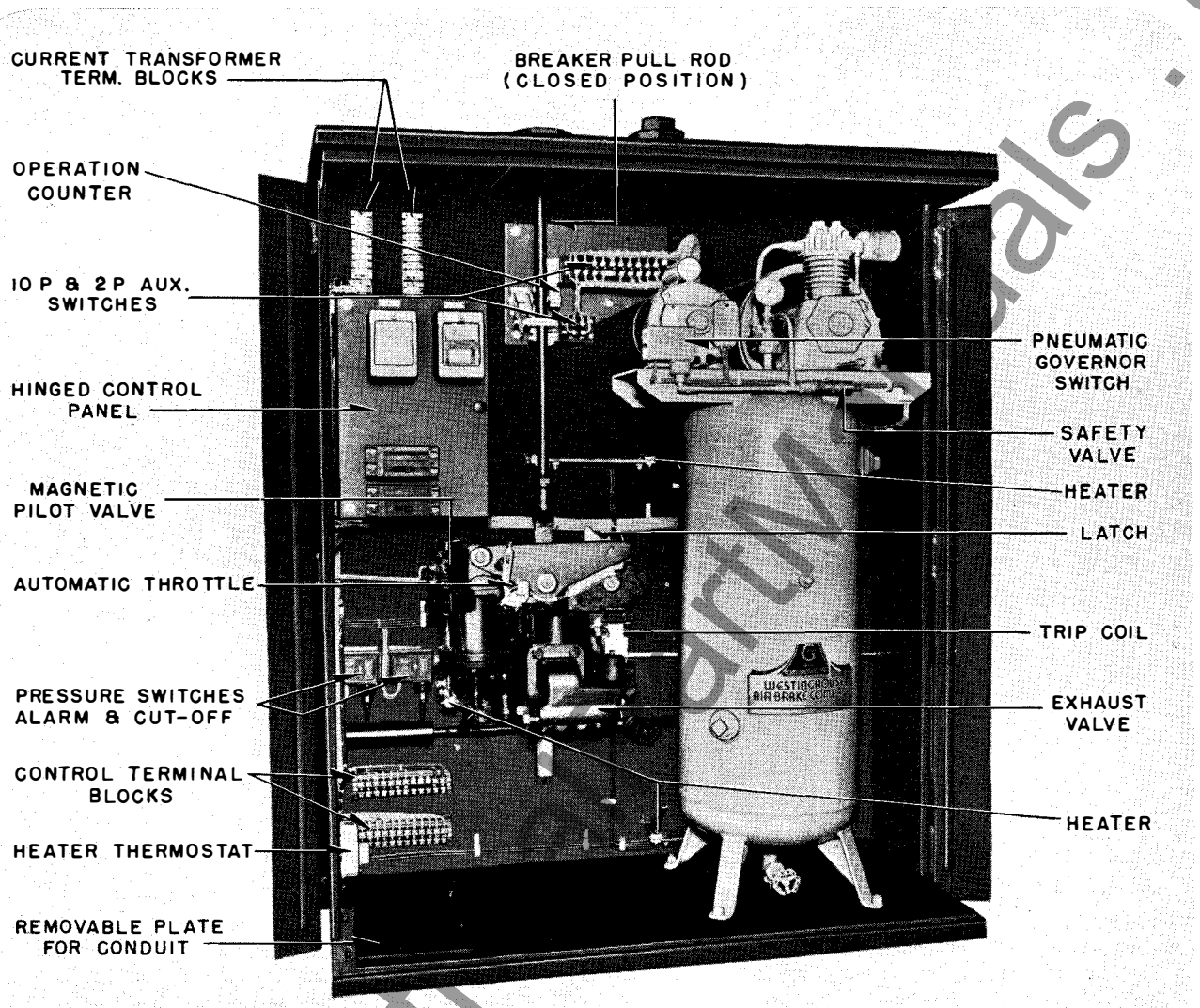

This mechanism is of the compressed air closed, spring opened type. It is pneumatically trip free, suitable for ultra high-speed reclosing, and is applicable to indoor and outdoor service. Application of this mechanism is sometimes made where high speed reclosing is not required, but where it is desirable to eliminate large batteries required for solenoid mechanisms.

DESCRIPTION

The Type CAS-8 Operating Mechanism is equipped with single coil shunt trip, an exhaust valve with magnetic pilot, a magnetically operated pilot valve for the automatic intake (this pilot valve can also be operated manually by means of a pushbutton on top of the magnet valve), an automatic throttle, a two pole auxiliary switch, a ten pole auxiliary switch, an operation counter, a control panel, an air compressor with storage tank, necessary heaters thermostatically controlled, control equipment, and an all steel weatherproof, outdoor housing which completely encloses all of the above equipment.

