SIEMENS-ALLIS

INSTRUCTION BOOK

OIL CIRCUIT BREAKER

BZO-121-6 10,000 MVA

BZO-145-6 10,000 & 15,000 MVA

1600, 2000, 2500 & 3000 AMPERES

WITH PH-33T-5 OPERATOR

MAY, 1979

BWX-6789-2

FORWORD

Siemens-Allis Outdoor Oil Circuit Breakers are precision built devices designed to function efficiently under normal operating conditions.

The successful performance of these breakers depends as much on proper installation and maintenance as it does on good design and careful manufacture.

The instructions included in this book are to aid you in obtaining longer and more economical service from your Siemens-Allis Oil Circuit Breakers. By distributing this information to your operators and engineers, you can assure proper installation and operation — resulting in better service and lower maintenance costs.

By carefully following these instructions, no difficulties should be encountered. However, they are not intended to cover all details or variations that may be encountered in connection with the installation, operation and maintenance of this equipment.

Should additional information be desired, contact the nearest Siemens-Allis office.

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OIL CIRCUIT BREAKER

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SHIPPING

TYPE BZO-6 SKID MOUNTED BREAKERS

Normally, the BZO breakers are shipped completely assembled. However, occasionally, when clearances can not be obtained, they are shipped with bushings and interrupting devices removed.

All BZO breakers are completely assembled at the factory. All adjustments are carefully made and the breaker is given rigorous mechanical tests after which the adjustments are re-checked. All control wiring is given a 1500 volt withstand test. The current transformers and their leads are insulation tested at 2500 volts and then given a 400 cycle induced potential test after being installed.

After these tests have been completed, unless the breaker is to be shipped assembled, the bushings are marked with the breaker serial number and their position in that breaker. They are then removed from the breaker and packed separately. The interrupters are packed in the tank in which they are to be assembled.

Positions 1 and 2 refer to pole number one, 3 and 4 to pole number two, and 5 and 6 to pole number three. When standing in front of the operator cabinet and facing the breaker, positions 1, 3, and 5 are on the viewer's left and positions 2, 4, and 6 are on the right.

For breakers shipped assembled, the interrupting devices are carefully braced to prevent damage to the bushings during shipment.

In all cases, the breaker is closed and a wedge is placed in back of the operator to prevent it from becoming unlatched while the breaker is in transit. The trip latch is also wired in place.

CAUTION: *Remove the temporary red cap from bushing stud when the standard bushing cap has been removed for shipping clearance. Check inside bushing conductor for moisture before installing permanent bushing cap.*

Thread the bushing cap into position making certain the O-ring gasket is in place. Tighten the cap until it seals firmly against the reservoir cover nut. Use a torque of 140-150 ft-lbs. to seal against the O-ring and provide the necessary metal-to-metal contact.

HANDLING

TYPE BZO-SKID MOUNTED BREAKERS

Particular care should be used when unloading the breaker from the flat car or when moving it about the switch yard to avoid the possibility of damaging the valves, oil gauges, oil and gas separators, and especially the bushings.

Since the three pole-units are assembled and permanently mounted on channels, the breaker must be moved as a unit.

The breaker can be moved with a crane by hooking the slings onto the lifting lugs near the top of the tanks on the first and third poles. The slings should be so proportioned as to lift the breaker as near level as practical.

The breaker can be skidded or moved by placing rollers under both channels. When jacking or moving the breaker, strains must be evenly distributed over both channels. The breaker should never be lifted or moved by placing jacks or tackle under the drain valves or other attachments. Moving the breaker while filled with oil is not recommended but can be done with proper precautions and instructions from the factory.

RECEIPT AND INSPECTION

Upon receipt of the breaker, check that the railroad car number agrees with that on the shipping manifest.

Inspect all parts carefully to see that nothing has been lost or damaged. If damage is evident, file a claim with the transportation company and send a copy of the inspector's report to Siemens-Allis Siemens-Allis Shipping Damage Claim procedure can be obtained for this purpose from the factory or local sales office. Since many transportation companies have a definite time limit in which damage claims may be filed, the inspection should be made as soon as possible.

All parts or special tools which must be shipped loose have been packaged and are stored either in the tanks or the cabinet for protection against weather and vandalism.

STORAGE

When possible, the breaker should be set up immediately in its permanent location and filled with oil. The tanks should be cleaned and inspected. If the humidity indicator cards show moisture present, find and correct the moisture entrance point. Remove the red pipe caps from the Gas and Oil Separator Pipes (219) and install one Separator (222) on each pipe (219). Remove the desiccant and humidity indicator cards, then fill the tanks with approved oil.

If the breaker cannot be set up in its permanent location, it should be filled with oil as described above if storage of more than 6 months is expected. For short term storage, however, it may be advantageous to employ the materials used for shipment as follows. Check the humidity indicator card; if moisture is indicated, find its entrance and correct. The indicator cards should be checked every 30 to 60 days thereafter. An alternate method is to use 300 watt minimum space heater in each tank.

When bushing terminal caps have been removed for shipping clearance, they should be installed immediately on receipt of the breaker. The caps should be torqued to 140-150 ft.-lbs.

If the interrupting devices are shipped separately, they should be stored in a warm, dry room to prevent insulation from absorbing moisture. Open crates to permit air to circulate freely. Just before installation, inspect the parts. If moisture is present, dry out in an oven for 6 to 8 hours at a temperature of 210-220°F for fibre parts and 110°F for other parts.

CAUTION: *Do not wash buttons (310) in any hydrocarbon base solvent.*

To prevent corrosion due to condensation inside the operator cabinets, the space heaters should be energized within a day or two. Machined parts of the operating mechanism should be coated with a light non-gumming oil.

Periodic inspection of the breaker while it is in storage is recommended to check for possible corrosion of mechanical parts. If the breaker has been filled with oil and stored for some time, the oil should be tested and possibly filtered (refer to Section, CARE OF INSULATING OIL).

INSTALLATION MAINTENANCE AND OPERATING CAUTIONS

LOCATION

In locations subject to flood conditions, the foundation should be high enough to keep the bottom of the operator cabinet above the high water mark.

GROUNDING

As a safety precaution, every oil circuit breaker should be permanently grounded as soon as it is set on its foundation. For this purpose, a stainless clad steel ground pad is welded on the side of each skid on skid mounted breakers. This pad has two 1/2"-13" tapped holes 3/4" deep spaced on 1-3/4" centers. Bolts used to make the ground connection should be approximately 1/2" longer than the thickness of the ground strap or connector.

DANGER

A good, permanent, low resistance ground is essential for adequate protection. A poor ground may be worse than no ground at all as it tends to give a false feeling of safety to those working around the equipment and may ***result in loss of life, or damage to the equipment.***

OPERATION

No attempt to operate the breaker should be made until all the shipping wedges and braces have been removed. (See procedure under "INSTALLATION" section).

MAINTENANCE

Work inside the breaker should be performed with the breaker in the open position and with the operator pressure at ZERO.

DANGER

It is NOT recommended that the breaker be left in the closed position. In this position the opening springs are charged and the breaker could possibly be accidentally tripped, causing injury. If adjustment is ever necessary inside the tank when the breaker is closed, the Operator Instruction Manual should be checked for the proper method of blocking the operator to prevent accidental discharge of the trip latch, or if the trip latch is accidentally tripped, to prevent any motion of the operator mechanism which could permit the breaker to trip.

As an additional precaution, all electrical connections to the breaker should be disconnected.

MAINTENANCE QUICK CLOSE (Ref. to Operator Instruction Manual)

Do not manually quick close the breaker by means of the hand lever on the pilot valve of the operator

unless pressure is at least up to the minimum operating pressure called for on operator nameplate.

OPERATIONS IN AIR

Operation of the breaker in air is not recommended. However, if required for relaying or installation checks, make certain that there is oil in the shock absorbers and only power close at pressures just above the lockout pressure value given on the operator nameplate.

To maintain oil in the opening shock absorbers, it will be necessary to jack the breaker towards the closed position (using the maintenance closing device) just far enough to allow the shock absorbers to reset. The shocks must then be filled with breaker oil through the 1/4 inch IPS tapped hole in the cylinder and then pipe plugs temporarily put in place.

Mechanical trip free operations place a severe stress on the operator. While the operator's components are designed to absorb this extra loading, this type of operation should be avoided or kept to a minimum.

OPENING SHOCK ABSORBERS

BEFORE FILLING THE BREAKER TANKS WITH OIL, MAKE SURE THAT THE PIPE PLUGS ARE REMOVED FROM THE SHOCK ABSORBERS 225.

INSTALLATION

REMOVAL OF BLOCKING AND PUTTING BREAKER INTO OPEN POSITION

As received, the breaker operating mechanism will be braced in the closed position and for a breaker shipped with bushings installed there may be bracing or strapping within each tank.

First carefully remove any bracing or strapping from inside the tanks leaving the operating mechanism braced as a safety precaution. Then carefully remove the blocking from the operator.

The breaker should now be "slow opened" using the maintenance closing device. **Do not disturb the trip latch.** Put the maintenance closing device in place and pump it up until the load is removed from the operator prop latch. The prop latch can now be pried out from under the toggle roll and the breaker let out slowly against the maintenance closing device.

DANGER

KEEP HANDS FREE OF THE BREAKER WHILE THE OPERATOR OR JACK IS DESCENDING. When using the maintenance closing device on breakers with pneudraulic operators, the accumulator pressure must be at zero and the pressure bleed valve between accumulator and oil reservoir must be left open.

PLUMB TANKS

After the breaker is placed on its foundation, the breaker tanks must be levelled to assure proper vertical alignment of the movable members.

The tanks can be levelled in the manner outlined below:

Suspend a plumb bob from the "V" block clip provided inside each tank at the side of the pole unit mechanism well. Each tank should be levelled and clamped down independently of the others. Insert shims as required under skid at the tie down bolts such that the plumb bob falls within .125" of the center prick punch mark on the tank bottom. Make sure that leveling one tank has not thrown off the reading of a tank previously leveled.

NOTE: *The correct prick punch mark is located within a circle of punch marks on the tank bottom.*

BUSHING INSTALLATION (Refer to Fig. 2)

Normally the bushings are shipped in place and need not be disturbed when installing the breaker. However, at times shipping clearances have made it necessary to remove the bushings prior to shipment and in some instances the bushings may have been shipped directly from the supplier.

When the bushings have been shipped separately, they are in good condition when they leave the factory. However, they should be carefully examined when received, and if any damage is apparent, a claim should be filed with the carrier and Siemens-Allis Plant notified.

Separate instructions are furnished for the particular bushings used on each breaker. These should be read before installing the bushings. In uncrating the bushings, excessive hammering and racking should be avoided so as to prevent damage to the porcelain parts.

After removing the bushings from the crates, place them in a vertical position and thoroughly clean all exposed porcelain parts.

When the bushings supplied have been assembled in the breaker for factory testing, both the bushing crates and the bushings are marked with the breaker serial number and position number in which they were installed. Installing each bushing in its indicated position will facilitate adjustments. (See page 6 for bushing positions.)

Shoulder spacers (255) are pr vided and are to be inserted into the 1-3/16" diameter holes in the bushing flanges with the shoulder on top of the flange. The bushing is then clamped down using the 3/4" nuts (202) and spring type lockwashers provided.

The nuts should be tightened slowly and uniformly until the bushing flange reaches the gasket stop which is provided to keep the gasket from being overstressed. Do not attempt, on the first tightening, to set them all down as far as they will go. Such practice might distort the bushing flange or damage the gasket.

All bushings are filled with high grade transformer oil to the proper level and sealed by the manufacturer before shipment. The expansion and contraction of the oil is provided for by means of an expansion space in the reservoir above the oil.

A magnetic oil gauge or a transparent reservoir is provided to indicate the actual level in the reservoir at all temperatures. The bushings are filled so as to indicate "NORMAL" on the gauge at 25 degrees C (77 degrees F).

Since the oil level in the reservoir is infuenced by the oil temperature, consideration must be given to the oil temperature when checking the level. When properly filled, the oil level gauge indication vs oil temperature is as follows:

GAUGE INDICATION	OIL TEMPERATURE
HIGH	65 degrees C (149 degrees F)
NORMAL	25 degrees C (77 degrees F)
LOW	-40 degrees C (-40 degrees F)

From this table it will be seen that at -40 degrees, the oil level gauge will indicate "LOW" but this level is normal for -40 degrees.

Since the temperatue pressure relation for the oil and the expansion space was established at 25 degrees C, do not remove the filling or drain plugs unless the oil temperature is somewhere near 25 degrees C. The permanently sealed condition allows the bushing to be laid down or handled in any position without danger of oil loss.

The power factor and watts loss given on the bushing nameplate apply to the bushing itself without any connected equipment. Values are obtained with a potential of 10 kV at 20 degrees C (68 degrees F).

Bushing potential devices when furnished are normally not mounted.

When connecting potential devices to the bushings, carefully follow the instructions furnished with the device.

ROD GUIDE AND MOVABLE MEMBER (Refer to Figs. 2 & 2A)

The rod guide assemblies (210) and movable members (204), if removed, have been tagged identifying them by pole number and should be installed accordingly to facilitate assembly.

Mount the rod guide to the rod guide supports on the mechanism well, locating the shims just as they are found strung with hardware and backing plate on the guides.

To install movable members (204), remove one wooden side plate (213) and the two rollers (212) by removing wooden nuts (214) from one side only. The movable member (204) can now be hung using lift rod clevis pin (209) and (2) 1/8 x 1" cotter pins. The contact rods (207) have been tagged according to their location to allow for orienting the lift rods in the original position.

The shimming in the upper and lower holes of the rod guide need not be identical. In the above, plumbing of the rod guide is not the intent. Temporarily center and steady the lift rod in the rod guide by inserting wedges and then determine any out of plumbness of the lift rod which must not exceed .009 per inch. Add washers to lift rod pin (209) between links of mechanism assembly (229) to center lift rod.

INTERRUPTING DEVICES (Refer to Figs. 2, 2A, 3A, 3B, 3C, 3D & 3E)

When the interrupters are shipped in place, they should not be disturbed during installation of the breaker. The procedures in the "Contact Adjustment" section, page 14, should be followed to ensure that there has been no shifting of components during transportation and handling.

