Composite Breaker/Mechanism

Instruction Book

Gas Circuit Breaker

Outdoor Type SP

ANSI STANDARDS

Type	Nominal 3 Phase MVA Class	Nominal Voltage Class kV rms
345SP1500	1500	34.5
460SP1500	1500	46.0
460SP2500*	2500	46.0
690SP2500	2500	69.0
690SP3500*	3500	69.0
90SP31.5*	31.5 kA	69.0

IEC STANDARDS

Type	Rated Short Circuit Breaking Current kA rms	Rated Voltage kV rms
360SP12.5	12.5	36
360SP16	16	36
360SP25	25	36
360SP31.5	31.5	36
520SP12.5	12.5	52
520SP20	20	52
520SP25 *	25	52
520SP31.5 *	31.5	52
725SP12.5	12.5	72.5
725SP16	16	72.5
725SP20	20	72.5
725SP25*	25	72.5
725SP31.5*	31.5	72.5

*External Capacitors Supplied With Breakers Of These Ratings

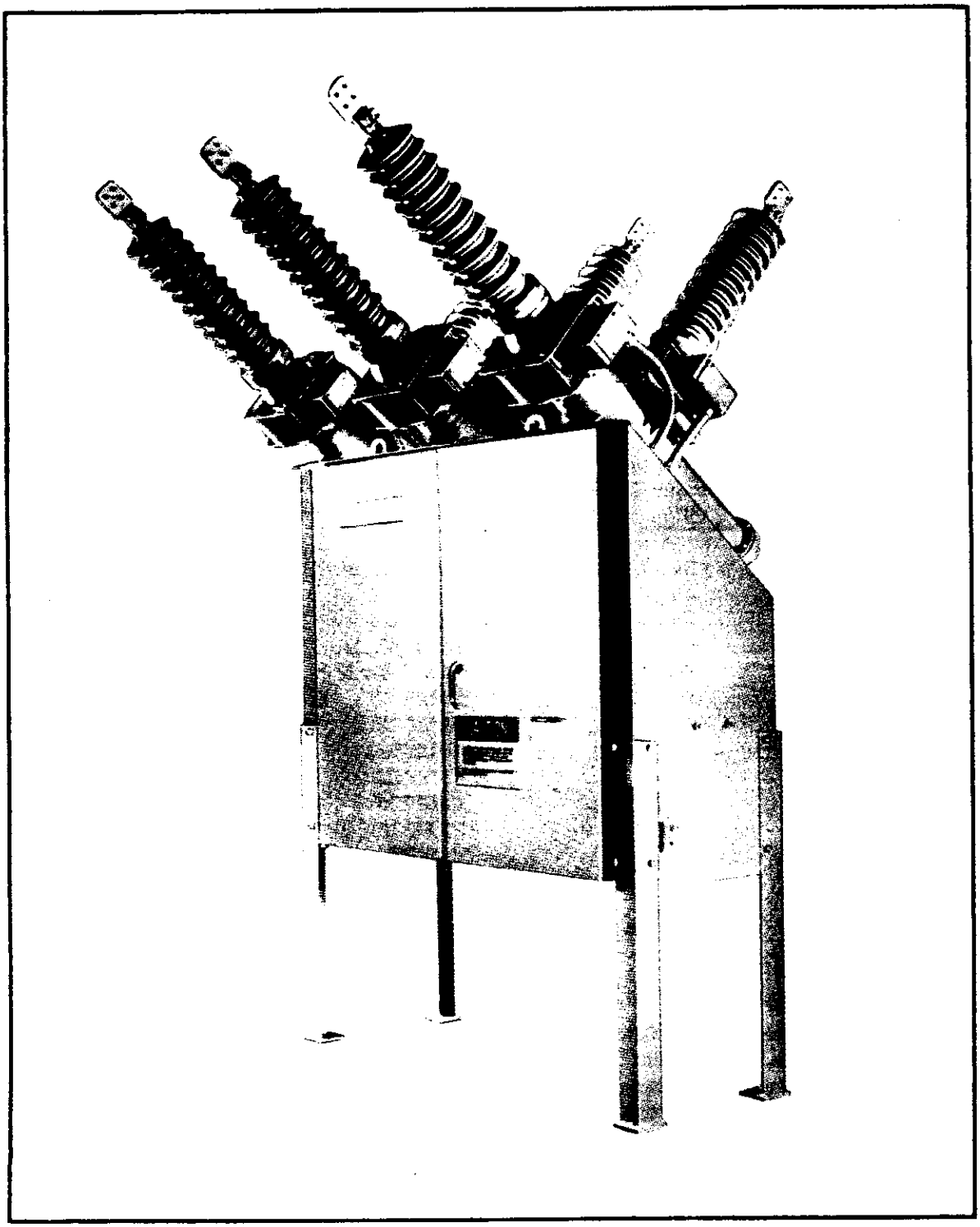
All possible contingencies which may arise during installation, operation, or maintenance, and all details and variations of this equipment do not purport to be covered by these instructions. If further information is desired by purchaser regarding his particular installation, operation or maintenance of his equipment, the local Westinghouse Electric Corporation representative should be contacted.

GAS CIRCUIT BREAKER

TYPE SP

Westinghouse Electric Corporation

Power Circuit Breaker Division, Trafford, PA 15085
I.B. 33-570-BM-1C Effective July, 1981
Supersedes I.B. 33-570-BM-1B October, 1980



WESTINGHOUSE OUTDOOR GAS CIRCUIT BREAKER
TYPE SP

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INTRODUCTION

The SF_6 circuit breaker is one of the most important units in electrical power systems. The protection, stability, and continuity of service of the entire system depend largely on the efficiency of its operation. Designed for use on 34.5 through 69 kV systems, Westinghouse Type SP circuit breakers protect electric utility systems by interrupting fault currents and switching line, load, and exciting currents. Type SP circuit breakers combine high interrupting capabilities, short arcing time, and approximately 270 milliseconds reclosing with long contact life to provide excellent reliability, fast fault clearing, and easy maintenance.

WARNING

PROPER INSTALLATION AND MAINTENANCE ARE NECESSARY TO INSURE CONTINUED SATISFACTORY OPERATION. CIRCUIT BREAKERS ARE DESIGNED, DEVELOPED, AND TESTED TO PERFORM THE FUNCTION OF CIRCUIT PROTECTION BY CURRENT INTERRUPTION UP TO AND INCLUDING THE NAMEPLATE RATING. THEREFORE, CIRCUIT BREAKERS ARE BY DESIGN A MAXIMUM RATED DEVICE. AS A RESPONSIBLE MANUFACTURER, WESTINGHOUSE CANNOT RECOMMEND NOR ASSUME ANY LIABILITY FOR ANY BREAKERS APPLIED ABOVE NAMEPLATE RATING. OUR EXPERIENCE HAS SHOWN THAT, ABOVE NAMEPLATE RATING, BREAKERS MAY BE DEFICIENT IN ONE OR MORE ASPECTS OF PERFORMANCE. THE CONSEQUENCES OF OPERATING A BREAKER ABOVE RATING CAN LEAD TO A CATASTROPHIC FAILURE. THIS COULD RESULT IN PROPERTY DAMAGE AND/OR PERSONAL INJURY. APPLICATION OF BREAKERS ABOVE RATING IN SO CALLED "EMERGENCY CONDITIONS" INVOLVES EXTREME RISKS AND SHOULD ONLY BE CONSIDERED WHEN THE CONSEQUENCES OF A CATASTROPHIC FAILURE ARE ACCEPTABLE.

When communicating with Westinghouse regarding the product covered by this instruction book, include all data contained on the nameplate attached to the equipment. Also, to facilitate replies when particular information is desired, be sure to state fully and clearly the problem and attendant conditions. For a permanent record, it is suggested that all nameplate data be duplicated and retained in a convenient location.

PART 1 - DESCRIPTION

Each breaker consists of three individual pole units mounted on a mechanism and control cabinet and connected mechanically to the operating mechanism. Each pole unit consists of two SF_6 gas bushings mounted on a grounded metal housing shaped like a large pipe tee which contains the interrupter. Each interrupter is mechanically connected to the operating mechanism through a connecting rod, operating shaft assembly, lever, tie bar, horizontal pull rod and bell crank lever. A spring acts to open the breaker and a pneumatic operating mechanism closes the breaker. Bushing type current transformers, when ordered, are mounted to each pole unit pipe. The circuit breaker is filled with 5 psig of SF_6 gas at the factory to maintain a positive pressure. In the field of SF_6 gas is added 75 psig during installation. Certain ratings of the type SP circuit breaker are shipped with (3 or 6) 5000 P_f external capacitors for short line fault protection.

1.1 Supporting Framework

To facilitate shipment the breaker was designed to offer a low profile. Four legs are shipped separately and must be assembled to the breaker to raise the breaker to the proper height.

1.2 Pneumatic Operating Mechanism

A Type AA-7 electro-pneumatic mechanism is used to operate the Type SP breaker. The mechanism is mechanically and electrically trip-free. Each mechanism is complete with its own storage reservoir, motor driven compressor, pressure switches, pressure gauge, and safety valve. The reservoir, at normal operating pressure, contains sufficient air for five immediate closing operations without operation of the compressor. A drain valve is provided to remove condensed moisture from the reservoir. The air supply system meets all the requirements of the ASME codes. The weatherproof cabinet has a large access doorway, sealed with rubber gaskets, to provide easy access for inspection and maintenance. A heater provides continuous inside-outside temperature differential, with additional thermostatically controlled heaters for winter use. Included in the housing are necessary auxiliary switches, cut-off switch, latch check switch, alarm switch and operation counter. The control relays and three control switches (one each for the control circuit, compressor motor, and heater circuit) are also mounted inside. Terminal blocks on the top and side of the housing are provided for control and transformer wiring. The AA-7 mechanism provides reclosing speeds of approximately sixteen cycles.

WARNING

EACH CIRCUIT BREAKER IS EQUIPPED WITH A MAINTENANCE HAND-TRIP DEVICE AND A HAND CLOSING JACK IS SUPPLIED ON EACH BREAKER ORDER. THESE DEVICES MUST NOT BE USED FOR CLOSING OR TRIPPING AN ENERGIZED BREAKER. THEY ARE INTENDED AS MAINTENANCE TOOLS AND MUST ONLY BE USED ON A DEENERGIZED BREAKER ISOLATED FROM THE CIRCUIT.

1.3 Operating Linkage

The components of the operating linkage contained in the mechanism cabinet are as follows:

1. A vertical pull rod connecting the pneumatic operating mechanism to the bellcrank lever.
2. A bellcrank to convert vertical to horizontal motion.
3. A horizontal pull rod which connects the bellcrank lever to the tie bar and operating lever assemblies.
4. The tie bar and operating lever assemblies which convert horizontal motion into rotational motion for the pole unit operating shafts.
5. The opening spring which is connected to the horizontal tie bar lever and provides the force necessay to open the breaker.
6. A hydraulic shock absorber which minimizes overtravel at the end of the opening stroke.

1.4 Bushings

Six bushings, two per phase, are located on the top. These bushings are SF_6 gas insulated and serve to provide an electrical path from the station bus to the breaker interrupters.

1.5 Current Transformers

Current transformers are mounted to the pole unit pipe and located concentrically about it. Transformers are usually of the multiratio type, having five leads to provide a range or ratios. Transformer leads are brought through flexible conduit to the mechanism cabinet where they are connected to terminal blocks. The transformers are normally of the relaying accuracy class, however, single ratio metering accuracy transformers and linear couplers are available.

1.6 The SF_6 Puffer Interrupter

The interrupter is a subassembly mounted inside each pole unit pipe. Electrical connections to the bushings are made through plug-in connections which are part of the interrupter subassembly. Each interrupter assembly consists of a stationary contact assembly and a moving contact assembly surrounded by an insulating interrupter tube.

1.7 Rupture Disc and Guard

A rupture disc and guard assembly is mounted to each pole unit pipe access cover assembly. Should the pressure in the pole unit pipe accidentally reach 150 psig ± 10 psig the disc would rupture exhausting the SF_6 gas to atmosphere. The guard acts as a baffle directing the exhausted gas and rupture disc fragments upward.

1.8 Pressure Gauge

A Bourdon tube type pressure gauge (0 to 150 psig) is mounted to each pole unit pipe access cover assembly. Fluctuations on either side of normal (75 psig) will be noted with ambient temperature changes.

1.9 Ground Pads

Two NEMA standard ground pads are mounted on the breaker frame, one on the left front and one on the right rear.

1.10 Lifting Lugs

Four lifting lugs are welded to the breaker top.

1.11 Characteristics of Sulfur Hexafluoride

Sulfur hexafluoride in a pure state is inert and exhibits exceptional thermal stability. It has excellent arc quenching properties. These characteristics combined with its good insulating properties make it an excellent medium for use in circuit breakers.

Chemically, SF_6 is one of the most stable compounds. In the pure state it is inert, non-flammable, non-poisonous, odorless, and produces no harmful effects on personnel. However, after the gas has been exposed to an electric arc, there will be some breakdown of the gas. Molecular sieve filters are used in the apparatus to remove most of the gaseous by-products and some of the gas-borne powders. These by-products are injurious and exposure to them should be avoided by maintenance personnel. The precautions to be followed in handling the gas are covered in detail in PART 6 - MAINTENANCE/ADJUSTMENT AND LUBRICATION.

There is some depreciation of the gas after extended periods of arcing; however, such decomposition is very slight and has a negligible effect upon dielectric strength and arc interrupting ability. Furthermore, the solid arc products formed at arc temperatures are the metallic fluorides, which are good insulators under the conditions used in the breaker.

Sulfur hexafluoride is furnished in standard industrial type cylinders, color coded green at the top end and the balance silver for easy identification. The cylinders have special size (.965" dia.-14 thds/inch Nat. Std. left hand) pressure connections supplied for absolute safety. The adapter for connection to the cylinder is a CGA #590 bullet shaped coupling nipple with .960 left hand, external male thread, 14 thds/inch. The gas is stored in the cylinders at approximately 300 pounds pressure which is the vaporization pressure at 75°F, and each cylinder contains 115 pounds of gas. Smaller cylinders containing 25 pounds of gas are also available.

The pressure developed while operating are only a fraction of those developed in a liquid medium. The pressure from arcing in SF_6 is generated from the thermal expansion of the gas rather than from the formation of a large amount of dissociation products, such as occurs in a liquid medium. Furthermore, shock pressures are neither produced nor transmitted as in the liquid medium.

The breaker requires approximately 15 lbs. of sulfur hexafluoride (SF_6) to fill to the recommended operating pressure, shown on the density chart (Fig. 7).

PART 2 - RECEIVING, HANDLING, AND STORING

2.1 Receiving and Shipment

All Type SP breakers are assembled and production tested at the factory, after which they are carefully inspected and prepared for shipment. Breakers covered by this instruction book are normally shipped completely assembled, except for the four legs and position indicator which are removed to facilitate shipment and external capacitors when supplied. However, when required for oversea's shipment, a breaker may be shipped knocked-down. Each pole unit is shipped from the factory with approximately 5 psig of SF_6 gas to insure a dry atmosphere during transit in order to protect the insulation.

NOTICE

UPON RECEIPT OF A CIRCUIT BREAKER, IT SHOULD BE EXAMINED FOR ANY DAMAGE SUSTAINED IN TRANSIT. DAMAGE SHOULD BE REPORTED IMMEDIATELY TO THE CARRIER AND THE NEAREST WESTINGHOUSE SALES OFFICE.

2.2 Unpacking Parts and Accessories

Check all parts against the shipping list as they are unpacked and identified. Search the packing material carefully for bolts, nuts, screws, etc., which may have loosened in transit. Instruction books, cards, or leaflets shipped with the breaker should be kept with the breaker.

A bag of silica gel is hung in the mechanism cabinet. This bag should be removed and discarded prior to placing the breaker into service.

2.3 Handling Procedure

WARNING

THESE BREAKERS HAVE A HIGH CENTER OR GRAVITY; CARE MUST BE TAKEN WHILE HANDLING TO PREVENT THEM FROM TIPPING OVER.

The weight of the breaker is listed on the nameplate. Breakers must be lifted by hooking onto four lifting eyes on the breaker housing roof. Four cables of the proper length (two 7' long and two 9' long) should be used to avoid interference with the bushings. Two cables must be approximately 2 feet longer than the other two to lift the breaker correctly.

WARNING

THIS BREAKER IS EQUIPPED WITH SF_6 FILLED BUSHINGS WHICH ARE PRESSURIZED. WHEN USING CABLE SLINGS OR CHAINS, TAKE EXTREME CARE TO PREVENT FROM STRIKING OR BEARING AGAINST THESE BUSHINGS AS ANY UNUSUAL SHOCK OR STRAIN MAY CAUSE RUPTURE OF THE BUSHING ENDANGERING NEARBY PERSONNEL. DO NOT MOVE THE BREAKER IF THE SF_6 PRESSURE IN ANY POLE UNIT IS ABOVE 10 PSIG.

When moving breakers, do not lash the breaker down by the bushings. The shipping braces and the wooden skids on which the breaker is mounted should not be removed until the breaker is installed.

2.4 Storage of Breaker and Breaker Parts

Even though the breaker may not be placed into service immediately, installation in its permanent location is recommended. If this is not practicable, it should be stored in a place where it can be protected from mechanical damage. The following precautions should be taken:

Each pole unit is shipped from the factory charged with approximately 5 psig of SF_6 gas to insure a dry atmosphere during transit in order to protect the insulation. This positive pressure must be maintained during storage. Pressure readings should be monitored and recorded monthly during storage. If for some reason the shipping pressure is lost in a pole unit and leakage is suspected, the source of leakage should be located and repaired. The breaker should be purged of moist atmosphere either by filling twice with dry nitrogen to approximately 75 psig and then draining to atmosphere or by evacuating to approximately 2 millimeters of mercury. SF_6 should then be admitted to a pressure of 5 psig and maintained during storage.

All accessories, spare parts, and tools should be stored indoors and protected from dirt and moisture.

Machined parts, pinned joints, etc. of the operating mechanism should be protected against corrosion. This is best accomplished by closing the cabinet doors and energizing the space heaters. This is recommended even if it requires the use of a temporary electrical circuit to the heaters. The air compressor should be run for a minimum of 15 minutes every three (3) months.

PART 3 - INSTALLATION

NOTICE

THE TYPE SP BREAKER HAS BEEN COMPLETELY ASSEMBLED, TESTED, AND INSPECTED AT THE FACTORY AND REQUIRES A MINIMUM OF FIELD CHECKS DURING INSTALLATION. IF THE BREAKER IS SHIPPED KNOCKED-DOWN, ADDITIONAL INSTALLATION TIME AND TOOLS WILL BE REQUIRED. SEE APPENDIX III FOR ASSEMBLY OF A KNOCKED-DOWN SP BREAKER.

THE INSTALLATION CHECKLIST LOCATED AT THE END OF PART 3 IS INTENDED TO PROVIDE A TABULATION OF THOSE CHECKS AND TESTS NECESSARY TO EFFECT A PROPER INSTALLATION. ACTUAL MEASURED VALUES SHOULD BE ENTERED ON THE BLANK SPACES RATHER THAN AN INDICATION THAT THE VALUES WERE WITHIN THE PRESCRIBED TOLERANCES AS THE INSTALLATION CHECKLIST IS ALSO INTENDED TO BE USED AS A REFERENCE WHEN INSPECTION AND MAINTENANCE IS PERFORMED.

Tools and Service Equipment

The following material and equipment is required for the installation of the Type SP circuit breaker, and should be available before commencing work. These items are not supplied by Westinghouse.

1. Leak-tec for leak testing.
2. 1-1/2 ton crane with a working height of 15 feet.
3. One pair of hook chains 7 feet long, and one pair of hook chains 9 feet long. (The preceding chains will require shorteners for knock-down breaker assembly).
4. 10 foot "A" frame stepladder to work at the top of the breaker.
5. Shim material - various thicknessess
6. Wrenches - standard sizes of open end or box type.
7. 0 to 100 ft.-lb. and 0 to 400 ft.-lb. torque wrench and sockets.
8. Thermometer accurate within 2°F.
9. 1/4 inch blade screwdriver.
10. Timing equipment and mounting hardware - see Part 3.10.
11. Corrosive-resistant conductive joint compound and wire brush or steel wool.
12. Ductor or equivalent 100 Amp. DC source with micro-ohmmeter.

13. 2 Cloth slings each 4 feet long - for knock-down breaker assembly only.

14. Two .375"-16 x 3" long studs - for knock-down breaker assembly only.

15. Thread sealant for installing position indicator cover (Silicone RTV sealant 45793BX or equivalent).

The following items are more difficult to procure and are provided by Westinghouse with each breaker order.

1. Adapter fitting for SF_6 filling.

2. Service hose for SF_6 filling.

3. AA-7 mechanism hand closing jack.

4. SF_6 gas.

5. Timer mounting bracket.

3.1 Selecting the Location

The breaker should be installed with sufficient space for cleaning, inspecting, opening doors, and operating the hand closing device. Refer to the outline drawing located in the pocket of the mechanism cabinet door.

The foundation should be prepared before the breaker arrives and should be level within .25" at the four stud locations. Consult the outline for necessary dimensions and foundation bolt locations. The breaker foundation should be high enough to prevent flood water from entering the mechanism housing.

3.2 Placement of the Circuit Breaker

Remove the breaker from its shipping skids and place on the permanent foundation. The precautions described under "Handling Procedure", Part 2.3, should be observed.

WARNING

THIS BREAKER IS EQUIPPED WITH SF_6 FILLED BUSHINGS WHICH ARE PRESSURIZED. WHEN USING CABLE SLINGS OR CHAINS, TAKE EXTREME CARE TO PREVENT FROM STRIKING OR BEARING AGAINST THESE BUSHINGS AS ANY UNUSUAL SHOCK OR STRAIN MAY CAUSE RUPTURE OF THE BUSHING ENDANGERING NEARBY PERSONNEL. DO NOT MOVE THE BREAKER IF THE SF_6 PRESSURE IN ANY POLE UNIT IS ABOVE 10 PSIG.

Note that the breaker must be lifted in order to assemble the four legs which are removed to facilitate shipment. The legs should be first assembled to the breaker, then the breaker assembly bolted to the foundation. Bolts should be firm but not tight to allow proper alignment. Insert shims, if necessary, under the legs to level the breaker before tightening the foundation bolts. The circuit breaker should be level so that moving parts within the breaker can operate freely; otherwise, friction may develop and undue strains may be imposed which could result in breaker malfunction. When breaker and legs are properly aligned and leveled, tighten all bolts securely to the torque value specified on Fig. 1.

The breaker is shipped from the factory with 2 shipping braces - an angle brace bolted diagonally across the inside of the mechanism cabinet and an angle brace mounted to connect the 3 pole unit pipe flange. The mechanism cabinet brace should be removed after placing the breaker on the foundation to permit easy access to the components within the cabinet. The pole unit shipping need not be removed however is should be painted with a finish coat if left on permanently. This brace can be removed by removing the three access cover bolts that fasten the brace to the pole unit pipes. After removal of the brace replace the access cover bolts and tighten to 55 ft-lbs.

If the breaker was shipped knocked-down, follow assembly instructions in Appendix III at this time.

3.3 Grounding Connections

Two NEMA standard ground pads are mounted on the breaker mechanism housing, one on the left side and one on the right side. A connection should be made from these pads to the station grounding network. The grounding conductor should be capable of carrying the maximum short circuit current for the duration of the fault. All joints must be clean, bright and free from burrs or surface roughness.

WARNING

A PERMANENT, LOW RESISTANCE GROUND IS ESSENTIAL FOR PERSONNEL PROTECTION. A POOR GROUND MAY BE WORSE THAN NONE, AS IT GIVES A FALSE FEELING OR SECURITY TO THOSE WORKING WITH THE EQUIPMENT

3.4 Control Wiring

All control wires to the circuit breaker should be in conduit where practicable. A control wiring diagram is located in the pocket on the inside of the mechanism cabinet door.

The control wiring should be installed so that trouble with any other equipment cannot be communicated to the control wiring of this breaker. The breaker requires the full rated control voltage as specified on the nameplate in order to perform a close or trip operation.

The proper wire size should be selected to minimize the voltage drop, otherwise, tripping time could be increased.

3.5 Connecting Current Transformers

Bushing type current transformers, supplied only when ordered, are mounted outside the breaker around the pole unit pipe. (See Fig. 1).

Transformers are usually of the multi-ratio type with five leads to provide a wide range of ratios. These leads are brought into the mechanism cabinet to terminal blocks. Each lead has an identification indicating the transformer tap to which it is connected lettered on the terminal block marking strips. Refer to the table on current transformer nameplate, which is mounted to the inside of the cabinet door, to determine transformer taps required to obtain the desired ratio. Care must be exercised so as not to confuse the polarity of the transformers. If there is any question as to the proper method of connection, refer to the polarity, ratio, and connection diagrams. These diagrams were supplied with detail drawings.

WARNING

BE SURE THE CORRECT TR SF ER CONNECTIONS ARE MADE TO A BURDEN OR A SHORT CIRCUIT IS PLACED ACROSS THE TERMINALS AT THE TERMINAL BLOCKS BEFORE THE BREAKER IS CLOSED ON THE LINE. IF A SHORT CIRCUIT IS TO BE MADE, THE CONNECTION SHOULD BE ACROSS THE TAPS OF THE HIGHEST RATIO, OTHERWISE, DANGEROUS VOLTAGES MAY OCCUR ACROSS THE OPEN TRANSFORMER SECONDARY TERMINALS.

WARNING

BREAKER MUST NOT BE TRIPPED WITHOUT HAVING NORMAL OPERATING SF_6 GAS PRESSURE.

3.6 Checking the Pneumatic Operating Mechanism

Read carefully the Operating Mechanism Instruction Book (I.B. 33-125-C6A) included with this instruction book for information on the operating and maintenance of the pneumatic mechanism. Be certain the air compressor crankcase is filled with oil to the proper level. Inspect all insulated wiring for damage. The air compressor may now be energized and allowed to pump to normal operating pressure. During compressor pump-up, check for air leaks and operation of the pressure switches at the proper pressures as indicated on the mechanism nameplate.

3.7 Installation of External Capacitors

External capacitors are required on the 460 SP 2500, 690 SP 3500, 690 SP 31.5, 725 SP 25, and 725 SP 31.5 ratings for short line fault capability. These capacitors are shipped separately from the breaker

and must be mounted during field installation of the breaker. The three external capacitors can be mounted on either side of the breaker, (See Fig. 6.).

Mounting is on the side of the breaker for which short line faults might be expected on the electrical system. Where short line faults can occur on either side of the breaker, capacitors must be installed on both sides. In some applications such as for cable circuits the external capacitance of the circuit may be sufficient to preclude the necessity for adding capacitors to the breaker.

Before installation of the capacitors it is important that the following procedure be adhered to so as to ensure proper performance.

1. Place capacitor in upright position, as indicated on the capacitor, and bring to room temperature or warmer.

2. Shake capacitor from side to side to release any possible air bubble entrapment to the top of the capacitor.

3. Keep in upright position for several hours at room temperature.

4. Capacitor is now ready to be installed on breaker. Do not turn capacitor upside down or on its side after this procedure is followed.

NOTICE

It is recommended that any storage of the capacitor be done at room temperature with the capacitors in their upright position.

The field mounting procedure is as follows. (See Fig. 6.)

1. Attach the 15.25 x 6.625 x .5" steel lower mounting straps to the bushing flanges on breaker terminals using four .375-16 x 1.25" hex steel bolts and .375" steel lockwashers. Note that the straps on terminals #1 and #5 must face outward 30°. (See Fig. 6) Torque the mounting bolts to 15 ft. lbs. The lower mounting straps must not touch any metal on the current transformers.

2. Lift at a 40° angle and place the capacitors on each lower mounting strap in the proper direction as indicated on the capacitor. Fasten with two .5-13 nylok flat head screws and torque 30 ft. lbs.

3. Attach the 18.88 x 3 x .25" aluminum bar upper mounting straps to the capacitors and bushing studs using two .5-13 x 1" hex steel bolts and .5" lock washers and one 1.5-12 nut. Torque the .5-13 x 1" hex steel bolts to 30 ft. lbs. and the 1.5-2 nut to 50 ft. lbs.

3.8 Filling a De-Energized Breaker With SF_6

Each breaker is shipped with a positive pressure of approximately 5 psig of SF_6 therefore evacuation is not required before filling. Before filling with SF_6 check each pressure gauge to confirm that pressure has not been lost due to damage or leakage. If pressure is reduced to 0 psig it will be necessary to find and repair the cause of the leakage and then pull a vacuum to 2 mm of hg before filling with SF_6.

Before the breaker is operated or placed into service it must be filled with sulfur hexafluoride gas to the proper pressure taking into consideration the ambient temperature (see Fig. 7 or breaker nameplate). To fill the breaker with SF_6 gas proceed as follows:

1. Locate the special high pressure filling hose assembly. This 10' long hose is supplied with the breaker order.

2. Remove the blank cap on the gas cylinder and the cap on the gas filling valve on one of the pole unit access cover assemblies.

3. Connect the special filling hose assembly to the gas bottle and the pole unit filling valve. Tighten hose assembly at the cylinder, but assemble loosely at the breaker fill valve.

4. Blow out the air within the filling hose assembly by opening the valve slightly on the SF_6 gas cylinder. Then close gas cylinder valve.

5. Tighten the filling hose assembly at the breaker fill valve and open both the gas cylinder valve and the breaker filling valve. Fill with gas to the proper pressure (see Fig. 7) while monitoring the pressure gauge on the pole unit access cover assembly. Only a few seconds are required to fill.

WARNING

DON'T OVER PRESSURIZE THE POLE UNIT

Approximately 5 pounds of SF_6 gas will be required. Then close both valves.

6. Remove the hose assembly from the breaker fill valve and replace the cap on the breaker fill valve.

7. Repeat this filling process on the remaining two pole units.

The relation between pressure and temperature is given by $P = .2T + 61$. If the ambient temperature is 70°F, then fill to 75 psig. A spread of $\pm$ 1 psig is allowed in the filling pressure. Refill and check for leaks if the pressure falls below the minimum curve shown in Fig. 7.

3.9 Breaker Inspection

The Type SP breaker has been completely assembled, tested, and inspected at the factory. However, to preclude breaker malfunction due to shipping damage it is recommended that a final check should be made for loose hardware, wire connections and locking devices.