Figs. 1 and 2 show the mechanism in the closed and latched position with the names of the various parts. Referring to these figures, the breaker operating rod is connected to the mechanism operating lever, which is in turn connected to the piston which operates in the cylinder of the compressed air mechanism. The main lever is connected through a link to the mechanism frame. This link allows enough lateral motion for the piston and vertical pull rod to keep their alignment throughout the opening and closing stroke of the mechanism. The trip end of the operating lever is held closed by a double latch arrangement.

Caution: The mechanism is not trip free from the hand closing device. Caution should therefore be taken to make sure that the mechanism control circuit and breaker disconnecting switches are open when the mechanism is being operated by hand, and also that the air supply to the mechanism is shut off.

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 which is continuously energized reduces the condensation of moisture in the housing. Two other 350-watt heaters operated by thermostatic control to cut in at low temperatures are strategically located to reduce the danger of moisture freezing around the valves of the mechanism and compressor. 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 closing equipment consists of an 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 value; the compressor motor is started when the pressure falls approximately 15 lbs below this value. The normal pressure may be set anywhere between 150 lbs and 200 lbs, depending on the particular breaker the mechanism is to be used with. 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.

Compressor. The air compressor is equipped with a single phase, 60-cycle, 115/230 volt a-c motor. The motor will be 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 will be suitable for at least five operations without recharging. The system will recharge from atmospheric pressure in one hour or less. The pressure will build back to normal after the motor has been started by the pneumatic governor (15 lbs below normal) in approximately 5 minutes. The storage tank fulfills all requirements of State Inspection Codes and is supplied with suitable accessories. All equipment is manufactured under the ASME requirements and receives underwriter inspection before shipment.

Safety Devices. If anything should go wrong with the compressor or air equipment so that normal pressure is not maintained, a low pressure alarm and cutout switch are provided for indication and protection. The low pressure cutout switch is set to open the closing control circuit before the pressure drops too low to close the breaker satisfactorily. The low pressure alarm switch is set 5 to 10 lbs above this to close the circuit to the station alarm. A safety valve is supplied on the storage tank which will pop off at approximately 15% 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, except to re-adjust if necessary to settings given on nameplate mounted on inside of housing door.