The interrupting devices if removed have been marked with the breaker serial number and position number or were packed in the tank in which they are to be mounted. Final adjustment will be facilitated by mounting them in these same locations. (See page 5)

Referring to Figure 3D, the interrupting devices as shipped are completely assembled except for the bushing adaptors (301) which are packed separately.

1. Mount adapter (301) to the bottom of the bushing using 1/2-13 x 2" long hex head cap screws, 1/2" spring type lockwashers and plain heavy duty washers 1.25 OD x 1/4 thick placing the lockwasher directly under the head of the screw and then the plain washer. Refer to Figure 9 for the leveling procedure. A preliminary adjustment should be made by leveling the bottom surface of the adapter with a spirit level in both X-X direction and Y-Y direction.

2. Mount the interrupter assembly (245) to adapter (301) and just snug up the hardware at this time.

3. To align the stationary contacts (333) and push rod (363) with the movable contact rods, using the maintenance closing device, slowly jack the breaker towards the closed position bringing the contact rods (207) into the interrupter shell. Shift the interrupting assembly (245) horizontally as required to provide clearance on all sides between the contact rod (207) and interrupter (245) and then tighten the mounting cap screws (303). Care must be taken to see that the contact rods do not stub on the bottom of ruptors while operating the maintenance closing device.

After the above preliminary alignment adjustment has been made, jack the breaker further closed until the tip of the contact rod is about at the level of the upper exhaust port. Shake the movable member to see that the contact rod is entered in the interrupters. If binding is evident, realign the interrupter by moving it laterally on the adapter or by tilting the adapter on the bushing.

FINAL CHECK FOR ALIGNMENT

After all components have been reassembled make sure that the contact rods enter and pass up through the interrupting device throat and into the stationary contacts without interference. Close the breaker using the maintenance closing device until the contact rods are about to enter the interrupting device throats. Then proceed to close the breaker in one inch intervals checking the clearance in the throat at each interval.

CAUTION: *Be certain that there is mechanical clearance between the movable member (204) and the lower end of the resistors with the breaker in the closed position.*

If not, loosen cap screws (303), rotate the interrupting device until it is clear, and retighten.

ADJUSTMENTS

Before operating the breaker, the following adjustments should be checked and set as required.

Since many of the breaker adjustments are interdependent, the following order of adjustment is recommended in order to minimize readjustments. Before any of the following adjustments can be made, the extended height of the operator ram must be adjusted to provide the proper latch clearance of "G" (Refer to operator instruction book).

SHOCK ABSORBERS (Ref. Fig. 2)

Hydraulic shock absorbers (225) are located under the oil in each of the circuit breaker tanks. During normal operating conditions, these shock absorbers are supplied with oil from the circuit breaker tanks through a vent in the shock absorber housings.

The shock absorbers are set so that in the breaker open position the plunger (272) is down as far as it

will go on any one pole and within .18" of this setting on the other two poles. The settings are made by adding or removing shims (224) under the shock absorber mounting flange. The nominal quantity of spacers under each shock absorber is 3.

CAUTION: *Do not operate this breaker unless the shock absorbers are filled with oil. Also before filling tanks, make sure any pipe plugs are removed from shock absorbers.*

During test conditions (that is, with breaker contacts operating in air), the shock absorbers must be filled with oil (use the oil furnished for the circuit breaker tanks) and the vents closed with the pipe plugs (279) provided. The contact rods (207) and the stationary contacts (333) (Fig. 3C) should be well coated with vaseline.

CAUTION: *Due to the velocity and mass of the moving contacts, the number of operations in air should be kept to a minimum and all closing operations which are made in air should be made at pressures just higher than lockout pressure given on operator nameplate.*

BELL CRANK POSITION BREAKER OPEN (Ref. to Fig. 5)

With the vertical pull rod not pinned to the operator and the breaker open and at least one opening shock absorber down solid, adjust the length of the front horizontal pull rod (503) to locate the bell crank pin (502) 11.30 ± .12 from the inside of the housing and insert pin. (This dimension may have to be reset following adjustment of toggles and shock absorbers.)

The length of the vertical pull rod can now be adjusted to insert the pin at the operator output crank. With the breaker open there must be a positive gap between the operator toggle roll and the operator ram. (Refer to the operator instruction book.)

TOGGLE ADJUSTMENT (Ref. to Fig. 5)

CAUTION: *Shock absorber settings, overtravel stops, and contact rod penetration must be rechecked and readjusted as required if the toggle settings are ever distrubed for this has a direct effect on each.*

The proper toggle adjustment is a very vital factor in the smooth and easy operation of the breaker mechanism particularly on breakers having high current ratings. Its adjustment affects the ease of closing, the tripping characteristics, and the opening speed of the breaker. A breaker with its toggle linkage too far off center will close very hard because the proper mechanical advantage is not obtained. In this condition, the breaker may also fail to trip due to the excessive pressure on the trip latches in the operating mechanism.

The toggle is in correct adjustment when the 1/8" diameter hole in the clevis (505) is within .09" of the center marks on the sides of the mechanism well.

To check this, it will be necessary to remove the pipe plugs (506). Close the breaker slowly with the maintenance closing device until it is just latched in.

If this adjustment is not correct on the first pole (the pole on which the operator cabinet is mounted), open the breaker, remove the end box cover and remove the pin (502) in the bell crank (501). The check nut can then be loosened and the clevis rotated as necessary to obtain the correct adjustment.

SECOND AND REAR POLES

Once the first pole has been adjusted, poles two and three will have to be checked and adjusted if necessary, in that order.

To do this, with the breaker in the open position, remove the four nuts (510) on the Dresser coupling (507) just ahead of the pole to be adjusted. Slide the coupling (507) onto the two parts of the connecting rod pipe exposing the turnbuckle (508). Loosen the check nut (509) and rotate the turnbuckle (508) to obtain the necessary adjustment. This turnbuckle has a 1 1/4-12 right hand and left hand thread. Since both threads will affect the adjustment, each turn of the turnbuckle will move the rod approximately 1/8 inches.

READJUSTMENT BELL CRANK POSITION — BREAKER OPEN (Ref. to Fig. 5)

Following all of the preceding adjustments the bell crank dimension can be reset if it is no longer within tolerance.

With the breaker open pull the pin (502) at the bell crank to the horizontal pull rod and the pin at the vertical pull rod to the operator output crank. Lengthen or shorten the horizontal rod (503) as required counting the number of turns taken on the clevis (505) and then replace the pin. The clevis on the vertical pull rod must now be changed the same number of turns in the opposite direction and then pinned.

NOTE: *The threads of the horizontal and vertical pull rods and check nuts have been sealed. Whenever the check nut or rod threads have been loosened or rotated to adjust the pull rod lengths, a new application of thread sealant (Loctite) is required.*

OVERTRAVEL STOPS (Ref. to Fig. 2)

This BZO Oil Circuit Breaker is equipped with resilient overtravel stops (216). They are located in the mechanism well of each pole unit directly above the top of the lift rod. The stops serve to prevent the pole unit mechanism and lift rods from overtravel enough to cause damage. The stops have been set at the factory to allow slight overtravel of the lift rods and no further adjustment should be necessary. However, the adjustment should be checked to see that there is the proper clearance of .06" ± .03" between the top of the lift rod and the bottom of the stop with the breaker in the full closed (latched in) position. All adjustments and maintenance can be done by removing the pipe cap (217). There is a special wrench furnished for making this adjustment.

With the breaker in the closed position, proper adjustment is obtained by screwing the stop down until it touches the top of the lift rod, and then backing off on the stop screw 3/4 ± 1/4 turns. After the setting has been made, the stops must be locked in position with the check nuts (270).

When it is necessary to remove the resilient spacers (283 and 284) from the overtravel stop for replacement or inspection, first remove nut (270) and then unscrew the assembly from the tank. Removing retaining ring (285) will then free plug (282) and the resilient spacers. Upon removal, it is advisable to make note of the number of spacers used, their thickness and their relative position to facilitate their replacement. There should be sufficient spacers to provide a tight stacking with the plug and retaining ring in place.

CONTACT ADJUSTMENT (Ref. to Figs. 2A, 3D, 9)

With the breaker closed, draw a reference line on the contact rod (207) adjacent to the bottom surface of the interrupter shell (325). For the correct contact rod penetration, this reference line should be 13.56 ± .09 inches down from the top of the contact rod. The contact rods can be screwed

up or down to provide the necessary adjustment by first loosening socket head cap screws (253) and then retightening after adjustment. An alternate procedure is to attain 1.62 ± .06 of profile penetration with the interrupter shell assembly removed.

TAILSPRING (Ref. Fig. 6)

The tailspring (608), mounted on pole #3, is provided to ensure the proper movable member speed during an opening operation. The tailspring is preset at the factory to provide a movable member opening speed of 14 to 16 feet per second during the first four inches of travel after contact part.

During factory test, the tailspring is initially adjusted to have approximately 1-3/4" precompression and a follow through compression of 2". The precompression setting may be changed during factory test to obtain the proper opening speed. Precompression is determined by the position of the nut (601) on the rod (607). When the proper setting of the spring has been obtained, a #6 hole is drilled through the nut (601) and the rod (607) and a cotter pin (609) inserted to retain this setting.

Rarely, if ever, will this adjustment need to be changed in the field. If any significant change in the tailspring setting appears necessary, the operator, bell crank and toggle adjustments should also be rechecked.

OPERATIONAL CHECK

An operational check can now be made to determine that the breaker operating speeds are correct.

To facilitate checking the operating speed, a 10-32 tapped hole has been provided in the top of the lift rod of each pole. A connecting rod may be inserted by first removing pipe cap (217), (Fig. 2).

Several speed analyzers are available on the market. Two of these are the "CIRCUIT BREAKER OPERATION ANALYZER" manufactured by the Cincinnati Clock and Instrument Company, and the "TYPE TR-1A CIRCUIT BREAKER MOTION ANALYZER" sold by the Doble Engineering Company. These instruments, when used in accordance with supplied instructions, give a full scale record of lift rod travel vs. time.

The operating speed is defined as the average speed over the four inches of travel after contact part during opening operations, and over the same distance before contact make during closing operations. Contact make or break points are assumed to occur 1-1/8 inches below the fully closed position. The velocities are calculated in feet per second (see Fig. 10) during the 4 inches of vertical travel.

1. **Opening Speed**

   The opening speed must average 14 to 16 feet per second over the first 4 inches of stroke from contact separation. The breaker opening speed may be adjusted by changing the amount of pre-compression of the tailspring. (See TAILSPRING ADJUSTMENT).

2. **Closing Speed**

   The closing speed must average 19 to 25 feet per second over that portion of the stroke from 4 inches below contact make. The breaker closing speed is dependent on the operating pressure and is not adjustable. If it is not within specifications, it should be referred to the factory.

SUMMARY OF ADJUSTMENTS

ADJUSTMENT	MEASUREMENT	MEANS OF ADJUSTMENT	PAGE
Shock Absorber	Solid on one pole — not over .18" on other two	Spacers under each Shock Absorber	11
Bell Crank (open position)	11.30 ± .12 inches	Adjustment of front horizontal pull rod	12
Toggle (closed position)	±.09" of center lines	Adjustment of clevis on front horizontal pull rod	12
Overtravel Stop Gap	.06 ± .03 inches	Setting on stop screw	13
Contact Rod Adjustment	Contacts centered in interrupter entrance holes.	Adjusting interrupter on bushing adapter	13
Contact Rod Penetration	13.56 ± .09 inches	Screwing rod up or down	13
Contact Rod Profile Penetration	1.62 ± .06 inches	Screwing rod up or down	13
Tailspring	Determined by speed analyzer	Positioning of nut on rod	14
Opening Velocity	14 to 16 feet per second	Setting of tailspring	14
Closing Velocity	19 to 25 feet per second	Not adjustable Determined by operating pressure	—
Stroke	18.0 ± .75 inches	Not adjustable	—
Prop Latch Clearance	.03 + .03 inches ("G") — .00	Operator Instruction Book	—
Operator Ram and Toggle Roll (open position)	.005 to .313 ("I")	Operator Instruction Book	—
Plumbness of Lift Rod	.009 inches per inch (max.)	Spacers on Pin	10
Rod Guide	To give clearance and support to Lift Rod	Shims on Side of Rod Guide	10

Large gaskets which cannot be made from one piece are built up of strips. These strips are joined by use of scarfed joints, and they should be assembled before installing the gasket into its groove. The joints are made by tapering the ends and fitting them together. The taper is made by starting about 1-1/2" to 2" from the end and cutting diagonally at an angle of 10 degrees. It is advisable to file or sandpaper the cut after it is made. It is necessary in assembling the strips that the two pieces be tapered the same. A thin coat of cement should be applied to each strip and allowed to dry until tacky. The strips can then be clamped together. After the cement has set, the joint should be filed or sandpapered until it is the same thickness as the rest of the gasket.

OIL LEAKS

A great deal of care has been taken to make all Siemens-Allis Oil Circuit Breakers oil tight and to prevent oil seepage through the joints. Every joint on Siemens-Allis Oil Circuit Breakers is carefully designed to give maximum tightness. Gaskets are made of special, high-grade materials, with machine-scarfed joints where required. Tanks on the frame mounted breakers and manhole cover flanges on the floor and skid mounted breakers are pulled down to make metal-to-metal contact, compressing the gasket material to the most efficient compression point. This design prevents stressing the gasket beyond its elastic limit and prevents possible leaky joints.

If oil leaks should appear at a gasketed joint, the bolts should be checked for tightness. If tightening the bolts is not effective, a new gasket must be installed as described in the section on "GASKETS".

Oil leaks at welds may be stopped by peening, soldering or welding. Peening is often effective for small leaks. Larger leaks can usually be stopped by soldering alone, or a combination of peening and soldering.

Leaks that cannot be stopped by any of these methods must be welded.