3.10 Final Tests

WARNING

BEFORE ELECTRICALLY OPERATING THE BREAKER, THE HAND CLOSING JACK AND THE MAINTENANCE LOCKING BAR MUST BE REMOVED FROM THE MECHANISM. ALSO, THE CONTROL CIRCUIT SWITCHES MUST BE CLOSED.

Start with normal air pressure (governor shut-off) on the pneumatic mechanism. To check the breaker timing properly, a Westinghouse digital interval timer, graphic travel time analyzer or slide wire/oscillograph may be used. The digital interval timer is the easiest to use in timing the Type SP breaker.

If the graphic travel time analyzer is used it may be mounted on the mechanism housing as shown in Figure 4. The pipe plug is removed and replaced with the timer mounting bracket which threads onto the housing. The end of the horizontal linkage tie bar is provided with a .190-32 tapped hole for the timer connection. The timer is fastened to the bracket with two .250-20 x 3.5" hex steel bolts, .250 lock washers and .250-20 hex steel nuts.

The contact part time should now be measured during a trip operation. If the contact part time exceeds 32 ms (1.9 cycles) the difficulty may be due to one of the following reasons:

1. Incorrect zero setting on the graphic recorder.

2. Excessive voltage drop in the d-c control cable to the breaker.

3. Misadjustment of the trip unit. Refer to Part 5C and Part 4 - Tripping of the Mechanism Instruction Book (I.B. 33-125-C6A).

   At this point a close operation and an open close operation should be performed. Contact part time and contact make time should be measured. Contact make time should be within 90 to 100 milliseconds for DC close coil (84-94 milliseconds for AC close coil) measured from energization of the close coil. If graphic time travel analyzer is used, a measurement of close a velocity should be used as a substitute for contact make time. (Limits are 6.5 to 10 ft./sec. during the last 1" of travel before contact touch. See Figure 3A.) After the final timing test and contact resistance is measured, the breaker should be

left in the open position. The closing curve should not indicate any significant change in velocity throughout the breaker travel. If a change in velocity is obvious or if the contact make time or close velocity is not within the allowable limits, the difficulty may be due to improper setting of the throttle. Information on adjustment of the throttle is given in Part 4 of the Mechanism Instruction Book. If the difficulty cannot be cleared up by adjustment of the throttle, refer to Part 5 of the Mechanism Instruction Book. Remove timing device from breaker.

3.11 Line Connections

Line connections should have sufficient flexibility and support to limit the load on the bushings (150 lbs. max). Conductor and connector must have adequate current-carrying capacity to prevent heat transfer into the breaker bushing. All joints must be clean, bright and free from burrs or surface roughness.

Special consideration must be shown in the connection of an aluminum or tin plated conductor to a copper alloy terminal. Galvanic action could occur, resulting in serious corrosion unless the mating surfaces are properly protected. Several different means of protecting the surfaces are available. A heavy coating of corrosion resistant, conductive compound such as Alcoa No. 2 Electrical Joint Compound (Westinghouse No. 53535 BU or equivalent) on both surfaces, in conjunction with tin plating of the copper alloy terminal is recommended. The mating surfaces must be cleaned just prior to, or through, the application of the compound. The use of this compound also serves to minimize the surface formation of oxide films that have a higher resistance than the primary material.

3.12 Bushings

The epoxy bushings are especially designed to be self cleaning and must not be coated with any grease or any other material.

3.13 Installation of Position Indicator and Cover

The position indicator and its plexiglass housing are shipped inside the breaker cabinet to prevent breakage during shipping. The indicator is to be mounted on the left side of the housing. Feed the threaded end of the indicator through the hold and attach to the horizontal lever assembly. The plexiglass housing is then screwed in the pipe fitting on the housing. A standard thread sealant (Silicone RTV 45793 BX or equivalent) should be put on the cover threads before assembly for weather tightness.

INSTALLATION CHECKLIST

Station _____ Bus or Line _____

Installation Date _____

1. Nameplate Data

   1.1 Breaker Type _____ Amp. _____

   Serial-S.O. _____ I.B. 33-570-BM-1C

   1.2 Mechanism Type AA-7 I.B. 33-125-C6A

   Control Diagram _____ Control Voltage _____

   Compressor and Heater Voltage _____

2. General Condition of Breaker when Received: _____

NOTICE

THE FOLLOWING CHECKS ARE TO BE MADE AFTER THE BREAKER HAS BEEN SET, LEVELED, AND BOLTED TO ITS PERMANENT FOUNDATION AND EXTERNAL CAPACITORS, IF REQUIRED, HAVE BEEN INSTALLED.

3. Breaker Bolted to its Permanent Foundation and Shipping Braces Removed. _____

4. Grounding Connections Installed (Left) _____

   (Right) _____

5. Control Wiring Installed _____

6. Current Transformer (I.L. 33-256-CTA)

   6.1 Connections made _____

7. Pneumatic Mechanism (I.B. 33-125-C6A)

   7.1 Air Compressor:

      7.1.1 Proper Oil level to bottom thread of fill hole _____

7.2 Energize air compressor motor and allow to pump to operating pressure. Check for leaks. Maximum allowable leak rate is 5 psig/hour. _____ psig/hour

7.3 Pressure switch operation:

7.3.1 Governor switch; opens on rising pressure (190 psig) _____ psig.

7.3.2 Low pressure alarm; opens on falling pressure (140 psig) _____ psig.

7.3.3 Low pressure cut-out; opens on falling pressure (130 psig) _____ psig.

7.4 Fill Breaker with SF_6 (See Fig. 7 or housing nameplate) (Pole 1) _____ psig.

(Pole 2) _____ psig.

(Pole 3) _____ psig.

Ambient Temperature _____

8. Breaker Inspection

8.1 Final check for loose hardware _____

9. Timing Tests (These tests are to be made at normal operating voltage and rated air pressure 190 psig.)

9.1 Trip coil energized until contacts part (32 milliseconds max.) _____ milliseconds

9.2 Close coil energized until contacts touch (90 to 100 msec. DC, 84 to 94 msec. AC) _____ milliseconds

9.3 Close velocity (graphic time-travel analyzer only) Limits: 6.5 to 10 ft./sec. during last 1" of travel before contact touch. _____ ft./sec.

10. Contact Resistance Terminal to Terminal Measured with Ductor or Equivalent 100 amp d-c Source (80 micro-ohms max. (2000A) or 100 micro-ohms max. (1200A)) for new contacts

(Pole 1) _____ micro-ohms

(Pole 2) _____ micro-ohms

(Pole 3) _____ micro-ohms

11. Position Indicator and Cover Installed _____

12. Operation Counter Reading as Left _____

13. SF_6 Gas Pressure as Left

(Pole 1) _____ psig.

(Pole 2) _____ psig.

(Pole 3) _____ psig.

Ambient Temperature _____ °F

14. Check all labels and nameplates attached to the breaker to be sure that they are securely fastened in place and are readable.

Contact Resistance Terminal to Terminal Measured with Ductor or Equivalent 100 amp d-c Source (80 micro-ohms max. (1200A) or 100 micro-ohms max. (2000A)) for new contacts

(Pole 1) ______________ micro-ohms

(Pole 2) ______________ micro-ohms

(Pole 3) ______________ micro-ohms

Position Indicator and Cover Installed ______________

Operation Counter Reading as Left ______________

SF_6 Gas Pressure as Left

(Pole 1) ______________ psig.

(Pole 2) ______________ psig.

(Pole 3) ______________ psig.

Ambient Temperature ______________ °F

16. Check all labels and nameplates attached to the breaker to be sure that they are securely fastened in place and are readable.

PART 4 - PRINCIPLES OF OPERATION

CLOSING

To close the breaker, a low energy electrical signal actuates an air valve on the Type AA-7 pneumatic mechanism. High pressure air stored in the reservoir operates against the piston. The closing force is transmitted to a vertical pull rod in the mechanism cabinet, through a bellcrank to the horizontal linkage which charges the opening spring and draws the moving contacts to the closed position. Having reached the full closed position the air valve is de-energized and a mechanical latch in the Type AA-7 mechanism is engaged to hold the breaker in the closed position.

OPENING

Energy for opening is stored in the opening accelerating spring located around the horizontal tie bar inside the mechanism cabinet and in a spring at the base of the Type AA-7 mechanism piston permitting the breaker to be tripped with a low energy electrical signal. When tripped, the springs transmit their energy to a single, horizontal linkage located in the mechanism cabinet to a lever at each interrupter which transfers the motion to the moving contact assemblies. As the breaker opens, the moving contacts move downward and an electrical arc is formed in the chambers of the interrupters between the moving and stationary contacts. The internal construction of the interrupter assures efficient extinction of the arc. Since the interrupter performance is velocity dependent, the opening spring controls the moving contact velocity throughout the opening stroke. A hydraulic shock absorber provides the necessary shock absorbing action at the end of the opening motion.

4.1 Pneumatic Operating Mechanism

The Type AA-7 pneumatic mechanism is used to operate the Type SP breaker. Details of the operation of the mechanism are contained in Instruction Book 33-125-C6A.

4.2 Bellcrank Assembly

The primary function of the bellcrank assembly is to convert the vertical motion of the mechanism into horizontal motion. To accomplish this, the vertical pull rod from the operating mechanism is attached to a bellcrank lever. The motion of this lever is transmitted through a horizontal pull rod to a tie bar crank housing. The tie bar is attached to the three operating levers. With the breaker and mechanism in the open position, the vertical pull rod is at the upper limit of its travel. A position indicator is located externally on the left-hand side of the mechanism cabinet and is attached to the horizontal tie bar. Its motion and position coincide with that of the bellcrank lever. Closed and open position overtravel stop bolts are positioned to contact the bellcrank lever.

4.3 Operating Shaft Assemblies

Attach to the horizontal tie bar through the operating levers are the operating shaft assemblies. These convert horizontal motion of the operating linkage through rotary motion to straight line motion of the moving contact connecting rods. Each of the three operating shaft assemblies incorporates a spring loaded chevron seal arrangement to prevent SF_6 gas leakage from the interrupters.

4.4 Opening Spring

The opening spring is located inside the mechanism cabinet and is positioned around the horizontal tie bar. This is the main force to open the breaker at the proper velocity and provide the proper contact part time. When the breaker closes, the spring is compressed and is in position for the next open operation.

The opening spring is adjusted at the factory and should not require any field adjustments.

4.5 Interrupter Assemblies (Fig. 9)

The interrupter assembly is designed to be manufactured as a complete unit. An insulating tube houses the stationary contact and moving contact assemblies. The tube has the dual function of providing the mechanical support for the stationary and moving contact assemblies and the inside diameter is utilized as the cylinder wall for the piston in the moving contact assembly. Because of this multi-function design, the interrupter has spring loaded finger type contacts for the bushing leads. This interrupter is attached to the pipe assembly at the operating rod end with a flanged and bolted connection. There are no other insulating supports between the interrupter assembly and the aluminum pipe. The interrupter operates at 75 psig. The SF_6 is communicated to the interrupter through stationary contact vent holes and the operating rod end, which is open to the pipe.

With the interrupter in the closed position the main current path is through the auxiliary fingers which are parallel to the arcing fingers. Since the auxiliary fingers are not arced during interruption, they maintain low resistance electrical contact for the life of the interrupter.

During the opening operation the piston compresses SF_6 between the support plug and cylinder wall. When the arcing contacts have parted, the compressed gas flows along the arc, sweeping hot gases upstream through the teflon orifice and downstream through the hollow moving contact. The hot gases and arc products are contained within the pipe.

4.6 Hydraulic Shock Absorber

A hydraulic shock absorber is mounted on the mechanism bellcrank assembly and is contacted by the bellcrank lever during the opening stroke. This shock absorber serves to control the decelleration phase of the opening stroke and minimizes overtravel. The hydraulic shock absorber is factory sealed and adjusted and normally requires no maintenance. If breaker overtravel on opening or close-opening exceeds the specific limits the shock absorber must be readjusted using the procedure outlined in Part 6.1.12.

PART 5 - INSPECTION

The intent of this section is to identify the parameters which can be used to establish and carry out a proper program to assure reliability of the equipment.

Of primary importance in carrying out an effective program is that the individuals involved understand the equipment, how it is to function, and the potential problems should out-of-specification conditions exist.

It is desirable to maintain a permanent record of each circuit breaker. Included in this log should be the complete records of all installation, inspection, maintenance, and lubrication work performed. Installation, Periodic, 3 Year Inspection, 6 Year Inspection and Major Inspection Checklists should be included as well as information relative to the number of faults and associated current magnitudes the breaker has been required to interrupt.

Record keeping of this type will permit accurate evaluation of the conditions of the breaker at all times and assure reliable service if the suggested procedures are followed. In addition, it will permit the comparison of present-day values of such items as contact resistance, contact engagement, etc., to previously obtained data.

Many of the tests which are made are diagnostic type tests which will provide information relative to potential problems. This is to say that when one analyzes the test results and compares the results with previous test data, it can be determined whether a change is normal or whether it is one which requires attention.

An effective maintenance program begins during the installation of the equipment. A copy of an Installation Checklist follows Part 3 of this book. Adherence to the procedures identified on the Installation Checklist and verification that the items checked are within the allowable tolerances will assure a proper installation. This information is then to be used as a base reference for future maintenance. The checklists do not provide an in-depth description of the checks and tests to be made. This information is contained in the text of this instruction book. Breakers installed in areas of severe environmental conditions may require more frequent inspection procedure. It is recommended that frequent visual inspections be made by operators while touring the switchyard in order to observe any obvious abnormal conditions.

5.1 Periodic Inspection Procedure

Periodic Inspections should be made at monthly and semi-annual intervals to assure continued satisfactory performance of the breaker. At the end of Part 5 is a Periodic Inspection Checklist.

5.2 3 Year Inspection Procedure

An inspection should be made every 3 years and used as an additional guideline in determining the necessity of maintenance. This inspection includes checks which may be made externally. At the end of Part 5 is a copy of a 3 Year Inspection Checklist which identifies those items which can be checked without removing the gas from the breaker. By making the checks identified on the list, it can be verified whether or not the breaker is satisfactory for continued service without performing a 6 Year or Major Inspection.

5.3 6 Year Inspection Procedure

An inspection should be made every 6 years and used as an additional guideline in determining the necessity of maintenance. This inspection includes checks which may be made externally. At the end of Part 5 is a copy of a 6 Year Inspection Checklist which identifies those items which can be checked without removing the gas from the breaker. By making the checks identified on the list, it can be verified whether or not the breaker is satisfactory for continued service without performing a Major Inspection.

5.4 Major Inspection

Major Inspection is that which requires removal of the gas from the breaker to determine the condition of the interrupters, contacts, and other internal components. The following are some of the factors to be considered in determining the frequency of a major inspection procedure.

Whichever comes first:

Twenty times the accumulated interrupting rating, i.e., 20 full rated faults, 40 half rated faults, etc.

2,000 mechanical operations.

Information received from 3 Year and 6 Year Inspections.

Accumulated experience of breaker characteristics and duty.

PERIODIC INSPECTION CHECKLIST

Station _____ Bus or Line _____

Date of Inspection _____

1. Nameplate Data

1.1 Breaker Type _____ Amp. _____

Serial-S.O. _____ I.B. 33-570-BM-1C

1.2 Mechanism Type AA-7 I.B. 33-125-C6A

Control Diagram _____ Control Voltage _____

Compressor and Heater Voltage _____

MONTHLY CHECKS

2. General Condition of Breaker: _____

3. Pneumatic Mechanism (I.B. 33-125-C6A)

Operation Counter Reading _____

Drain water from air storage tank _____

4. Breaker Checks

SF_6 Gas Pressure (Pole 1) _____

(Pole 2) _____

(Pole 3) _____

Ambient Temperature _____

6 MONTH CHECKS (In Addition To Monthly Checks)

5. Pneumatic Mechanism (I.B. 33-125-C6A)

Check condition and tightness of "V" belt. 3/8" to 3/4" deflection with 5 pounds pressure applied vertically to center of the belt. _____ each

Check air compressor oil level.

Drain enough air from air storage tank to start and run air compressor.

Check compressor cut-out switch for proper setting.

Check air compressor air cleaner element and clean if necessary.

Inspect exposed hardware, control wire terminals, and tube fittings for tightness.

Check all labels and nameplates attached to the breaker to be sure that they are securely fastened in place and are readable.

ANNUAL CHECK

(In addition to monthly check and 6 month check

Change compressor oil. Fill to bottom thread of fill hole.

3 YEAR INSPECTION CHECKLIST

Station _____ Bus or Line _____

Date of Inspection _____

1. Nameplate Data

   1.1 Breaker Type _____ Amp. _____

   Serial-S.O. _____ I.B. 33-570-BM-1C

   1.2 Mechanism Type AA-7 I.B. 33-125-C6A

   Control Diagram _____ Control Voltage _____

   Compressor and Heater Voltage _____

WARNING

PRIOR TO PERFORMING INSPECTION OF THE BREAKER, TRIP THE BREAKER AND OPEN ADJACENT BREAKER DISCONNECT SWITCHES, SOLIDLY GROUND ALL BUSHING TOP TERMINALS TO REMOVE THE RESIDUAL ELECTRICAL CHARGE. (IF NOT GROUNDED, BUSHINGS CAN RETIAN AN ELECTRICAL CHARGE WHICH MAY CAUSE SERIOUS SHOCK TO A WORKMAN.) OPEN ALL A-C AND D-C SWITCHES.

2. General Condition of Breaker: _____

3. Breaker Hold Down Bolts Tight _____

4. Grounding Connections Tight (Left) _____

   (Right) _____

5. Pneumatic Mechanism (I.B. 33-125-C6A)

   5.1 General Checks:

   5.1.1 Condition of mechanism.
   Corrosion of hardware.
   Loose hardware. _____

   5.1.2 Lubricate in accordance with Part 6.2 and Part 6 of the Mechanism Instruction Book _____

5.1.3 Connections on terminal blocks, switches, and relays: tight and no corrosion. _____

5.1.4 Heaters operating properly _____

5.1.5 Wiring: deteriorated or damaged insulation _____

5.2 Air Compressor:

5.2.1 Change air compressor oil. Fill to bottom thread of fill hole. _____

5.2.2 Condition and tightness of "V" belt _____

5.3 Open reservoir drain valve and lower pressure to 130 psig. Close drain valve and compressor knife switch and allow to pump to normal pressure. Pump-up time from low pressure cut-out point (130 psig) to normal operating pressure (190 psig) should be less than 30 minutes. _____ min.

5.4 Pressure switch operation:

5.4.1 Governor switch; opens on rising pressure (190 psig) _____ psig.

5.4.2 Low pressure alarm; closes on falling pressure (140 psig) _____ psig.

5.4.3 Low pressure cut-out; opens on falling pressure (130 psig) _____ psig.

5.5 Operation rundown starting at governor shutoff with compressor knife switch open.

5.5.1 Number of operations before low pressure cut-out switch opens (5 minimum). _____

5.5.2 Number of operations after low pressure cut-out switch opens with low pressure cut-out switch contacts jumpered (1 minimum). _____

WARNING

REMOVE JUMPER AFTER TEST

5.6 Leak Rate: Beginning at 190 psig with compressor de-energized, the maximum allowable pressure drop is 5 psi/hr in the air system. _____ psi/hr.

5.7 Minimum operating voltages (See Mechanism nameplate for voltage ranges)
Close _____ Vd-c
Trip _____ Vd-c

6. Breaker Checks

6.1 Install timing device rod onto tie bar and maintenance hand jack on mechanism. Install ohmmeter or light out device between bushings on each pole, jack breaker slowly toward the closed position, and mark timing device rod with reference to housing for each pole when circuit is obtained. Continue to jack breaker closed to the point where the AA-7 mechanism just latches, loosen jack to load mechanism and mark full closed position on the timer rod.

Measure contact engagement as determined by the difference in position. If this dimension is less than 0.69 inches then a Major Inspection must be performed.

(Pole 1) _____ in.
(Pole 2) _____ in.
(Pole 3) _____ in.

6.2 Jack breaker to the open position.

Measure horizontal pull rod travel from full closed to full open position. (4.937 ± .060 inches) Remove maintenance hand jack from mechanism and timing device rod from tie bar. _____ in.

7. Contact resistance terminal to terminal measured with ductor or equivalent 100 amp d-c source. 120 micro-ohms maximum for used contacts (2000A) or 135 micro-ohms maximum for used contacts for the 1200 Ampere breaker. If maximum micro-ohms values are greater than those listed a major inspection is required.

(Pole 1) _____ micro-ohms

(Pole 2) _____ micro-ohms

(Pole 3) _____ micro-ohms

8. Operation Counter Reading as Left _____

9. SF_6 Gas Pressure as Left

(Pole 1) _____ psig

(Pole 2) _____ psig

(Pole 3) _____ psig

Ambient Temperature _____ °F

6 YEAR INSPECTION CHECKLIST

Station _____ Bus or Line _____

Date of Inspection _____

1. Nameplate Data

   1.1 Breaker Type _____ Amp. _____

   Serial-S.O. _____ I.B. 33-570-BM-1C

   1.2 Mechanism Type AA-7 I.B. 33-125-C6A

   Control Diagram _____ Control Voltage _____

   Compressor and Heater Voltage _____

WARNING

PRIOR TO PERFORMING INSPECTION OF THE BREAKER, TRIP THE BREAKER AND OPEN ADJACENT BREAKER DISCONNECT SWITCHES, SOLIDLY GROUND ALL BUSHING TOP TERMINALS TO REMOVE THE RESIDUAL ELECTRICAL CHARGE. (IF NOT GROUNDED, BUSHINGS CAN RETIAN AN ELECTRICAL CHARGE WHICH MAY CAUSE SERIOUS SHOCK TO A WORKMAN.) OPEN ALL A-C AND D-C SWITCHES.

2. General Condition of Breaker: _____

3. Breaker Hold Down Bolts Tight _____

4. Grounding Connections Tight (Left) _____

   (Right) _____

5. Pneumatic Mechanism (I.B. 33-125-C6A)

   5.1 Wire Check:

   5.1.1 Inspect wiring for damaged or deteriorated insulation. _____

5.1.2 Inspect wiring for possible grounds or short circuit. _____

5.1.3 Connections on terminal blocks, switches, and relays, tight and no corrosion. _____

5.1.4 Heaters: electrical continuity and terminals not shorted to ground. _____

5.2 Lubricate in accordance with Part 6.2 and Part 6 of Mechanism Instruction Book. _____

5.3 Air Compressor:

5.3.1 Change compressor oil. Fill to bottom thread of fill hole. _____

5.3.2 Condition and tightness of "V" belt _____

5.3 Remove air filter, clean in kerosene and reinstall. _____

5.4 Open reservoir drain valve and lower pressure to 130 psig. Close drain valve and compressor control switch and allow to pump to normal pressure. Pump-up time from low pressure cut-out point (130 psig) to normal operating pressure (190 psig) should be less than 30 minutes. _____ min.

5.5 Pressure switch operation:

5.5.1 Governor switch; opens on rising pressure (190 psig) _____ psig.

5.5.2 Low pressure alarm; closes on falling pressure (140 psig) _____ psig.

5.5.3 Low pressure cut-out; opens on falling pressure (130 psig). Open reservoir drain valve & reduce pressure to 0 psig. Open compressor control switch. _____ psig.

5.6 Mechanism dimensional checks (breaker open):

5.6.1 Trip assembly air gap (.188 inches minimum) _____ in.

5.6.2 Trip assembly free travel before kickoff spring is engaged (.060 inches less than dimension measured in 5.5.1 above) _____ in.

5.6.3 Clearance between top of trip rod plunger and catch (.012 inches minimum) _____ in.

5.6.4 Clearance between the trip free trigger and roller lever (.032 ± .005 inches) _____ in.

5.7 Mechanism mounting bolts tight (250 ft. lbs.) _____ ft. lbs.

6. Breaker Checks

6.1 Install maintenance hand jack on the mechanism and check that mechanism horizontal pull rod and tie bar and all three interrupter connecting rod operate freely and without interference during a manual (hand jack) operation.

Interrupter 1 _____

Interrupter 2 _____

Interrupter 3 _____

Mechanism _____

6.2 Check contact engagement by installing the timing device rod onto tie bar. Place ohmmeter or light out device between bushings on each pole, jack breaker slowly toward the closed position and mark timing device rod with reference to the mounting bracket for each pole when circuit is obtained. Continue to jack breaker closed to the point where the AA-7 mechanism just latches, loosen jack to load mechanism and mark full closed position on the timer rod.

Measure contact engagement as determined by the difference in position. If this dimeninsion is less than 0.69 inches, then a Major Inspection must be performed.

Interrupter 1 _____ in.

Interrupter 2 _____ in.

Interrupter 3 _____ in.

6.3 Check lever system closed position stop clearance (.027~.037 inches). (Refer to Fig. 4 and Part 6.1.2.1) _____ in.

6.4 Check travel of horizontal pull rod assembly (4.937 ± .060 inches). (Refer to Fig. 4 and Part 6.1.2.1) _____ in.

6.5 Check the closed position operating lever adjustment using gauge 7358D12H01. Limits are 2.500 ± .025. (Ref. Fig. 4) _____ in.

6.6 Using bellcrank, lever checking gauge 7358D12H02, check the bellcrank adjustment (Ref Fig. 4). Limits are 4.250 ± .030. _____ in.

6.7 Check the open position operating lever adjustment using gauge 7358D12H01. Limits are 2.437 ± .035 _____ in.

6.8 Check lever system open position stop clearance. There should be no clearance between the bellcrank lever and the stop bolt. (Ref to Fig. 4 and Part 6.1.2.2).

6.9 Final check for loose hardware. Remove maintenance hand jack. Reconnect the bushing line connections. (See Part 3.11)

7. Mechanism Operational Checks. Reference I.B. 33-125-C6A.

7.1 Breaker trips manually with .032 inch shim on moving armature.

7.2 Overtravel on closing piston (.125 inches minimum). _____ in.

8. Operation run-down starting at governor shut-off with compressor de-energized. Operations must be made electrically.

8.1 Number of operations before low pressure cut-out switch opens (5 minimum).

8.2 Number of operations after low pressure cut-out switch opens with low pressure cut-out switch contacts jumpered (1 minimum)

WARNING

REMOVE JUMPER AFTER TEST.

9. Minimum operating voltage (see mechanism nameplate for voltage range). Close _____ Vd-

10. Timing Tests: (These tests are to be made at normal operating voltage and rated air pressure with 75 psig SF_6 in the interrupters. Attach timing device to tie bar (see Fig. 4).

10.1 Trip coil energized until contacts part (32 milliseconds max.) _____ milliseconds

10.2 Opening velocity-measured between contact part and 1 cycle later (14.6 ft/sec to 15.8 ft/sec). (See Fig. 3A) _____ ft/sec

10.3 Close coil energized till contacts touch (90 to 100 milliseconds DC, 84 to 84 milliseconds AC). _____ milliseconds

10.4 Close velocity limits 6.5 to 10 ft. per second during last 1" of travel before contact touch. _____ ft/s

10.5 Reclose time (if required) trip coil energized until contacts touch (approximately 270 milliseconds). (See Fig. 3B) _____ milliseconds

10.6 Rebound on opening (1.0 inch max.) (See Fig. 3A) _____ in.

10.7 Overtravel on opening. Limit is $\pm$ 0.1" from full open position (See Fig. 3A). _____ in.

10.8 Overtravel on close-open. Limits are + 0.2" - 0.1" from full open position (See Fig. 3A) Remove timing device. _____ in.

11. Leak Rate: Beginning at 190 psig with the compressor motor de-energized the maximum allowable pressure drop is 5 psi/hr in the air system. _____ psi/hr

12. Contact resistance terminal to terminal measured with ductor or equivalent 100 amp d-c source 120 micro-ohms max. for used contacts on the 2000 ampere breaker; 135 micro-ohms max for used contacts on 1200A breaker. If maximum micro-ohm values are greater than those listed a major inspection is required.

(Pole 1) _____ micro-ohms

(Pole 2) _____ micro-ohms

(Pole 3) _____ micro-ohms

13. Capacitor Tests

13.1 Measure capacitance of external capacitors if so equipped. The value should be 5000 pF ± 10%.

(Pole 1) _____ pF

(Pole 2) _____ pF

(Pole 3) _____ pF

14. Operation Counter Reading as Left _____

15. SF_6 Gas Pressure as Left

(Pole 1) _____ psig

(Pole 2) _____ psig

(Pole 3) _____ psig.

Ambient Temperature _____ °F

MAJOR INSPECTION CHECKLIST

Station _____ Bay or Line _____

Date of Major Inspection _____ Installation Date _____

1. Nameplate Data

1.1 Breaker Type _____ Amp. _____

Serial-S.O. _____ I.B. _____ 33-570-BM-10

1.2 Mechanism Type AA-7 I.B. _____ 33-125-C6A

Control Diagram _____ Control Voltage _____

Compressor and Heater Voltage _____

WARNING

PRIOR TO PERFORMING INSPECTION OF THE BREAKER, TRIP THE BREAKER AND OPEN ADJACENT BREAKER DISCONNECT SWITCHES. SOLIDLY GROUND BUSHING TOP TERMINALS TO REMOVE THE RESIDUAL ELECTRICAL CHARGE. IF NOT GROUNDED, BUSHINGS CAN RETAIN AN ELECTRICAL CHARGE THAT MAY CAUSE SERIOUS SHOCK TO A WORKMAN. OPEN AUX. ACC. AND D-SWITCHES.

2. General Condition of Breaker _____

_____

_____

3. Breaker and Hold Down Bolts Tight _____

4. Grounding Connections Tight (Left) _____

(Right) _____

5. Pneumatic Mechanism (I.B. 33-125-C6A)

5.1 Wire Check:

5.1.1 Inspect wiring for damaged or deteriorated insulation _____

5.1.2 Test wiring for possible grounds or short circuit. _____

5.1.3 Connections on terminal blocks, switches, and relays, tight and no corrosion. _____

5.1.4 Heaters: electrical continuity and terminals not shorted to ground. _____

5.2 Air Compressor:

5.2.1 Change compressor oil. Fill to bottom thread of fill hole. _____

5.2.2 Condition and tightness of V-belt _____

5.2.3 Remove air filter, clean in kerosene and reinstall. _____

5.3 Open reservoir drain valve and lower pressure to 130 psig. Close drain valve and compressor control switch and allow to pump to normal pressure. Pump-up time from low pressure cut-out point (130 psig) to normal operating pressure (190 psig) should be less than 30 minutes. _____ minutes

5.4 Pressure switch operation:

5.4.1 Governor switch; opens on rising pressure (190 psig) _____ psig.

5.4.2 Low pressure alarm; closes on falling pressure (140 psig). _____ psig.

5.4.3 Low pressure cut-out, open on falling pressure (230 psig). Open reservoir drain valve & reduce pressure to 0 (psig). Open compressor control switch _____

5.5 Mechanism dimensional checks (breaker open):

5.5.1 Trip assembly air gap (1.88 inches minimum) _____

5.5.2 Trip assembly free travel before kickoff spring is engaged (.060 inches less than dimension measured in 5.5.1 above) _____

5.5.3 Clearance between top of trip rod plunger and catch (.012 inches minimum) _____

5.5.4 Clearance between the trip free trigger and shifter lever (.157 ± .005 inches) _____

5.6 Mechanism mounting bolts tight (250 ft. lbs.) _____

6. Internal Inspection:

6.1 Remove SF_6 gas from pole units by opening all pole unit fill valves and releasing to atmosphere. Disconnect the line connections from bushing terminals 1, 3, and 5 (Fig. 6).