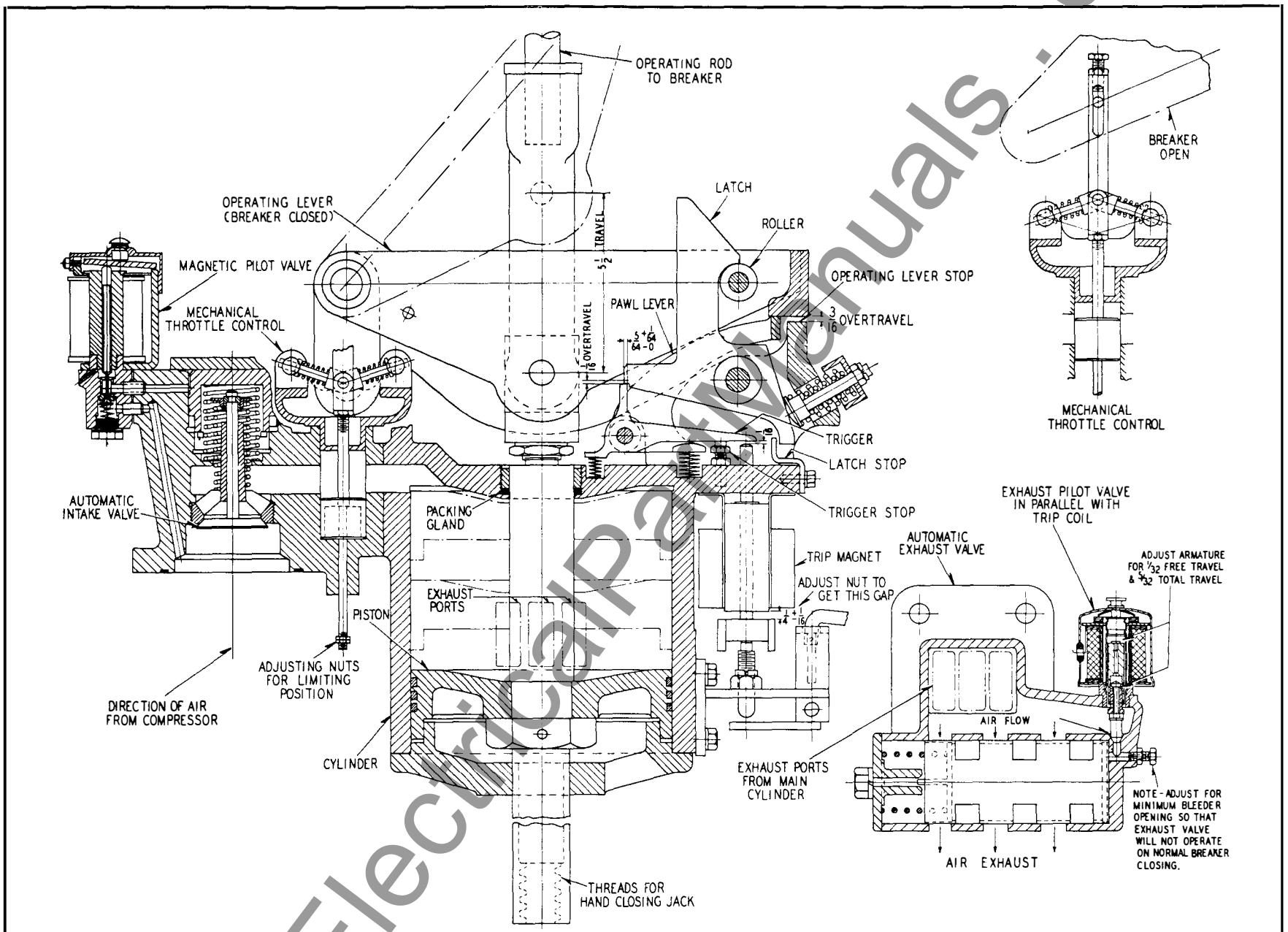

FIG. 1. Cross-Sectional View of Type CAS-8 Operating Mechanism

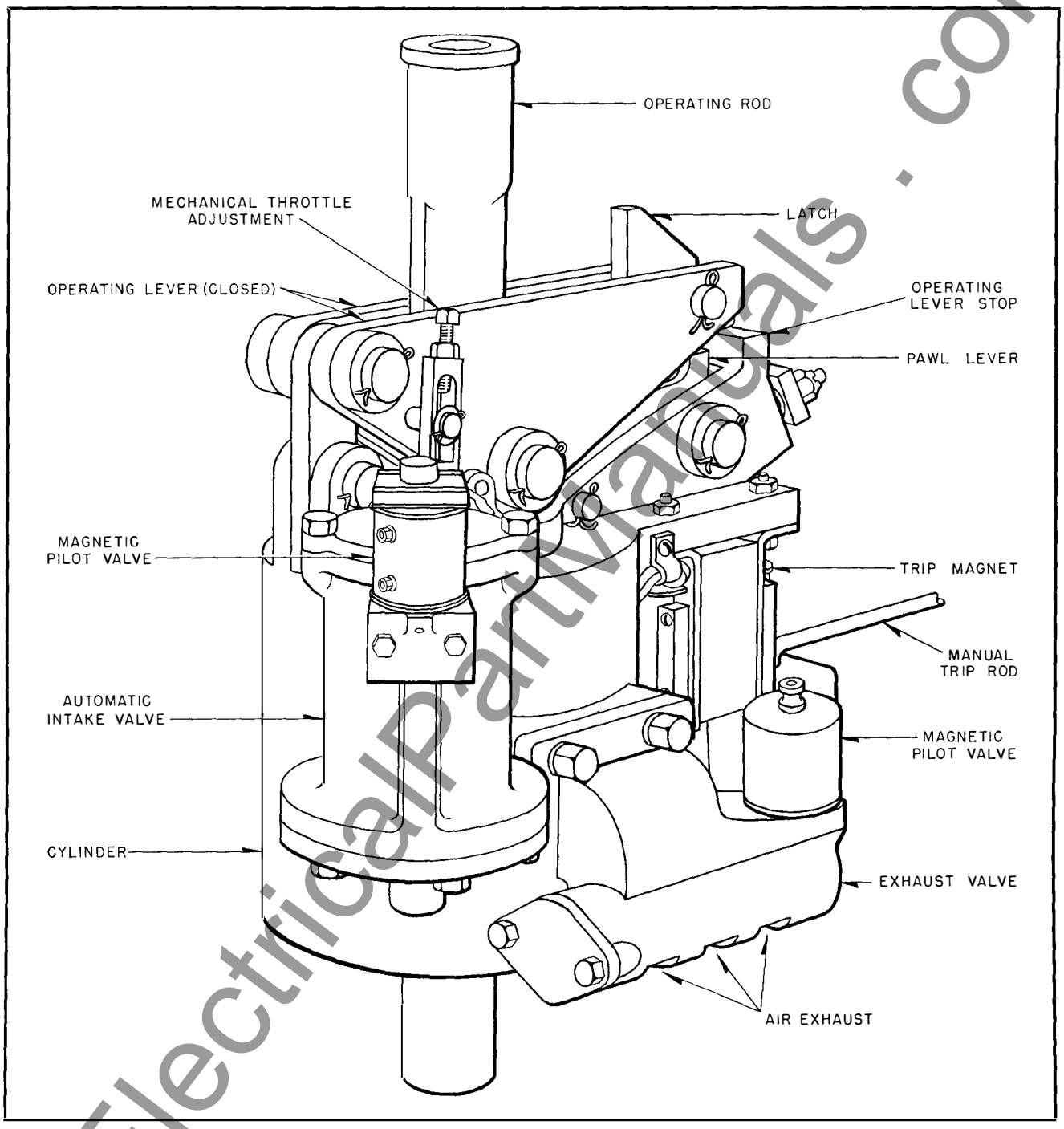

FIG. 2. Type CAS-8 Operating Mechanism

Manual Closing. For closing the mechanism by hand, a manual closing device is available. To close the breaker, it is attached to the lower end of the piston rod which also serves as a guide for the piston (see Fig. 1). It should always be removed when the breaker is to be operated by air, or tripped from the closed position. An external tripping handle is also provided on one side of the housing.