CARE OF INSULATING OIL

OIL SPECIFICATIONS: NEMA STD. SG-P1/TR-P8 (A-C UNIVERSAL NO. 3)

A-C Universal #3 circuit breaker oil has been developed to meet very rigid specifications, and each shipment is carefully tested to be certain that the following requirements are met:

TEST	VALUE	ASTM METHOD OF TEST
MINIMUM FLASH POINT	145 deg. C (290°F)	ASTM Std. Test D-92
Maximum Pour Point	-40°C (-40°F)	ASTM Std. Test D-97
Maximum Viscosity cSt/SUS at		
100°C (212°F)	3.0/36	
40°C (102°F)	12.0/66	
0°C (32°F)	76.0/350	
Maximum Specific Gravity 15°C (59°F)	.91	ASTM Std. Test D-1298
Minimum Interfacial Tension 25°C (77°F)	40	ASTM Std. Test D-971
Visual Examination	Clean and Bright	ASTM Std. Test D-1524
Maximum Neutralization Number	.03	ASTM Std. Test D-974
Minimum Dielectric Breakdown		
Disc Electrodes	30.0 kV	ASTM Std. Test D-877
VDE Electrodes (New Oil Only) .040 Inch (1.02mm) Gap	28.0 kV	ASTM Std. Test D-1816

This oil should be used in all Siemens-Allis oil circuit breakers. In cases where it is not, the oil used must be approved by the company. Siemens-Allis cannot assume responsibility for their approval. The use of "inhibited" oil is not preferred.

METHOD OF SHIPPING OIL

In general, sufficient A-C Universal #3 oil is shipped with each order for oil circuit breakers to fill the tanks to the required level. The oil is shipped in steel drums or in tank cars.

CARE IN STORAGE

When the oil shipped in tank cars is to be stored, the storage tanks must be thoroughly cleaned and precautions taken to prevent condensation of moisture in these tanks. Keeping the temperature inside the tanks above the ambient is the best way to prevent condensation.

Drums should be stored in a closed room having uniform temperature. When it is necessary to store drums of oil outdoors, they should be covered to protect them from the weather. Each drum should be placed on its end with the bung down. The bung must be kept tight. Drums should be stored on boards or on a concrete mat. Do not store them on dirt or loose gravel.

Except for test purposes, the drums should not be opened or unsealed until the oil is actually needed. If they are to be opened in a warm room, they should be allowed to stand before opening until it can safely be assumed that the temperature of the oil in the drums is the same as that of the room. Any difference in temperature between the oil and the air to which it is exposed may result in the entrance of moisture into the oil.

When the drums are opened outdoors, this should be done on a clear dry day and just after the heat of the day has passed so that the oil will be at least as warm as the air.

METHOD OF HANDLING

In the transfer of oil, metal hoses or pipes should be used. No rubber should be allowed to come in contact with the oil, because the oil will dissolve the sulphur in the rubber resulting in reduced dielectric strength of the insulating oil.

OIL TESTING

EQUIPMENT

To test for dielectric strength, a standard oil test set arranged for continuous voltage variation and equipped with a circuit breaker set to trip instantaneously when the oil breaks down should be used. The use of step-type oil test sets is not recommended. The standard oil test cup has disc terminals 1" in diameter spaced 0.1" apart. The test cup should be thoroughly cleaned with Trichloroethane, then rinsed out with a portion of the oil to be tested. The test gap should be checked before use with the feeler gauge provided.

SAMPLES FOR TEST

The sample container should be a large mounted glass bottle with a cork stopper. A rubber stopper should not be used as sulphur in the rubber would dissolve and spoil the sample. The bottle should be cleaned with gasoline and dried before being used.

The sample for dielectric tests should be at least 16 ounces, and if other tests are to be made, one quart (32 ounces).

Test samples should be taken only after the oil has settled for some time, depending on the amount of oil from which the sample is to be taken. Cold oil is much slower in settling and may settle very little even after a long period of time. Oil samples from the oil circuit breaker should be taken from the sampling valve on the side of the drain valve. It is not necessary to open the drain valve to obtain this sample as the sampling valve opens into the tank side of the drain valve. Oil samples from a drum should be taken from the bottom. A brass or glass "thief" can be conveniently used for this purpose. The same method should be used for cleaning the "thief" as is used for cleaning the container.

When samples of oil are drawn from the bottom of the oil circuit breaker, sufficient oil must first be drawn off to be sure that the sample will be comprised of oil from the bottom of the tank and not from the oil stored in the drain pipe. A glass receptacle is desired so that, if water is present, it may be readily observed. If water is found, an investigation of the cause should be made and a remedy applied. If water is not present in sufficient quantity to settle out, the oil may still contain considerable moisture in a suspended state. The oil should, therefore, be tested for dielectric strength.

METHOD

When the test cup is filled with oil and both the oil and the test cup should be at room temperature, or approximately 25 degrees C. After the receptacle has been filled, two to five minutes should be allowed for air bubbles to escape before voltage is applied. Tapping or rocking the cup gently will be of assistance in dislodging air bubbles.

The rate of increase in voltage should be about 3000 volts per second. Five breakdowns should be made on each filling, the receptacle emptied and refilled with fresh oil from the original sample. After each breakdown, the cup should be locked to dislodge the carbonized oil from the gap. The average voltage of 15 tests (five tests on each of three fillings) is usually taken as the dielectric strength of the oil. It is recommended that the testing continue until the mean of the average of at least three fillings is consistent.

DIELECTRIC STRENGTH

The dielectric strength of Allis-Chalmers Universal #3 oil when shipped is at least 27.5 kV as tested in the standard gap. If the dielectric strength of the oil in service tests below 17 kV it should be filtered. Oil of less than 26 kV dielectric strength should not be put into an oil circuit breaker tank.

ACIDITY

The acidity, measured by neutralization number, is an indication of the extent of oil deterioration. It should be used as a general guide for deterioration. It should be used as a general guide for determining when the oil should be replaced before further decomposition leads to sludging.

The neutralization number of new oil should be 0.03 or less.

The oil should be replaced when the neutralization number is 0.5 or greater.

FILTERING

In all cases where tests show a low dielectric strength, the oil must be filtered to remove dirt and moisture.

When the oil in the circuit breaker is to be filtered, it is preferable to draw it from the circuit breaker and discharge it into a spare, clean, dry tank or drums. The circuit breaker tanks, bushings, liners, where used, and other insulating parts can then be thorougly cleaned and the oil returned after

filtering. This should be done on a clear dry day and care must be taken to prevent exposure of large surfaces of oil to the atmosphere. Aeration of the oil must also be avoided.

When this procedure cannot be followed, satisfactory results can be obtained by circulating the oil through the filter press and the breaker tank, drawing the oil from the bottom of the tank and returning it through the filter press valve at the top of the tank. This circulation should be continued until the oil tests at least 26 kV in a standard test set.

DANGER

Do not circulate the oil with the breaker energized. Allow at least two hours if at all possible for the oil to settle before energizing the breaker.

If tests show that there is a large quantity of moisture and dirt present in the bottom of the tank, the bottom oil should be drawn off and discarded or filtered separately.

When the dirt and water have been removed from the oil, the filter connection can be changed to the top filter press valve in order to return the oil to the top of the circuit breaker. Filtering must continue until the oil tests at least 26 kV.

PREVIOUSLY USED INSULATING OIL

Previously used (i.e. service-aged) insulating oil may be utilized in new power circuit breakers if the following criteria is met.

1. The oil was originally purchased to the manufacturer's specification or to a specification he accepts.

2. The oil has been restored or reclaimed to insure meeting the following requirements:

ASTM TESTS	RECOMMENDED VALUES
Dielectric Breakdown (Delivery Acceptance Criteria) ASTM-D877 Minimum Voltage	25 kV
Dielectric Breakdown (Breaker in Service) 0.04 inch gap. ASTM-D1816 Minimum Voltage	20 kV
Power Factor, 60 HZ at 25 degrees C. ASTM-D974 Maximum Percent	1
Neutralization Number, Milligrams of KOH per gram of oil. ASTM-D974 Maximum	0.30
Moisture Content, ASTM-D1315 and ASTM-D1533 Maximum PPM	35
Interfacial Tension ASTM-D971 Minimum dynes per centimeter	30

CAUTION

In filling or processing this equipment at the factory, dielectric fluid containing less than 50 ppm polychlorinated biphenyl is used.

The Purchaser should take necessary precautions to prevent PCB contamination during field filling or maintenance.

REPLACEMENT PARTS

GENERAL

When ordering replacement parts for a Siemens-Allis Oil Circuit Breaker it is very important to give complete information. This information should include:

1. Number of pieces required.
2. Instruction Book number (on Breaker Nameplate).
3. Reference number (figure and item number).
4. Description of Part — Use instruction book description so far as possible.
5. Type of breaker.
6. Rated amperes of breaker.
7. Rated voltage of breaker.
8. Breaker serial number (on breaker name plate).

While the breaker can be identified by the serial number alone, all additional information that is given will serve as a check to be certain that the part or parts furnished are correct for the breaker in question. Without this serial number Siemens-Allis cannot be sure of the correct identity of the desired parts.

If any doubt exists as to the instruction book reference number or the description, a dimension sketch of the desired part will help to properly identify it.

Siemens-Allis recommends that a supply of repair parts be kept on hand so that emergency repairs can be made without waiting for shipment of parts from the factory. A list of recommended spare parts is sent with the breaker.

Before removing any part to be replaced, observe its function and adjustment. This usually saves adjustment time during its installation.

VOLTAGE DIVIDING RESISTORS (Ref. to Fig. 3A)

A resistor is shunted across each interrupting device in order to distribute the voltage equally between the two devices on each pole. The resistance of standard units is approximately 2000 ohms, when shipped, or 4000 ohms per pole unit. Breakers furnished for definite purpose use are furnished with a resistance of 1000 ohms per unit or 2000 ohms per pole unit. These values may vary somewhat with age. The springs (312) at each end of the unit allow for expansion or contraction of the resistors while still firmly clamping the carbon discs together to provide good electrical contact.

Should it be necessary to replace a damaged unit, care should be taken to match the resistance of the other unit in the same pole so that the voltage will be equally distributed. The resistance of these units may differ considerably from the normal, but so long as both resistors in any one pole unit are matched within 10% they will operate satisfactorily.

Each resistor is made up of 16 individual blocks (316) so the resistance can be made to match by interchanging some of the blocks.

On 121 kV (115 kV), an aluminum dummy block is occasionally used to compensate for resistor blocks which are on the extreme plus (+) side of the tolerance. The dummy block, when used, should be installed on the end of the resistor unit, with this end of the unit installed on the upper end of the interrupting device. The end of the resistor assembly shell (315) should be marked to indicate which end has the dummy.

LIFT ROD (Refer to Figs. 2 & 2A)

To change a lift rod (205) the breaker must be in the open position. The movable member can then be removed from the tank to change the lift rod.

Take the nuts (214) off of one of the side plates (213) and then remove the side plate and the two rollers (212). Remove lift rod pin (209) and take down the movable member (204). Referring to figure 2A, loosen socket head cap screw (253). Loosen the two lower bolts (257) and remove the top bolt (257) and slide out the keys (257). The lift rod can now be removed.

Reinstall the movable member making sure that all fastenings are secure, that the lift rod travels freely in the rod guide (210), and that the contacts are in alignment. Check contact adjustments as outlined in ADJUSTMENTS SECTION.

CONTACTS (Refer to Fig. 3, 3C, 3D, 3E)

To change the contact assembly (308 Fig. 3), the breaker must be in the open position.

Remove resistor mounting screws (368) and lift out resistor unit (304). Remove interrupter shell assembly (309) by removing socket head cap screws (325). The contact assembly (308) can now be removed by removing the two flat head machine screws (344). The piston assembly (357) will be engaged to contact assembly. Disengage it by pushing on the exposed end of push rod (363 Fig. 3E). When lowering the contact assembly with the piston assembly attached, valve (321) and impluse disc (320) will also drop out.

While it is possible to change the contact fingers (333 Fig. 3C) only, this assembly is generally put together with special fixtures and it will be much easier to replace the entire unit.

If the fingers only are changed, upon the reassembly of the unit, tighten nut (334 Fig, 3C) to 60 foot pounds torque and then stake in several places so that it cannot lossen during breaker operations.

To reassemble:

Push piston assembly (357) back onto contact assembly (308). The push rod (363 Figure 3E) will protrude slightly below the contact fingers (333 Figure 3C) when it is properly engaged.

Refer to figure 3D and position valve (321) and impulse disc 320 on top of the piston and then carefully raise the parts thusly into place.

CAUTION: *Valve (321) and impulse disc (320) must engage guide pin (370) and in the order shown on Figure 3D.*

Note that the two flat head machine screws (344) will not go into their tapped holes in cylinder (326 Figure 3B) unless the contact assembly is in the proper position. If one flat head screw (344) fits into a tapped hole and the other does not, rotate the contact assembly until both flat head screws will fit into their respective tapped holes in the housing.

When replacing the interrupting device shell assembly (309), be sure that the hole in the top of the shell (345 Figure 3D) lines up with the locating screw (338 Figure 3C) in contact assembly.

PUSH ROD (Refer to Figs. 3E, 3)

To change push rod (363 Figure 3E), first remove interrupter shell assembly (309) and contact assembly (308) per instructions under CONTACT ASSEMBLY CHANGE (starting page 33). It is preferable to replace the whole piston assembly (357 Figure 3) rather than just the push rod (363 Figure 3E) for set screws (364 Figure 3E) are staked in place and may be difficult to remove. However, if it becomes necessary to replace only the push rod (363), observe the degree of looseness of the push rod in the socket of piston body (361 Figure 3E). This push rod is purposely left slightly loose in the recess to provide for self alignment in the contact assembly (308). Washers (362) should be just sufficient in number to line up the tapped holes in the piston body and set screw holes in the push rod. Screw in set screws (364) until just flush with the surface of piston body and then stake in place. This will allow for the degree of looseness required in the push rod mounting.

WARNING: *Do not run set screws (364) in tight against the push rod.*

To reassemble interrupting device, follow reassembly procedure given under "CONTACT ASSEMBLY CHANGE".

NOZZLES AND BAFFLES (Refer to Figs. 3 and 3D)

To replace the fibre baffles (346 Figure 3D) or any other of the expendable parts within the interrupting device, first remove resistor (304 Figure 3) and then remove the eight socket head cap screws (325 Figure 3). Lift parts out from the top end starting with deflector (349 Figure 3D) and then reassemble in the reverse order. In order to control the tightness of the baffle stack the quantities of washers (365 Figure 3D) may have to be varied. Refer to note 1 on Figure 3D.