WARNING

REFER TO PART 6, PRECAUTIONS TO BE OBSERVED WHEN HANDLING ARCED SF_6 GAS.

6.2 Remove interrupter cover plates

Interrupter 1 _____
Interrupter 2 _____
Interrupter 3 _____

6.3 Remover bushings #1, #3, and #5. Remove interrupters (Fig. 9), dismantle and wipe all surfaces clean with alcohol and check for excessive interrupter orifice erosion. The diameter of this orifice should not exceed 1.156 inches in diameter. (Refer to Fig. 8) If the diameter exceeds 1.156 inches at any point, the entire interrupter assembly must be replaced. This can be checked with orifice wear gauge 7249A88H01.

Interrupter 1 _____

Interrupter 2 _____

Interrupter 3 _____

6.4 Replace piston seal ring as shown in Fig. 9 and described in text (Part 6.1.3.4)

Interrupter 1 _____

Interrupter 2 _____

Interrupter 3 _____

6.5 Replace moving contact teflon guide seals. (See Fig. 9.)

Interrupter 1 _____

Interrupter 2 _____

Interrupter 3 _____

6.6 Check all hardware on moving contact assembly for tightness

Interrupter 1 _____

Interrupter 2 _____

Interrupter 3 _____

6.7 Wipe clean the inside of the interrupter tube with alcohol and apply Molykote G-N (53701DK) sparingly to the moving contact assembly

Interrupter 1 _____

Interrupter 2 _____

Interrupter 3 _____

6.8 Reassemble interrupters after inspection and replacement of necessary parts. Clean inside of pole unit pipes, install interrupter in pipes and install cover plates with new desiccant. Immediately prior to installation of desiccant, remove moisture protective foil covering. Use Dow Corning No. 11 (53701RB) to hold cover plate gasket in place. Install bushings #1, #3, and #5.

Interrupter 1 _____

Interrupter 2 _____

Interrupter 3 _____

6.9 [illegible] maintenance hand [illegible] on the mechanism and check [illegible] mechanism horizontal [illegible] pull rod and tie bar and al[illegible] [illegible] interrupter connecting [illegible] operate freely and without [illegible] interference during a manual [illegible] and jack) operation.

6.10 Check contact engagement by [illegible] fitting the timing device [illegible] onto tie bar. Place [illegible] dielectric or light out device [illegible] between bushings on each pole [illegible] jack breaker slowly toward [illegible] the closed position and mark [illegible] timing device rod with reference [illegible] to the mounting bracket for each pole when circuit is obtained. Continue to jack breaker closed to the point where the AA-7 mechanism just latches, loosen jack to load mechanism and mark full closed position on the timer rod.

[illegible] measure contact engagement as determined by the difference in [illegible] position (0.89 + .06 net, .8[illegible] inches minimum for used contacts).

6.11 Check lever system closed position [illegible] gap clearance (.027-.037 inches). (Refer to Fig. 4 and Part 6.1.2.1)

6.12 Check travel of horizontal pull rod assembly (4.937 + .060 inches). (Refer to Fig. 4 and Part 6.1.2.1)

6.13 Check the closed position operating lever adjustment using gauge 7358D12H01. Limits are 2.500 + .025. (Refer Fig. 4).

Interrupter 1 _____

Interrupter 2 _____

Interrupter 3 _____

Mechanism _____

Interrupter 1 _____

Interrupter 2 _____

Interrupter 3 _____

6.14 Using bellcrank lever checking gauge 7358D12H02, check the bellcrank adjustment (Ref Fig. 4). Limits are 4.250 ± .030. _____ in.

6.15 Check the open position operating lever adjustment using gauge 7358D12H01. Limits are 2.437 ± .035. _____ in.

6.16 Check lever system open position stop clearance. There should be no clearance between the bell crank lever and the stop bolt (Ref. to Fig. 4 and Part 6.1.2.2). _____ in.

6.17 Final check for loose hardware. Pull vacuum to 2 mm of mercury and fill with SF_6. See Part 3.8) Remove maintenance hand jack. Reconnect the bushing line connections. (See Part 3.11) _____

7. Mechanism Operational Checks. Reference I.B. 33-125-C6A.

7.1 Breaker trips manually with .032 inch shim on moving armature. _____

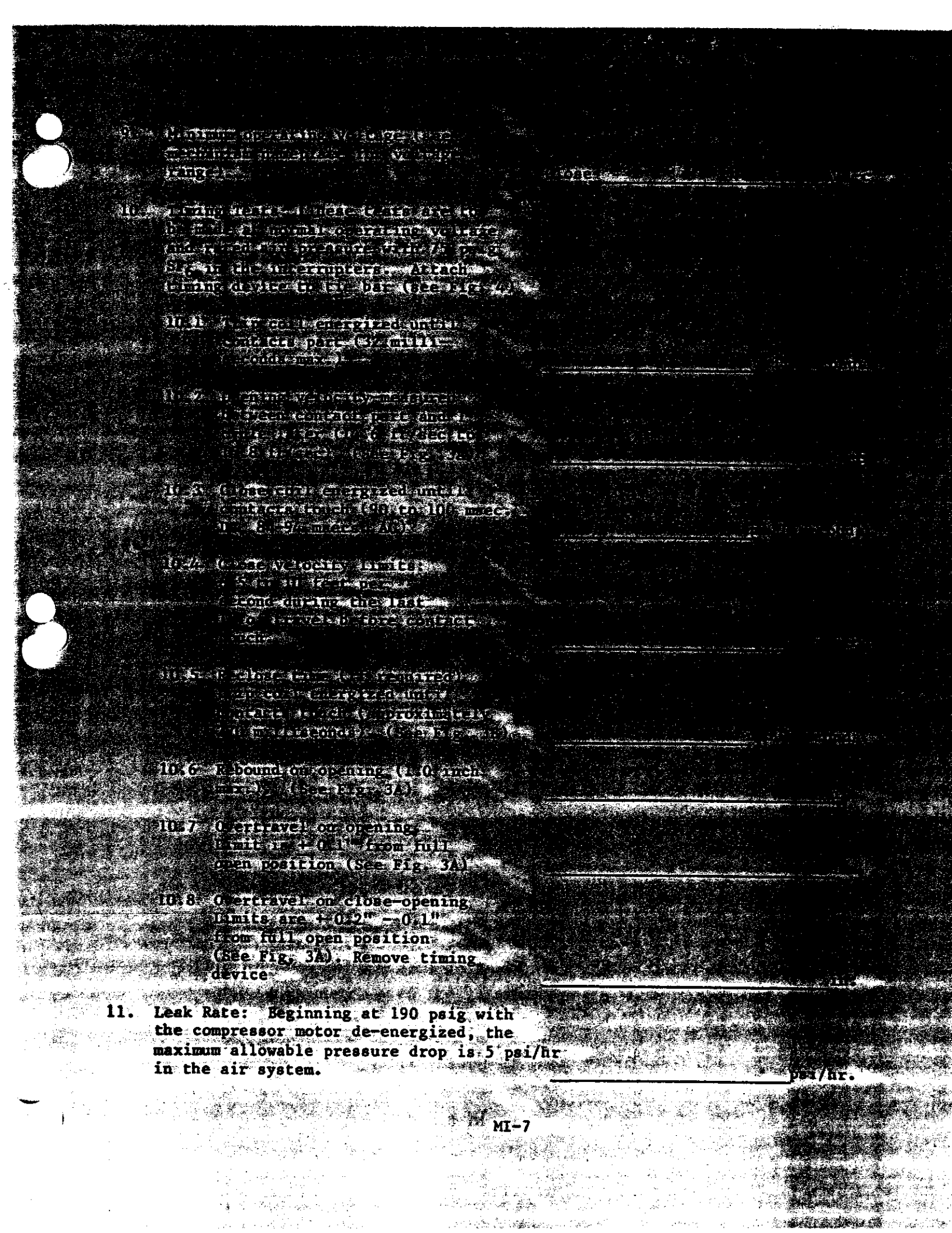
7.2 Overtravel on closing piston (.125 inches minimum). _____ in.

8. Operation run-down starting at governor shut-off with compressor de-energized. Operations must be made electrically.

8.1 Number of operations before low pressure cut-out switch opens (5 minimum). _____

8.2 Number of operations after low pressure cut-out switch opens with low pressure cut-out switch contacts jumpered (1 minimum). _____

WARNING
REMOVE JUMPER AFTER TEST.



11. Leak Rate: Beginning at 190 psig with the compressor motor de-energized, the maximum allowable pressure drop is 5 psi/hr in the air system.

12. Contact resistance terminal to terminal measured with ductor or equivalent 100 amp d-c source (80 micro-ohms max. for new contacts; 120 micro-ohms max. for used contacts on the 2000 ampere breaker; 100 micro-ohms for new contacts, 135 micro-ohms for used contacts on 1200A breakers.

(Pole 1) _____ micro-ohms

(Pole 2) _____ micro-ohms

(Pole 3) _____ micro-ohms

13. Capacitor Tests

13.1 Measure capacitance of external capacitors if so equipped. The value should be 5000 pF ± 10%

(Pole 1) _____ pF

(Pole 2) _____ pF

(Pole 3) _____ pF

14. Operation Counter Reading as Left _____

15. SF_6 Gas Pressure as Left

(Pole 1) _____ psig

(Pole 2) _____ psig

(Pole 3) _____ psig

Ambient Temperature _____

PART 6 - MAINTENANCE/ADJUSTMENT AND LUBRICATION

This instruction book section describes procedures to be followed when adjustments or part replacement is necessary as determined by the Installation, Periodic, 3 Year, 6 Year or Major Inspection Checklist or by circuit breaker malfunction. The step-by-step instructions given should be followed carefully to assure proper equipment operation. Reference to the included instruction leaflets and instruction books may be necessary.

PRECAUTIONS TO BE OBSERVED WHEN HANDLING ARCED SULFUR HEXAFLUORIDE (SF_6) GAS

WARNING

SULFUR HEXAFLUORIDE GAS IN THE PURE STATE IS COLORLESS, ODORLESS, TASTELESS, AND NON-TOXIC. BEWARE OF OXYGEN DEFICIENCY IF LARGE VOLUMES OF GAS ARE BREATHED. TOXIC DECOMPOSITION PRODUCTS ARE FORMED IN THE GAS WHEN ARCING OCCURS IN IT. DO NOT BREATHE GAS CONTAINING THESE TOXIC PRODUCTS, ESPECIALLY WITHIN A FEW MINUTES AFTER THE DOORS ARE OPENED OR UNTIL THE DECOMPOSITION PRODUCTS ARE SAFELY DILUTED WITH FRESH AIR.

MOLECULAR SIEVES ARE INCORPORATED IN ALL SF_6 BREAKERS. THIS MATERIAL IS EFFICIENT IN REMOVING THE CHEMICALLY ACTIVE PRODUCTS FORMED DURING ARCING. A SUFFICIENT AMOUNT OF THIS FILTER MATERIAL IS USED TO REMOVE THE EXPECTED TOXIC GASES PRODUCED FROM ARCING BETWEEN MAINTENANCE OPERATIONS ON THE BREAKER. USUALLY ONLY A SMALL PERCENTAGE OF GAS REMIANS IN THE PIPE AFTER RELEASING THE GAS TO ATMOSPHERE, AND MOST OF IT ESCAPES AFTER OPENING THE COVER PLATES. AS A RESULT, OPERATING PERSONNEL WILL NOT BE EXPOSED TO A SIGNIFICANT AMOUNT OF TOXIC GAS AFTER THE BREAKER IS OPENED.

IF FOR SOME REASON A SIGNIFICANT AMOUNT OF ARC FORMED TOXIC GAS IS PRESENT, AN UNPLEASANT STINGING ODOR OR IRRITATION OF THE UPPER RESPIRATORY TRACT AND EYES SHOULD GIVE AN EARLY AND SUFFICIENT WARNING WITHIN SECONDS TO PERSONNEL IN THE VICINITY BEFORE A SIGNIFICANT TOXIC REACTION SHOULD OCCUR. THE ABSENCE OF ANY DETECTABLE ODOR OR NASAL IRRITATION SHOULD INDICATE SAFE WORKING CONDITIONS.

CAUTION SHOULD BE OBSERVED TO PREVENT THE INHALATION OF THE FINE METALLIC FLUORIDE DUST. A DUST MASK SHOULD BE WORN WHILE DOING THIS WORK, AND IT IS ALSO ADVISABLE TO AVOID SKIN IRRITATION BY WEARING GLOVES AND KEEPING OTHER PARTS OF THE BODY COVERED. VACUUM CLEANING EQUIPMENT MAY BE USED TO REMOVE ARC POWDERS IF AVAILABLE. IT IS RECOMMENDED THAT WORKMEN EXPOSED TO ARC POWDERS WASH CAREFULLY TO REMOVE THE METAL SALTS FROM HIS SKIN.

MAINTENACE TOOLS, MATERIAL, AND EQUIPMENT

The following tools, material, and equipment are recommended to perform maintenance, adjustment, and lubrication on the breaker:

PI - Periodic Inspection
3I - 3 Year Inspection
6I - 6 Year Inspection
MI - Major Inspection

(PI) (3I) (6I) (MI)	1.	Wrenches - Standard sizes of open end and box type and allen wrenches. 1/4", 3/8" and 1/2" drive ratchets, ratchet extensions, and sockets.
(PI) (3I) (6I) (MI)	2.	Thermometer accurate to within 2°F.
(PI) (3I) (6I) (MI)	3.	Screwdrivers - 1/8", 1/4", and 3/8" blade.
(3I) (6I) (MI)	4.	Ten foot "A" frame stepladder
(3I) (6I) (MI)	5.	Ductor or equivalent 100 ampere DC source with a micro-ohmmeter.
(3I) (6I) (MI)	6.	Feeler gauges and 6" and 12" measuring rules.
(3I) (6I) (MI)	7.	Mechanism hand closing jack.
(3I) (6I) (MI)	8.	Timing device rod.
(MI)	9.	Leak-tec for leak testing.
(MI)	10.	1-1/2 ton crane with a working height of 20 feet and 2 cable slings (for removing the bushings, and if so equipped, the capacitor assemblies).
(MI)	11.	0-50 ft. lb. torque wrench - 3/8" drive, (Snap-on Model TE 50 FFU-A Recommended) and 0-100 ft. lb. torque wrench.
(6I) (MI)	12.	Timing equipment and mounting hardware (see Part 3.10).
(MI)	13.	Corrosive resistant conductive joint compound and wire brush.
(6I) (MI)	14.	Capacitance measuring device - Doble or equivalent high voltage type.
(MI)	15.	Slip-joint pliers
(MI)	16.	Linemans pliers with side cutters.
(MI)	17.	Small vacuum pump (Welsh Duo-Seal Model 1400B (0.9CFM) or equivalent) with vacuum gauge measuring down to at least 1 mm of mercury.

	(MI)	18.	Hammer.
	(MI)	19.	1/16" diameter pin punch.
	(MI)	20.	Alcohol and clean, lint free cloths.
	(MI)	21.	Dust mask and gloves
	(MI)	22.	SF_6 gas (15 lbs.).
	(MI)	23.	Service hose and adapter for SF_6 filling.
(6I)	(MI)	24.	Timer mounting bracket, 9" Torpedo Level.
	(MI)	25.	Long 5/32" allen wrench or 1/4" drive socket with 5/32" allen wrench attachment.
	(MI)	26.	Orifice wear gauge (7249A38H01).*
(6I)	(MI)	27.	Operating lever checking gauge (7358D12H01).*
(6I)	(MI)	28.	Bellcrank lever checking gauge (7358D12H02).*
	(MI)	29.	Short 5/16" allen wrench stub (7358D12H03) (for torquing bushing clamp rings).*
	(MI)	30.	Interrupter spanner wrench (7358D12H04).*
	(MI)	31.	X washers (3 required, 6 supplier). * **
	(MI)	32.	Cover plate gaskets (3). * **
	(MI)	33.	Bushing gaskets (3).* **
	(MI)	34.	Guide seals (6). * **
	(MI)	35.	Seal rings (3). * **
	(MI)	36.	Loctite - Medium strength 242 * ** ***
	(MI)	37.	Molykote (53701DK) grease. * **
	(MI)	38.	Beacon 325 (55213AG) grease. * **
	(MI)	39.	Dow Corning #11 (53701RB) grease. * **
	(MI)	40.	Desiccant (3 bags of Molecular Sieve (1657B11G01) and 6 long nylon cable ties. * **
	(MI)	41.	Silicone RTV sealant 45793BX * **

* Available from Westinghouse as Major Inspection Tool and Parts Kit, Style No. 1658B22G01.

** Available from Westinghouse as Major Inspection Parts Kit, Style No. 1658B23G01.

*** Shelf Life 1 Year.

BUSHING WEATHERCASE REPLACEMENT ITEMS

1. Bushing weathercase removal spanner wrench (7358D12H05).***
2. Petrolatum (55821CA). ***
3. Seal. ***
4. Gasket. ***
5. "O" Ring. ***
6. Bushing to flange gasket. ***
7. Short 5/16" allen wrench stub (7358D12H03).***
8. Loctite 242 ** ***
9. Desiccant (1 bag of Molecular Sieve (1657B91G01) and 2 long nylon cable ties. ***
10. Cover plate gasket (1). ***
11. Dow Corning #11 grease (53701RB) Style 512A196H07.***
12. Weathercase-ordered separately.

** Shelf Life 1 Year.

*** Available from Westinghouse as Bushing Weathercase Replacement Kit, Style No. 1658B21G01.

WARNING

PRIOR TO PERFORMING MAINTENANCE ON THE BREAKER, TRIP THE BREAKER AND OPEN ADJACENT BREAKER DISCONNECT SWITCHES. SOLIDLY GROUND ALL BUSHING TOP TERMINALS TO REMOVE THE RESIDUAL ELECTRICAL CHARGE. (IF NOT GROUNDED, BUSHINGS CAN RETAIN AN ELECTRICAL CHARGE WHICH MAY CAUSE SERIOUS SHOCK TO A WORKMAN.) OPEN ALL A-C AND D-C SWITCHES. OPEN AIR RESERVOIR DRAIN VALVE AND REDUCE AIR PRESSURE TO ZERO PSIG.

6.1 Maintenance/Adjustment

6.1.1 Pneumatic Operating Mechanism

For maintenance, adjustment and lubrication of the Type AA-7 pneumatic mechanism refer to I.B. 33-125-C6A.

6.1.2 Operating Linkage (Fig. 4)

6.1.2.1 Closed Position Adjustments

The bellcrank lever is set at the factory and should not require readjustment. The bellcrank setting should not be set unless proper horizontal pull rod travel is not attained. Using the hand closing jack, just latch the mechanism, taking care that the operating lever does not exceed 2.500 $\pm$ .025. Use operating lever checking gauge (7358D12H01). Exceeding this dimension could result in damage to the interrupters. If the operating lever does not reach the 2.500 dimension, adjust the horizontal pull rod as required.

Check the 4.250 $\pm$ .030 dimension after releasing the jack and with the mechanism latched. Use bellcrank lever checking gauge (7358D12H02). If this dimension is not correct, jack the breaker open, and make the appropriate adjustment of the vertical pull rod. Jack the breaker closed again and recheck the 4.250 dimension.

Repeat this procedure until the 4.250 $\pm$ .030 dimension is obtained. Then make final adjustment to horizontal pull rod to get 2.500 $\pm$ .025 dimension in the closed position. Tighten locknuts.

Loosen .25 in socket head screw. Adjust the closed position stop bolt on the mechanism frame to .027-.037 dimension. Tighten .25" socket head screw.

6.1.2.2 Open Position Adjustments

Unlatch the mechanism and jack the breaker open. If the open position dimension is not 2.437 $\pm$ .035, loosen lock nut and adjust the open position stop bolt solid on the bell crank lever until dimension is obtained. Tighten locknut.

Refer to Part 6.1.1.2 for hydraulic shock absorber adjustment.

Remove the mechanism jack.

6.1.3 Interrupter

6.1.3.1 Removal Of The Interrupter (Reference Figs. 1, 5, and 11)

To inspect or perform maintenance on the interrupter, it must be removed from the pipe. The procedure is as follows:

a. Open the filling valves and release the SF_6 gas to atmosphere. Disconnect the line connection from the load side bushing.

b. Remove the (6) .375-16 x 2.5 nylok cylinder head cap screws from the load side bushing split clamp rings that fasten to the pipe. A 5/16" allen wrench is required. Remove the capacitor assembly if so equipped (see Part 3.7).

c. Remove the split clamp rings and pull the bushing straight out from the pipe. (The bushing weighs about 65 pounds) Be extremely careful not to damage the 8" long voltage shield. This shield need not be removed. The shield is used on the 46 and 69 kV breaker only.

d. Remove the (8) .5-13 x 3 hex steel bolts, nuts and lockwashers holding the cover plate and remove the cover plate. A 3/4" socket, ratchet, 6" extension and 3/4" box end wrench is required. If the breaker has been subjected to a number of fault interruptions, a cup full of arc product powders may drop out. Observe the precautions outlined at the beginning of Part 6 for handling arced SF_6 gas products.

e. Remove the hitch pin and washer that fastens the connecting rod levers to the operating shaft assembly.

f. Remove one "X" washer (Ref. Figure 11) by squeezing tabs with a pair of pliers and discard. Remove the pin and the 2 brass washers.

g. Carefully remove the connecting rod levers and spacers from the operating shaft assembly.

h. Remove the (3) .375-16 x 1.62 hex steel bolts and lockwashers that fasten the interrupter to the pipe. A 9/16" socket, ratchet and 12" extension is required.

i. Rotate interrupter as required and carefully slide out of the pipe. (The interrupter weighs about 25 pounds.) Do not let the interrupter fall when it separates from the line side bushing.

6.1.3.2 Disassembly Of The Interrupter (Fig. 9)

With the interrupter placed on a level, clean surface, disassembly can proceed as follows:

a. Using the interrupter spanner wrench (7358D12H04), remove the 2 large nuts at the center of the interrupter tube.

NOTICE

MEDIUM STRENGTH ADHESIVE HAS BEEN APPLIED TO THESE NUTS. DO NOT DAMAGE THE POLISHED SURFACE OF THE LARGE NUTS AS THEY ARE VOLTAGE GRADING DEVICES.

b. Remove the (2) .25-20 x 1 cylinder head cap screws and Belleville washers holding the contact carrier to the interrupter. A 3/16" allen wrench is required. Pull out the contact carrier assembly. Do not damage the polished surface of this voltage grading device.

c. Pull on the interrupter connecting rod (Fig. 11) and slowly remove the moving contact assembly from the interrupter tube. The lip of the seal ring must be depressed to clear the holes in the interrupter tube during removal.

d. Slide the interrupter contact assembly off the moving contact assembly and over the connecting rod.

6.1.3.3 Inspection Of The Interrupter

a. Check the inside diameter of the teflon orifice (see Fig. 8). If the diameter is greater than 1.156 inches, replace the entire interrupter assembly. This dimension can be easily checked with orifice gauge 7249A88H01.

b. Check the connecting rod for any signs of wear or damage. Replace as needed.

c. Inspect the rest of the interrupter parts (tube, stationary contact assembly, valve and valve spring, and bushing finger contact assemblies) for wear or damage. Do not over tighten the valve spring set screws.

d. Check the 12 set screws on the interrupter contact assembly transfer fingers for tightness using a long 5/32" allen wrench.

e. The interrupter seal ring and the two guide seals must be replaced at this time.

6.1.3.4 Replacing Interrupter Seal Ring

To replace the interrupter seal ring, first remove the old seal ring. Be careful not to scratch the seal groove. Remove the "O" ring from the new seal ring and discard the "O" ring. Slide the new seal ring over the moving contact assembly. Orient the seal ring as shown in Fig. 9.

6.1.3.5 Replacement Of Interrupter Guide Seals

a. Remove both interrupter guide seals by prying out with a small screwdriver. Refer to Fig. 9. Be careful not to damage the seal groove.

b. Replace with new split ring guide seals by inserting carefully into seal grooves. The split in the inner ring should be supported by the seal groove.

6.1.3.6 Cleaning and Lubricating Interrupter

Wipe the entire interrupter and components clean with a lint-free cloth saturated with alcohol. Wipe the inside of the interrupter tube also.

Apply a very light film of Molykote grease (53701DK) to the surface of the moving contact assembly as shown in Fig. 9. Apply a light film of Beacon 325 Grease (55213AG) to the moving contact assembly as shown in Fig. 9.

6.1.3.7 Assembly of the Interrupter

a. Slide the interrupter contact assembly onto the moving contact assembly (Fig. 9). Be certain the radiused end of the interrupter contact assembly is free of nicks, scratches or dents.

b. Slide the moving contact assembly into the interrupter tube slowly while carefully guiding the seal past the openings in the interrupter tube.

c. Rotate the moving contact assembly to line up the contact carrier mounting holes with the contact carrier (Fig. 9).

d. Install (2) .25-20 x 1 cylinder head cap screws and Belleville washers to hold the contact carrier to the moving contact. The Belleville washers must be placed on the convex position against the bolt head. Torque to 10 ft. lbs.

e. Apply medium strength adhesive (Loctite 242, Westinghouse Spec. 53320UC) to the threads of the large nuts. Use the interrupter spanner wrench (7358D12H04) to install both nuts into the moving contact assembly.

   Make sure the nuts and the contact carrier are oriented as shown in Fig. 9.

6.1.3.8 Replacing the Interrupter

a. Insert the interrupter into the pipe, rotating slightly as required to get past the operating shaft assembly. Keep the stationary contact end of the interrupter centered so that the interrupter can be inserted onto the load side bushing. This can be facilitated by lifting through the removed bushing opening using a thin cloth tape or rope sling looped abound the contact carrier at the midpoint of the interrupter. Use care to be sure interrupter is held in position while centering. Bolt the interrupter to the pipe using (3) .375-16 x 1.62 steel bolts and lockwashers. Torque to 18 ft. lbs.

b. Fasten the connecting rod levers to the operating shaft using the washers, spacer and hitch pin (see Fig. 11). Replace the pin, brass washers and new "X" washer in the connecting rod. Squeeze the "X" washer closed tightly. Cut off the two tabs at the open end of the "X" washer and half of the other two tabs before installation (see Fig. 11).

c. Hold new bushing gasket in place with Dow Corning #11 grease (53701RB). Install the bushing into the pipe, making sure that the bushing lead slides into the contact carrier of the interrupter. Be careful not to damage the voltage shield (46 and 69 kV only).

d. Install the split clamp rings as shown in Fig. 6 and bolt the bushing assembly to the pipe using (6) .375-16 x 2.5 nylok cylinder head cap screws and Loctite 242 adhesive. Be certain the epoxy flange of the bushing is centered on the aluminum flange of the pipe before tightening. Use the short allen wrench stub (7358D12H03), a 5/16" -3/8" drive socket and 3/8" drive torque wrench. Torque to 25 ft. lbs. Replace the capacitor assembly if so equipped (see Part 3.7).

e. Attach a new bag of desiccant to the cover plate. See Fig. 12 for specific details. Hold new gasket in place with Dow Corning #11 grease (53701RB). Bolt the cover plate to the pipe using (8) .5-13 x 3 hex steel bolts, nuts and lockwashers. Using the cross tightening technique torque to 55 ft. lbs. Reconnect the line connection to the bushing (see Part 3.11).

f. Pull vacuum to 2 mm of mercury and fill the pole unit with SF_6 to the normal operating pressure curve (Fig. 7). See Part 3.8.

g. Use Leak-tec or equivalent to check for leak at the bushing and cover plate gasket. No leakage is allowed.

6.1.4 Filling an Energized Breaker with SF_6 Gas

The preferred method of adding SF_6 gas to the breaker is with the breaker deenergized and isolated from the electrical system. This method is outlined in Section 3.8. If however, it is necessary to add SF_6 gas to an energized breaker the following procedure may be used if the pressure has not fallen below 40 psig.

WARNING

DO NOT ADD SF_6 TO AN ENERGIZED BREAKER IF THE PRESSURE HAS FALLEN BELOW 40 PSIG. IF PRESSURE IS BELOW 40 PSIG TAKE THE BREAKER OUT OF SERVICE, ISOLATE FROM THE ELECTRICAL SYSTEM AND CORRECT THE CAUSE OF THE LOW PRESSURE BEFORE FILLING. IF PRESSURE IS BELOW 20 PSIG DO NOT OPERATE BREAKER BEFORE OPENING ADJACENT BREAKER TO ISOLATE THE BREAKER IN QUESTION FROM THE SYSTEM. CORRECT THE CAUSE OF THE LOW PRESSURE AND FILL USING THE METHOD DESCRIBED IN SECTION 3.8.

When servicing a type SP breaker that is energized and the pressure gauge shows a gas pressure that is below minimum operating pressure, stand clear of rupture disc deflector plate opening located on breaker cover plate. This will prevent personnel injury should the rupture disc fragment due to an over pressure caused by an internal electrical failure as a result of an abnormal system condition such as a voltage transient, surge or fault interruption or due to overpressurization during the gas filling process.

1. Using a thermometer, measure the ambient temperature at the breaker and determine from the decal on the breaker or Figure 7 the pressure to which the breaker should be filled.

2. Remove the cap on the SF_6 gas cylinder (which should be positioned in front of the mechanism and control cabinet) and connect the SF_6 pressure regulator to the gas cylinder.

3. Connect the special high pressure filling hose assembly to an SF_6 pressure regulator.

4. Standing clear of pole unit rupture disc deflector opening, attach the special filling hose assembly to pole unit filling valve.

5. Adjust SF_6 pressure regulator to required breaker filling pressure determined in Step 1.

6. Standing clear of pole unit rupture disc deflector opening, loosen the fitting to the filling hose assembly at the breaker fill valve and purge the air from the assembly with SF_6. Then tighten the fitting.