Auxiliary Switches. A 10-pole and a 2-pole type W multi-contact rotary auxiliary switch, each independently adjusted and mechanically connected to operate with the breaker contacts is supplied for signal lights and other control circuits. Contacts not used for breaker control can be set to close or open as the breaker closes.

RECEIVING AND STORAGE

Each mechanism is carefully inspected and 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, so as not to damage the mechanism. All parts should be checked with the shipping list and care should be taken not to leave any part in the packing material. If the apparatus as been damaged in any way, file a claim immediately with the carrier and notify the nearest Westinghouse Sales Office.

If the mechanism is to be stored, it should be kept in a clean, dry place, protected from corrosion and moisture. It should never be allowed to stand where moisture can reach the wiring and insulated parts. 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 given thereon, and file for ready reference. Remove blocking from relays, wire from main latch, and all other material which was used for safe shipment. Before operating compressor, make sure that it is filled with a good grade of SAE #30 Engine Oil (SAE #20 for extreme cold weather conditions), that the belt and flywheel are free from all foreign material, and that the valve at the bottom of the storage tank is closed. In freezing weather allow the space heaters to remain energized several hours before operating compressor. Also read the Westinghouse Air Brake Co. installation and maintenance leaflet accompanying each compressor unit before operating.

Close the mechanism with the hand closing jack once or twice before operating it with air just to make sure that all moving parts of the mechanism and breaker are free.

Caution: Always make sure that the valve between the storage tank and the intake valve on the mechanism is closed before using the hand closing jack or before doing any work on the mechanism.

When the mechanism has been closed and latched by the hand closing jack and it is desired to open it in the same way, hold up on the trip armature while backing off the jack so that the latch will be released; otherwise the latch will hold the mechanism closed. Avoid letting the jack part way out before releasing the latch as the blow may break the bearing in the jack. Always make certain that the jack is removed from the piston rod before operating the mechanism by air or tripping it from the closed position.

Simple Closing. Starting with the mechanism in the completely open position, when the control switch on the switchboard (see diagram Fig. 3) is turned to the "close" position, the "X" contactor on the control panel closes. This energizes the magnet coil of the magnetic pilot valve (see main section view Fig. 1). This coil opens the small magnetic pilot valve, permitting air from the reservoir to flow above the automatic intake valve piston. Since the intake valve piston has an area larger than the face of the valve, the intake valve is opened when pressure is applied. This permits air to flow through the large air duct into the cylinder above the main piston which is at the top of the cylinder in the fully opened position.

If air were allowed to flow freely through the large duct during the complete closing stroke, the mechanism and breaker would be subjected to unnecessarily hard slamming. To prevent this, an automatic throttle is provided to slow down the normal closing operation. This throttling action is accomplished as follows: The air is admitted at first through a port which is partially closed by the throttle valve piston. This opening is adjusted to allow the minimum flow of air required to start the breaker closed.

Just before the breaker picks up its contact load, the throttle piston is automatically thrown to the wide open position which admits the maximum amount of air into the cylinder. This insures that sufficient pressure is available to close the breaker positively against its contact load and possible short circuit conditions, thus matching the inherent characteristics of the solenoid mechanism. The throttle adjustment has been set at the factory for best operation and should not be disturbed.