When replacing the interrupting shell (345 Figure 3D), be sure the hole in the top of the shell lines up with locating screw (338 Figure 3C) of contact assembly.

CONTACT RODS (Refer to Fig. 2A)

To change contact rods (207) loosen socket head screws (253) and then screw out the rod. Prior to unscrewing the rod, it would be well to measure and record the dimension from the top of the rod to the top surface of the crosshead. The contact penetration will have to be reset and this can serve as an initial setting.

Refer to pages 11, 13, and 15 for "CONTACT PENETRATION ADJUSTMENT".

BUSHING (Refer to Figs. 2, 3)

In order to change a bushing, it will be necessary to remove the interrupting device (245). While this device can be removed as a unit by removing the cap screws holding the adapter (301 Figure 3) to the bottom of the bushing, it will be necessary to partly disassemble the device so as to check adjustments after the replacement bushing is installed. Therefore, the following procedure is recommended:

Refer to Figure 3 and remove the resistor (304) and interrupter shell assembly (309) as a unit by removing the socket head cap screws (325). Remove cylinder and valve assembly (307) by removing cap screws (303).

Remove the adapter (301).

Remove the bushing flange nuts (202). The old bushing can then be slowly lifted out of the breaker, being careful not to damage the current transformer.

Refer to "HOW TO MAKE GASKETED JOINTS", and replace the bushing gasket (250).

When a new bushing is supplied with a protective coating on its oil end, it is recommended that this coating be left on until after the bushing is slid into the breaker as this coating will then serve to protect both the bushing and the transformer from damage during the installation.

All bushings are in good condition when shipped from the factory. However, they should be carefully examined when received, and if any damage is apparent, a claim should be filed with the carrier and Siemens-Allis Plant, notified.

In uncrating the bushings, excessive hammering and racking should be avoided so as to prevent damage to the porcelain parts. After removing the bushings from the crates, place them in a vertical position and thoroughly clean all exposed porcelain parts.

Bushings should be installed in such a position that the oil gauges face outward, perpendicular to the longitudinal center line of the breaker.

When securing the new bushing be sure that there are spring type lockwashers under each bushing flange nut (202) and that there is a shoulder spacer inserted in each bushing flange mounting hole with the shoulder set on top of the flange (refer to instructions on "BUSHING INSTALLATION").

Refer to "INSTALL INTERRUPTING DEVICES" in the installation section for procedure in remounting the adapter and interrupting device.

CURRENT TRANSFORMER (Ref. to Figs. 2, 7, and 8)

The bushing current transformers must be mounted from within the tank.

Before adding or removing a transformer, it is recommended that the apparatus bushing and movable member first be removed. This will not only facilitate work in the tank but will also eliminate any possibility of damaging the bushing while doing this work. Refer to Replacment Parts Section "BUSHINGS" for instructions on bushing removal.

DANGER

These tranformers could weigh up to 135 pounds each. Provision must be made to safely handle its weight in the limited space available.

1. **REMOVAL OF A LOWER TRANSFORMER**

   When two transformers are mounted on the same bushing, the bottom transformer can be removed without disturbing the upper transformer.

   Remove the transformer lead terminal box cover (801). Identify the leads of the transformer to be removed and cut out the crimped type two way connector.

   The leads are labeled at the splice for identification. The numbers correspond to the bushing on which the transformer is located, and the letter Y or X designates an upper or lower transformer respectively. (Example: 3Y is a lead on the upper transformer on number 3 bushing).

   Loosen bushing (802) and pull the transformer leads down through the gas seal into the tank. The lower transformer can now be removed by removing the 5/8-11 hex nuts (804). Locking strips (805) must first be bent out flat to allow backing off the nuts.

REINSTALLING LOWER TRANSFORMER

When installing the new transformer, the transformer polarity mark (a black stripe on the top of the transformer) must be in the up position. Make sure that there is a washer (806) at top and bottom of the transformer and that the transformer is positioned on bottom plate (807) such that the leads are in line with the cut out in the CT well.

Torque up nuts (804) to 25 ± 5 foot pounds, and then bend corners of locking strip (805) against a flat on the nut and up against adjacent corner of plate (807).

2. REPLACING TRANSFORMER LEAD GAS SEAL

After the transformer leads have been strung they must be brought out through the gas seal. The housing must be repacked to assure a proper seal.

Completely unscrew bushing (802) and lift out washer (811), spacer (812), top steel washer (808), and top neoprene washer (810) from housing (813). These parts can be left strung on the transformer leads. Pack duct seal (809) onto the exposed surface of bottom neoprene washer (810) to a depth of approximately 1/4 inch; also spread the leads apart and apply sealer between them.

The sealer (809) is non-hardening and oil proof. The top neoprene washer, top steel washer, and spacer are than reinserted in the housing and the bushing (802) retightened to form the gas seal.

Refer to appropriate section for procedure in reinstalling the bushing, interrupting device, and movable member.

After the bushing has been installed, make sure that the transformer bottom plate (807) does not touch the bushing ground sleeve at any point; otherwise, a shorted turn would be simulated resulting in a transformer ratio error.

REMOVAL OF UPPER TRANSFORMER (TWO TRANSFORMERS PER BUSHING)

To remove the upper transformer, the lower transformer must first be removed as outlined in the previous section ("REMOVAL OF LOWER TRANSFORMER"). The transformer leads of the upper transformer are then identified and cut free at the splice in the terminal box atop the breaker tank and pulled down through the gas seal.

The lower jam nuts (816) can now be backed off of threaded rods (819) freeing the transformer and center plate (815). To facilitate backing off the jam nuts, the transformer and center plate should be temporarily held in place by other means.

When installing the new transformer make sure that the polarity mark (a black stripe on the top end of the transformer) is in the up position and that there is 4 washers (814) on the top and one on the bottom. Also make sure that the transformer leads are located at the conduit connection. Torque jam nuts (816) to 25 ± 5 foot pounds.

Reinstall lower transformer and repack the transformer lead gas seal per instructions in previous section.

3. REMOVAL OF UPPER TRANSFORMER (ONE PER BUSHING)

Refer to previous sections for procedure in identifying, isolating, and pulling the transformer leads down through the gas seal.

The transformer can now be removed by backing out cap screws (817). The cap screws will turn hard since they have been locked in place with LOCTITE.

REINSTALLING UPPER TRANSFORMER (ONE PER BUSHING)

When installing the new transformer, the transformer polarity mark (a black stripe on the top end) must be in the up position. Make sure that there are 4 washers (814) on the top and one on the bottom and that the transformer leads are located at the cut out in CT well.

Torque cap screws (817) to 25 ± 5 foot pounds applying a new application of LOCTITE to the thread.

Remove the original application of LOCTITE so that it won't influence the torque reading by using new bolts or by repeated thread engagement prior to mounting the transformer. Also prior to applying the LOCTITE, clean the threads of oil using LOCTITE primer.

BEARINGS MECHANISM ASSEMBLY (Ref. to Fig. 2B)

The bearings in the pole unit mechanism links have a special Teflon coated inner race and are sized to permit a press fit into the housings in the links. No reaming is required after pressing into place thus the finish is preserved. Should it become necessary to replace a bearing, the housing in the link should be coated with vaseline before pressing the bearing into place.

ORDERING INSTRUCTIONS FOR RENEWAL PARTS

1. ALWAYS SPECIFY THE COMPLETE NAMEPLATE DATA OF BOTH BREAKER AND OPERATOR.
2. SPECIFY THE QUANTITY, DWG. NO. (IF LISTED), REF. NO. AND DWG. NO. OF RECOMMENDED SPARE PARTS LIST.

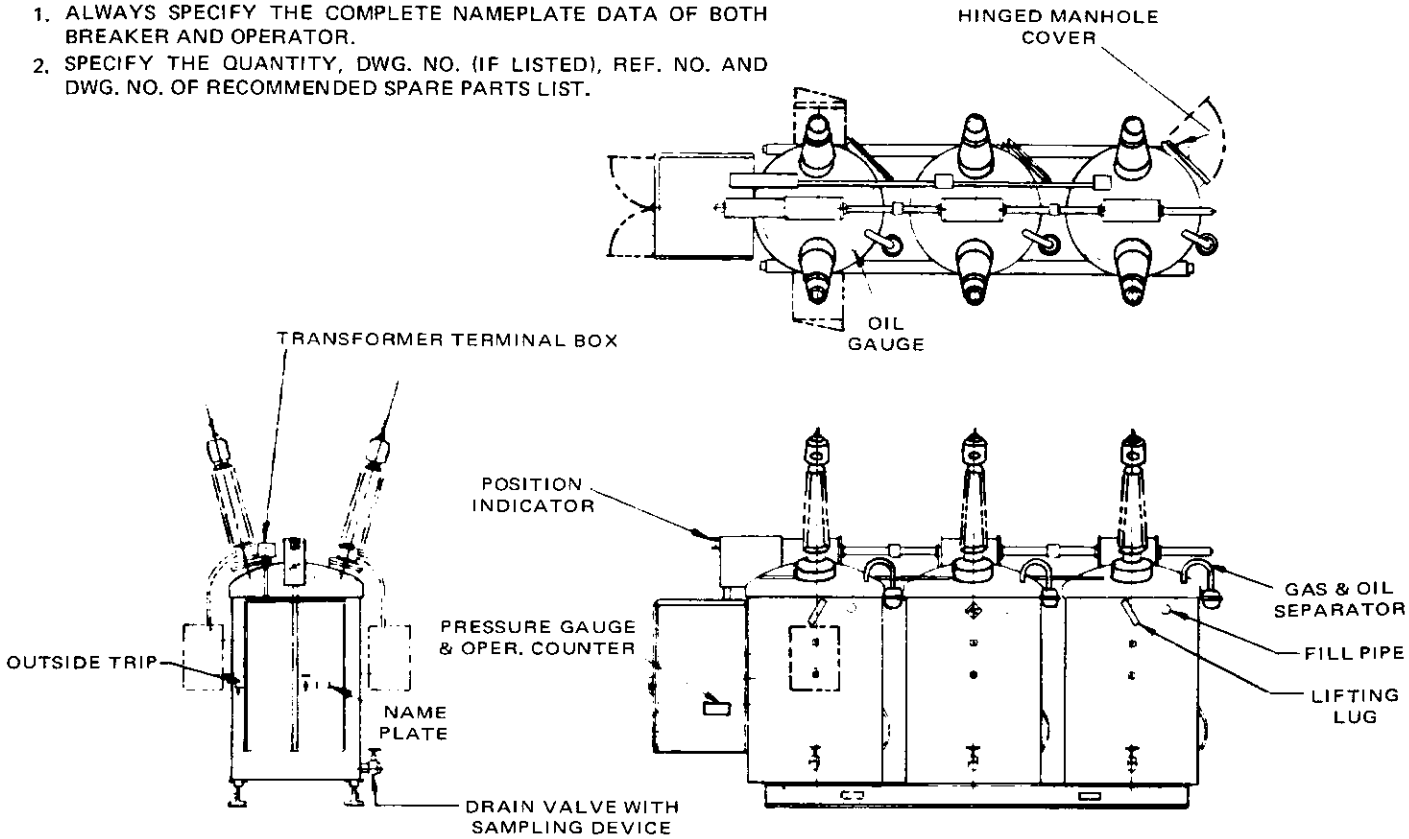
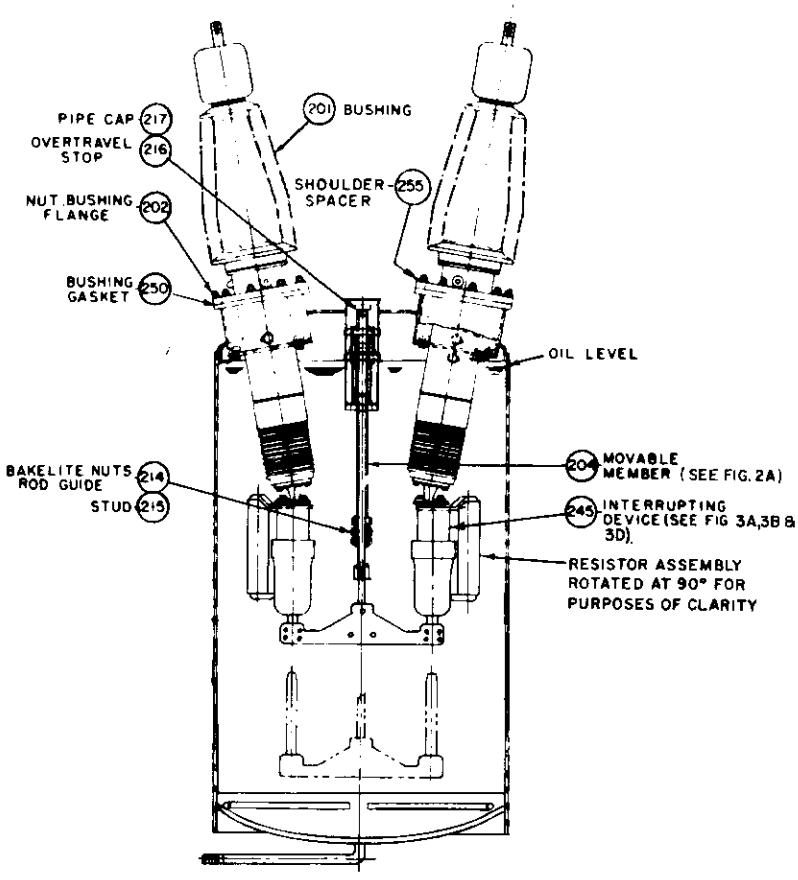
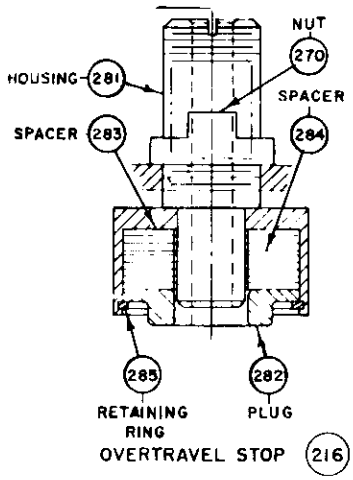
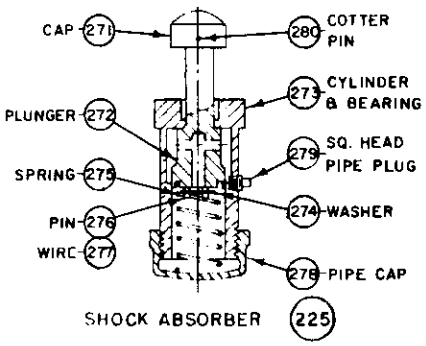