WARNING

DO NOT OVER PRESSURIZE THE POLE UNIT. THIS COULD CAUSE THE RUPTURE DISC TO FRAGMENT AND POSSIBLE INJURY TO PERSONNEL.

7. Open the breaker fill valve, open the SF_6 gas cylinder hand valve and add gas to the pole unit to the required pressure. During filling carefully monitor the pressure gauge on the SF_6 regulator. Only a few seconds are required to fill. Then shut off the SF_6 gas cylinder hand valve and the breaker fill valve.

8. Remove the hose assembly from the breaker and replace the cap on the breaker fill valve.

9. Periodically monitor the SF_6 gas pressure in each breaker pole unit in accordance with the instructions given in Part 5.

6.1.5 Operating Shaft Assembly (Fig. 11)

Normally, maintenance will not be required on the operating shaft assembly as it is factory lubricated and sealed for the life of the breaker.

6.1.6 Opening Spring (Fig. 4)

The opening spring has been adjusted at the factory to provide the coorect opening velocity. If field adjustment is neccessary, loosen the (2) .375" clamp bolts on the 1.5" adjustment nut with the breaker in the open position. Unscrew adjusting nut which lengthens opening spring, to reduce opening velocity. To increase opening velocity, shorten open spring by screwing in the adjusting nut. When proper velocity is obtained, lock adjusting nut by tightening the (2) .375" clamp bolts.

6.1.7 Replacing the Weathercase (Fig. 10)

If an epoxy weathercase is damaged, it can be replaced without replacing the conductor.

a. Open the filling valve and release the SF_6 gas to atmosphere. Remove the capacitor assembly at the bushing, if so equipped (see Part 3.7), and disconnect the line connection from the appropriate bushing.

b. Remove the (6) .375-16 x 2.5 cylinder head cap screws from the split rings which clamp the bushing to the interrupter pipe. A 5/16" allen wrench is required.

c. Remove the split clamp ring and pull the bushing out from the pipe. Either bushing weighs about 65 lbs. Be careful not to damage the voltage shield (46 and 69 kV only).

d. Using a spanner wrench (7358D12H05) unscrew the retainer and remove the gasket and washer. Do not scratch the retainer. An adhesive is used between the retainer and lead, so heat may have to be applied to help break the retainer free. If necessary, place the bushing lead in a vise to hold while loosening. Do not scratch the bushing lead.

e. Pull the lead through the weathercase and pull the seal out. Replace the "O" ring. Clean the threads of the lead with a wire brush.

f. Install a new weathercase onto the lead, then install the new seal.

g. Apply petrolatum (55821CA) to the washer and new gasket, and install.

h. Apply adhesive Loctite 242 (Westinghouse Spec. 53320UC) to the lower threads of the lead. Install the retainer with the spanner wrench (7358D12G05) and torque to 120 ft. lbs.

i. Installation of the weathercase is described in Part 6.1.3.8-c and d.

j. The cover plate must now be removed as described in Part 6.3.1-d and the desiccant replaced and cover plate reinstalled as described on Parts 6.1.3.8-e, f, and g.

6.1.8 Replacement Of The Rupture Disc (Fig. 12)

Normally maintenance will not be required on the rupture disc assembly. If the rupture disc is accidentally damaged due to overpressure, replacement is as follows:

a. Remove the 4 .375-16 x 1.00 and 2 .375-16 x 1.25 steel bolts and lockwashers fastening the rupture disc guard and retainer.

b. Remove the gasket, aluminum shim plates (s), the broken rupture disc and the thin inner gasket.

c. Wipe the groove clean.

d. Install new thin inner gasket, new rupture disc one aluminum shim plate and outer gasket. The flat surface of the rupture disc should be installed toward the inner section the the pipe. The outer gasket must extend beyond the cover plate surface by .060 to .090".

e. Add or remove aluminum shim as required to achieve this value. Replace the retainer and guard orienting the guard to vent upward.

f. Replace the 4 .375-16 x 1.00 and 2 .375-16 x 1.25 steel bolts and lockwashers and tighten evenly all around. (The two longer bolts are used to hold the guard to the cover plate.)

g. Pull vacuum to 2 mm of mercury and fill the breaker with SF_6 as described in Part 3.8.

h. Check for leakage with Leak-tec or equivalent.

6.1.9 Checking External Capacitors

The breaker must be out of service and in the open position with adjacent disconnect switches open before checking the external capacitors. The capacitors can be checked while connected to the breaker. The capacitance should be measured using a reliable capacitance bridge. The capacitance is 5000 pF $\pm$ 10%. If the capacitance is not within these limits, the capacitor must be replaced.

6.1.10 Leak Checking (Figs. 5 and 7)

The breaker has been thoroughly leak tested at the factory and will be essentially leak-free between the major maintenance periods. There are a minimum of leak sources. The "O" rings, gaskets, and fittings shown on Fig. 5 provide the sealing to atmosphere on each phase.

Before beginning a leak check, pay careful attention to the pressure and temperature of the SF_6 gas. If the initial pressurizing is done according to the normal operating pressure curve in Fig.7, any other readings should fall on the same curve.

Use Leak-tec or equivalent to detect lea s. No leakage is permitted at any of the joints. During maintenance, f any seal has been removed, that seal only should be leak checked after a vacuum has been obtained and SF_6 added to the pole unit.

6.1.11 Current Transformers

For current transformer test procedures and maintenance refer to I.L. 33-256-CTA.

6.1.12 Paint

In areas on the circuit breaker where the paint requires attention due to blistering, peeling, cracking or chipping of the finish or rusting of the base metal, the following remedial action is recommended.

1. Remove loose particles of paint with a sharp putty knife, scraper and/or wire brush.

2. Use sandpaper to feather the edges of the paint to the base metal. Remove dust.

3. Brush on the area to be repaired, overlapping onto the bonded paint surface 6 to 8 inches, a phosphating agent such as Ospho, Kephos or Rusticide.

4. Allow one hour to dry.

5. Apply a primer coat; Westinghouse material 32220KO is recommended; however, a good oil resistant primer is acceptable.

6. Sufficient drying time must be allowed before the final coat(s) are applied. A pint can of the finish coat is supplied with each breaker for use in repairs of this type.

6.1.13 Hydraulic Shock Absorber

The hydraulic shock absorber is factory adjusted and normally requires no maintenance. If overtravel is outside the specified limits, the hydraulic shock absorber must be readjusted. Limits are shown in Fig. 3A - View A.

To readjust, loosen the .25-20 socket head set screw on the (bell crank) and, with the breaker in the open position, screw shock in one turn (360°) at a time to reduce the overtravel. The shock absorber should be unscrewed out one turn (360°) at a time if breaker travel does not reach full position. Do not screw in further than one turn from fully compressed position. This fully compressed position can be determined by screwing shock in as far as it will go by hand until solid with the breaker in the open position. Check progress of adjustments by performing tripping and close-open operations.

If overtravel is correct for a tripping operation but excessive for a close-open test the possibility of a defective shock absorber is indicated.

After adjustment is complete, tighten the socket head set screw on the bell crank.

6.2 Lubrication

Mechanism lubrication is covered in the mechanism instruction book IB 33-125-C6A, and should be performed at least once every 3 years. All other parts of the breaker have been lubricated at the factory and further lubrication is rquired only if that particular item has been disassembled.

a. Molykote (53701DK) is applied sparingly to the moving contact assembly shaft. (Fig. 9).

b. Molykote (53701DK) is applied to all the pins in the horizontal linkage (Fig. 4), sliding surfaces and sleeve bearings on the mechanism.

c. Petrolatum (55821CA) is applied to the gasket and washer of the weathercase. (Fig. 10)

d. Beacon #325 (55213AG) is applied to the shaft seal, and needle and roller bearings on the mechanism. Maintenance is not expected on the shaft seal for the life of the breaker (Fig. 11) and on the moving contact of the interrupter.

e. Dow Corning #11 (53701RB) is applied to cover plate gaskets and to bushing to flange gaskets.

f. G.E. Vesilube is applied to the close control valve poppet seats and piston ring. These normally require no relubrication.

g. SAE 20 non-detergent engine oil is used in the air compressor crankcase and for lubrication of the mechanism cylinder housing.

6.3 Recommended Torque Values

Following is a tabulation of recommended torque values to be used on the Type SP breaker during installation and maintenance:

1. Leg attaching bolts - 250 ft. lbs.
2. Breaker to foundation hold down bolts - 400 ft. lbs.
3. Capacitor mounting straps to bushing split rings - 15 ft. lbs.
4. Capacitors to lower capacitor mounting straps - 30 ft. lbs.
5. Capacitors to upper capacitor mounting strap - 30 ft. lbs.
6. Upper capacitor mounting strap to bushing stud - 50 ft. lbs.
7. Mechanism mounting bolts - 250 ft. lbs.
8. Contact carrier to interrupter mounting contact bolts - 10 ft. lbs.
9. Interrupter to pipe bolts - 18 ft. lbs.
10. Bushing clamp ring bolts - 25 ft. lbs.
11. Cover plate - 55 ft. lbs.
12. Bushing weathercase retainer - 120 ft. lbs.

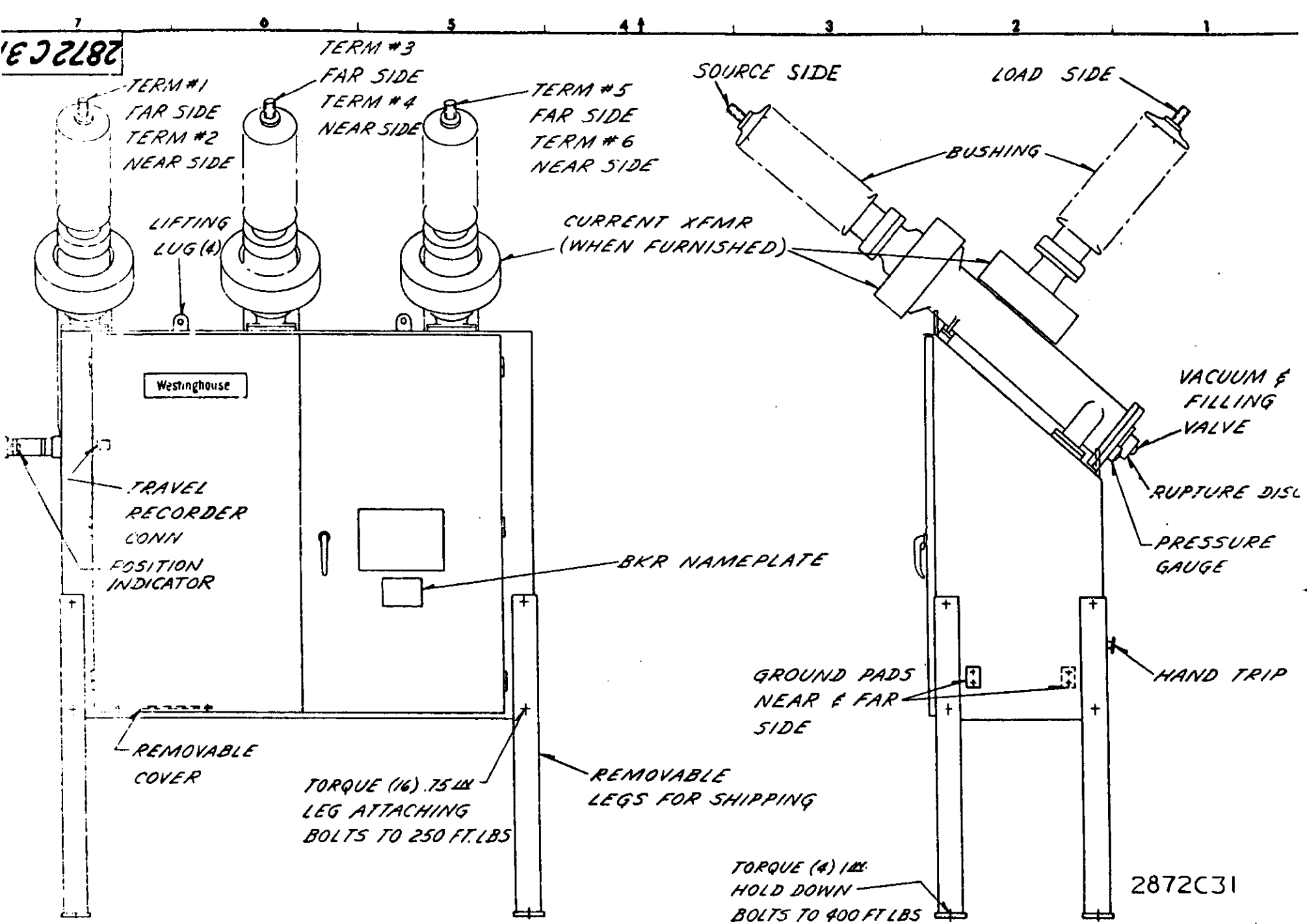


FIGURE 1

Westinghouse Electric Corporation

TITLE "S.P." 1 B. DWG. OUTLINE

DIMENSIONS IN INCHES - SCALE

DRN MISTICK

2872C31

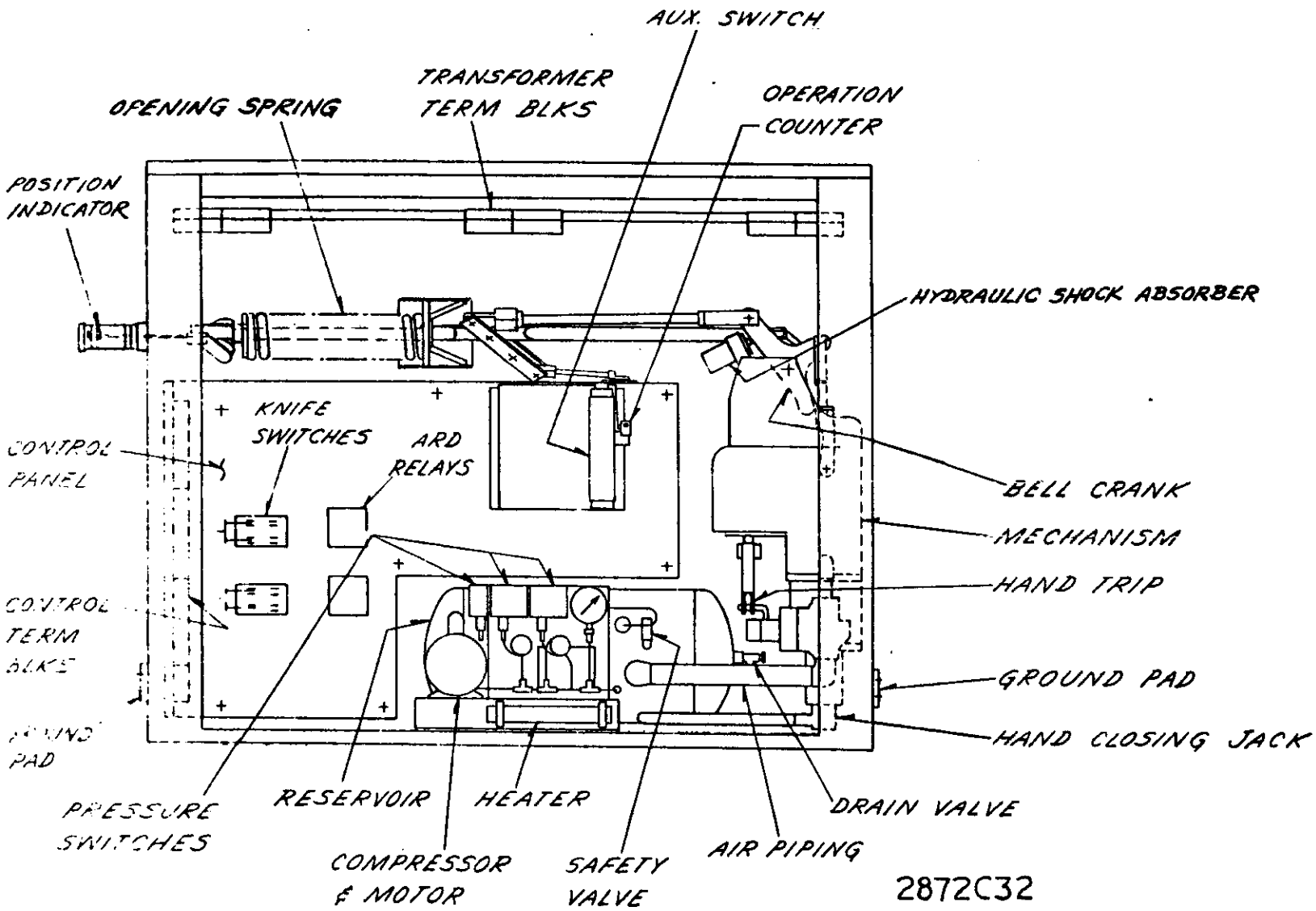
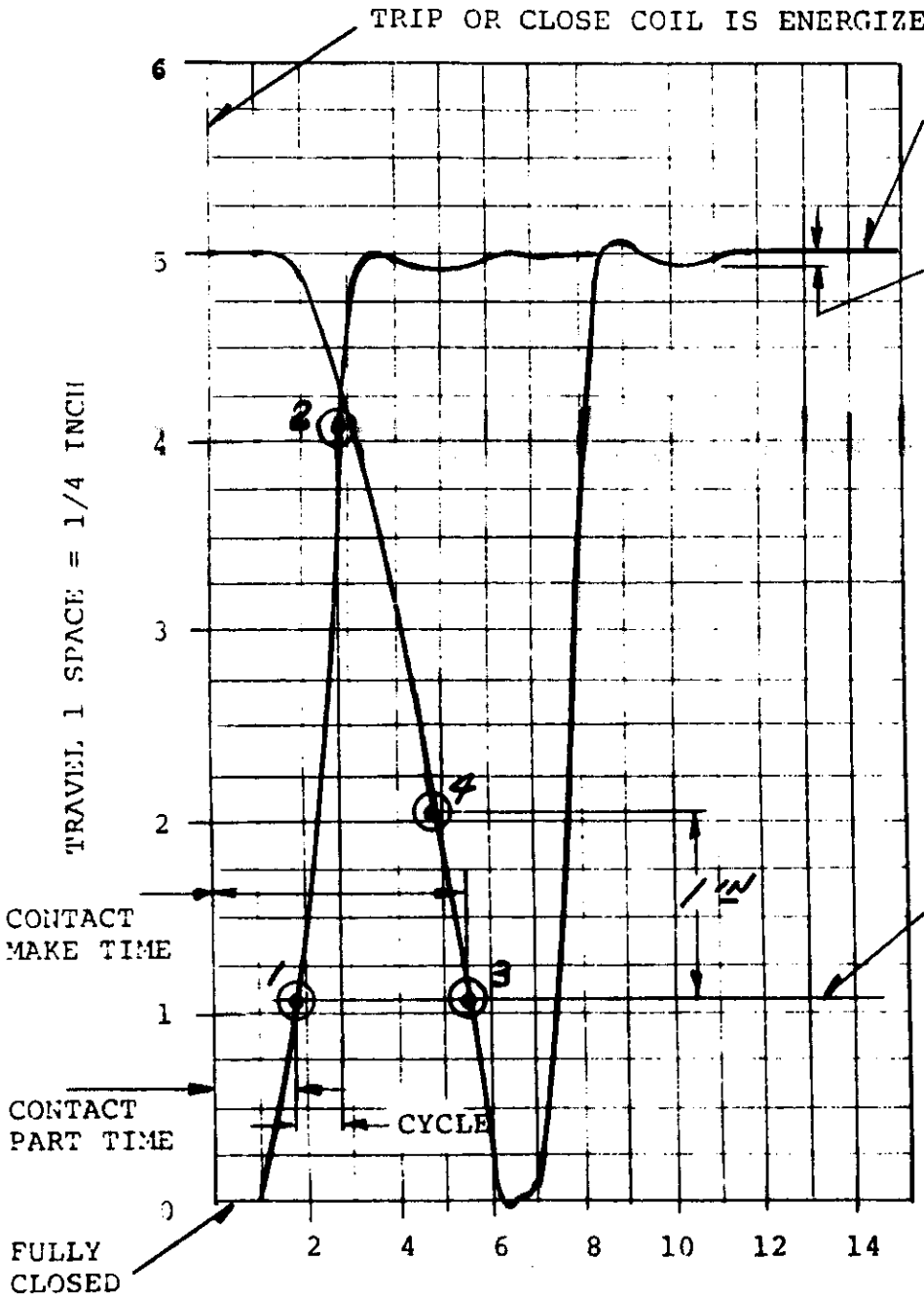


FIGURE 2

Westinghouse Electric Corporation	
TITLE "CP" I.D. DWG MECHANISM CABINET	
DRAWN MISTICK	APPD Pimentel
	2872C32

FIGURE 3A TYPICAL TRIP AND CLOSE - OPEN TIMING CURVE



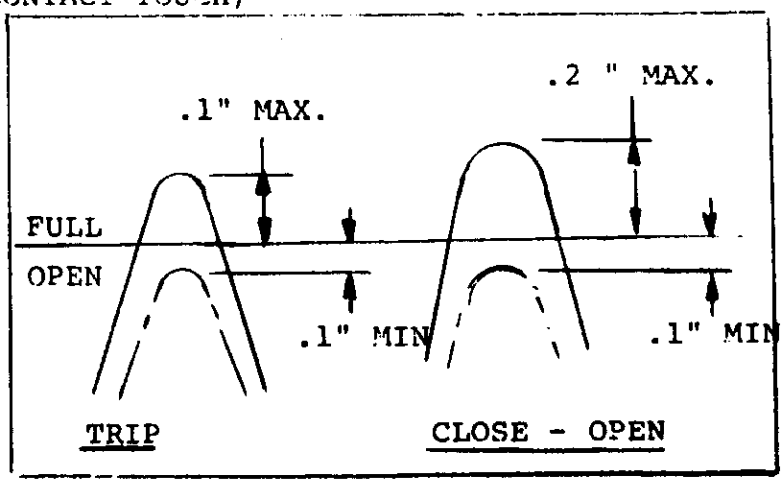
OPERATING SPEED RANGE
AT NORMAL PRESSURE AND VOLTAGE

TRIP: 14.6 TO 15.8 FEET PER SECOND DURING OPENING OPERATION LINE DRAWN THROUGH POINTS (1) AT CONTACT PART AND (2) ONE CYCLE BEYOND CONTACT PART

NOTE: 1 CYCLE EQUALS .0167 SECONDS

CLOSE: FOR DIGITAL TIMER CONTACT MAKE TIME LIMITS ARE 90 TO 100 MILLISECONDS DC, 84-94AC TIME - TRAVEL ANALYZER CLOSE VELOCITY LIMITS ARE 6.5 TO 10.0 FEET PER SECOND FOR A LINE DRAWN THROUGH POINTS (3) AND (4).

CONTACT INDICATION
(CONTACT TOUCH)



VIEW A - OVERTRAVEL LIMITS

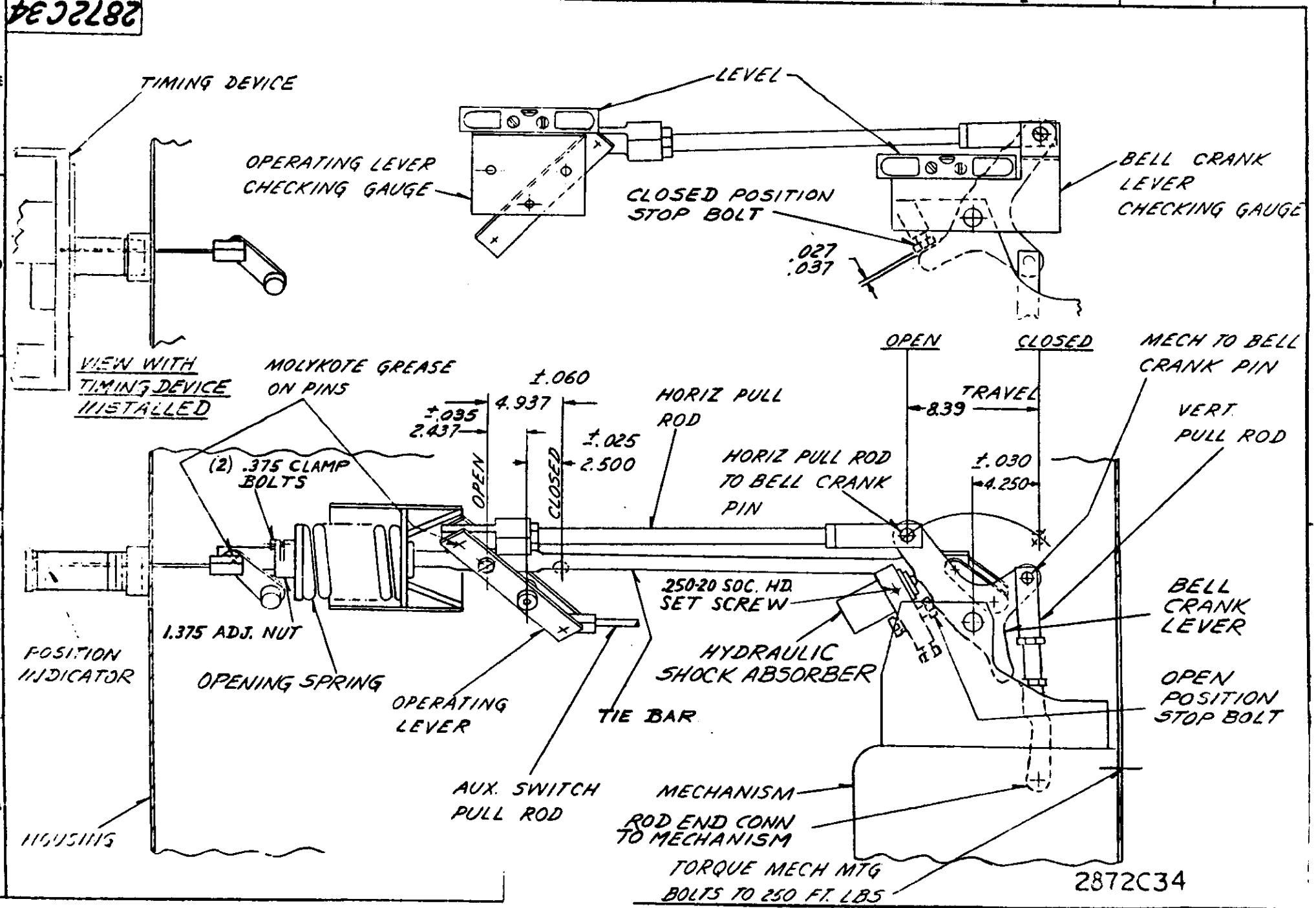


FIGURE 4

Westinghouse Electric Corporation

TITLE 50" LA DWG
HORIZONTAL LINKAGE

DIMENSIONS IN INCHES - SCALE

DFTM MISTICK 8/10/71

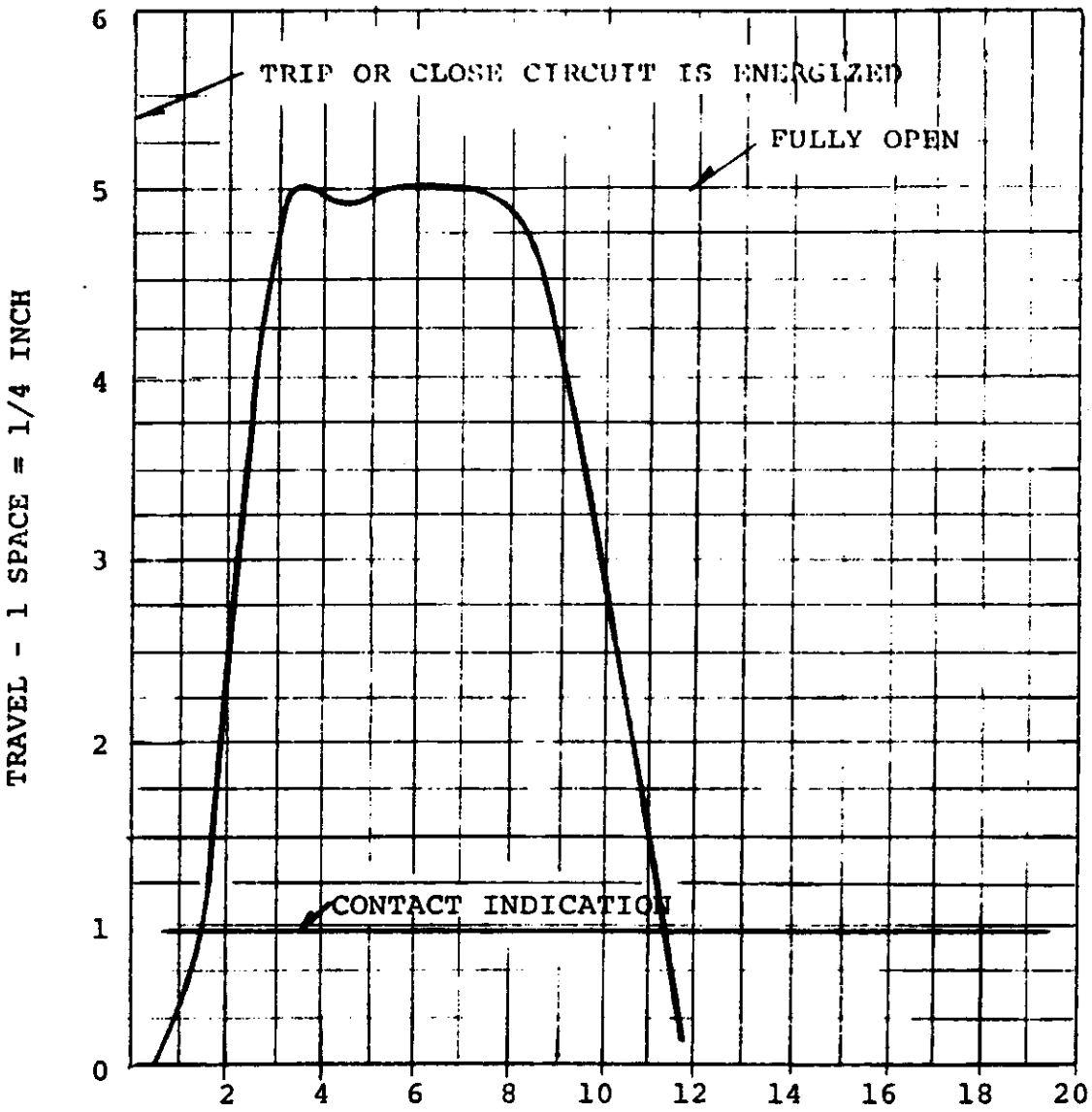
DIV & PLANT LOCATION

1553D87

2872C34

FIGURE 3B

TYPICAL RECLOSE TIMING CURVE



TIME-CYCLES - 60~ BASIS

LOW SPEED - 1 SPACE = 1 CYCLE

2872C35

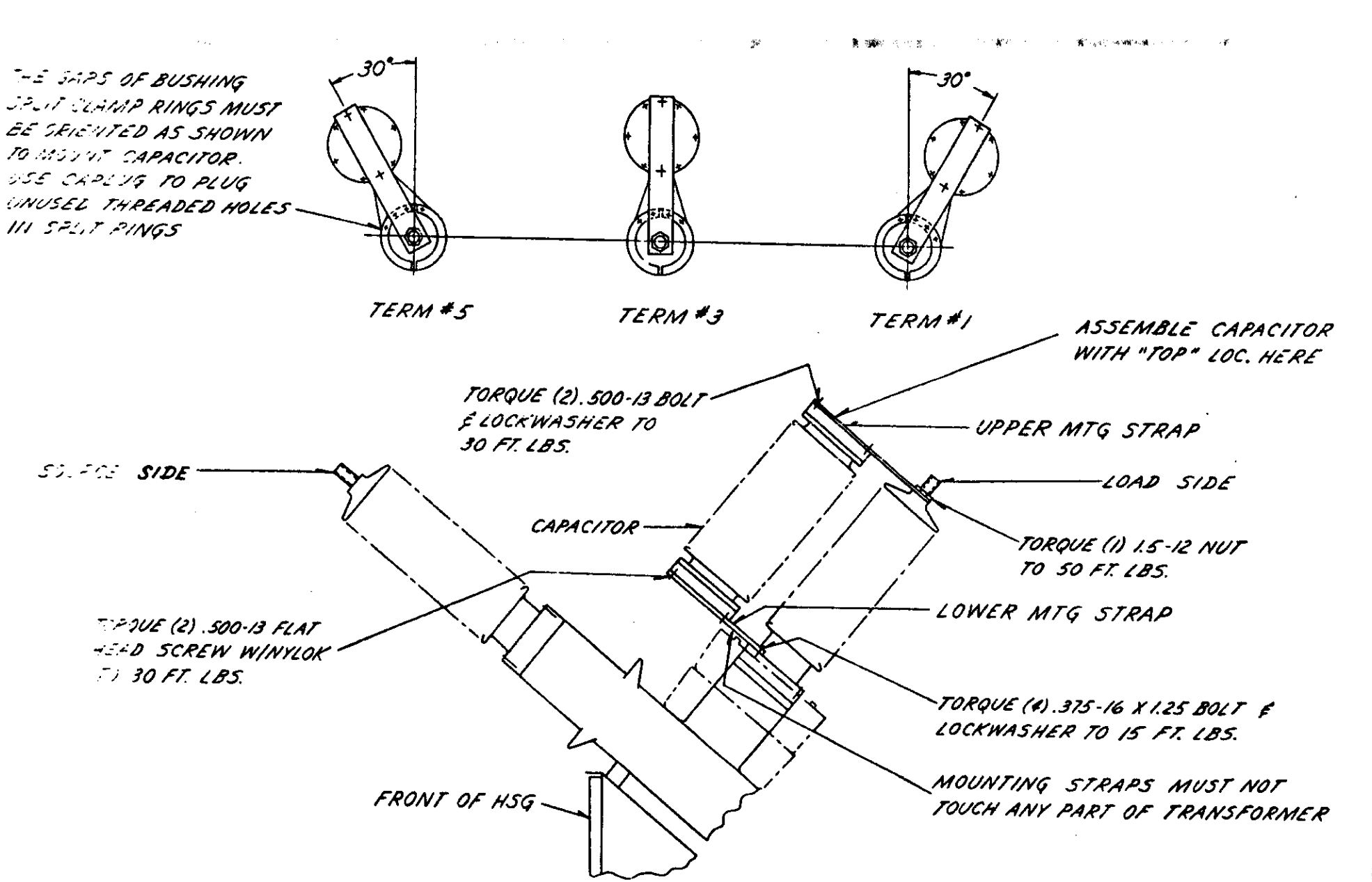


FIGURE 6

2872C35

Westinghouse Electric Corporation

TITLE "PIP" LA DWG.