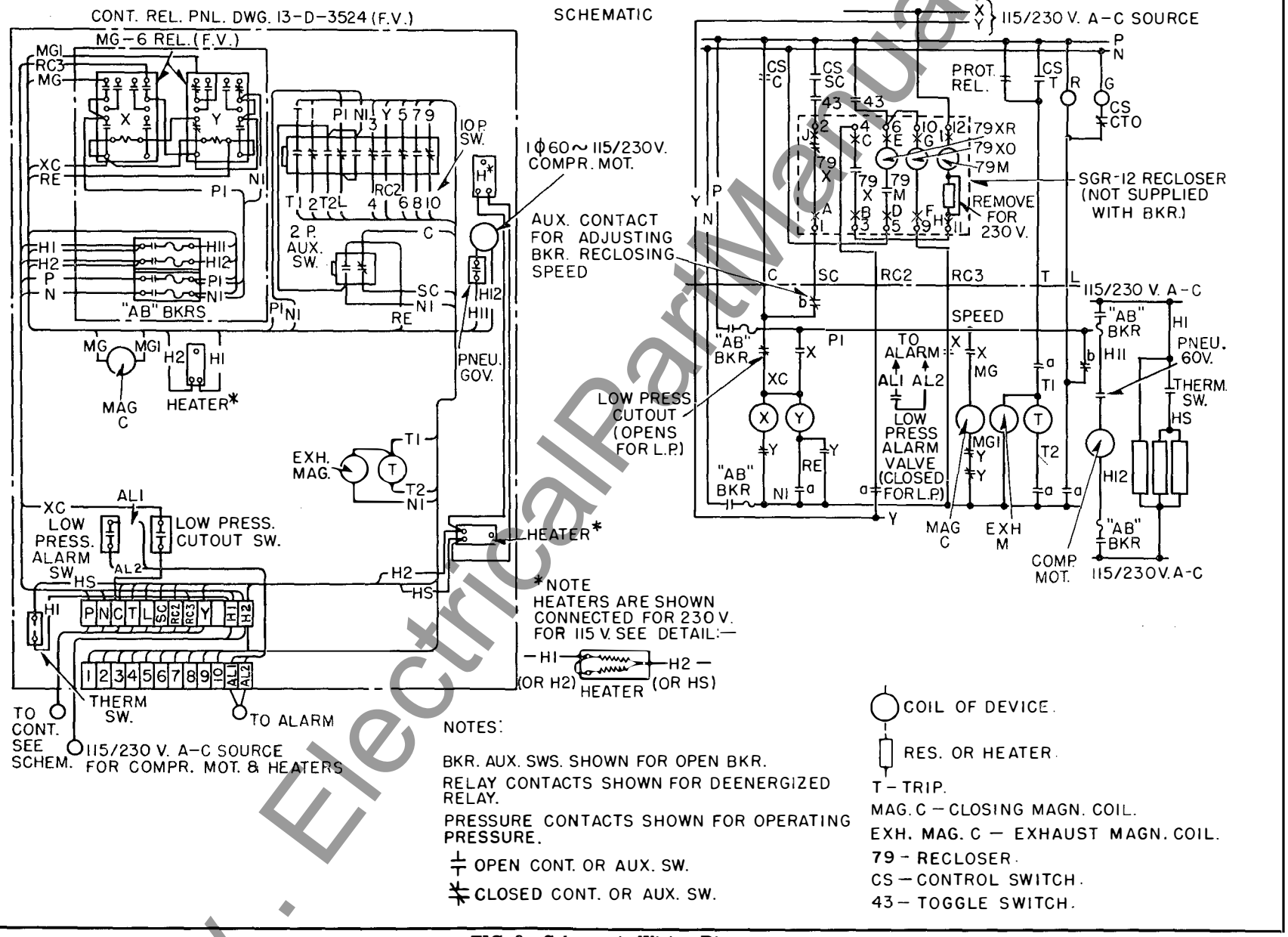

FIG. 3. Schematic Wiring Diagram

When the main piston approaches the end of its stroke, the roller on the trip end of the main lever strikes the sloping face of the latch, forcing it to rotate counter-clockwise about its fulcrum pin. As the main lever moves further down toward the closed position, it forces the pawl lever down thus freeing the trigger to rotate clockwise about its fulcrum pin so that as the roller clears the nose of the latch and the latch snaps into place, the trigger engages it to prevent the release of the roller and opening of the breaker.

When the breaker is nearly closed, the "a" contact of the auxiliary switch in series with the "Y" or cutoff contactor closes. This energizes the "Y" contactor operating coil, causing it to simultaneously open two contacts in series with the "X" closing contactor and close a contact which seals in around the auxiliary switch "a" contact. The opening of the first contact causes the "X" coil to be de-energized and drop out its contacts. When the second contact is closed, the "Y" coil is sealed in and is thus kept energized even in case a fault trips the breaker out. Since the breaker cannot close again until the "Y" contactor has been de-energized by opening the control switch, pumping is prevented.

A third contact on the "Y" contactor opens the intake pilot magnet circuit (slightly ahead of "X" contactor drop-out), so that the automatic intake valve piston returns immediately to the top of its cylinder, thus allowing the intake valve itself to close under action of the automatic intake valve spring. At the same time, the automatic intake valve piston opens some small ports in its cylinder wall allowing the air in the main cylinder to exhaust to atmosphere.

Simple Opening. Starting with the mechanism in the closed position, when the control switch on the switchboard is turned to the "trip" position (see Fig. 3), the trip coil is energized through the two auxiliary switch "a" contacts. As the trip plunger snaps upward to strike the trigger, the latter rotates counter-clockwise about its fulcrum pin to release the latch, which is forced back by operating lever under action of the breaker accelerating spring. As the opening lever moves upward, it releases the pawl lever spring engaging the trigger, thus keeping the trigger spring compressed and the trigger in readiness for another closing operation.

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. 4, 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. See also schematic diagram Fig. 5.