FIG. 1
TYPICAL BZO OUTLINE







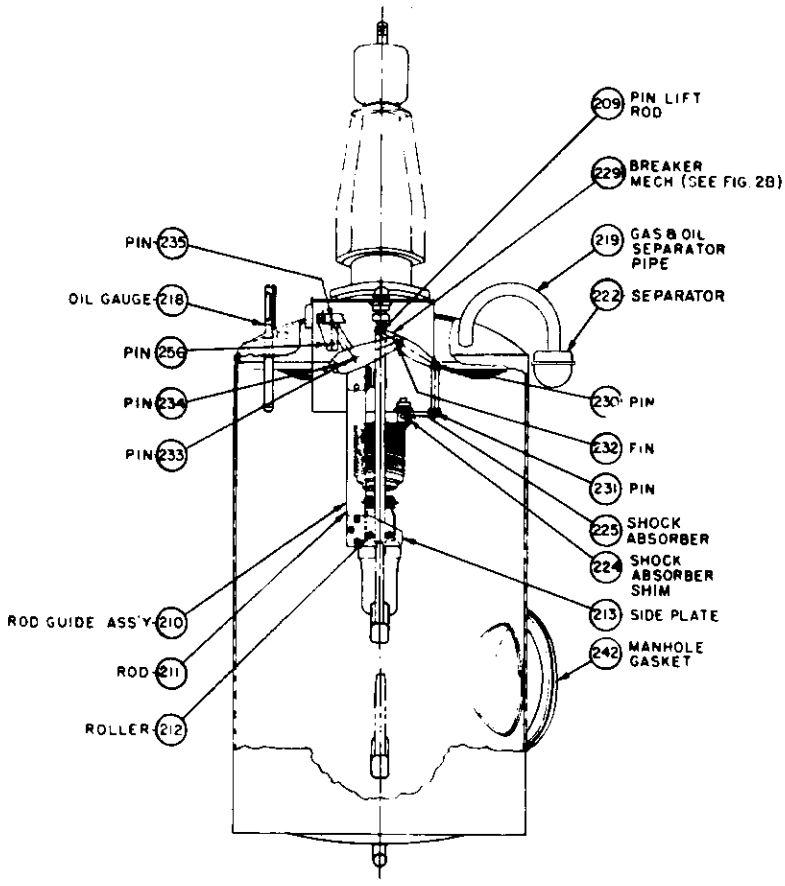


FIG. 2
TYPICAL POLE UNIT

JUNE 29, 1977 72-211-774-401

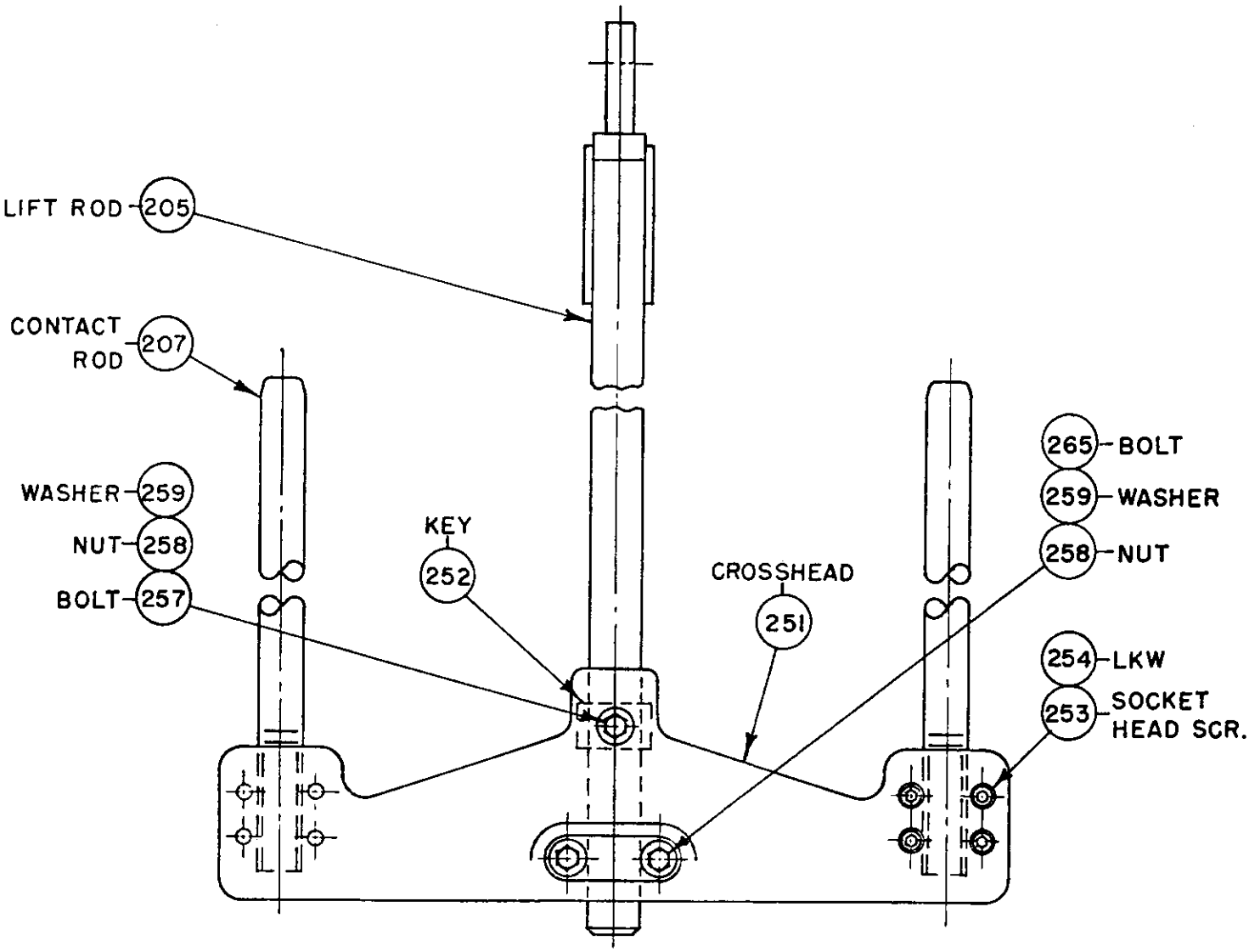


FIG. 2A
MOVABLE MEMBER

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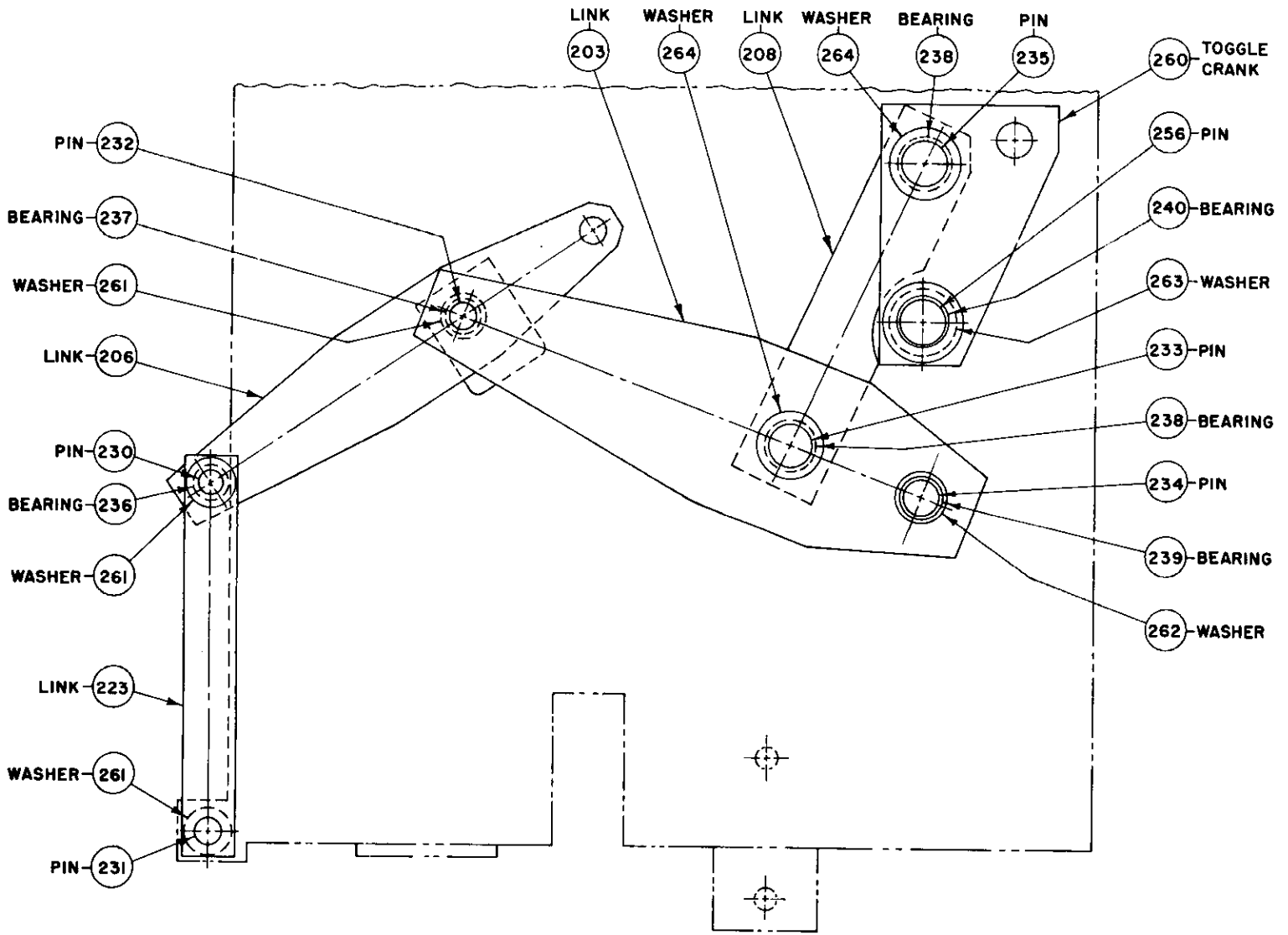
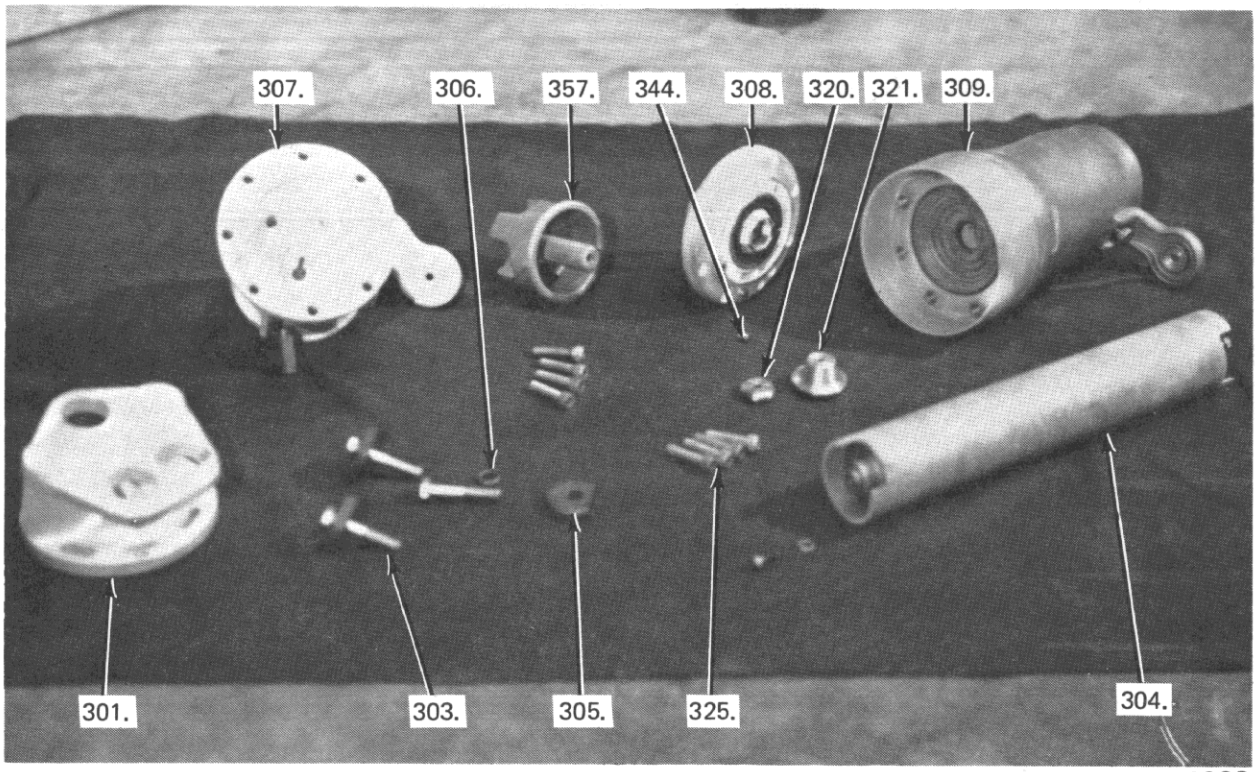