TYPICAL CAPACITOR MOUNTING

DIMENSIONS IN INCHES - SCALE

DFTM MISTICK

2872C35

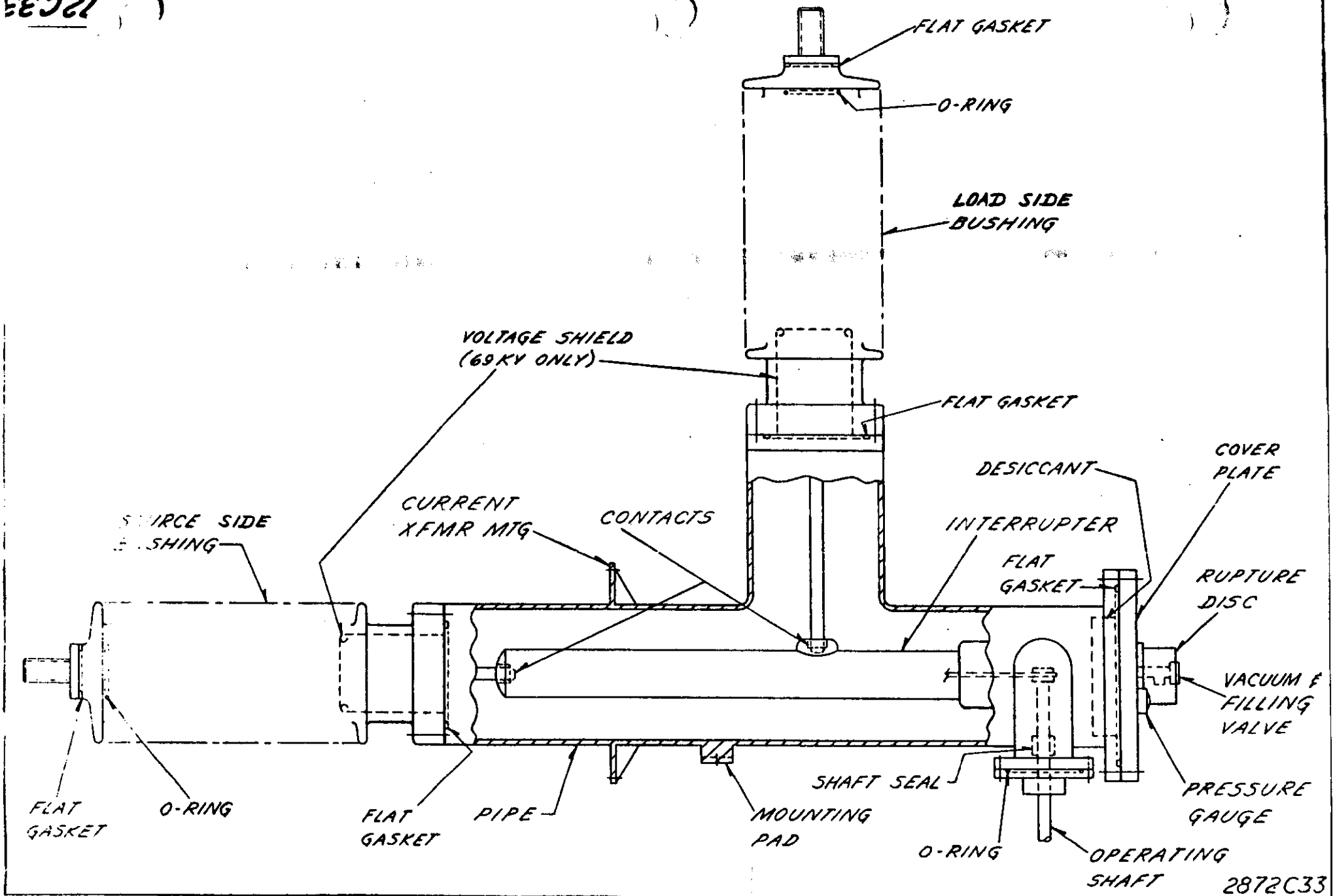


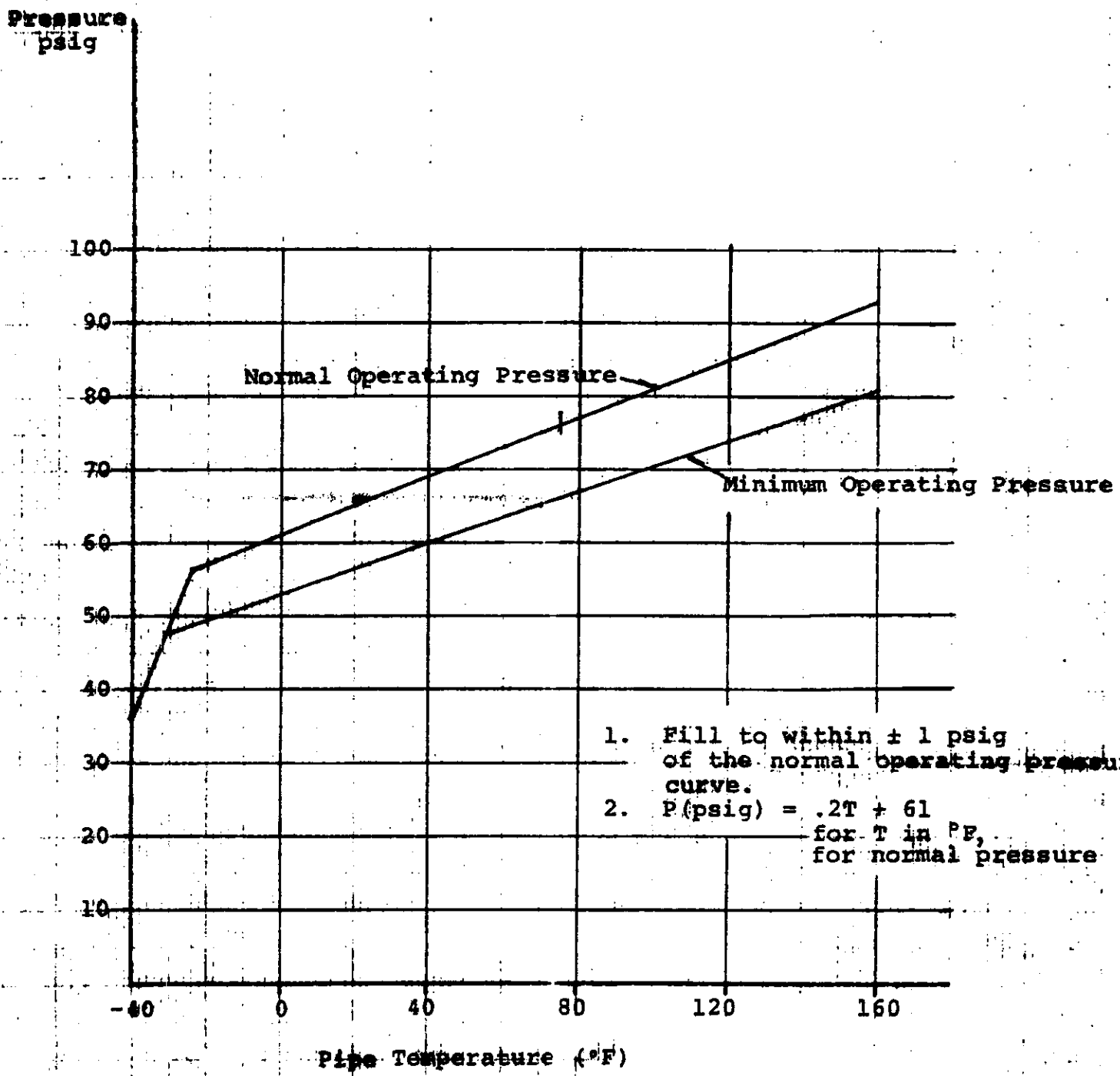
FIGURE 5

Westinghouse Electric Corporation
TITLE PIP L.B. DWG.
POLE UNIT
2872C33

FIGURE 7

SF_6 PRESSURE-TEMPERATURE CURVE

FOR FILLING AT 75 psig, 70°F



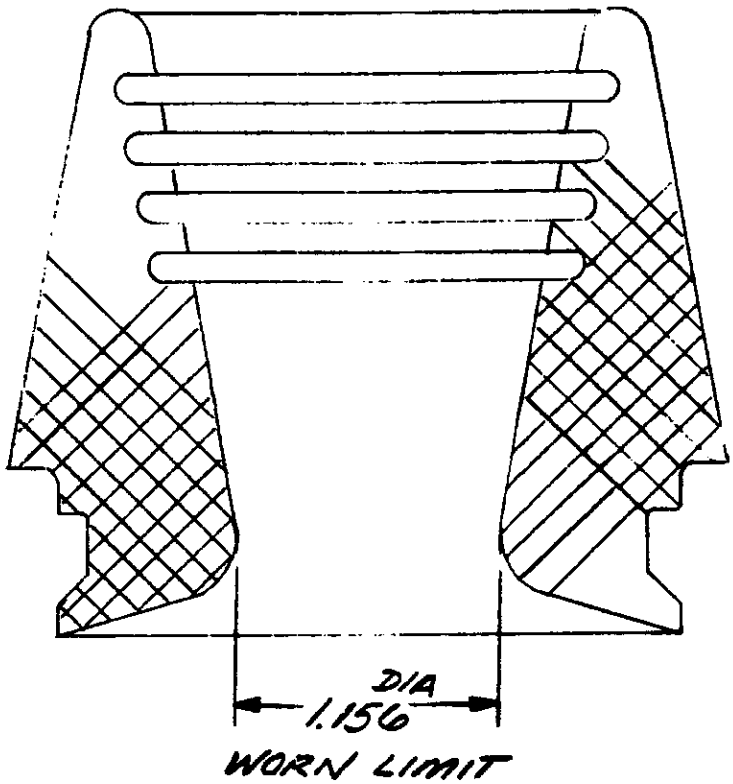


FIGURE 8 -ORIFICE

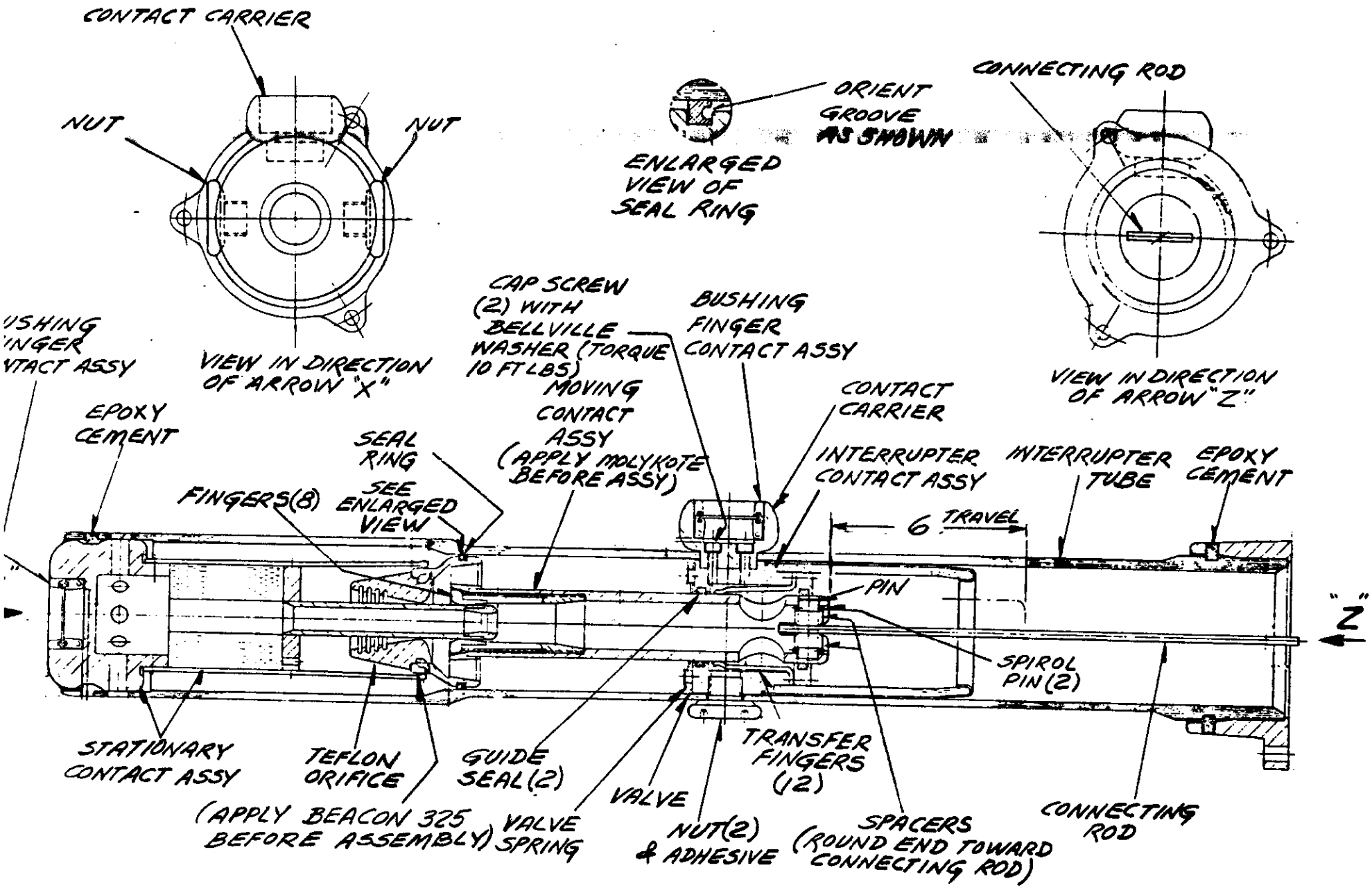


FIGURE 9 - INTERRUPTER ASSY

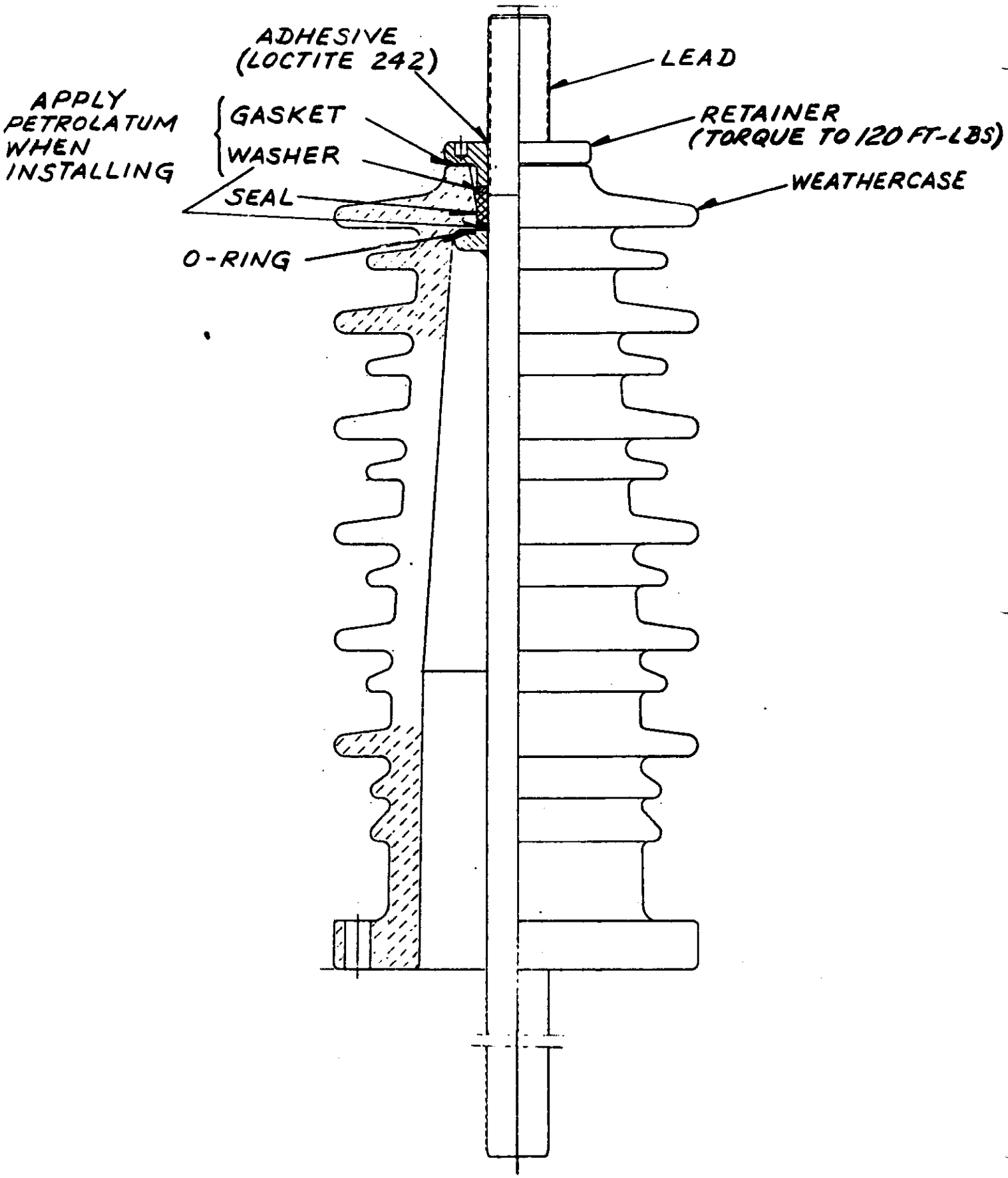


FIG. 10 - BUSHING

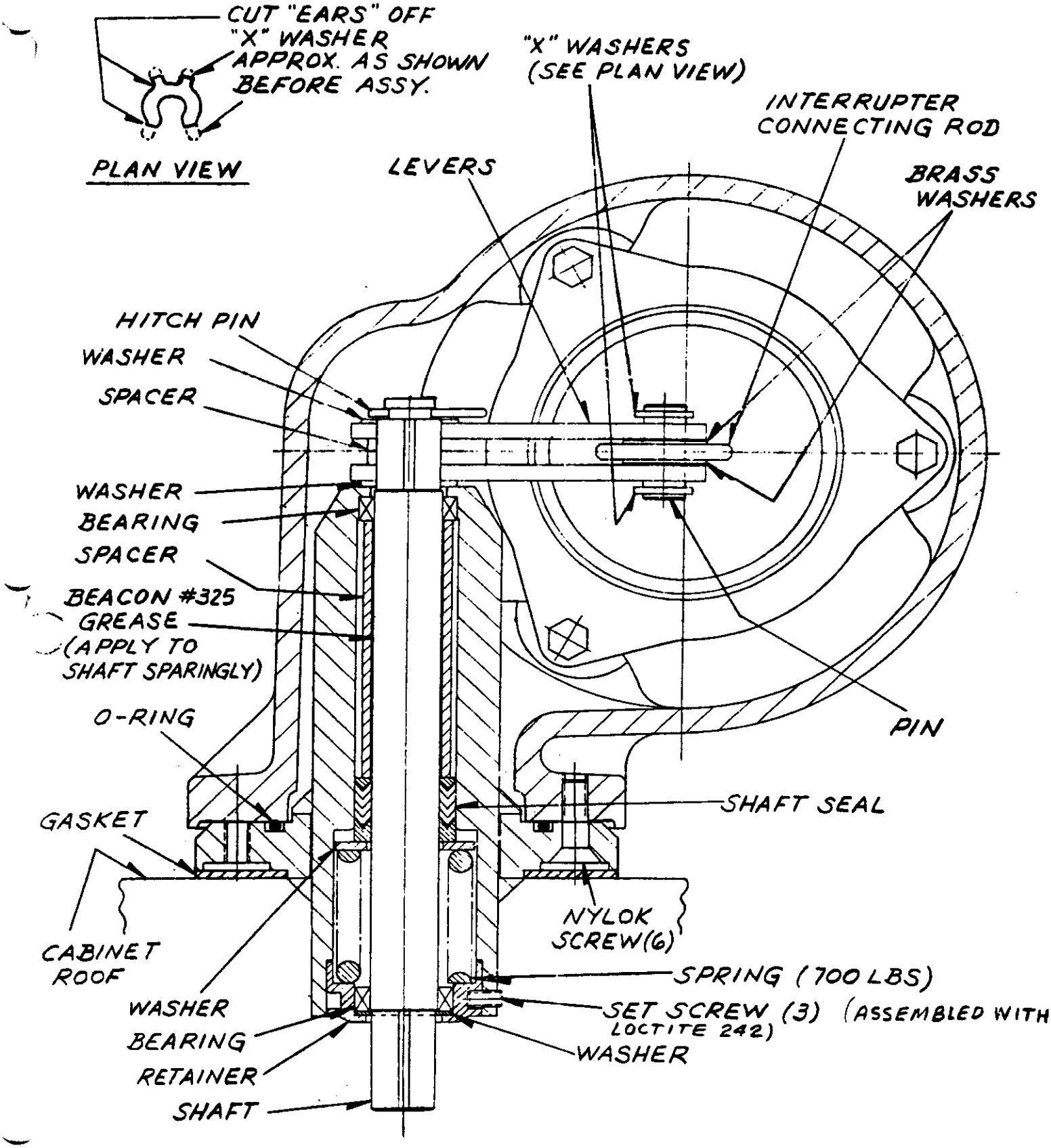


FIG. 11 - OPERATING SHAFT SEAL

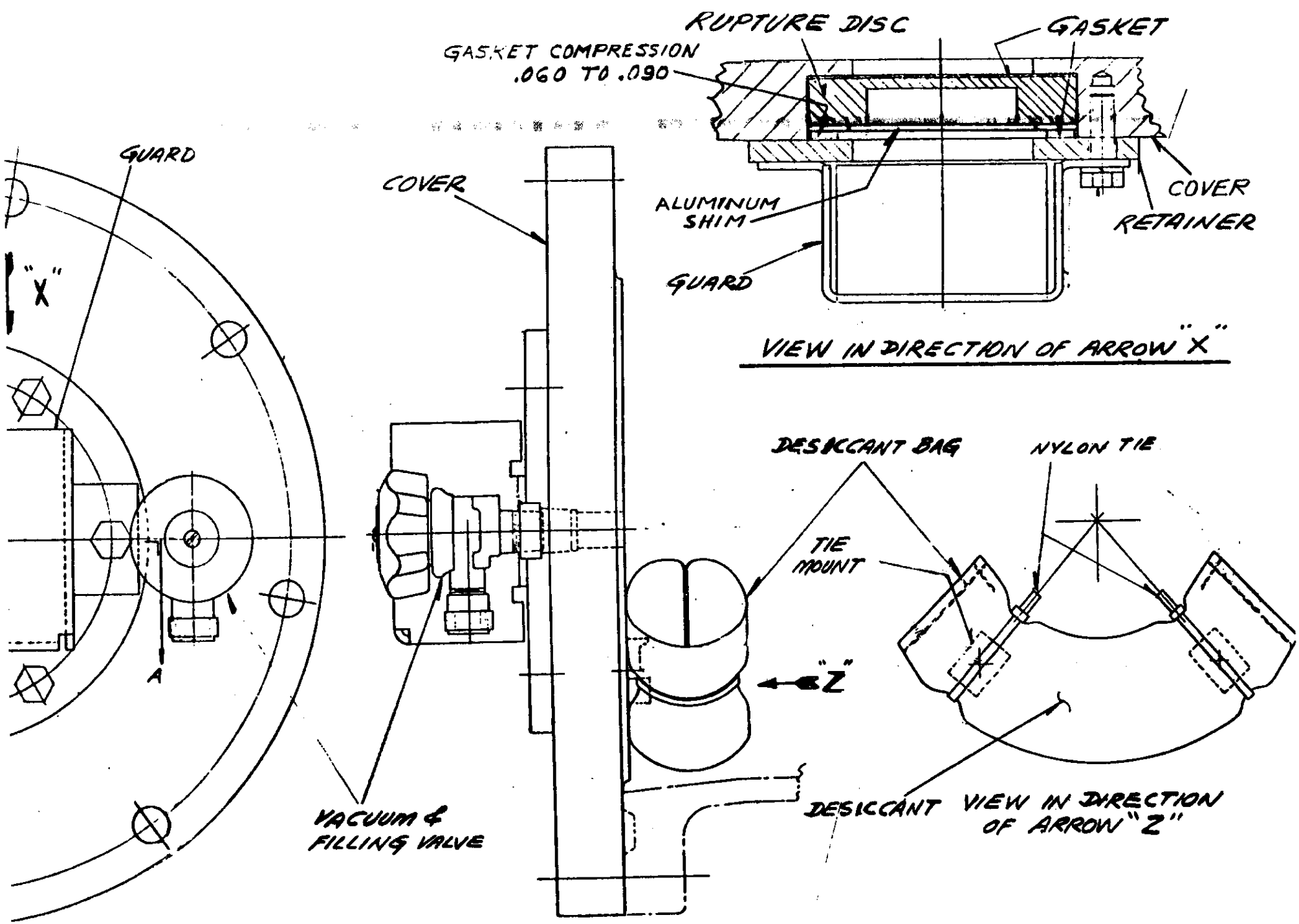


FIGURE 1 - ACCESS COVER ASSY

APPENDIX I

INSTRUCTIONS FOR PNEUMATIC

OPERATING MECHANISM

TYPE AA-7 FOR SF_6

CIRCUIT BREAKERS

All possible contingencies which may arise during installation, operation, or maintenance, and all details and variations of this equipment do not purport to be covered by these instructions. It further information is desired by purchaser regarding his particular installation, operation or maintenance of his equipment, the local Westinghouse Electric Corporation representative should be contacted.

WESTINGHOUSE ELECTRIC CORPORATION

Power Circuit Breaker Division, Trafford, PA 15085
I.B. 33-125-C6A

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LIST OF FIGURES

INTRODUCTION

Type AA-7 circut 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 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.

PART 1 - RECEIVING, HANDLING, 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 damage is evident, or indication of rough handling is visible, a claim for damage should be filed at once with the carrier (Trasnportation 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 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 the above precautions. Periodic inspections should be made to determine the condition of the apparatus.

PART 2 - DESCRIPTION

General

Included within the dust tight sheet metal housing 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 trigger for rapidly disengaging the breaker pull rod from the piston, and 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, 2 or 5 pole and 11 pole 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.