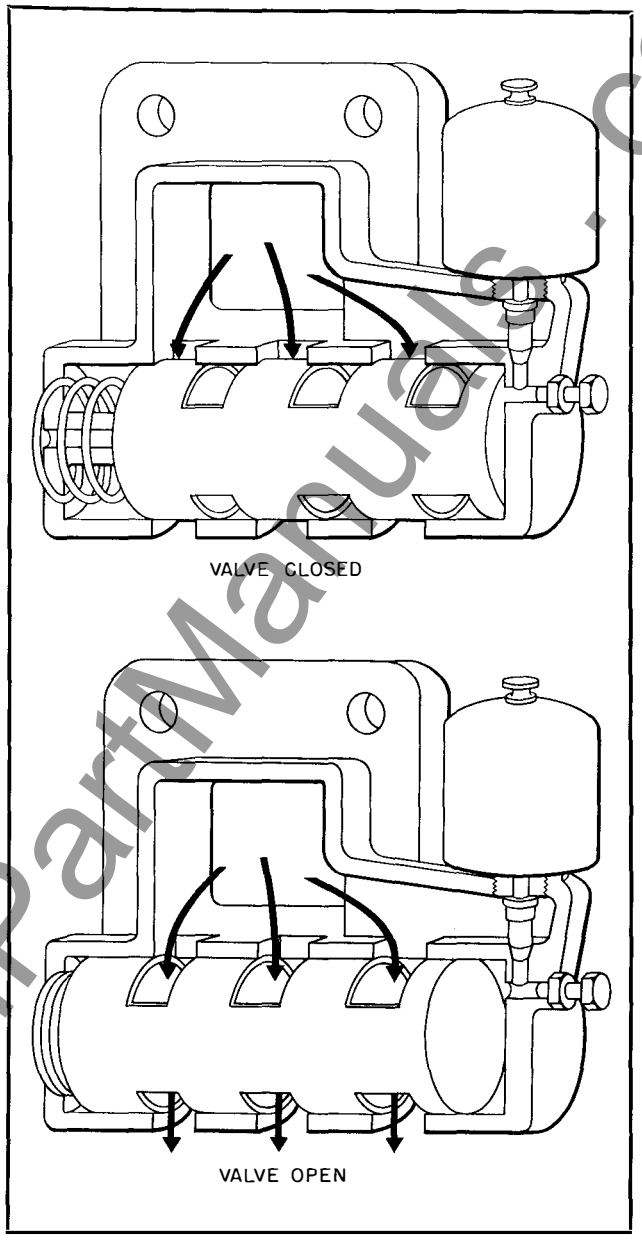

FIG. 4. Operation of Exhaust Pilot Valve

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

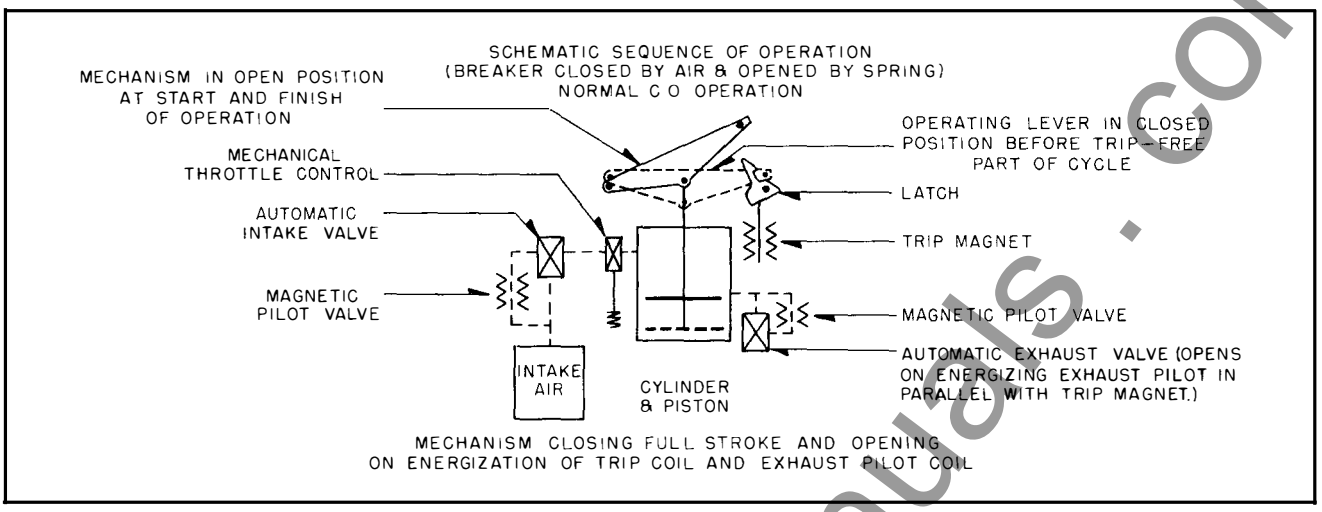

FIG. 5. Schematic Diagram of Close-Open Operation

core by means of a trip-free lever in order to obtain adequate opening speed when opening under such conditions. This action of the pneumatic mechanism is called pneumatically trip-free operation and by permitting direct connection 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. 3 shows a typical high speed reclosing set-up using the Westinghouse SGR-12 single-shot recloser. Also refer to schematic sequence diagram Fig. 6, starting 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 coil and exhaust pilot coil are de-energized by the two "a" contacts (see Fig. 3) which are in series. The mechanism is now ready for reclosure.