NOTE 1: PLAIN BRASS WASHERS REQUIRED BETWEEN LINKS AND BETWEEN FRAME AND LINKS

FIG. 2B
MECHANISM ASSEMBLY

FEB. 3, 1972

72-310-410-401



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LEGEND

301. ADAPTER
303. HEX HEAD CAP SCREW
304. RESISTOR ASSEMBLY See Figure 3A
305. WASHER
306. LOCKWASHER
307. CYLINDER AND VALVE ASSEMBLY See Figure 3B
308. CONTACT ASSEMBLY See Figure 3C
309. INTERRUPTER SHELL ASSEMBLY
320. WASHER (Impulse Disc)
321. VALVE
325. SOCKET HEAD CAP SCREW
344. FLAT HEAD MACHINE SCREW
357. PISTON ASSEMBLY

FIG. 3

LCP INTERRUPTING DEVICE WITH MOUNTING

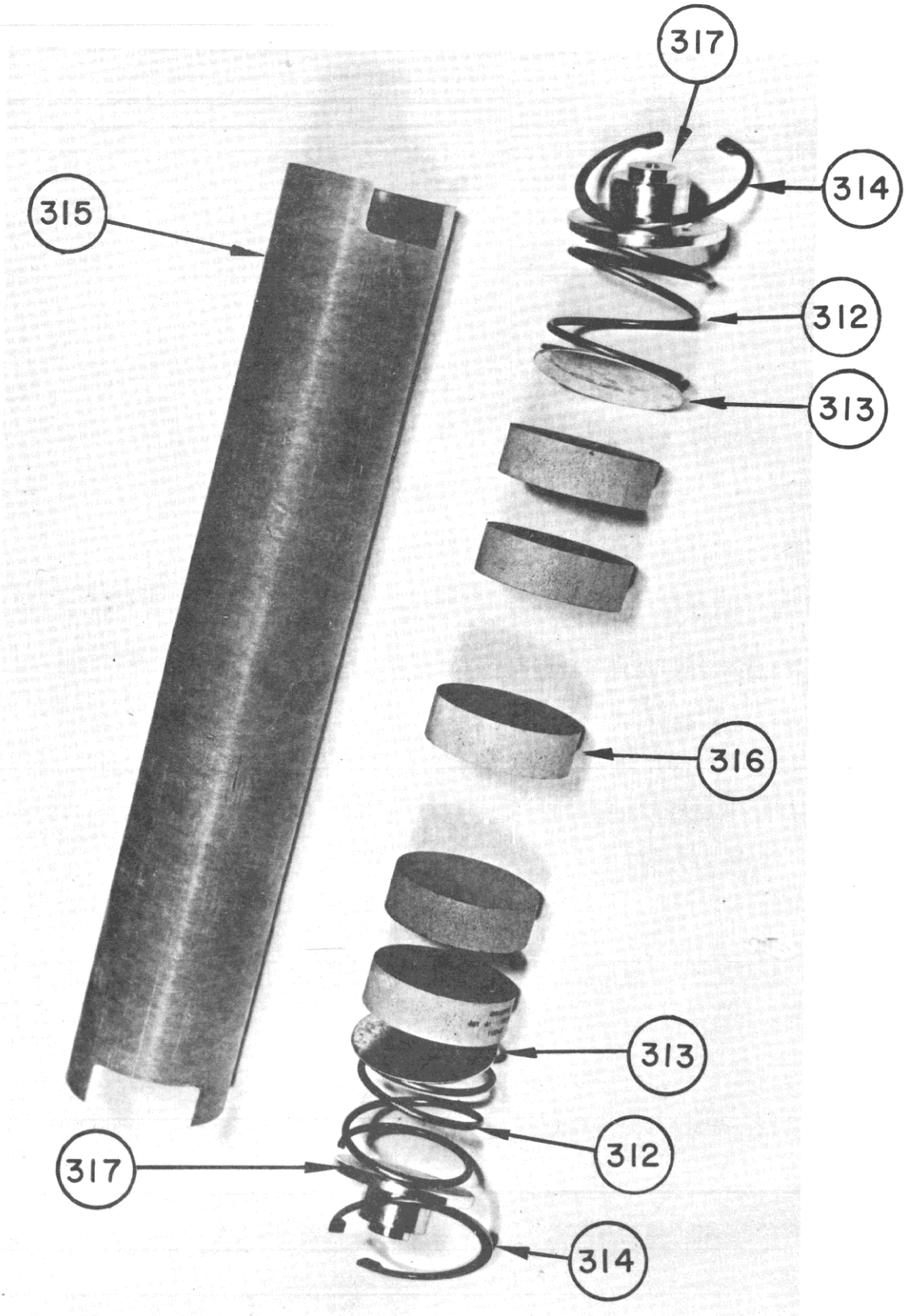
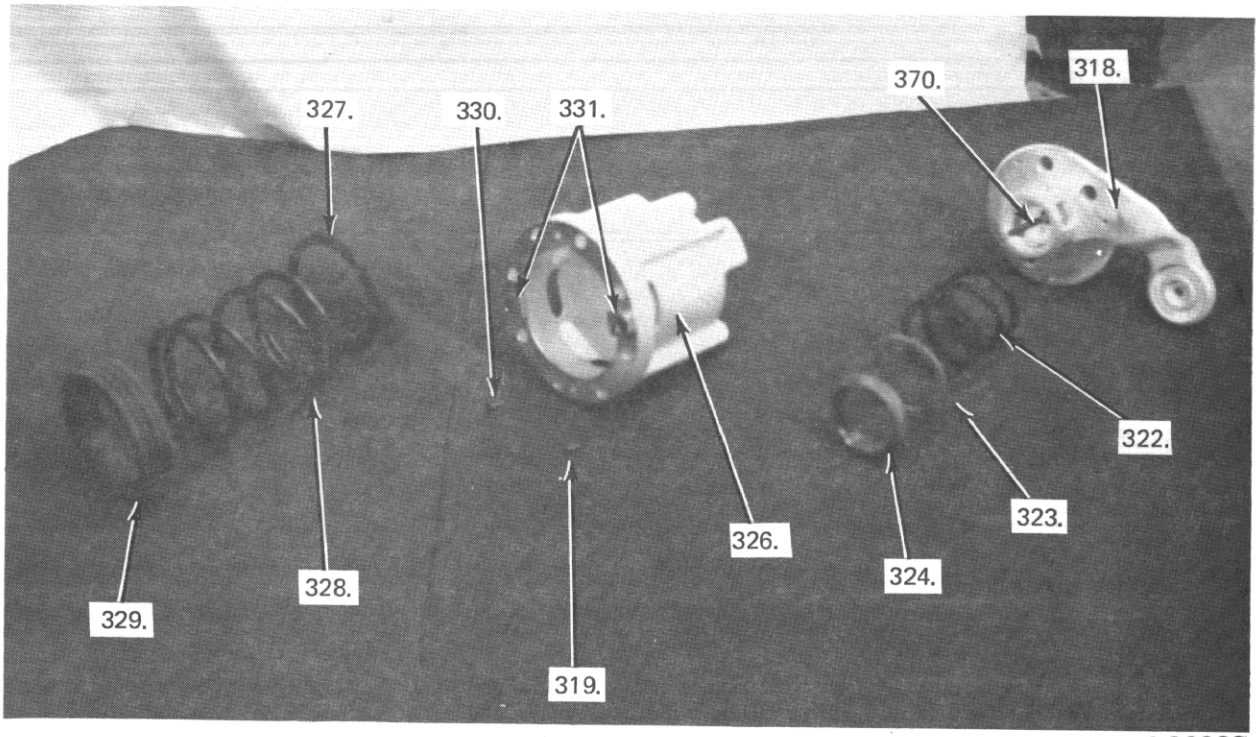


FIG. 3A
RESISTOR ASSEMBLY

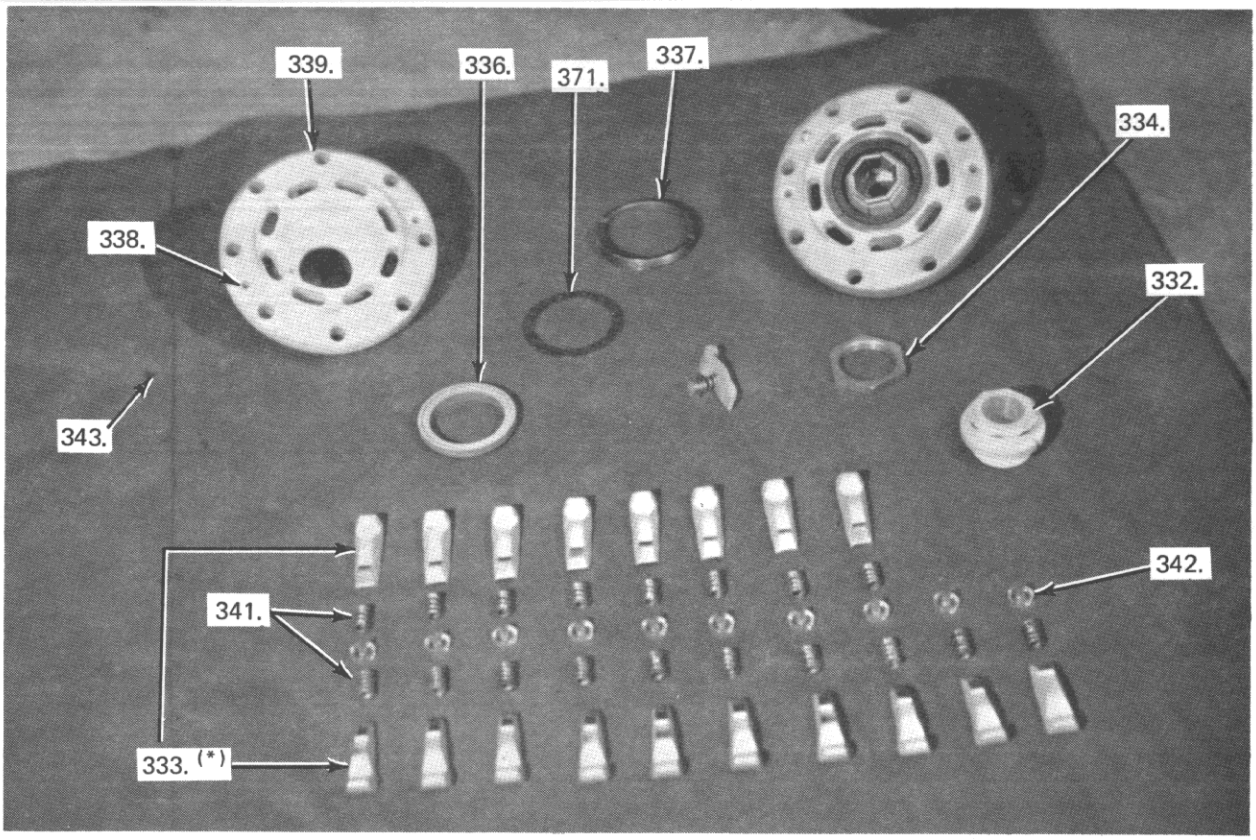


LEGEND

318. VALVE CASTING	327. WASHER
319. FLAT HEAD MACHINE SCREW	328. SPRING
322. SPRING	329. PISTON RING
323. RING	330. FLAT HEAD MACHINE SCREW
324. RELIEF VALVE ELEMENT	331. BLOCK
326. CYLINDER	370. GUIDE PIN

FIG. 3B

CYLINDER AND VALVE ASSEMBLY



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LEGEND

332. COLLAR
333. CONTACT FINGER (*)
334. NUT
336. BAFFLE
337. BUSHING
338. LOCATING SCREW
339. CONTACT HOUSING
341. SPRING (*)
342. BUTTON (*)
343. ROLL PIN
371. WASHER BRASS

(*) Contact Finger (333), Spring (341) and Button (342) –
Eight (8) each for 2000A ratings.
Ten (10) each for 3000A or 63KA Ratings.

FIG. 3C
CONTACT ASSEMBLY

NOTE 1 - PRESS DEFLECTOR, ITEM 349, FIRMLY DOWN BY HAND BEFORE ASSEMBLY OF CONTACT ASSEMBLY, ITEM 308, AND CYLINDER, ITEM 326. VARY QUANTITY OF WASHERS, ITEM 365, TO OBTAIN DIMENSIONS SHOWN.
NOTE 2 - PORTS ARE SHOWN ROTATED AT 30° FOR PURPOSES OF CLARITY.