Compressor and Air System

The compressor is single stage and air cooled type. The pressure governor switch which regulates the pressure in the storage reservoir, operates to start the compressor as soon as the pressure in the reservoir has dropped to a predetermined differential below the stop pressure setting and stops the compressor as soon as the pressure has been raised to a predetermined value as 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 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 on the reservoir to prevent 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 operating range of all pressure switches and safety valves are set 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.

The schematic diagram for the air system is shown on Fig. 8 thru 11. 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.

Pneumatic Mechanism and Control

Referring to Figs. 1-2-3 and 14 while following this description will facilitate the understanding of the construction and functioning of the mechanism.

The mechanism is both electrically and mechanically trip-free in all positions. The mechanical trip-free feature is obtained by maintaining a system of linkages, which serve to transmit the movement of the closing piston to the breaker pull rod, in a releasable relative position by a trigger. Fig. 1 illustrates this arrangement of the linkage for the open position of the mechanism. Tripping the trigger, frees the system of linkages, permitting movement of the closing piston independent of the breaker. This condition is illustrated by Fig. 3 which shows the mechanism in the trip-free position.

Main Frame

The mechanism is built up about the main frame which serves as a housing for all of the levers and triggers, supports and control valve, main cylinder and auxiliaries and includes the mounting pads for mounting the mechanism to the breaker.

Cylinder and Closing Piston

The cylinder is clamped by four studs between the top plate which is a part of the frame, and the removable bottom plate. While these plates are made of steel, they are given a corrosion resistant protective finish. The main

closing piston is fastened to and approximately at the center of the piston rod. The upper end of the piston rod carries the cross-head, which serves as a means of attaching the system of linkages and also provides an engagement surface for the main holding latch to maintain the mechanism in the closed position. The lower end of the piston rod extends through the spring housing and serves as a means for attaching the hand closing device. An adjustable packing gland around the piston rod, minimizes the air losses during closing operations.

Retrieving Spring Assembly

The spring housing is part of the bottom plate of the cylinder and supports the retrieving springs. The retrieving springs, which are compressed during the closing stroke, supply the force required to move the piston back to the open or starting position following a trip-free operation, and reset the system of linkages from the position shown in Fig. 3 to the open position Fig. 1.

Lever System (Fig. 1, 2, and 3)

The closing links are attached to the crosshead by pin "B". Rollers on back end of pin "B" run between the guide rails and serve the dual purpose of guiding the upper end of the piston rod and reducing the friction resulting from the side thrust of the closing links. Pin "C" joins the upper end of the closing links to one end each of the intermediate link and the cam lever. Pin "A" connects the other end of the cam lever to the breaker pull rod rod-end. Rollers at each end of this pin run between the guide rails to constrain pin "A" to move in a vertical plane.

In order to transmit the motion of the closing piston to the breaker pull rod, points A, B and C must be maintained in approximately the same relative position as shown in Fig. 1 or Fig. 2. This is accomplished by the following arrangement. The intermediate link is connected at one end by pin "C" to the cam lever and closing links, and at the other end by the thrust pin to the trip free lever through either hole "D" or "E" depending on the breaker load to which the mechanism is applied. To simplify the description it is assumed that the pin is located in hole "E" as shown. As long as point "E" remains a fixed point, the intermediate link will maintain points A, B and C in the same relative position of Fig. 1, and the closing piston and breaker pull rod are effectively coupled and move in unison. By regulating point "E" so that it can either be maintained as a fixed center

or released at will, the means are at hand to make the mechanism mechanically trip-free. The releasable function of point "E" is accomplished by locating the thrust pin midway between the fulcrum point of the trip free lever and the free or roller end. It will be noted from Fig. 1 and Fig. 2 that the line through "C"-"E" is always below the trip free lever fulcrum pin. Thus the component of the breaker load, which appears as a thrust on the intermediate link will tend to rotate the trip free lever in a counterclockwise direction about the trip-free lever fulcrum pin. In order to keep the same force on the thrust pin with lightly loaded breakers and heavily loaded breakers, the thrust pin is assembled in hole "D" for larger breaker applications and in hole "E" for the smaller breakers. A different cam link is used when the pin is assembled in hole "E" in order to keep the same engagement between the holding latch and the cross-head for the latch position.

Trip Free Trigger

A trigger, free to rotate on needle bearings about a fulcrum pin and positioned approximately tangential to the direction of motion of the free end of the trip-free lever, provides the final releasable means of regulating the fixation of point "D". 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 clockwise whenever there is a load on the breaker pull rod. This moment, in addition to the moment provided by the trip-free trigger spring, keeps the trigger against the trip free trigger stop on the trip free lever, insuring a definite engagement of the trigger with the roller. The long horn on the trip free lever serves to maintain the trip free trigger in the tripped position whenever the mechanism is in any intermediate position between fully closed or fully retrieved positions.

To guard against the possibility of a shock, incident to stopping all the moving parts at the end of a closing operation, causing the trip free trigger to release the trip free lever, a 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, interposed between the trip rod and the trip-free trigger, serves to release the catch before the trip rod engages the trip free trigger.

Trip Magnet Assembly (Fig. 14)

The trip magnet assembly is located on the underside of the frame directly under the trip free trigger. 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 trigger, 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. The 1/32" thick copper rivets on the underside of the pole faces creates a 1/32" air gap between the armature and the pole faces which also speeds up the retrieving of the armature.

A spring mounted bar supports the armature in the open position and prevents vertical shocks from driving the armature upward. The position of the bar is adjustable providing a means for setting the armature air gap.

Holding Latch

In order to maintain the mechanism and its connected load in a closed position (Fig. 2) a spring biased holding latch engages the upper edge of the cross head. The relation between the engaging surface at the lower end and the fulcrum point at the upper end of the latch is such that the load on the pull rod tends to hold the latch in engagement.

Closing Piston Snubber

To help absorb the energy of all of the rapidly moving parts that must be suddenly decelerated at the end of a closing stroke, a collar extension on the underside of the closing piston seals off the large opening in the bottom plate as the piston approaches the closed position. This traps air between the underside of the piston and the bottom plate and rapidly builds up a back pressure to cushion the shock.

Control Valve and Manifold Assembly

The control valve assembly combines both the inlet and exhaust functions in a single compact unit, and consists of a main valve operated by an electro-pneumatic pilot valve as illustrated in Figs. 4 to 7.

Certain illustration liberties were taken in Figs. 4 to 7 to facilitate the illustration and understanding of the valve construction and operation.

The solenoid pilot valve is double acting. For example, when the inlet seat is closed the exhaust port is open. The pilot valve inlet has a composition to metal seat and is spring biased closed. The valve is opened either by energizing the pilot valve coil or by manually operating the push button on top of the coil which in both cases moves the valve stem down and opens the valve. 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 control valve is double acting also. When the inlet seat is closed the exhaust seat is open. This blocks the high pressure air from entering the mechanism cylinder and at the same time allows the air in the cylinder to exhaust to atmosphere.

As shown in Fig. 4, the operating piston and exhaust poppet seat have a common body. The inlet poppet is driven by a stem attached to the operating piston poppet. The inlet seat is held tightly closed by a spring bias and the air pressure acting upon the underside of the inlet poppet. This also holds the exhaust poppet open and operating piston to the top of its bore.

When the pilot valve is opened, it allows high pressure air to enter above the operating piston forcing it down. Thus it closes the exhaust seat and opens the inlet seat allowing the air to flow to the mechanism cylinder. When the pilot is closed, the air from above the operating piston is exhausted and allows the exhaust seat to open and the inlet seat to close.

A manifold links the control valve with the operating mechanism and controls the volume of air permitted to enter the mechanism cylinder. The manifold accomplishes this by means of an adjustable throttle valve as shown in Figs. 4 to 7. The position of the throttle valve is regulated by the throttle cam lever, which in turn is controlled by the position of the breaker. The throttle cam may be adjusted to obtain optimum breaker performance by placing in either holes "A" or "B" shown in Figs. 13 and 14. 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 valve in the metering position. Thus, the air is forced to reach the cylinder through the slight throttle valve opening (Figs. 5 and 9). Shortly before the breaker contact load is picked up, the throttle valve is opened to provide maximum air flow (Figs. 6 and 10).

When the breaker is tripped, the air above the closing piston must be exhausted to atmosphere to allow the piston to return to the full open position. This must be accomplished rapidly to insure quick operation in the event reclosing is a necessity. The air which is being forced from above the piston is at a pressure great enought to overcome the force of the throttle valve retrieve spring. Therefore, the exhaust air has an almost unrestricted flow through the manifold and out the control valve exhaust port to atmosphere (Figs. 7 and 11).

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 is located in a convenient position on the left hand side of the housing in order to provide maximum accessibility and unrestricted working space around the mechanism. The equipment on the standard panel includes a closing relay, a cut-off relay, and 3 fused knife switches. Referring to a typical diagram, Fig. 16, 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 through an operating lever to an extension of the pin through the cross head. 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 the closing relay to the de-energized position. Simultaneously the two normally closed cut-off relay contacts, in the pilot valve coil 152CC 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 a protective relay trips the breaker immediately upon closing, the cutoff relay contact in parallel with the "aa" contact seals in the "Y" coil and even though contact "aa" opens on the opening stroke of the breaker, the "Y" coil remains energized holding open the normally closed contact in the "X" coil circuit. The closing circuit is locked out until the operator releases the control switch to the neutral position and initiates a second closing operation.

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, has its contact connected in the closing circuit between the operators control switch and the closing circuit. The low pressure cut-out switch contact is normally closed, but opens before the critical operating pressure is reached.

The low pressure alarm and low pressure cut-out switches and in turn is fed are from the air manifold through a restrictive orifice 0.016 inch diameter. This arrangement desensitizes these switches to momentary pressure transients.

To further insure against a possible faulty operation due to the low pressure cut-out switch opening its contacts during a closing operation, "make" contacts of the closing relay are provided to by-pass the low pressure cut-out switch. As soon as the closing relay is energized, the "make" contacts "seal-in" and insures the admission of air to the mechanism to complete the closing operation. These "seal-in" contacts also insure 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 "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,

Two contacts of the cut-off relay are situated in the pilot valve coil circuit to de-energize the inlet valve at the conclusion of the closing stroke.

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. One of the other fused knife switches is provided for the compressor motor circuit, and the other for the heater circuit.

Latch Check Switch

Reference Fig. 16. For reclosing duty, besides the addition of a reclosing relay such as the Type SGR-12, an auxiliary switch indicated as LC (latch check) on the diagram and located in the circuit from the recloser to the control relays is required. This switch which is normally closed except while the trip-free trigger is disengaged, 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.

Accessories

Auxiliary Switches

In addition to the 2 pole cut-off switch, on all pole auxiliary switch is provided for the customers use for interlocking, indicating, alarm and trip circuits. This switch which is mounted on the back of the housing and connected through a linkage to the breaker pull rod, indicates the position of the breaker contacts.

Operation Counter

An operation counter mounted on the 2 pole auxiliary switch, 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.

Heaters

Three heaters are provided in the 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 are thermostatically controlled to maintain this differential in cold weather.

Hand Closing Device

A screw type jack, with a ratchet handle is available for closing the breaker during maintenance and inspection periods.

WARNING

FROM A SAFETY STANDPOINT IN ORDER TO INSURE AGAINST ACCIDENTAL OPENING WHILE MEN ARE WORKING ON THE BREAKER, THE PIN, WHICH IS SUPPLIED WITH THE MECHANISM, MUST INSERTED THROUGH TWO HOLES PROVIDED IN THE SIDE PLATES OF THE FRAME.

The safety pin passes behind the catch and directly above the tail section of the trip free trigger blocking the trigger in the latch position. This pin must be removed before putting the breaker back in service.

WARNING

THIS DEVICE MUST NOT BE USED FOR CLOSING AN ENERGIZED BREAKER. IT IS INTENDED AS A MAINTENANCE TOOL AND MUST ONLY BE USED ON A DEENERGIZED BREAKER ISOLATED FROM THE CIRCUIT.

PART 3 - OPERATION

Closing

Starting with the mechanism and breaker in the open position (Fig. 1), and with the trigger engaging the trip-free lever to maintain the linkages in the relative position shown, closing the control switch energizes the "X" coil which closes the "X" contacts in the pilot valve coil circuit, thus energizing the pilot valve coil. This opens the inlet valve which admits compressed air stored in the reservoir to the closing cylinder. The high pressure air acts on the piston to close the mechanism. When the breaker is nearly closed, the "aa" auxiliary switch contact closes 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 coil circuit de-energizing the closing relay and opening its "seal-in" contact "X" and (3) closes the "seal-in" "Y" contact in parallel with the "aa" switch and the "Y" contact in parallel with the latch check switch and low pressure cut-out switch to maintain the control relays locked out until the control switch is released. The point where the "aa" switch makes up its contacts 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. 2), the holding latch engages the cross head on the upper end of the piston rod, keeping the mechanism and breaker closed.

Opening

Starting with the breaker in the closed position (Fig. 2), 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 trigger which has been restraining the roller on the trip-free-lever. The connected breaker load acting through the cam lever and intermediate links on the trip-free lever cause it to rotate about its fulcrum pin releasing the breaker (Fig. 3). The long horn on the trip-free lever maintains the trigger in the released position until the mechanism is fully retrieved. As the cam lever rotates about pin A, the cam extension disengages the holding latch. This action permits two heavy retrieving springs, which are confined between the main closing piston and the bottom of the spring housing, and which were compressed during the closing operation, to move the piston to the open position. If the speed of the breaker pull rod is greater than the piston speed, the extreme trip-free position shown in Fig. 3 may be approached. If the piston retrieving speed is greater than the breaker pull rod speed, as will be the case in some applications, the piston will "overtake" the breaker, completely retrieving the levers and resetting the trigger as shown in Fig. 1, before the breaker and mechanism have reached the full open position.

Close-Open

The close-open operation is merely a combination of the closing and tripping operations described previously. When the breaker closes on a fault, the protective relay energizes the trip coil, disengaging the trigger just before the mechanism reaches the closed position. This releases the connection between the piston and the breaker pull rod and the breaker is allowed to immediately re-open unimpeded, (Fig. 3). The cam lever being in a released position keeps the holding latch from engaging the cross head as the piston reaches the closed position. Opening the exhaust valve exhausts the air from the main cylinder, releasing the closing piston. In this instance, however, there is enough delay introduced by exhausting the air from the cylinder to allow the breaker to reach the full open position (Fig. 3) before the piston starts to return to the open position. Once the piston starts to move, however, the retrieving action is rapidly accomplished.

Open-Close

Reclosing requires the use of a separately mounted reclosing relay of either the SGR-12 or RC type. When the trip-free trigger is disengaged by the protective relay energizing the trip coil, the action described previously under "Opening" takes place. As the trigger resets, a latch checking switch makes contact completing the reclosing circuit, energizing the pilot valve coil. This admits high pressure air to the cylinder and the mechanism immediately recloses.

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

PART 4 - INSPECTION, MAINTENANCE, ADJUSTMENT

Inspection

Since operating conditions vary 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.

Refer to instructions of the compressor unit for recommendations for inspection and maintenance.

Maintenance

WARNING

BEFORE WORKING AROUND THE MECHANISM OR BREAKER AND PERFORMING ANY MAINTENANCE THAT DOES NOT REQUIRE AIR PRESSURE, OPEN THE COMPRESSOR CONTROL KNIFE SWITCH, OPEN THE AIR RESERVOIR DRAIN VALVE AND REDUCE AIR PRESSURE TO ZERO PSIG.

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

There is considerable blast from the exhaust valve when the closing air is exhausted from the main cylinder. Therefore, maintenance personnel should be cautioned to keep clear of the area immediately in front of the valve whenever the mechanism is operated pneumatically.

WARNING

PERSONNEL MUST 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 FROUT Of THE TRIP FREE LEVER, AS THIS LEVER TRAVELS AT A VERY FAST SPEED AND COULD RESULT IN SERIOUS INJURY IF THIS PRECAUSTON 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 operated for extended periods of time, several operations should be made at each inspection period.

Latches and Triggers

The holding latch and cross-head are made of hardened steel machined to shape. The engaging surfaces of the holding latch and cross-head 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 inhibiter Beacon 325 (Westinghouse M-55213AG) to the latch, cross-head, and outside surface of the roller on the trip-free lever. This inhibiter is 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 of their condition.

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, the main holding latch can be disengaged easily by first taking the load off the latch by pulling the mechanism slightly into the overtravel position and then keeping the latch disengaged until the cross-head passes the end of the latch as the mechanism is let out. (The latch may be disengaged by inserting a screwdriver through a hole in the side frame just behind the guiderail and prying back on the latch.)

The trip-free trigger is cast from a tough, high strength non-ferrous alloy, tipped with a highly corrosion resistant, file hard stellite latching face. The latching face has been accurately ground to the correct angle. Do not attempt to regrind this surface nor change the angle. The needle bearings in the roller and the trip-free trigger are packed with Beacon 325 (Westinghouse M-55213AG) and should not require repacking more often than every 18 months.

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

Air Leakages

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. Allow the system to cool for about 2 hours before reading pressures if the reservoir has just been filled from atmospheric pressure. A pressure drop of a few psig 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 five pounds psig per hour, 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 leaks is the pilot valve. This may be

determined by applying a soap solution to the pilot valve exhaust port. Leakage here is generally due to dirt particles on the valve seat. "Cracking" the valve several times by pressing the manual operating button will usually serve to dislodge the dirt and make the valve seal properly. At this point, it should be stated that general recommendations require that the complete valve with coil be carried as a renewal; part for important power station installations rather than attempting repair of this small pilot valve. If necessary, disassembly of the pilot valve and replacement of parts may be accomplished by following instructions detailed in Appendix IV Fig. 1. A listing of parts available in a service kit is given.

Checking for leaks past the main inlet poppet seat can be accomplished easily. Obtain a standard pipe plug and drill a small hole through it. Insert the plug in the exhaust port and apply soap solution to the hole and threads. Caution: Immediately remove pipe plug upon determining if leakage exists. If a leak is detected here after having previously determined that the pilot valve is tight indicates that the main inlet poppet seal is not sealing properly. The quickest method and one that is generally successful is to "crack" the valve by bumping the manual operating button on the pilot valve several times. If the leak persists, the control valve can be disassembled and inspected. Directions for disassembly of the valve are given in Appendix IV Fig. 2. A listing of parts available in a service kit is given.

If the control valve "blows" through the exhaust port when the coil is energized it is an indication that the exhaust poppet is not seating properly. If this cannot be corrected by bumping the manual operating button, disassemble valve as described in Appendix IV and check for damage or dirt on slats.

If the leak is not in the control valve unit, all other connections including the safety valve should be checked with a soap solution.

Air Compressor Unit

The air compressur unit is equipped with a Type "FW-60" (Fig. 16) air compressor and the complete system is fully automatic in operation.

The air compressor and motor are mounted on a bedplate. Power is transmitted by single "V" belt drive with adjustable belt take-up.

Completely equipped with motor and electrical protective and control devices, the compressor unit is ready to connect to the line and start operation after checking the level of compressor oil.

It is important that the wiring to the motor be strictly in accordance with the National Electrical Code regulations. Consult regulations or local inspector regarding size of wire and proper fuse protection. The use of wire smaller than required for the installation will result in unsatisfactory operation and possible damage to the motor.

Air Compressor

The single stage, single cylinder air compressor is lubricated by the controlled splash system and is air cooled.

Proper rotation of the compressor is right-hand (clockwise) when facing the oil fill plug end of the crankcase (as indicated by the arrow).

The compressor is filled with oil before leaving factory. Check oil level before starting compressor.

Approximate Oil Capacity

Type "FW-60" . . . . . 1/3 Pint

The oil filling plug should be removed and the oil level observed periodically. On the Type FW-60, if the oil level is at the low mark on the exterior of the crankcase, add sufficient oil to raise the level to a point one thread below the top of the fill hole. A high grade non-detergent automobile engine oil - SAE-20 for temperatures above freezing or SAE-20W for temperatures below freezing may be used.

At least every six months a sample of oil should be drained from the crankcase to determine its condition which will govern the necessity for complete draining and refilling the crankcase. The necessity for this should conform to good automobile engine practice.

Also at six month intervals or more often, if environment dictates, the condition of the air filter should be checked. The filter in the type FW-60 compressor is a cellular type material and may be cleaned in kerosene or other solvent.

Leakage of air back through the compressor air intake indicates a faulty check valve. Disassemble the check valve, clean the valve body thoroughly, clean and remove any rough edges on the Teflon valve disc by rubbing lightly on very fine emery or sandpaper held on a smooth, flat surface. Examine the surface of the brass valve body on which the Teflon valve disc seats. If this surface is found to be rough or distorted, replace the complete valve.

The syphon valve at the side of the air reservoirtank should be opened during inspection or maintenance of the breaker to drain accumulated water resulting from condensation. Leave the drain valve open only as long as solid water runs, then close tightly.

The Safety Valve ordinarily requires no attention. It is set to blow off at 10% to 20% above working pressure of the apparatus. If, after blowing off, the valve fails to seat tightly, it is usually due to dirt on the seat. Opening and closing the safety valve slowly by means of the ring on its stem, with the compressor running, usually cleans the valve seat and restores proper seal.

The compressor belt should be maintained tight enough to prevent excessive slippage, but not tight enough to place undue strain on the motor and compressor bearings which will result in excessive heating of these bearings and increase the power required. When installing a new belt or adjusting old belt for normal wear, the correct tension is obtained by having a deflection of between 3/8 to 3/4 inch with approximately 5 pounds pressure applied vertically at center of belt.

Adjustments

Pressure Gauge

It is advisable to check the pressure gauge with a master gauge to verify the correctness of its indication before checking 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, may be corrected with adjustment of the slotted stud on top of the switch. 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 reduce the number of operations that are possible from a fully charged reservoir. The governor switch is normally set to start the compressor at a pressure well above the operating pressure of the cut-out switch, thus the cut-out

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.

Orifice

The orifice is installed in the 1/8 inch tube connecting to the air supply manifold. When pressure is dropped on the manifold system, check that the cut-off switch responds without abnormal delay. A clogged orifice can result in a damaged breaker.

Tripping

The latch and trigger 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 occassionally. With the mechanism in the open position Fig. 1, there should be approximately .030 $\pm$ .005" clearance between the trip free lever roller and 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 when the mechanism is in the open position to insure against putting any initial compression on the rubber bumper.

The air gap for the trip armature should be approximately 3/16". This adjustment is made by varying the height of the resilient stop assembly Fig. 14. 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. The adjustment is made by loosening the hex nut on the underside of the armature and screwing up or down on the trip plunger.

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 adjusting nuts.

One last check which should be made is to ascertain that there is a minimum of twelve thousandths clearance between the top of the trip rod and the catch which it strikes. Clearance at this point is necessary to prevent shock-out of the mechanism on a closing operation. This clearance may be obtained by varying the air gap (3/16" dim.). Care should be exercised in widening the air gap excessively as this will increase the minimum operating voltage of the trip unit and slow down its operation.

Overtravel

The overtravel of the 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 interrupter travel is incorrect and the linkage should be checked. See Part 6 of the breaker instruction book. To check the overtravel with the mechanism in the closed position, hold down the pushbutton on the intake valve, and note the travel of the cross-head roller pin extension.

Throttle and Throttle Cam Lever

The throttle cam lever has been set at the factory to give the most satisfactory closing performance of the breaker and should not require adjustment. The only adjustment is to vary the position in the closing stroke of the mechanism where the throttle piston is opened. This adjustment is made by shifting the location of the cam plate on the throttle lever.

The throttle is adjusted to obtain correct breaker closing time by holding the throttle stem and turning the elastic stop nut in or out, whichever is necessary. The valve is held toward the closed position by the retrieve spring.

When an adjustment is made either to the throttle or the throttle cam, be certain that a gap of approximately 3/16" remains between the throttle and the throttle cam lever with the mechanism in the open position. Also, when any adjustments are made to the above items, it is imperative to check breaker operation and compare it with the typical operating curves shown in the breaker instruction book.

PART 5 - 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 is closes its contacts.

3. Check the intake 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 admission of air to the main closing cylinder by observing whether there is a momentary discharge of air from the exhaust valve, when the botton on the pilot valve is momentarily closed then released.

6. Check the breaker stop to make sure there is no interference.

7. 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, 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 two 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 push button on top of the pilot valve and observe the overtravel of the roller on the cross-head pin. This should be about 1/8" to allow the latch time to reset.

4. 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 roller on the trip-free lever.

5. Check the engagement between the catch and the trip-free trigger to make sure that it resets properly.

6. Block the shunt trip armature open and perform a close operation. If the breaker closes successfully under this condition, the shunt trip is shocking the trip-free trigger out of position. This situation may be corrected by increasing the gap between the trip rod plunger and the trip free trigger catch as outlined under Part 4.

C. IF THE MECHANISM FAILS TO TRIP

1. Check the voltage at the trip coil.

2. Check the terminals and contacts 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. (See Fig. 15).

4. Raise the trip rod manually and observe whether the catch is disengaged prior to attempting to rotate the trigger, and that the trigger is moved sufficiently to release the roller on the trip free lever. Also check that the lower armature seats up against the upper stationary armature.

D. ON RECLOSING DUTY, IF THE MECHANISM TRIPS BUT FAILS TO RECLOSE

1. Check the contacts on the latch check switch to see that they are making good contact.

2. Make the checks outlined in A1 to A7.

PART 6 - LUBRICATION

The mechanism has been lubricated at the factory and should be relubricated at least once every 3 years. If the breaker operates frequently or is installed in a dusty or corrosive atmosphere more frequent lubrication is recommended.

WARNING

BEFORE LUBRICATING THE MECHANISM THE BREAKER MUST BE REMOVED FROM SERVICE AND ISOLATED FROM THE SYSTEM. THE BREAKER MUST BE IN THE OPEN POSITION AND ALL CONTROL SWITCHES MUST BE OPEN. THE AIR PRESSURE MUST BE REDUCED TO 0 PSIG BY BLEEDING THE AIR RESERVOIR USING THE DRAIN VALVE.

To lubricate the mechanism proceed as follows:

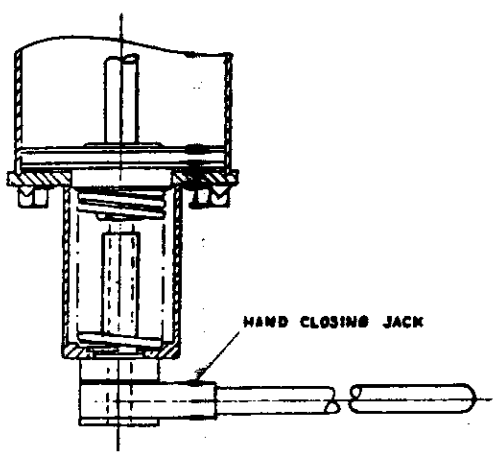
1. Coat all pins and sliding surfaces with Molycote (530701DK)

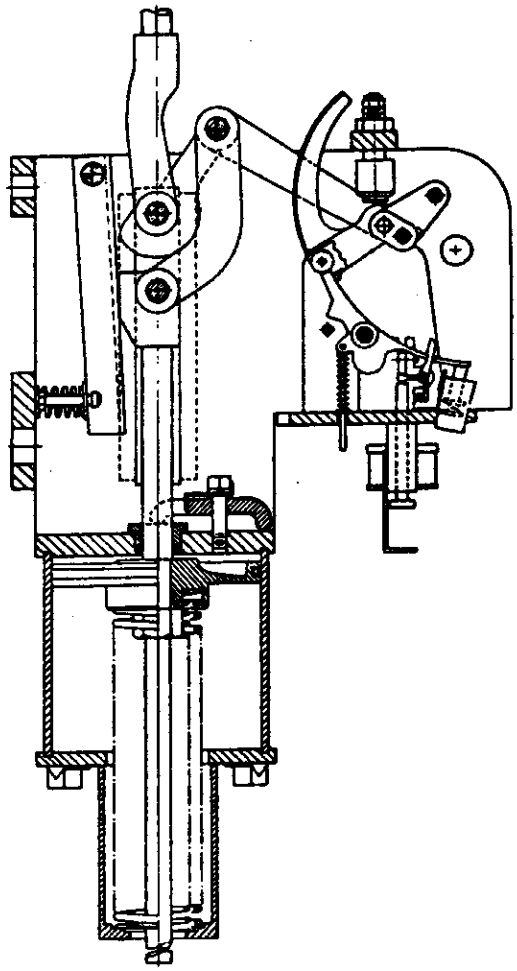
2. Coat all needle and roller bearings with Beacon #325 (55213AG)

3. Remove 1/4" pipe plug from the top plate of the mechanism cylinder housing and add 1 oz. of SAE 20 non-detergent engine oil. Replace the 1/4" pipe plug.

4. The close pilot valve has been lubricated at the factory and must be re-lubricated with GE Versalube (G322L) when parts are replaced.

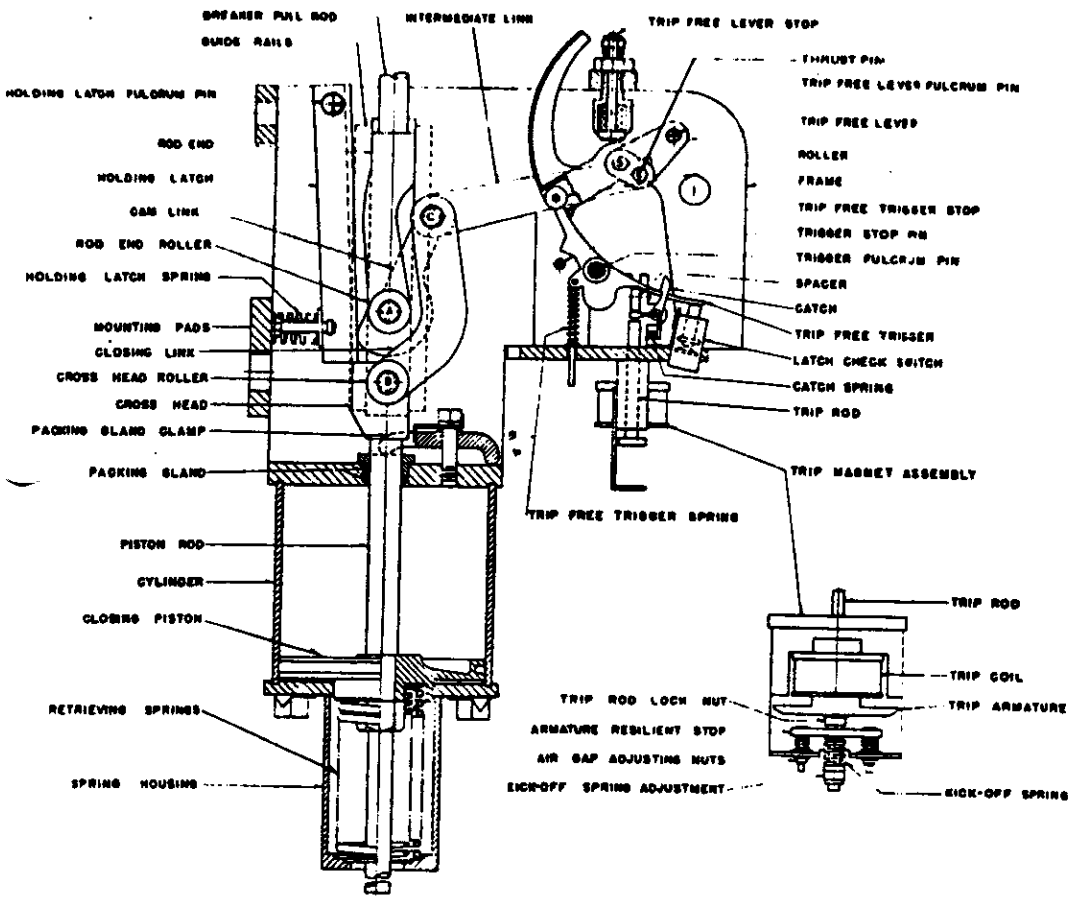
5. The poppets and piston in the close control valve main body will not normally require lubrication. If this valve is dismantled for maintenance the poppet seats and piston ring should be lubricated with GE Versalube (G322L) before reassembly.