Just after the "a" contacts de-energize the trip coil, the "b" contact in the SC circuit closes, energizing the coil of the magnetic pilot valve. Air is then admitted to the top of the main piston as described under normal-closing operation. In this case, however, the air is admitted through the wide open throttle air duct before the throttle piston has been reset by the main lever (resets when breaker opens). No throttling occurs and the full force of the air is available to stop the breaker in its opening stroke and return it to the closed position. 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" contact (special contact on 2 pole auxiliary switch—see diagram Fig. 4) which energizes the magnetic pilot valve. The sliding stationary members of this contact may be adjusted to give the desired reclosing speed, but too close a setting will prevent the breaker from reclosing at all. That is, there would be an overlap between this "b" contact and the "a" contact controlling the "Y" contactor, allowing the latter to pick up and prevent energizing of the intake valve coil.

If the fault no longer exists on the line, the breaker will remain in the closed position after opening and reclosing. (Position B, Fig. 6).

If the fault still exists on the line, the protective relay will cause the breaker to trip again and the action of the exhaust valve will cause all high pressure air to be exhausted from the cylinder, allowing the breaker to open unhindered under action of its accelerating spring. (Position C, Fig. 6).

In connection with rapid reclosing, it will be noted that the operation counter (mounted on auxiliary switch plate) is spring operated, so that it will count 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 valve, closing piston, latches, etc., have been properly adjusted and tested at the factory for satisfactory performance. It should not be necessary to change any of these adjustments before placing in service, except as mentioned for adjusting reclosing-speed.

A check on these adjustments before placing in service, on periodic inspections, or if trouble is experienced, can be made very easily. Refer to Fig. 1. With the air and control voltage shut off, attach the hand closing jack and close the breaker slowly until the latch nose is directly opposite the