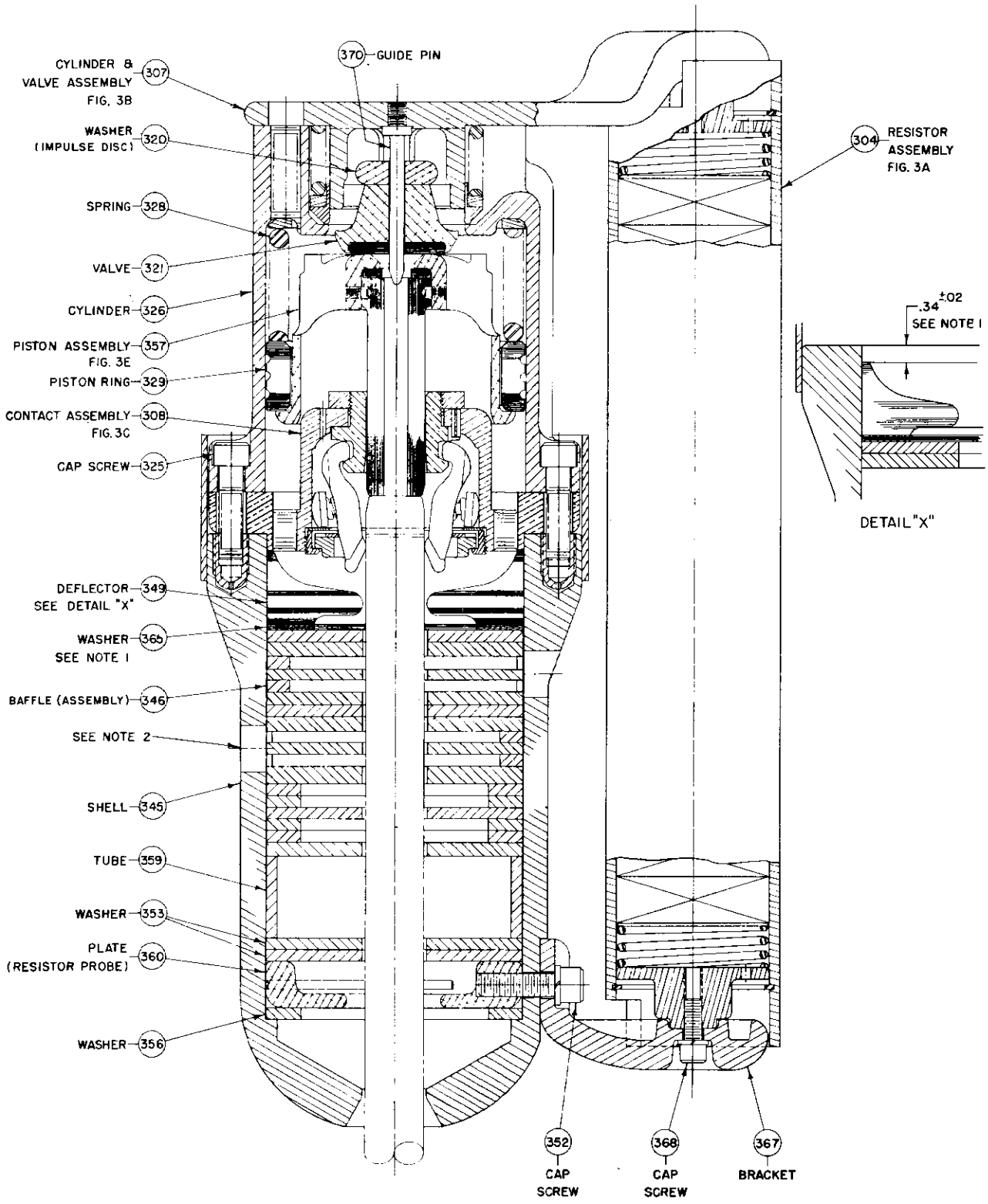


FIG. 3D
LCP INTERRUPTING DEVICE

AUG. 9, 1977

72-410-319-401

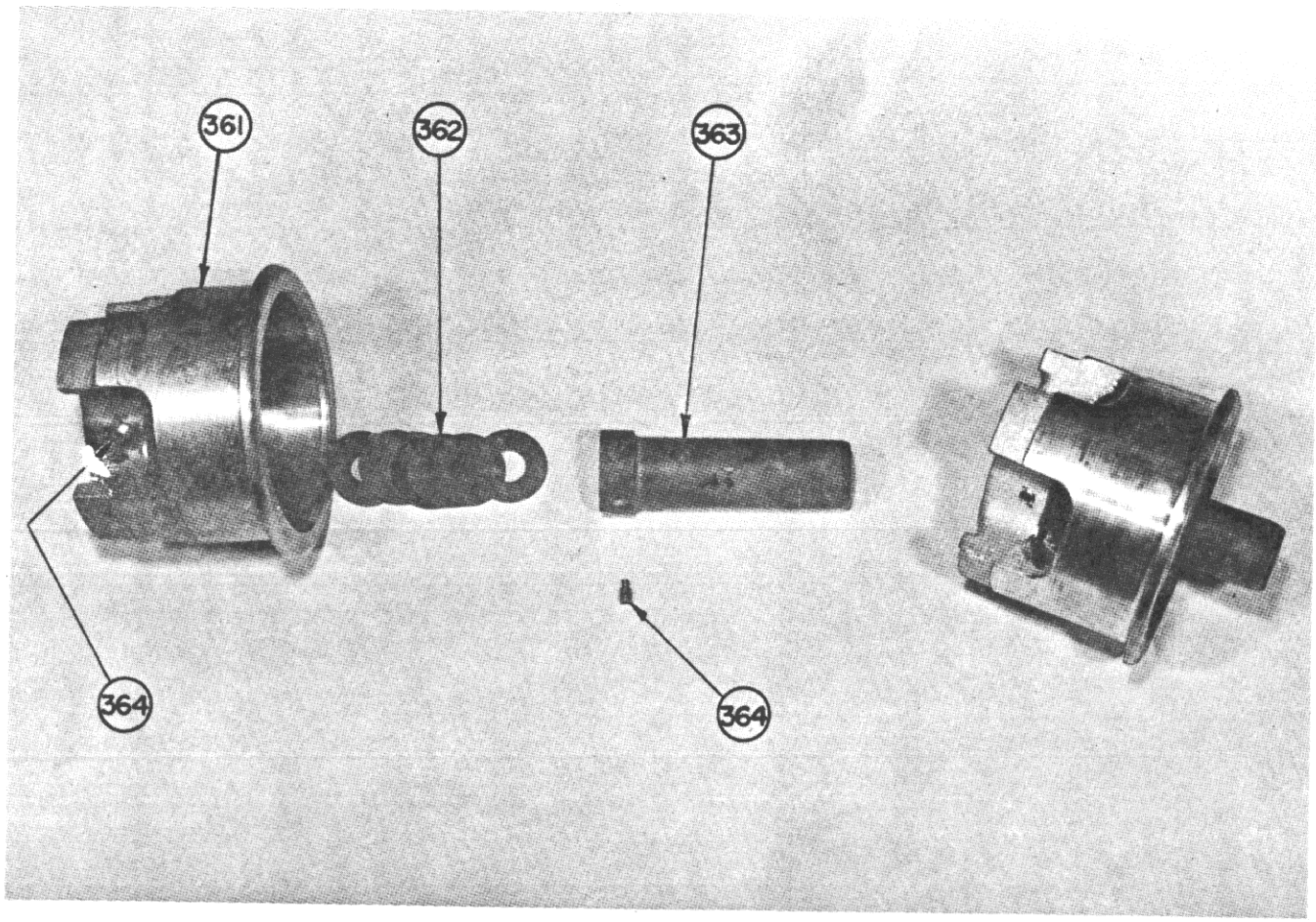


FIG. 3E
PISTON ASSEMBLY

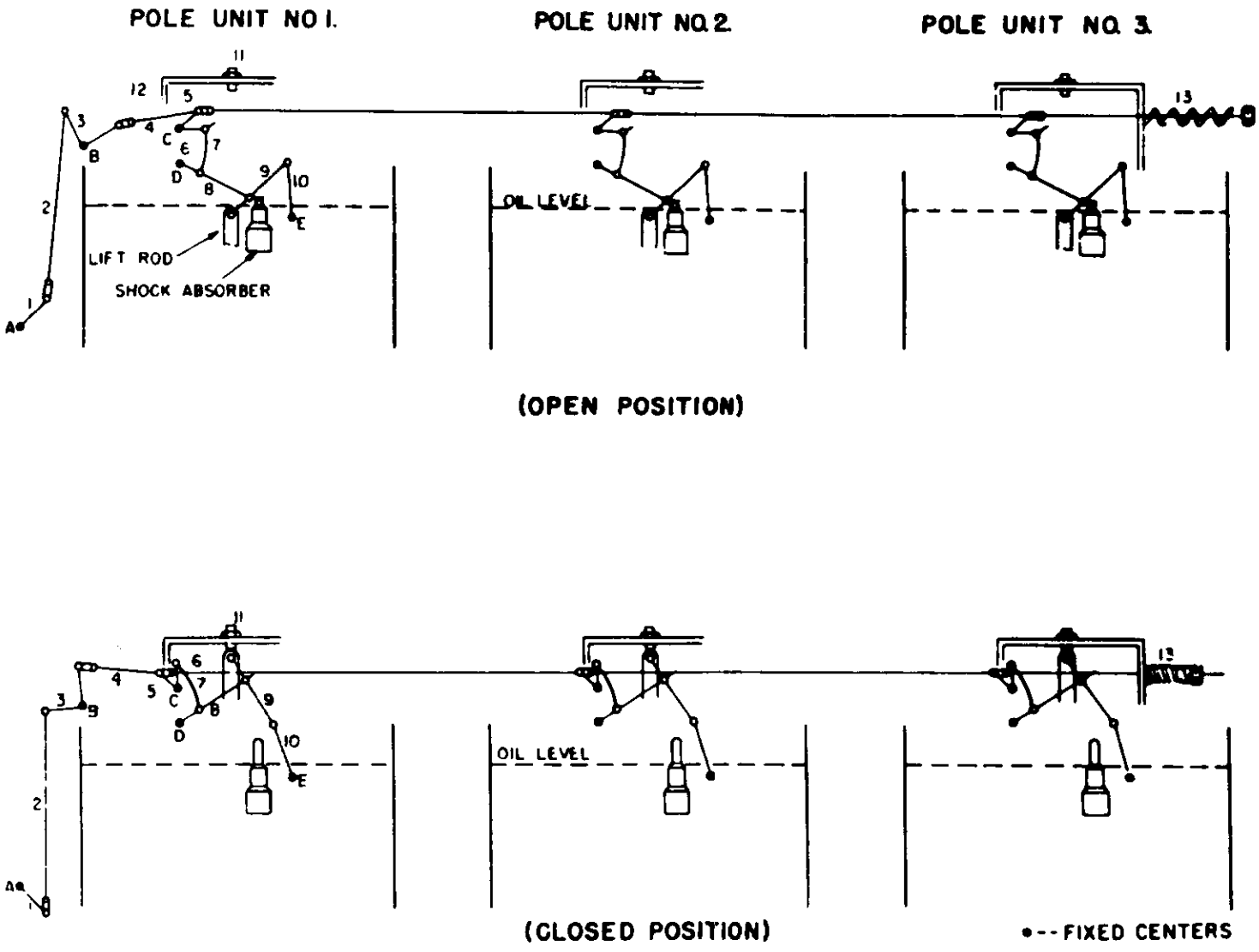


FIG. 4
TYPE BZO MECHANISM

MAY 2, 1957

71-301-539-401

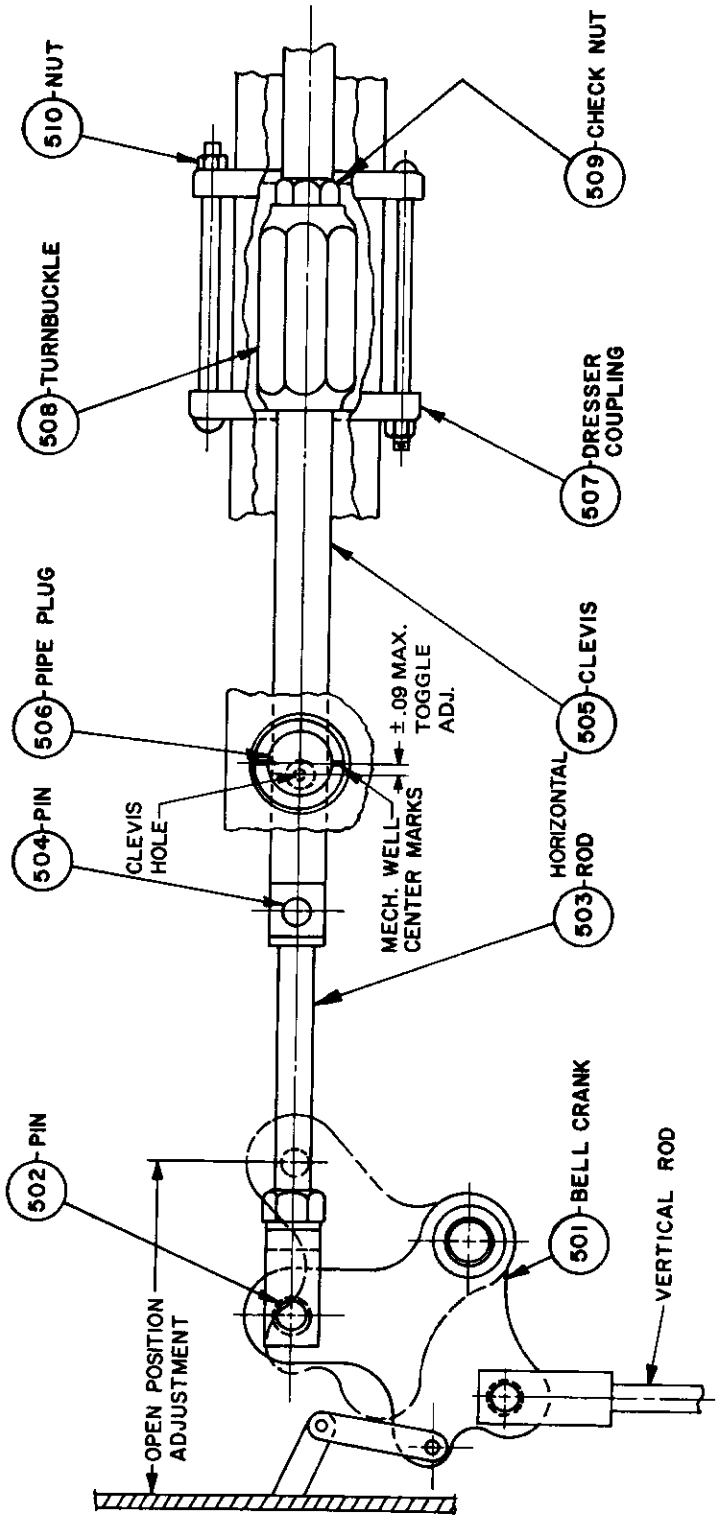


FIG. 5
INTERPOLE CONNECTING ROD

APRIL 1979

72-211-596-401

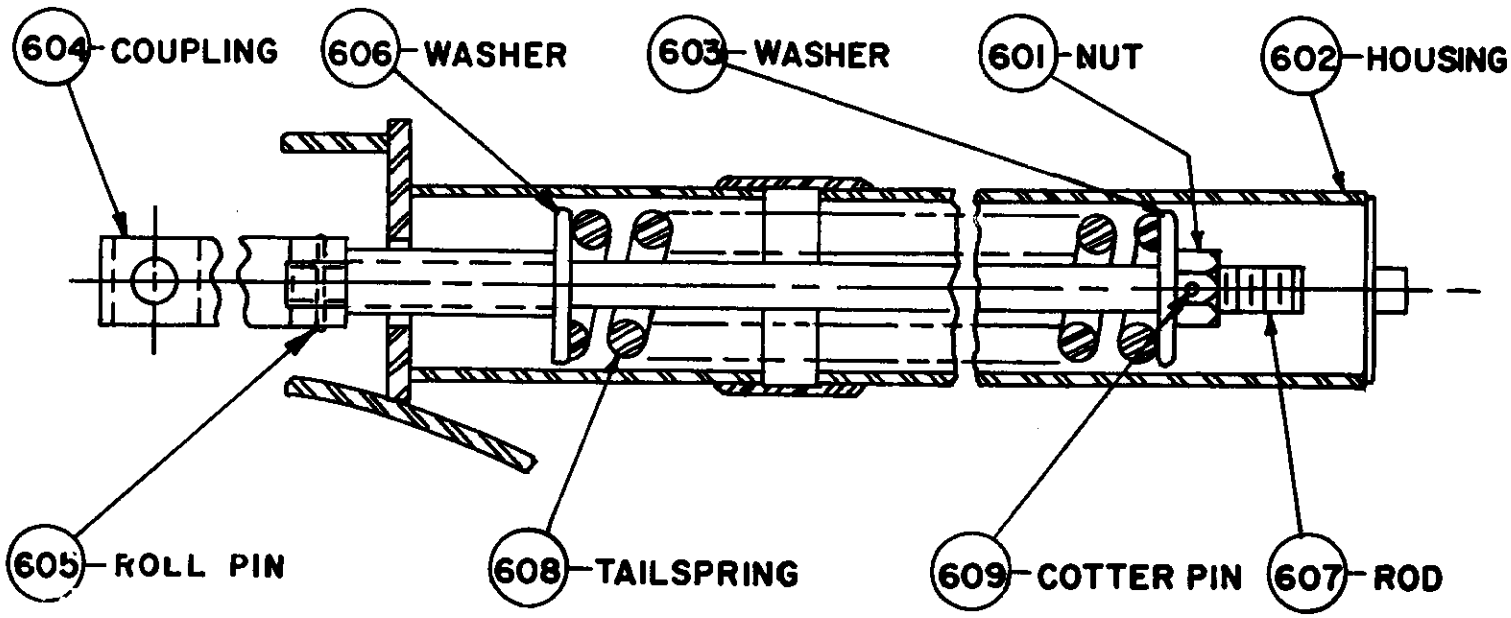
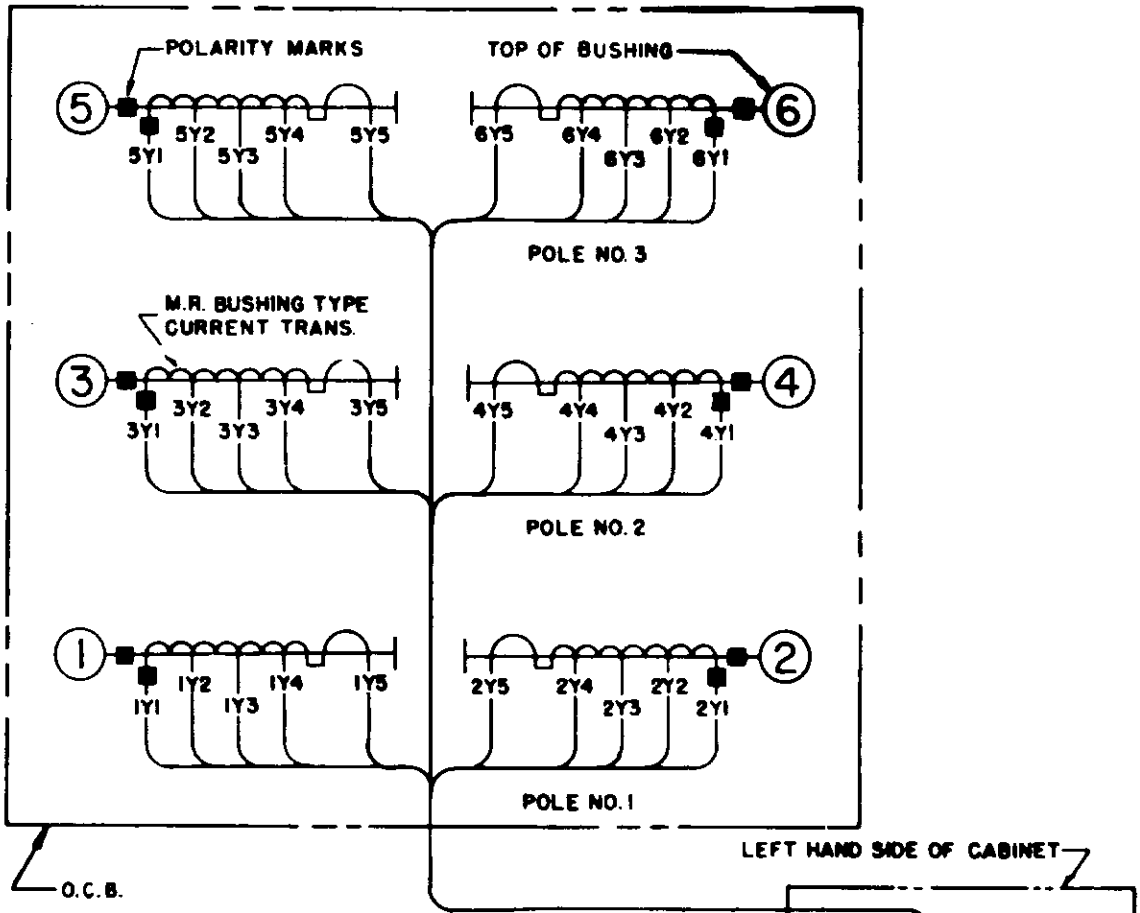


FIG. 6

TYPICAL TAILSPRING ASSEMBLY

AUG. 29, 1977

71-116-353-401



TAP	600/5A. MAX.		1200/5A. MAX.		2000/5A. MAX.	
	TURNS	RATIO	TURNS	RATIO	TURNS	RATIO
Y1-Y5	120	600/5	240	1200/5	400	2000/5
Y2-Y5	100	500/5	200	1000/5	320	1600/5
Y3-Y5	90	450/5	180	900/5		
Y1-Y4	80	400/5	160	800/5	300	1500/5
Y2-Y4	60	300/5	120	600/5	220	1100/5
Y3-Y4	50	250/5	100	500/5	60	300/5
Y4-Y5	40	200/5	80	400/5	100	500/5