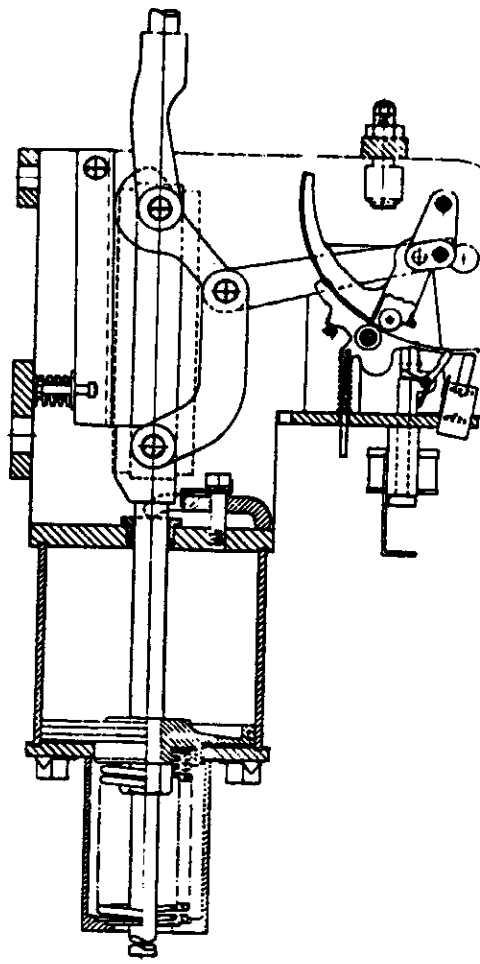
OPEN POSITION

FIGURE 1



CLOSED POSITION

FIGURE 2



TRIP-FREE POSITION

FIGURE 3

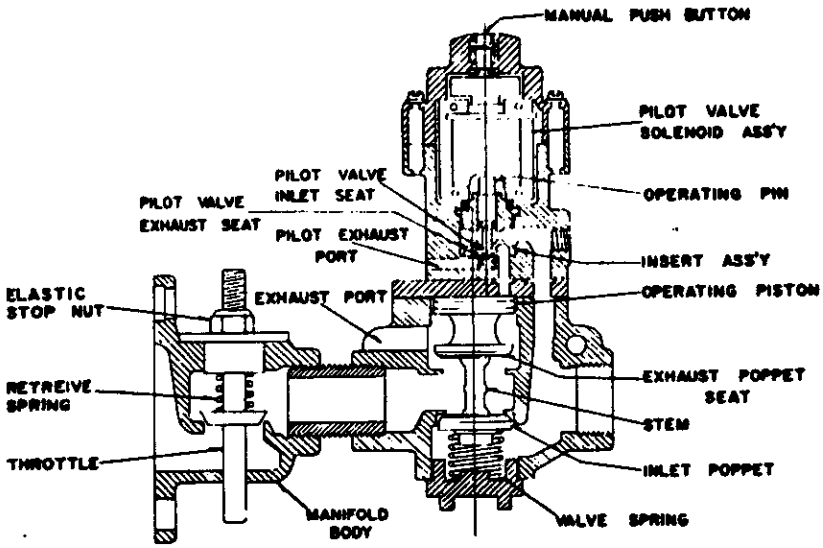


FIG. 4

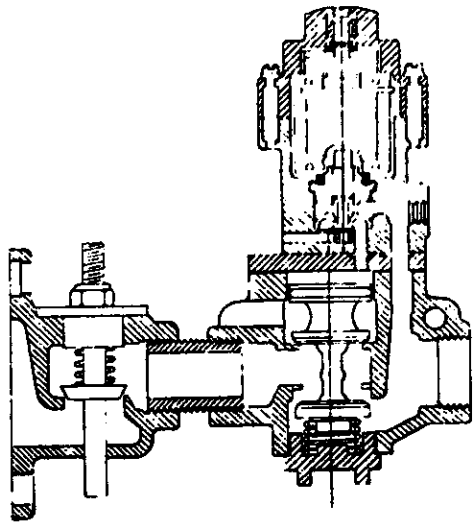


FIG. 5

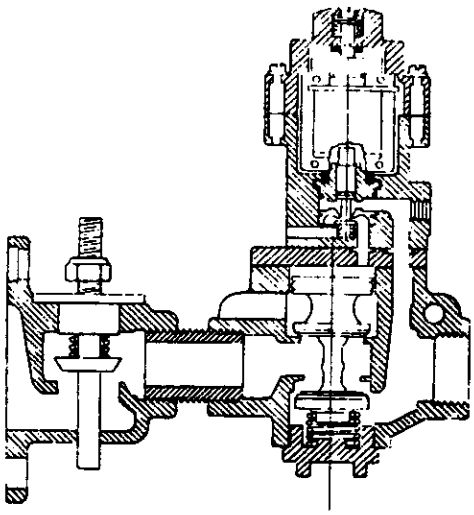


FIG. 6

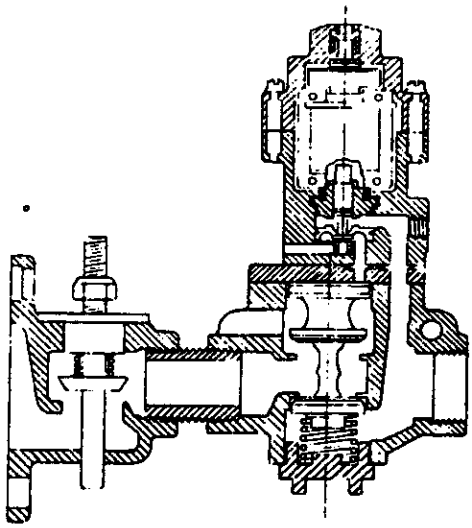


FIG. 7

BREAKER OPEN
CONTROL VALVE CLOSED

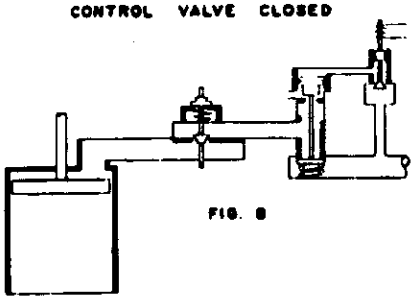


FIG. 8

BREAKER IN CLOSING MOTION
CONTROL VALVE OPEN
THROTTLE IN METERING POSITION

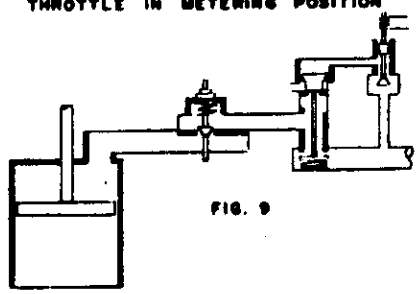


FIG. 9

BREAKER NEAR FULL CLOSED POSITION
CONTROL VALVE OPEN
THROTTLE FULL OPEN

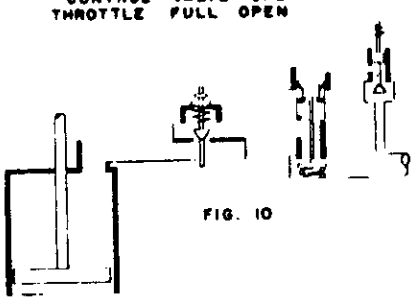


FIG. 10

BREAKER IN OPENING MOTION
CONTROL VALVE CLOSED
THROTTLE FULL OPEN

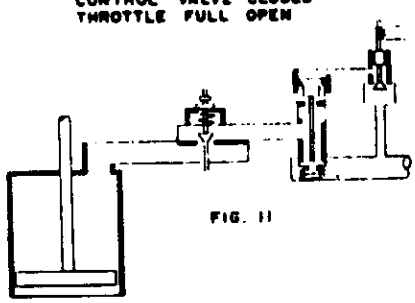


FIG. 11

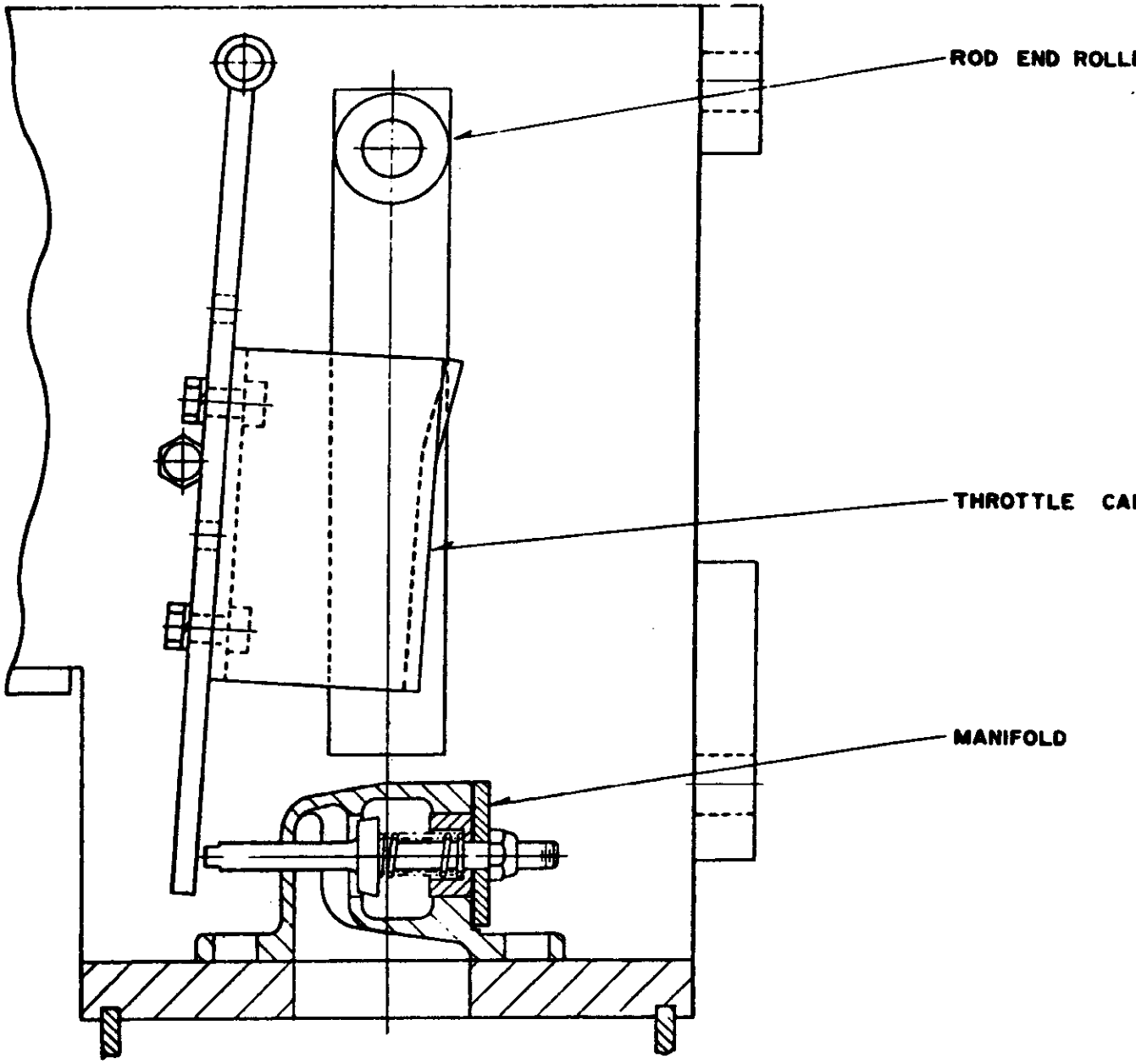


Fig. 12 *Throttle Valve Lever (Mechanism Open)*

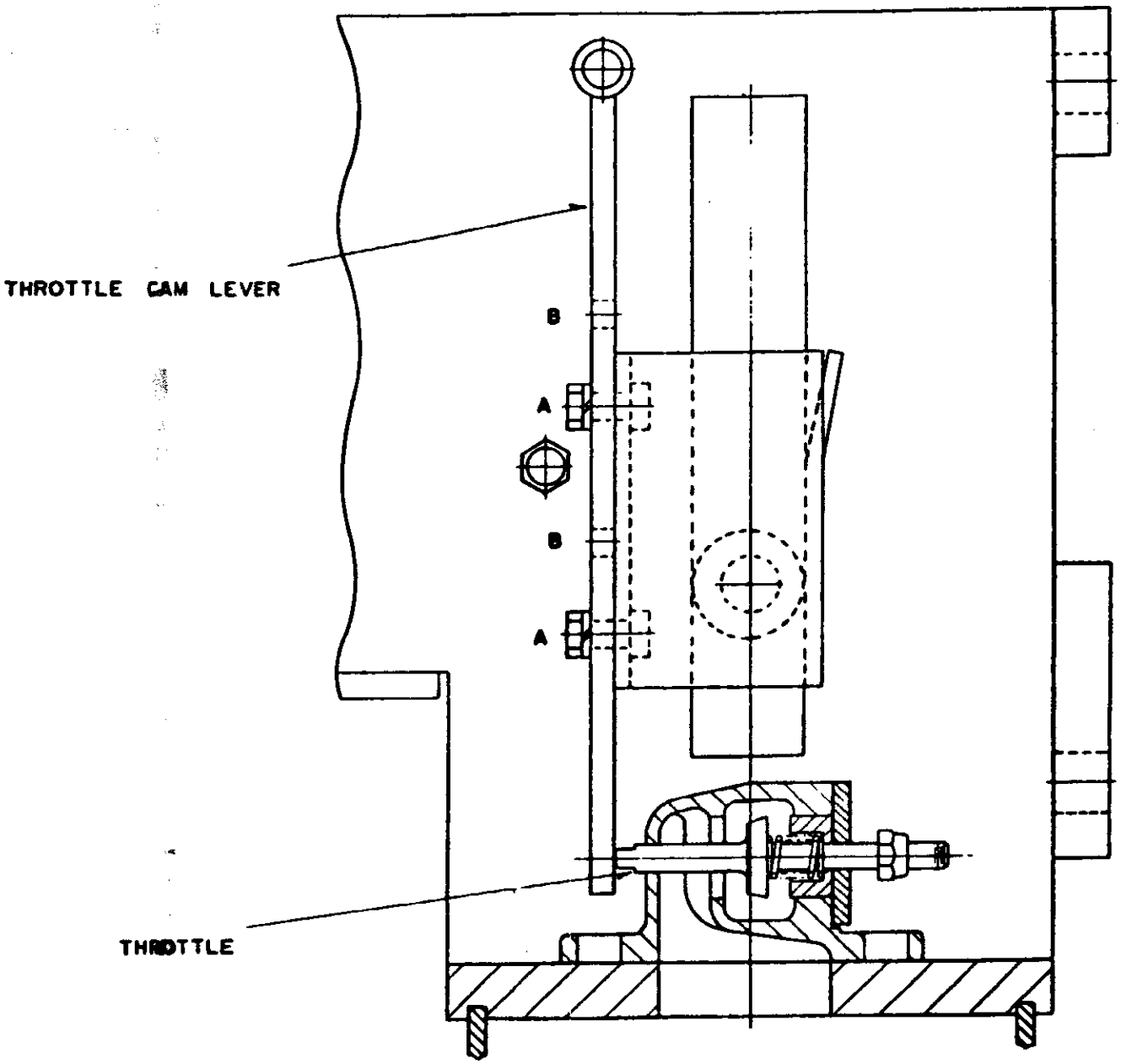


Fig. 13 *Throttle Valve Lever (Mechanism Closed)*

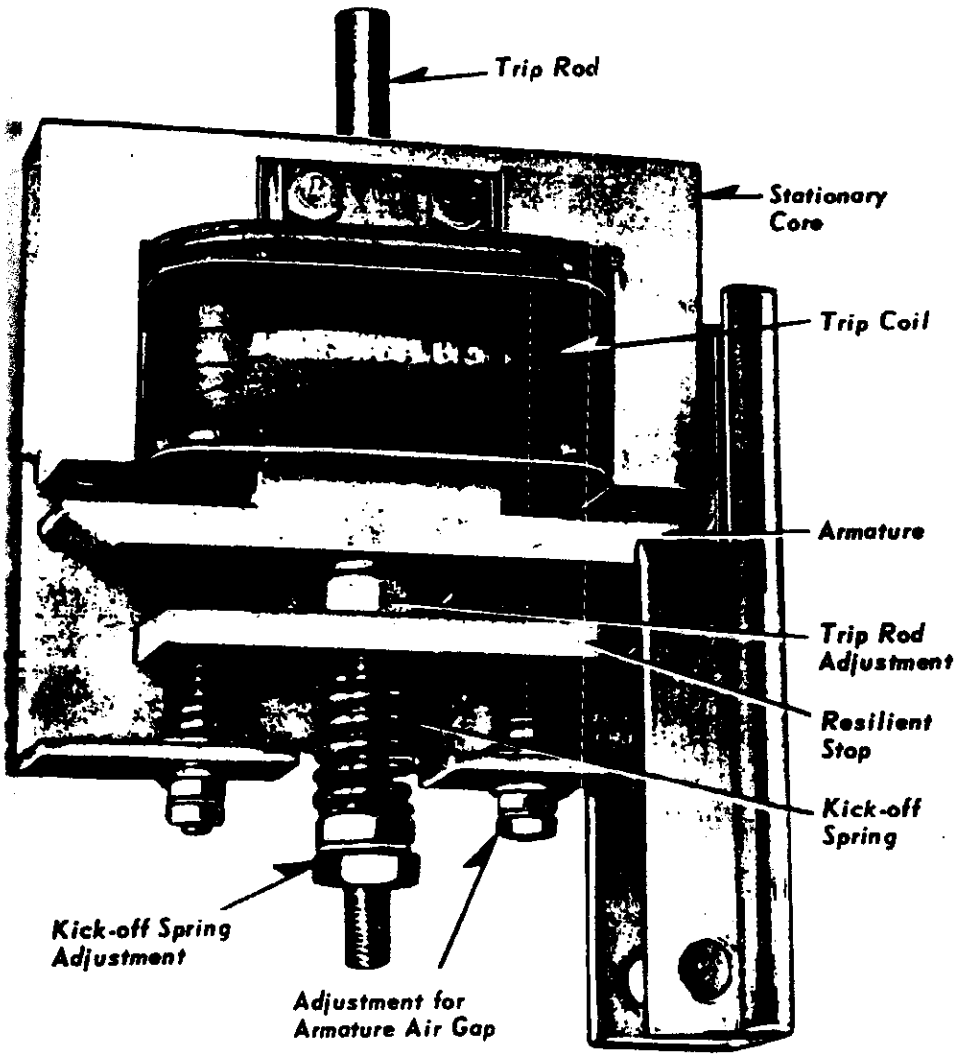


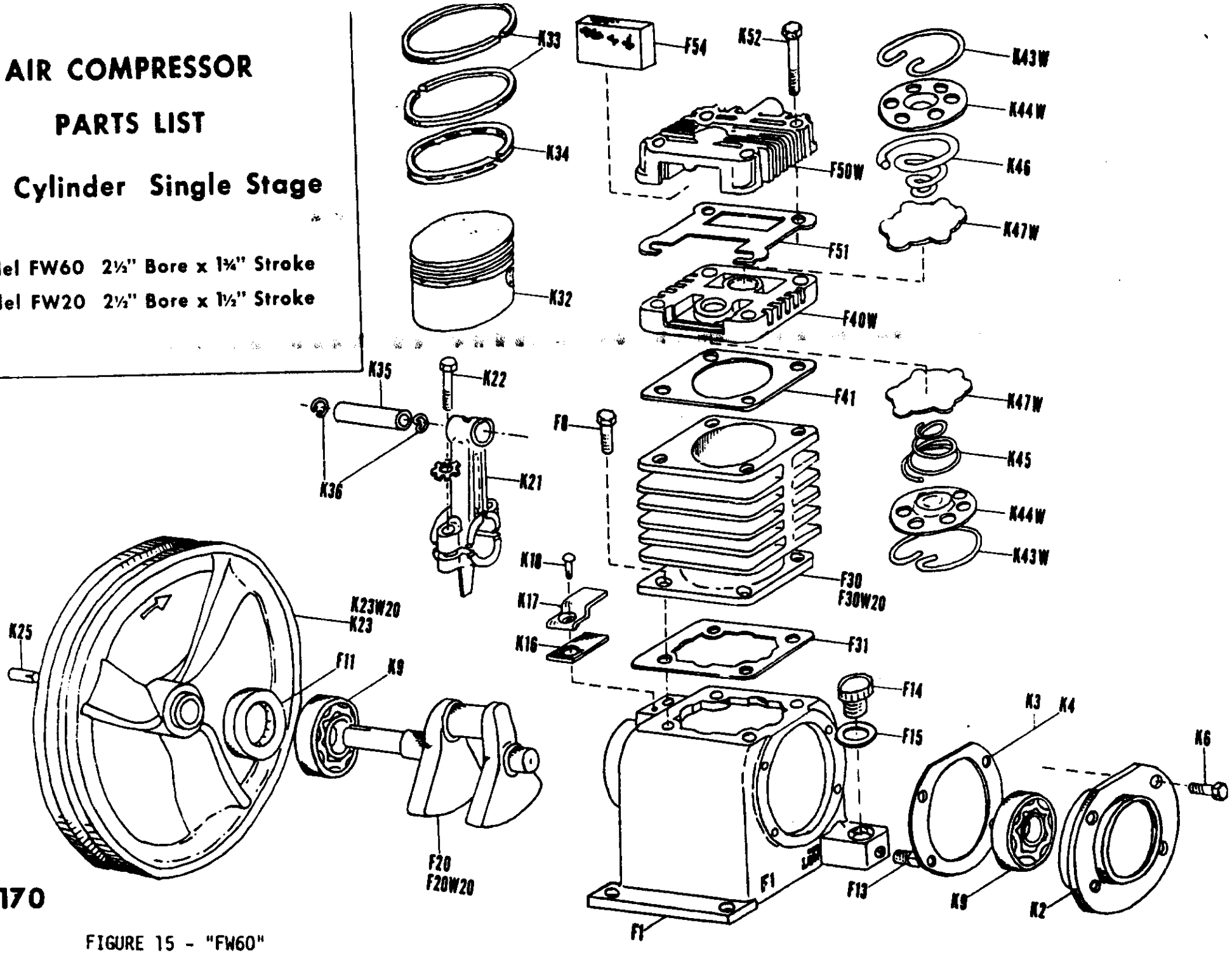
FIGURE 14 - TRIP MAGNET ASSEMBLY

AIR COMPRESSOR

PARTS LIST

ne Cylinder Single Stage

Model FW60 2½" Bore x 1¾" Stroke
Model FW20 2½" Bore x 1½" Stroke



#1170

FIGURE 15 - "FW60"
AIR COMPRESSOR PARTS

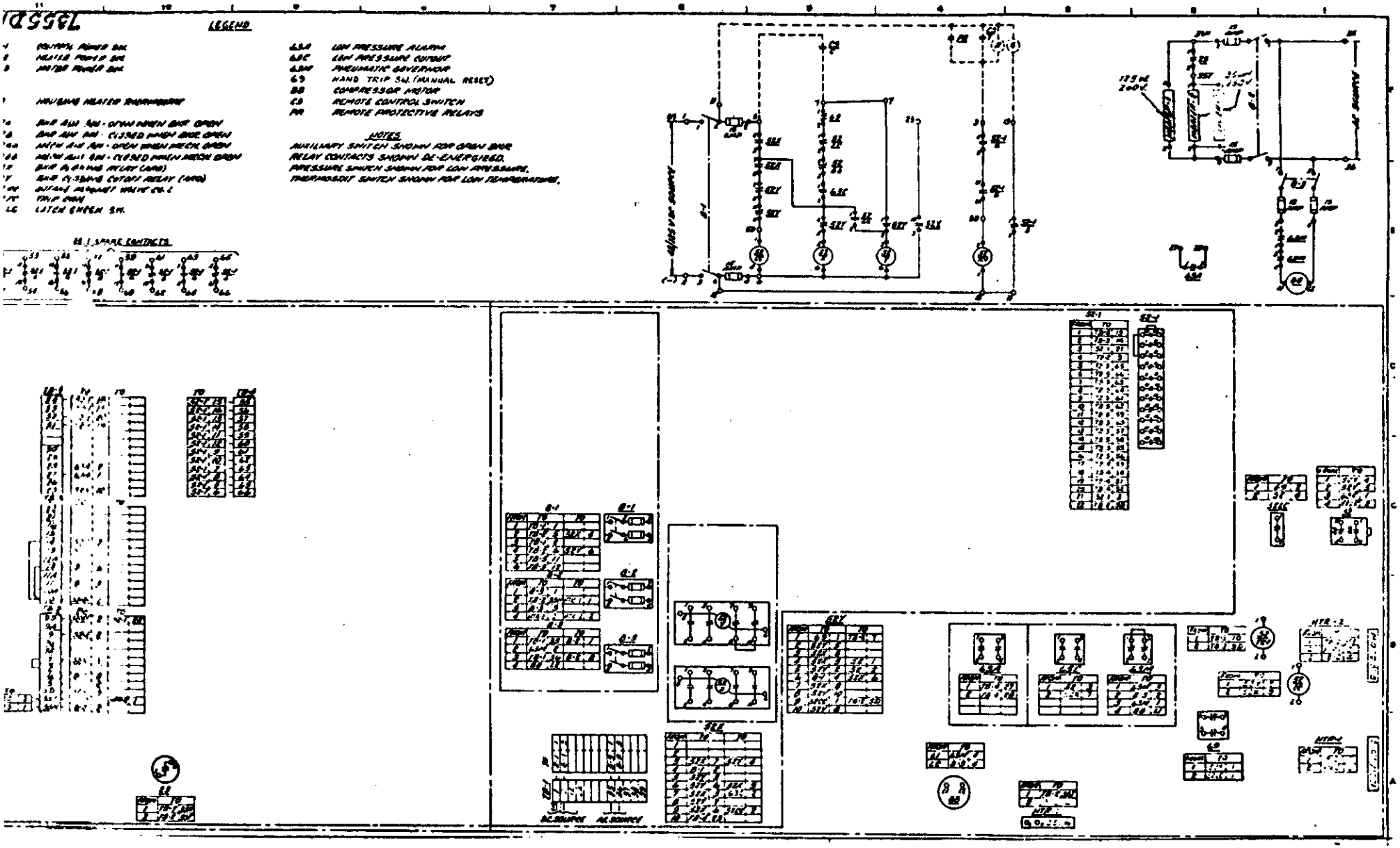


FIGURE 16 - TYPICAL SCHEMATIC

APPENDIX II

Relaying Type Current Transformers Field Testing

I.L. 33-256-CT-A

WARNING

IF THE METALLIC SUPPORT PLATE OF A BUSHING TYPE CURRENT TRANSFORMER TOUCHES A CIRCUIT BREAKER BUSHING, THE TRANSFORMER WILL NOT PRODUCE THE CORRECT RATIO. THE OUTPUT OF THE TRANSFORMER SECONDARY WILL BE REDUCED TO SOME VALUE DETERMINED BY THE IMPEDANCE OF THE CIRCUIT.

During any inspection of a circuit breaker the clearance between the transformer mounting plate and the bushing should be checked. A minimum of .062 inch is acceptable.

RATIO TEST

The voltage method and the current method are two common ways to measure transformer ratio. Since the voltage test requires simple apparatus to conduct, this method is discussed here.

Refer to Fig. 1. The burden or short circuit should be removed from all other transformers on the same pole. Some appropriate voltage below saturation, approximately 25% of the accuracy class, should be applied to the full winding of the secondary and the primary voltage read with a high impedance, 20,000 ohms/volt low range meter. The turns ratio is approximately equal to the voltage ratio. Refer to Table 1 for suggested impressed voltages.

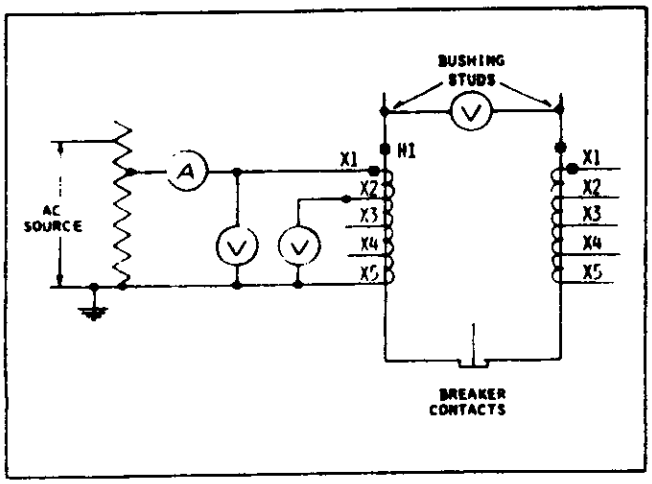


Fig. 1 *Ratio Check Connections*

After the overall ratio is measured, the tap ratios can be measured by comparing the tap voltage to the full winding voltage. Tap voltage can be determined by the ratio:

$$\frac{\text{Full Winding Volts}}{\text{Full Winding Turns}} = \frac{\text{Tap Voltage}}{\text{Tap Turns}}$$

A vacuum tube voltmeter is a good instrument for reading the primary. The turns ratio and accuracy class may be found on the transformer nameplate located on the mechanism housing door.

