UTILITIES G. Matter 759

# INSTRUCTIONS for the Installation, Care and Operation of Circuit Breakers and Accessories

— Note. — Trans. lush-ing data in this book - See note at bottom of this page Ed.

**TYPE FZO-50-15F**

**OIL CIRCUIT BREAKER**

**3000 AMPERES**

**BOOK ~~DWM-6536~~**

File 5-A

These instructions 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 Allis-Chalmers Mfg. Company.

**ALLIS-CHALMERS MFG. CO.**
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See note on inside of this sheet.

# ALLIS-CHALMERS MANUFACTURING COMPANY

INDEX COVERING
TYPE FZO-50-15F,
OIL CIRCUIT BREAKER

(Cont. of Book BWX-6535)

# INDEX OF ILLUSTRATIONS COVERING TYPE FZO-50-15F OIL CIRCUIT BREAKERS

| Fig. | DESCRIPTION | ILLUSTRATION NO. |
|---|---|---|
| 1 | Typical Outline | 71-400-998-401 |
| 2 | Typical Pole Unit | 71-500-259-401 |
| 3 | Typical Ruptor | 71-206-434-401 |
| 4 | Operating Mechanism | 71-301-674-401 |
| 5 | Toggle Setting | 71-109-013-401 |
| 6 | Tail Spring Assembly | 71-206-449-401 |
| 7 | Typical Transformer Connection Diagram | 71-109-325-401 |
| 8 | Brush Adjustment | CB-629813 |

# ALLIS-CHALMERS MANUFACTURING COMPANY

## CAUTIONS TO BE OBSERVED IN THE INSTALLATION, OPERATION, AND MAINTENANCE OF OIL CIRCUIT BREAKERS

### GENERAL

THIS EQUIPMENT CANNOT BE OPERATED UNTIL THE SHIPPING WEDGES AND TIES HAVE BEEN REMOVED. DO NOT OPERATE UNTIL ALL ADJUSTMENTS HAVE BEEN CHECKED.

BEFORE RAISING FZO BREAKER TANKS OR FILLING BZO TANKS, BE POSITIVE THAT ALL PIPE PLUGS HAVE BEEN REMOVED FROM THE FILL HOLES IN THE SHOCK ABSORBERS.

BEFORE MAKING ANY ADJUSTMENTS OR REPAIRS, BE SURE ALL ELECTRICAL CONNECTIONS TO BOTH THE BREAKER AND THE OPERATOR ARE DISCONNECTED FROM ANY SOURCE OF POWER.

OPERATION OF FZO AND BZO CIRCUIT BREAKERS IN AIR IS NOT GENERALLY RECOMMENDED. WHEN REQUIRED FOR RELAY CHECKING OR OTHER INSTALLATION CHECKS MAKE CERTAIN THAT OIL IS IN THE SHOCK ABSORBERS AND DO NOT POWER CLOSE THE BREAKER ABOVE LOCKOUT PRESSURE.

WHEN WORKING INSIDE OF BZO BREAKERS, IT IS RECOMMENDED THAT POSITIVE MEANS BE APPLIED TO PREVENT ACCIDENTAL TRIPPING OF THE BREAKER.

ON FRAME MOUNTED BREAKERS, THE SHIPPING BRACES BOLTED TO THE SIDES OF THE FRAME MUST BE REMOVED BEFORE LOWERING THE TANKS. THE DRAIN VALVES WILL NOT CLEAR THESE BRACES.

### SOLENOID OPERATED BREAKERS

ALWAYS REMOVE THE JACK FROM ITS SADDLE AND STORE IT IN A SAFE PLACE BEFORE OPERATING THE BREAKER ELECTRICALLY, AS IT MIGHT WORK OFF ITS SADDLE DURING SUCCESSIVE BREAKER OPERATIONS AND DAMAGE EQUIPMENT.

BE SURE LEADS FROM THE SOURCE OF OPERATING POWER TO THE BREAKER ARE LARGE ENOUGH TO CARRY THE CLOSING CURRENT WITHOUT EXCESSIVE VOLTAGE DROP.

### PNEUMATIC OPERATED BREAKERS

ALWAYS REMOVE THE JACK FROM ITS SADDLE AND STORE IT IN A SAFE PLACE BEFORE OPERATING THE BREAKER ELECTRICALLY, AS IT MIGHT WORK OFF ITS SADDLE DURING SUCCESSIVE BREAKER OPERATIONS AND DAMAGE EQUIPMENT.

CAUTIONS (CONT'D.)

AIR IN THE STORAGE TANK MUST AT LEAST BE AT THE MINIMUM (LOCKOUT) PRESSURE AS SHOWN ON THE OPERATOR NAMEPLATE, AND THE MANUAL SHUT-OFF VALVE MUST BE OPEN BEFORE ATTEMPTING A CLOSURE OF THE BREAKER BY MEANS OF THE HAND RELEASE ON THE SOLENOID AIR VALVE.