Y1-Y3	30	150/5	60	300/5	240	1200/5
Y1-Y2	20	100/5	40	200/5	80	400/5
Y2-Y3	10	50/5	20	100/5	160	800/5

TRANS. LEADS	
TAP	COLOR
Y1	RED
Y2	BLACK
Y3	WHITE
Y4	GREEN
Y5	YELLOW

NOTES

1- SHORT CIRCUIT EACH B.C.T. USING SHORTING SCREWS IN Y1-Y5 AT ASSEMBLY.

2-FOR POSITION, NUMBER & RATIO OF BCT'S FURNISHED - SEE SPECS.

FIG. 7

TYPICAL BUSHING CURRENT TRANSFORMER DIAGRAM

AUG. 9, 1962 71-116-584-401

NOTE: 1 - BOTTOM SURFACE OF ADAPTER 301 TO BE LEVEL IN BOTH X-X AND Y-Y DIRECTIONS USING A SPIRIT LEVEL.

2 - EXHAUST PORTS MUST FACE OUTWARD.

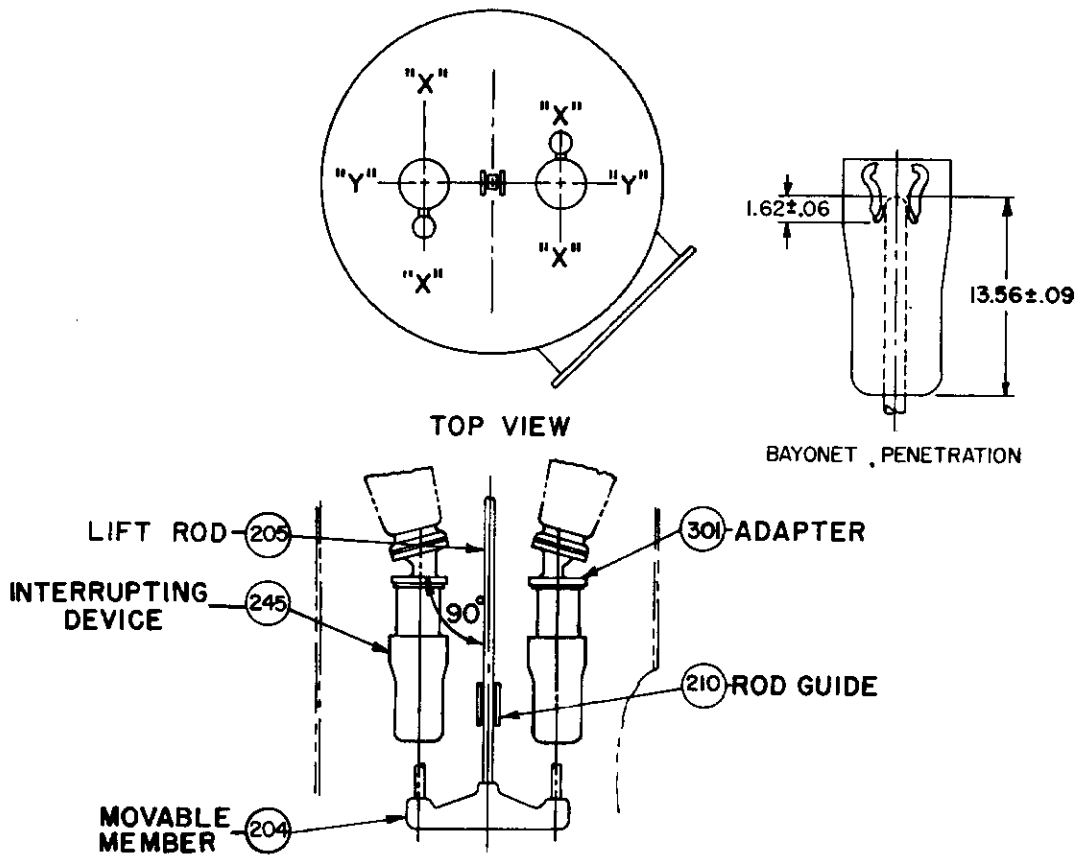
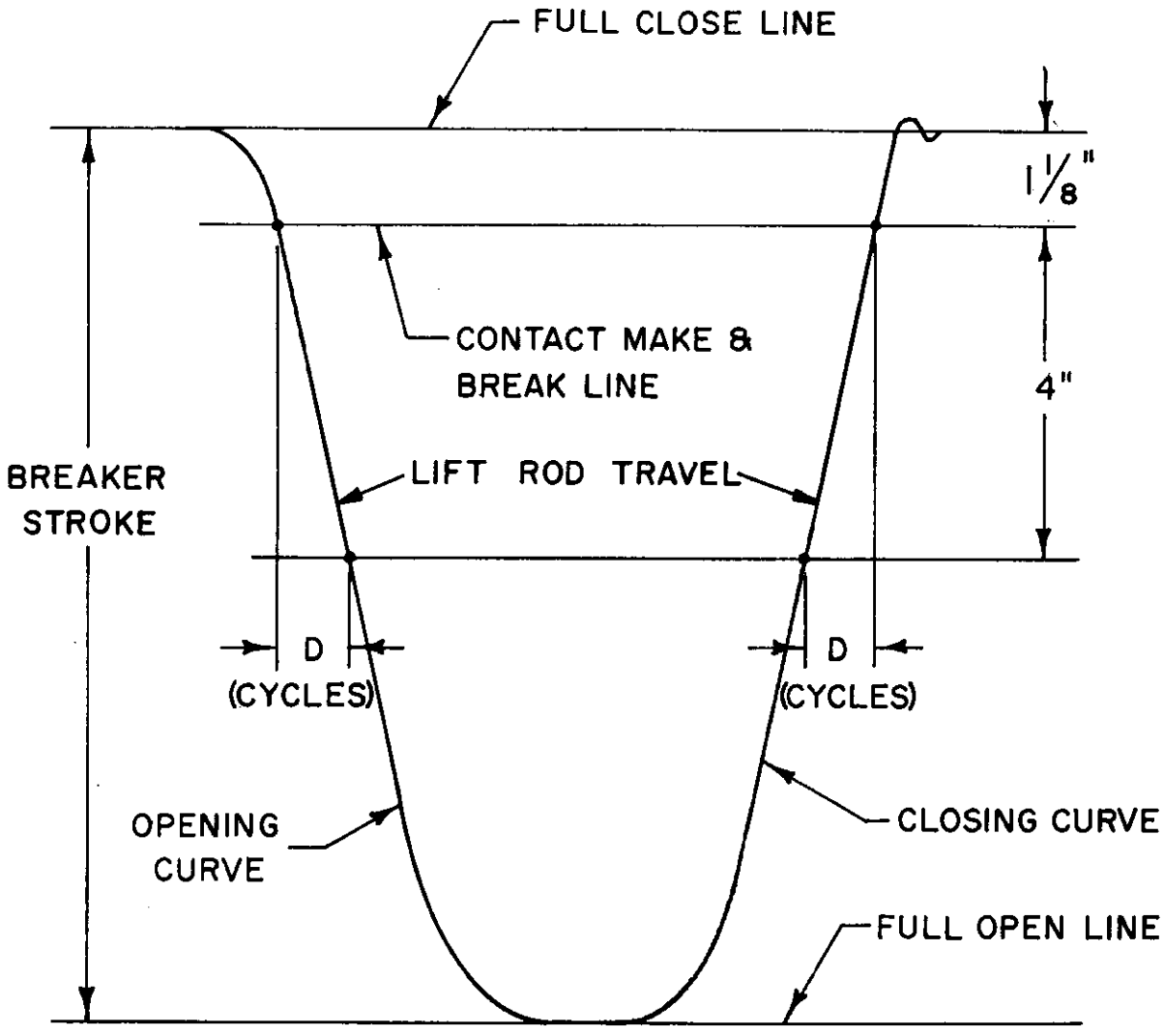


FIG. 9

LEVELING REQUIREMENTS FOR ADAPTER

AUG. 10, 1977 72-112-727-401



BREAKER SPEED = $\frac{20}{D}$ FT. PER SEC. @ 60 HZ. RECORDING

= $16.67/D$ FT. PER SEC. @ 50 HZ. RECORDING

FIG. 10

OPERATING SPEED MEASUREMENT