With the voltage in Table 1 applied on the respective transformers, the ammeter will read a very low current. If by accident a saturating voltage is applied the current will rise rapidly. When this occurs the voltage should be run slowly and continuously to zero and then the correct voltage applied.

Table 1
Voltage Applied on Secondary – Full Winding

C.T. Ratio	Accuracy Class			
	C100	C200	C400	C800
600/5	24V (.2V)*	48V (.4V)	96V (.8V)	--
1200/5	--	48V (.2V)	72V (.3V)	120V (.5V)
2000/5	--	--	100V (.25V)	200V (.5V)
3000/5	--	--	60V (.1V)	120V (.2V)
4000/5	--	--	100V (.25V)	200V (.25V)
5000/5	--	--	100V (.1V)	200V (.2V)

*NOTE: Figures in ( ) = Primary Volts

After the test the voltage should be run slowly and continuously to zero to prevent residual remaining in the core of the transformer.

WARNING

IF NO FURTHER TESTS ARE TO BE MADE, SHORT CIRCUIT OR ADD BURDENS TO ALL CURRENT TRANSFORMERS.

POLARITY TEST WITH OSCILLOSCOPE

A test set-up wired as per Fig. 2 may be used for polarity check. The voltage applied should be lower than the saturation voltage so the values established by Table I for the ratio test are safe to use. Again any other transformers on the same pole should be open circuited.

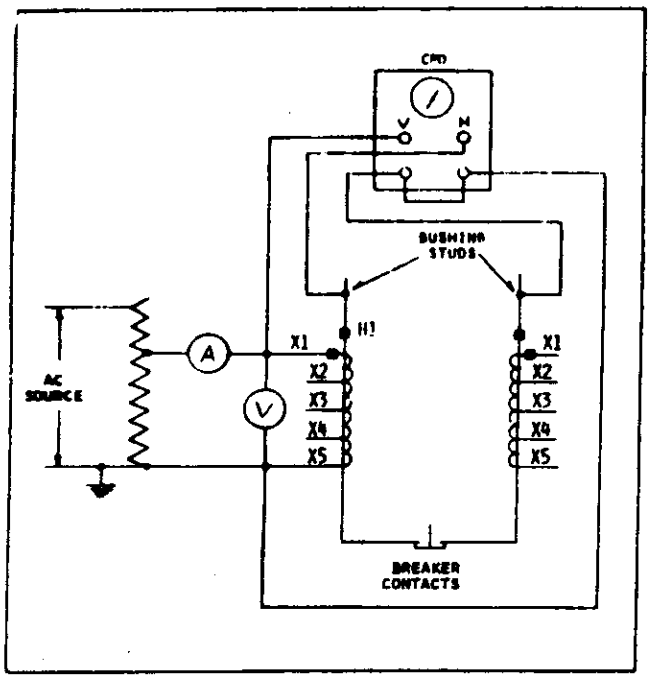


Fig. 2 *Polarity Check Connections*

Fig. 2 shows a single channel cathode ray oscilloscope with the secondary voltage applied to the vertical input terminals and the primary voltage applied to the horizontal input terminals with the polarity as shown. If the slope of the line on the oscilloscope is positive as shown, then the polarity agrees with the terminal marking.

If the ratios of the transformer taps have been checked, and are correct, then the polarity of the individual taps will be correct. So it is only necessary to check the polarity of the total winding.

If a dual channel oscilloscope is used the primary and secondary voltages should be connected on separate channels. The polarity is correct if the resulting wave forms are in agreement which they should be since the same voltage is applied to both channels.

With the voltages in Table I applied on the respective transformers the ammeter will read a very low current. If by accident a saturating voltage is applied the current will rise rapidly. When this occurs the voltage should be run slowly and continuously to zero and then the correct voltage applied.

After the test the voltage should be run slowly and continuously down to zero to prevent residual remaining in the core of the transformer.

If the polarity is proven to be incorrect then the transformer is mounted up-side-down on the bushing.

WARNING

IF NO FURTHER TESTS ARE TO BE MADE, SHORT CIRCUIT OR ADD BURDENS TO ALL CURRENT TRANSFORMERS.

INSULATION RESISTANCE

Insulation resistance between the current transformer secondary and ground may be measured with a 500 or 1000 volt megger or other conventional insulation test instrument.

The neutral ground must be disconnected from ground. All burdens should be removed. A wire jumper should be connected from X1 to X5 on each transformer. The neutral ground wire can then be used to test all the transformers simultaneously.

One megohm is usually considered the minimum insulation resistance acceptable. Any low reading should be thoroughly investigated and corrective action taken.

WARNING

IF NO FURTHER TESTS ARE TO BE MADE, SHORT CIRCUIT OR ADD BURDENS TO ALL CURRENT TRANSFORMERS.

APPENDIX III

ASSEMBLY OF KNOCKED-DOWN "SP" BREAKER

The breaker is shipped with the mechanism in the open position. This can be visually checked by observation of the close-open indicator. The pole units are shipped in the open position. Mechanism and pole units will be assembled in the open position.

1. Remove hole plugs, on top of housing, from current transformer conduit and pressure switch conduit holes, when supplied. (See Figure III-1).

2. Remove tape covering pole unit mounting pads.

3. Remove horizontal linkage shipping support assembly and linkage hardware from all three pole unit positions on housing. (See Figure III-2A).

   For each pole unit position, unbend locking plate and remove .312"-18 bolt and locking plate. Remove three .375"-16 bolts, .375" steel lockwashers, and .375" extra wide steel washers. Scrape sealant from around horizontal linkage shipping support. Pry or lift shipping support off housing at a 90° angle.

CAUTION

DO NOT DROP OR APPLY EXCESSIVE FORCE TO THE LINKAGE SYSTEM WHILE DISCONNECTED FROM SUPPORT OR POLE UNIT. EXCESSIVE FORCE MAY DAMAGE LINKAGE SYSTEM.

Retain all hardware -- all hardware will be used for pole unit installation except the locking plates and gaskets.

4. **Lift pole unit by installing cloth slings around aluminum casting.**

WARNING

THE POLE UNITS AND BUSHINGS ARE PRESSURIZED WITH 5 PSIG OF SF6. WHEN USING CABLE SLINGS OR CHAINS, TAKE CARE TO PREVENT FROM STRIKING OR BEARING AGAINST THESE BUSHINGS AS ANY UNUSUAL SHOCK OR STRAIN MAY CAUSE RUPTURE OF THE BUSHING ENDANGERING NEARBY PERSONNEL.

Figure III-3 shows sling and chain locations for lifting pole unit with 2 and 4 current transformers. The chains to be used are referenced in this instruction book under PART 3 - INSTALLATION, Tools and Service Equipment, Item #3. Attach chains to slings, protect bushing with wood or heavy cardboard, straddle bushing with chains, and lift at a 40° angle. Straddling the bushing gives the pole unit laterial stability.

5. Install two aligning studs (.375"-16 x 3" long) in the pole unit shaft seal housing into the two holes nearest the pole unit access cover. See Figure III-1 for location of holes in housing used for aligning during pole unit installation.

6. Lift pole unit, at 40° angle, into position above housing and apply sealant liberally to both sides of new gasket (7249A43H02). Install gasket onto pole unit by aligning holes in gasket with aligning studs. Feed current transformer and pressure switch wires and conduits thru provided holes. The sealing washer is to be mounted on outside of housing. Do not secure conduit pipe with nut at this time. See Figure III-2D for typical section of conduit pipe.

7. Lower pole unit onto housing using the aligning studs.

NOTICE

THE POLE UNITS ARE MARKED Ø1, Ø2, and Ø3. THESE MUST BE INSTALLED IN THE CORRECT POSITION AS SHOWN IN FIGURE III-1.

Fasten pole unit to housing with two .500"-13 bolts and .500" lockwashers. (See Figure III-2C and Figure III-3 for mounting location). Remove aligning studs and secure with three .375"-16 bolts, flat washers, and lockwashers. (See Figure III-2B and Figure III-2C for details and torque values.)

8. Repeat Steps 4 through 7 above until all three pole units are installed.

9. Assemble linkage to pole units. (See Figure III-2B for details.)

WARNING

POLE UNIT AND BREAKER MECHANISM MUST BE OPEN BEFORE LINKAGE IS ASSEMBLED. OPEN POLE UNIT COMPLETELY BY ROTATING THE INTERRUPTER OPERATING SHAFT COUNTERCLOCKWISE WHEN FACING SHAFT. VISUALLY CHECK THE CLOSE-OPEN INDICATOR TO ENSURE THAT THE MECHANISM IS OPEN. FAILURE TO ASSEMBLE MECHANISM AND ALL POLE UNITS IN THE OPEN POSITION MAY RESULT IN PERSONNEL INJURY OR BREAKER DAMAGE.

Align pole unit operating shaft with linkage holes by rotating pole unit operating shaft slightly. Assemble linkage with hardware removed in Step 3, except use a new locking plate (512A405H06) under head of .312"-18 x .88" bolt. Torque .312"-18 x 88" bolt to 17 ft.-lbs. and bend locking plate back.

10. Secure current transformer conduit pipes to housing with nut. (See Figure III-2D). Route current transformer wires to terminal blocks and connect as marked.

11. When provided, secure pressure switch conduit pipes to housing with nut. (See Figure III-2D). Route pressure switch wires thru duct to terminal blocks and connect as marked.

12. Repeat Steps 9 through 11 above until all three pole units are assembled to linkage and wiring is completed. Then continue with breaker installation as outlined in Section 3 of the Breaker Instruction Book -- 33-570-BM-1C.

Document 0889A
Disk 0041

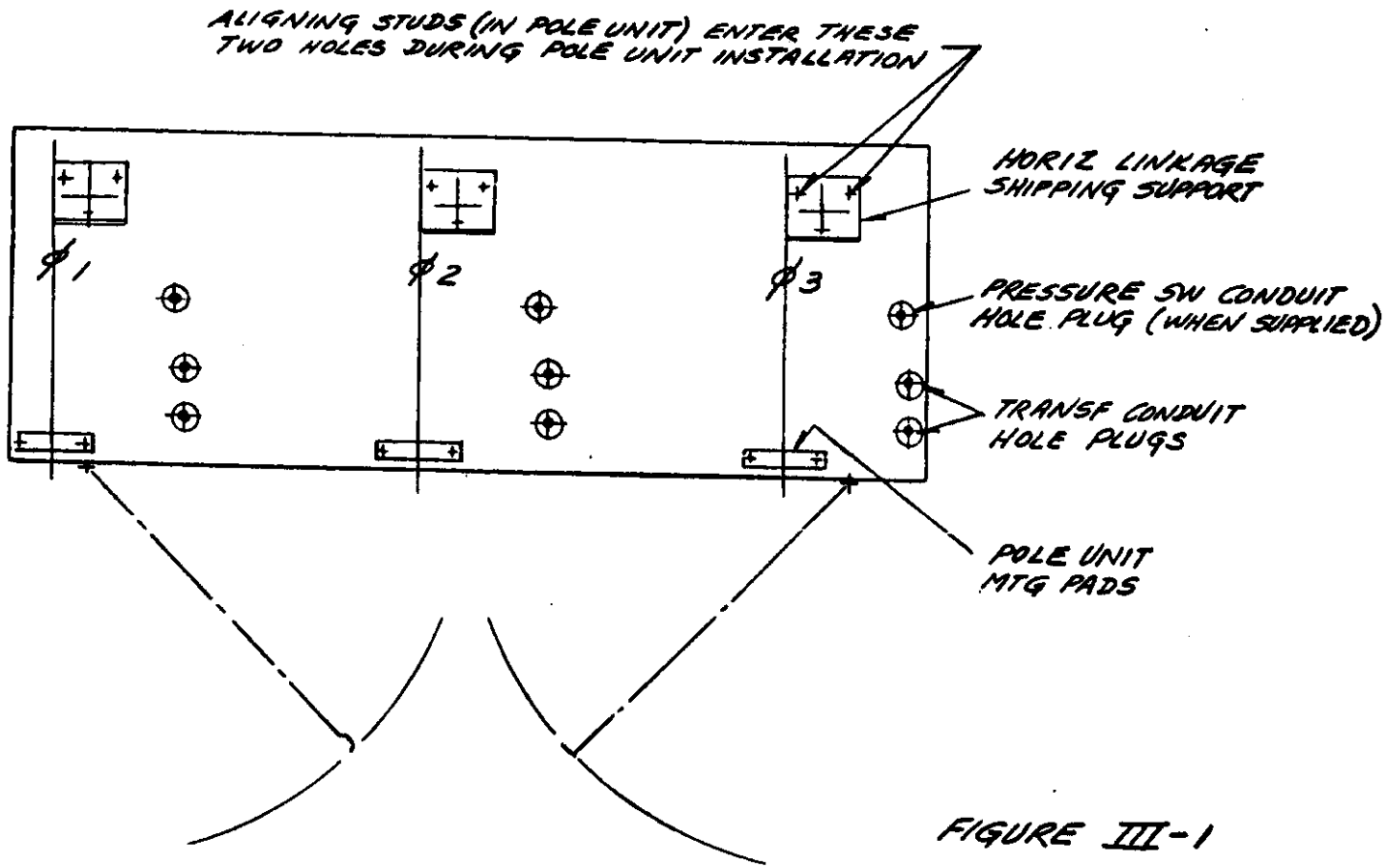


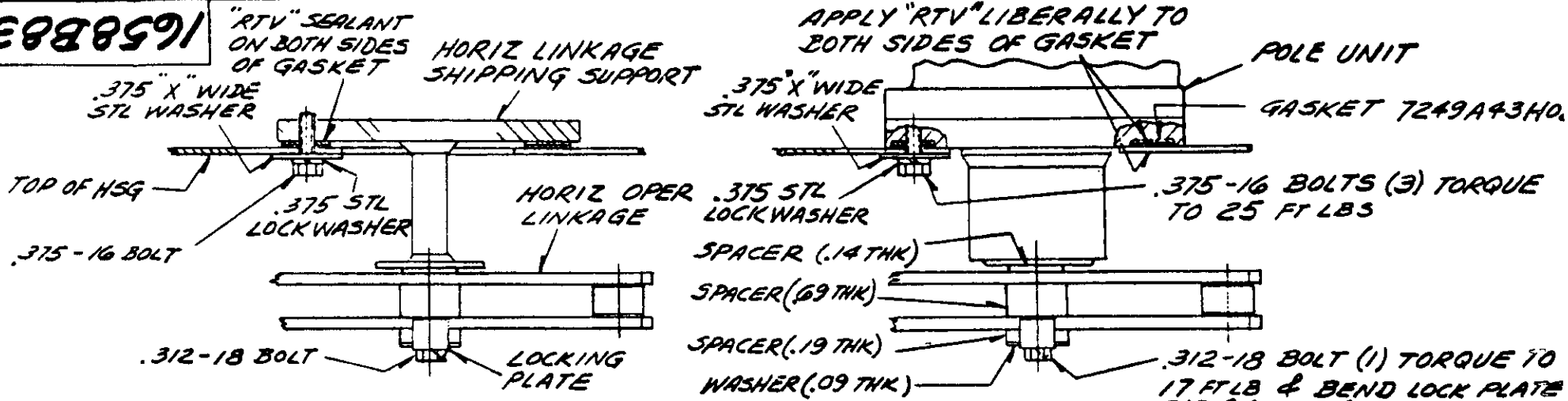
FIGURE III-1

1658B82

Westinghouse Electric Corporation					
TITLE H5G PLAN VIEW PCB TYPE 345/690 3P					
DIMENSIONS IN INCHES – SCALE					
DFTM R Kazimer	7/14/80	APPD R. M. Spaw	9/4/80	1658B82	
		APPD			
		APPD			
DIV & PLANT LOCATION PCB TRAFFORD PA				USA	6300

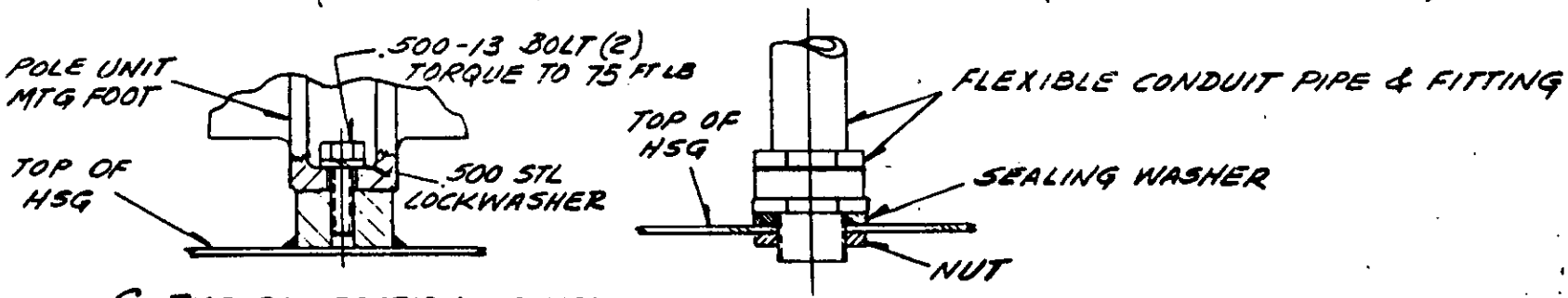
CHANGE

1658B83



A. TYPICAL SECTION OF OPER SHAFT (AS SHIPPED)

B. TYPICAL SECTION OF OPER SHAFT (POLE UNIT INSTALLED)



C. TYPICAL SECTION OF MTG POLE UNIT TO HSG

D. TYPICAL SECTION OF CONDUIT PIPE

FIGURE III-2
1458B83

10	7Y1039	1			
D	922052	CHANGE			

Westinghouse Electric Corporation

TITLE SECTIONAL VIEWS PCB TYPE 345/690 SP

DIMENSIONS IN INCHES - SCALE

DFTM R. Krumm 7/1/ APPD R.M. Scott 7/16/ APPD APPD

1658B8

DIV & PLANT LOCATION PCB TRAFFORD PA USA 63

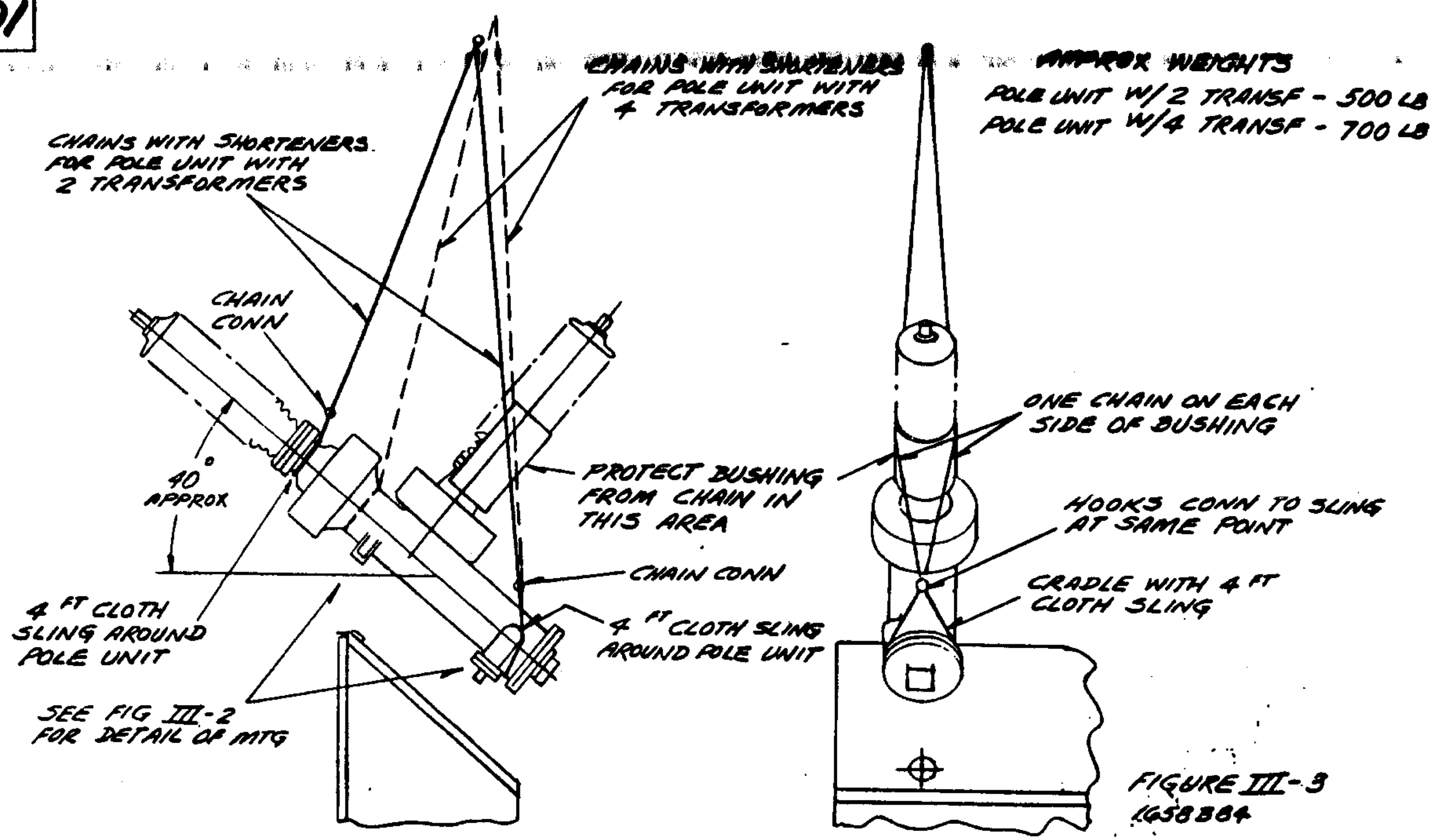


FIGURE III-3
1658B84

Westinghouse Electric Corporation	
TITLE	LIFTING INSTRUCTIONS PCB TYPE 345/690 SP
DIMENSIONS IN INCHES - SCALE	
DFTM	R Kazimer 7/21/60
APPD	R.M. Sorn 8/4/60
APPD	
APPD	
DWG NO.	1658B84
DIV & PLANT LOCATION	PCB TRAFFORD PA
USA	6300

0	972032
IT	CHANGE

1658B84

APPENDIX IV

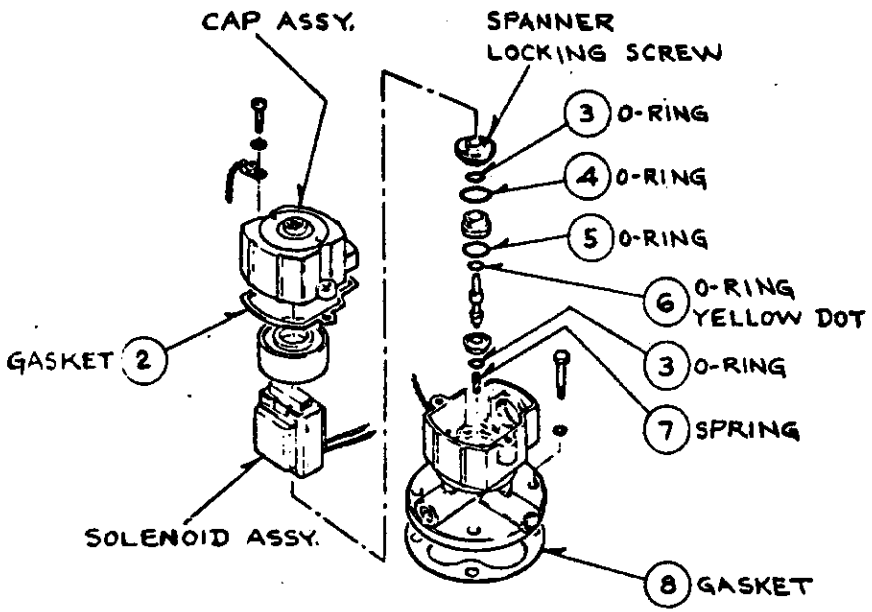
Pilot and Control Valve

Figure

1. Pilot Valve

2. Control Valve

4042B01



NOTE:
NUMBERED ITEMS SUPPLIED IN SERVICE KIT NO. 54853-01

FIGURE 1

A. REMOVE CAP ASSEMBLY AND SOLENOID BY REMOVING (2) PHILLIPS HEAD SCREWS
B. REMOVE SPANNER LOCKING SCREW USING NEEDLE NOSE PLIERS
C. REMOVE O-RINGS AND RETAIN FOR SIZING PURPOSES
D. REPLACE WITH O-RINGS FROM KIT USING OLD O-RINGS TO OBTAIN PROPER SIZE. ITEM 6 IS MARKED WITH A YELLOW DOT AND MUST BE IN THIS POSITION
E. COAT O-RINGS WITH LIGHT FILM OF LUBRICANT (GE VERSALUBE G322L)
F. TIGHTEN SPANNER LOCKING SCREW UNTIL SNUG USING NEEDLE NOSE PLIERS
G. REPLACE SOLENOID AND CAP ASSEMBLY

Westinghouse Electric Corporation

Title NORGREN SOLENOID SERVICE KIT
PCB TYPE 345/690 SP

PCB SPI 08 SPECIFIES MFG. TOLERANCES UNLESS SHOWN ON FACE OF DRAWING

PCB SPI 09 SPECIFIES GENERAL PRODUCT SPECIFICATIONS. PRACTICES

MACHINED DIMENSIONAL TOLERANCES UNLESS SPECIFIED ON FACE OF DRAWING

DECIMALS	DIMENSIONS UNDER 6	6-18	OVER 18
ZERO TO 2-PLACE	±.02	±.03	±.06
3-PLACE	±.010	±.020	±.030

Dimensions in inches - NTS.

Sign Off Committee			
ENG. G.V. Murray	7-2-81	MFG.	
ENG.		PURCH.	
ENG		QC	
DFTM P. J. YURAN	7-2-81	I.E.	
DFTM		Rel.	
DFTM			

4042B01

Div & Plant Location — Power Circuit Breaker, Trafford Pa. 15085 USA

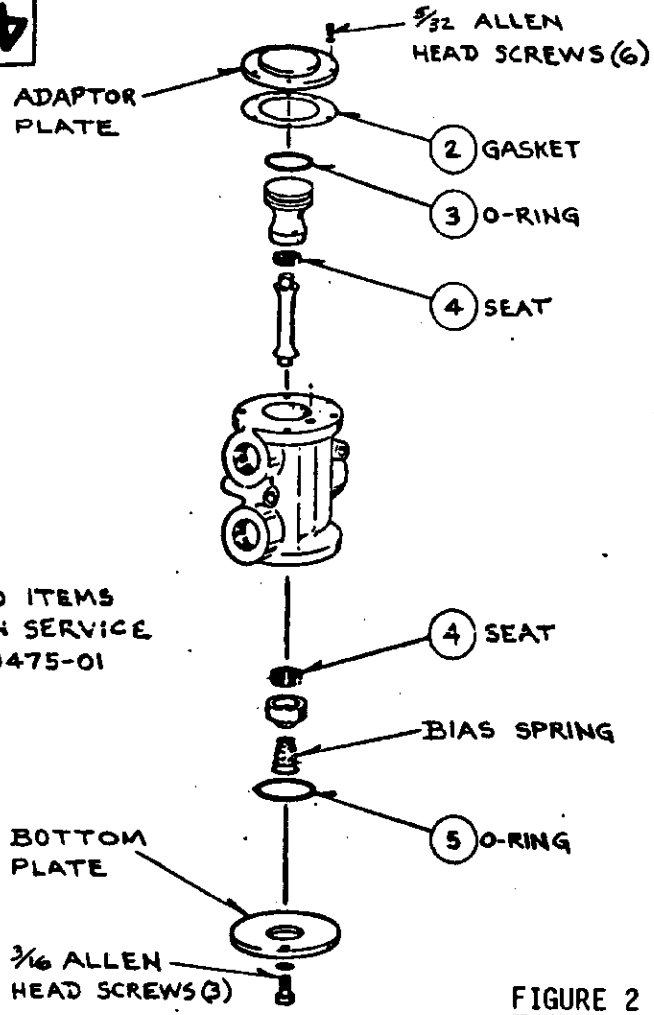
6300

ENG. REF. DWG.

SO 6-311004K-003 1

D — CHANGE — LT.

4042B02



NOTE:
NUMBERED ITEMS SUPPLIED IN SERVICE KIT NO. 53475-01

FIGURE 2

A. REMOVE ADAPTOR PLATE BY REMOVING SIX 5/32 ALLEN HEAD SCREWS
B. REMOVE BOTTOM PLATE BY REMOVING THREE 3/16 ALLEN HEAD SCREWS. THE BIAS SPRING PUSHES AGAINST THIS PLATE THEREFORE REMOVE THE SCREWS EVENLY.
C. THE UPPER SEAT ASSEMBLY IS PUSHED OUT THROUGH THE TOP OF THE VALVE
D. THE LOWER SEAT ASSEMBLY MUST BE REMOVED THROUGH THE BOTTOM OF THE VALVE
E. COAT REPLACEMENT PARTS WITH GE VERSALUBE (G322L) BEFORE REASSEMBLY

CHANGE			
D	17		

ENG. REF. DWG

Westinghouse Electric Corporation

Title NORGREN VALVE SERVICE KIT
PCB TYPE 345/690 SP

PCB SPI 08 SPECIFIES MFG. TOLERANCES UNLESS SHOWN ON FACE OF DRAWING

PCB SPI 09 SPECIFIES GENERAL PRODUCT SPECIFICATIONS/PRACTICES

MACHINED DIMENSIONAL TOLERANCES UNLESS SPECIFIED ON FACE OF DRAWING

DECIMALS	DIMENSIONS		
	UNDER 6	6-18	OVER 18
ZERO TO 2-PLACE	±.02	±.03	±.06
3-PLACE	±.010	±.020	±.030

Dimensions in inches - NTS.

Sign Off Committee

ENG. C Wynroy	7-2-81	MFG.	
ENG.		PURCH.	
ENG.		Q.C.	
DFTM. P. J. YURAN	7-2-81	I.E.	
DFTM.		Rel.	
DFTM			

4042B02

Div & Plant Location—Power Circuit Breaker, Trafford, Pa. 15085, USA

6300