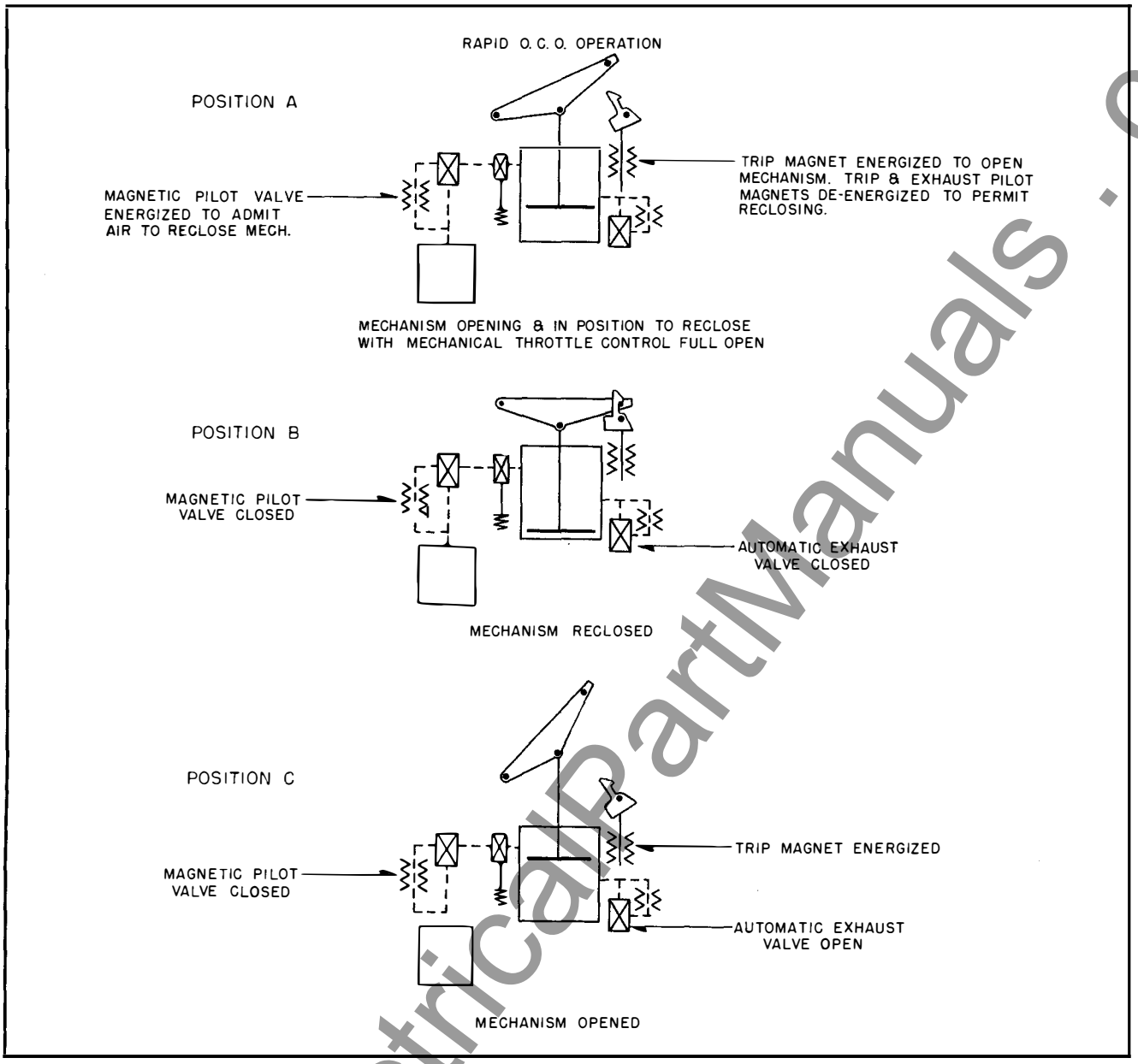

FIG. 6. Schematic Sequence Diagram of Rapid Reclosing Operation

roller on the main lever. At this point check to see that the latch has approximately 1/16" travel remaining and is not jamming against the roller. If this travel is not obtained, it is an indication that the latch compression springs are going solid; this may be corrected by adding an additional washer under each side of the spring mounting block. The castle nut on the stud through the springs is for assembly only, and should be backed out and locked far enough to allow spring pressure on the latch in either position.

With the mechanism closed and no load on the jack, check the horizontal overlap between the latching surfaces of the latch and trigger. This should be 5/64"—6/64" as indicated on Fig. 1, and may be adjusted by screwing the trigger stop in or out. With the jack just snug and ready to take the load check to see that the trip plunger has 1/32" to 1/16" free travel before striking the trigger, and when raised up all the way that there is approximately 1/32" clearance for the heel of the latch to slide down along the trigger. Close the mechanism completely so that the main lever rests against the mechanism stop and check to see that the pawl lever has 1/16" additional travel.

With the breaker open, check the overtravel of the latch as indicated on Fig. 1. This vertical clearance between the latch and trigger should be be-

tween 1/32"—1/16", and may be adjusted by shimming or bending the stop (see Fig. 1) for the latch. This is a high speed mechanism and these adjustments should be maintained if satisfactory operation is to be expected.

In connection with the spring pressure on the latch, it might be pointed out that the roller on the main lever passes the nose of the latch very fast, which means that the latch spring must have sufficient compression to snap the latch into place quickly before the air supply is shut off or the main lever bounces open. The 3/16" overtravel dimension is an important factor here since it allows the latch time to snap into place. However, too much spring compression will make the breaker harder to latch and reduce the number of operations possible before re-charging the storage tank.

It has already been pointed out that the breaker reclosing time is primarily determined by setting of the "b" contact (see diagram Fig. 3) which is a special contact on the 2-pole auxiliary switch. The pressure setting of the pneumatic governor also affects the breaker reclosing time, and should be adjusted to settings given on nameplate. The adjusting screw at the right on top of the governor switch controls the cut-off point, while the screw at the left controls the differential. Another factor affecting the reclosing time is the amount of compression on the breaker accelerating spring.

The automatic throttle in the air intake will not affect the breaker reclosing time if adjusted properly. The adjusting screw in the top of the slot of the throttle operating link should be adjusted so that the throttle toggle will not be snapped over center to limit the air intake until the breaker is very nearly to the full open position. Thus on a fast reclosing operation, the throttle will remain wide open since the breaker does not go all the way open. The adjusting nuts on the lower end of the throttle stem below the intake casting (see Fig. 2) determine the size of air passage for the limiting position (breaker open) of the throttle. Turning these nuts clockwise pulls the piston down to form a larger air passage. Adjusting these nuts will require an adjustment on the screw on the top of the slotted link.

It is best to make these adjustments when the breaker is open in order to make sure that the pin on the main lever is not jammed in the top of the slot. Do not change throttle adjustments unless there is some good reason for doing so. Opening the throttle wider for faster closing operation will abuse the breaker unnecessarily.

MAINTENANCE

Caution: When working around the mechanism 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. It should be considered that this instruction leaflet is primarily designed to recommend adequate maintenance for the compressor equipment as normally used in such places as gasoline stations, etc., where the compressor operates very frequently for long periods of time. It is logical that the equipment as used on these pneumatic mechanisms would not require such a frequent maintenance schedule since it operates relatively little. The instruction leaflet accompanying the compressor should be used as a guide to maintenance procedure, but our experience has indicated that the period between inspections can be materially increased. An adequate schedule can be best determined in each individual case by experience but in many cases it is likely that it can be set to coincide with regular breaker inspections.

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 therefore should be kept in good condition at all times.