ON REMOVING THE EXHAUST VALVE, DO NOT APPLY A WRENCH TO THE VALVE CYLINDER BODY AS WRENCH PRESSURE MAY CAUSE DISTORTION.

THE INSTALLATION OF A NEW VALVE ASSEMBLY IS OBVIOUS. HOWEVER, DO NOT USE ANY THREAD DOPE WHEN INSTALLING THE VALVE ON THE CYLINDER BASE.

PNEU-DRAULIC OPERATED BREAKERS

OIL PRESSURE IN THE HYDRAULIC ACCUMULATOR MUST AT LEAST BE AT THE MINIMUM PRESSURE AND THE MANUAL SHUT-OFF VALVE BE OPEN BEFORE ATTEMPTING A CLOSURE BY MEANS OF THE HAND LEVER ON THE CONTROL VALVE.

CLEANING FLUID

WHEN NECESSARY TO USE A CLEANING FLUID IN CONNECTION WITH CLEANING THE VARIOUS PARTS OF THE BREAKERS, IN THE TANK OR OTHERWISE, CARE SHOULD BE TAKEN IN THE SELECTION OF THE FLUID TO BE USED AS SOME CLEANING FLUIDS ARE DETRIMENTAL TO THE DIELECTRIC STRENGTH OF THE OIL, DISSOLVE PAINT, AND RUIN INSULATING MATERIALS. FLUIDS WHICH EVAPORATE QUICKLY AND DO NOT LEAVE ANY RESIDUE AFTER CLEANING ARE RECOMMENDED.

## GENERAL

One of the most important parts of a modern electric distribution system is the circuit breaker. Under abnormal conditions the entire system depends on the proper functioning of one or more breakers to clear these faults as quickly as possible.

Allis-Chalmers outdoor oil circuit breakers are precision built machines designed to function quickly and efficiently when necessary, even after long periods without operating, if they are properly maintained.

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 Allis-Chalmers 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 instruction, 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 office of the Allis-Chalmers Mfg. Company.

## SHIPPING

### F. TYPE FZO-50-15F, 4000A

This Allis-Chalmers oil circuit breaker has been completely assembled at the factory. All adjustments are carefully made and the breaker is given rigid mechanical tests. After these tests, the adjustments are re-checked. All control and secondary wiring is given a 1500 volt withstand test. The current transformers and their leads are tested at 2500 volts after being installed.

After these tests have been completed, the breaker is thoroughly cleaned and given a final coat of paint. It is then carefully packed for shipping.

The breaker is closed and a wedge is placed in back of the operator to prevent it from becoming unlatched during shipment. The tanks are raised into place and blocked so they cannot drop down even if the nuts on the tank bolts are loosened while the breaker is enroute.

## RECEIPT & INSPECTION

All parts of the oil circuit breaker are in first class operating condition when they are shipped from the factory. They have been carefully inspected, tested, and packed by workmen experienced in the proper handling of electrical equipment. All large parts and any necessary boxes or crates for smaller parts are securely fastened to the car and braced so as to prevent damage in transit. All possible steps have been taken to insure the arrival of the material in as good condition as when it left the factory.

Upon receipt of the circuit breaker, remove it from the car and check to see that the car number agrees with that given on the shipping manifest. Carefully remove all crating and packing, taking care that no parts are over-looked during the removal of this packing. All parts of the shipment should be carefully examined to see that nothing has been lost or damaged in transit. If any damage of the shipment is evident, a claim for damages should be filed at once with the transportation company, and the Allis-Chalmers Mfg. Company, Boston Works, notified, with a copy of the inspector's report.

Since many transportation companies have a definite time limit in which damage claims may be filed, this inspection should be made as soon as the equipment is unloaded, even though the breaker may not be installed for some time. Allis-Chalmers Mfg. Company cannot be held responsible for shipping damage, either external or internal, if this inspection is not made within the time limit set by the transportation company.

## HANDLING

### A. FZO 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 bushings, valves, etc.

The breaker should be lifted and moved by means of a crane with the slings hooked into the top of the frame near the corners. The slings should be proportioned so as to lift the breaker as near level as practical.

Care should be taken not to put any strain on the bushings or any of the attachments, such as the gas and oil separators, the tail spring housing, the oil gauges and the valves.

If it should become necessary to move the breaker by means of skids placed under the feet, enough rollers should be used to distribute the load along the skids.

STORAGE

## A. FZO BREAKERS, SHIPPED COMPLETE

Immediately upon receipt of your Allis-Chalmers oil circuit breaker, it should be set up on its permanent foundation. If the breaker is not to be connected in service immediately, the tanks should be cleaned, dried and filled with approved oil. When it is not possible to set the breaker on its permanent foundation, the tanks should be filled with oil so as to protect the insulating parts of the breaker. If it is impossible to fill the tanks with oil, then the insulating parts of the breaker should be kept dry through the use of space heaters or light bulbs inside the tanks. These must be of sufficient capacity to maintain the inside temperature above the ambient.

As an alternative to the above, the Ruptor pots and throats, the lift rods, and the wooden parts of the rod guides may be removed and stored in a warm dry room. The wooden parts should be laid on a flat surface or hung vertically so as to minimize danger of warpage. When these parts have been so stored, just before installation in the breaker, they should be inspected and if necessary, dried out in an oven for a period of six to eight hours, using a maximum temperature of 220 degrees F for the Ruptor throat and 110 degrees F for the other parts.

The operating mechanism housing is weatherprrof. However, to prevent corrosion due to moisture in the cabinet, the space heaters should be energized within a day or two at the latest, even to the extent of using temporary wiring. Machined parts of the operating mechanism should be slushed to insure them against corrosion.

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 13, care of insulating oil).

If moisture is observed in the tanks, it is advisable to remove the Ruptor pots with throats, the lift rods, and the wooden parts of the rod guide and dry them as outlined above.

## INSTALLATION

### B. TYPE FZO-50-15F

Accessibility and ease of inspection should be carefully considered in the selection of sites for oil circuit breaker installation. In locations subject to flood conditions, the foundation should be high enough to keep the bottom of the operating cabinet above the high water mark.

Mount the oil circuit breaker on the foundation, level the top of the breaker frame work by shimming the uprights on the foundation if necessary, and tighten the foundation bolts. Place the tanklifter in position and lower the tanks. Then remove the wedges and ties on the operator. The breaker cannot be opened until all the wedges and ties are removed.

CAUTION: THIS BREAKER IS BLOCKED IN THE CLOSED POSITION SO CARE MUST BE EXERCISED IN REMOVING THE WEDGES AND OPENING THE BREAKER.

## BREAKER OPERATION

### FZO-50 BREAKER

Figure 4 shows diagrammatically the breaker mechanism in the open and closed position. In closing the breaker, the operator produces a downward effort on the vertical operating rod (1) rotating the bell crank (2) clockwise about its fixed center (B). This rotation pulls the connecting rods (3) toward the front of the breaker, rotating the crank (4) counterclockwise about its fixed center (E). Rotation of the cranks (4) acting through the links (5) causes the levers (6) to rotate clockwise about their fixed centers (H). Consequent rotation of the arms (7) about the movable centers (K) produces a straight line vertical movement of the lift rod upward to the closed position of the breaker. During the latter part of the closing stroke, the tailspring (9) is compressed.

## ADJUSTMENTS

BELL CRANK (Ref. Fig. 4)

The bell crank (2) on the front of pole number one is set to have approximately the same amount of travel above and below its pin (B) during a breaker operation.

This is carefully set at the factory and should not have to be disturbed. It is adjusted by turning the turnbuckle on the vertical pull rod (1).

After any change in this setting, all other breaker adjustments must be checked.

TAILSPRING (Ref. Fig. 6)

A tailspring (602) is furnished on pole unit (3) to provide the necessary acceleration to the movable members on opening. This spring has been adjusted at the factory and need not be disturbed. In general, this spring is adjusted to give an average opening speed of 6-3/4 to 8' per second for the first 4" after contacts parts while, at the same time allowing the breaker to close with minimum voltage applied to the solenoid and, with pneumatic or pneu-draulic operators, with minimum operating pressure.

This spring is initially set for 2-3/8 plus or minus 1/8" compression but this may be changed during test as explained above.

The compression is adjusted by changing the number of spacers (606). In order to do this, it will be necessary to remove the tube (601) and the rod (604) as the nut (605) is welded to this rod. When replacing the rod (604), be sure the check nut (607) is tight.

If any change is made in the tail spring setting, all other adjustments must be checked before operating the breaker.

TOGGLE ADJUSTMENT (Ref. Fig. 5)

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 carrying 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. On the other hand, if the toggle linkage is permitted to go overcenter, the breaker

will close easily, but it will lock in the closed position and it will become necessary to use pry bars to open the breaker.

To check the toggle adjustment, with the breaker closed, place a straight edge against the operator side of the pins (501) and (503). The toggle is in correct adjustment when the distance from this straight edge to the operator side of the pin (502) (dimension "A", Fig. 5) is at least 7/16" but not over 1/2".

This is adjusted by turning the clevises on the horizontal connecting rods. After making an adjustment, it may be necessary to lift the movable member slightly in order to replace the pin between the clevis and the mechanism toggle crank. Be sure the check nuts on the horizontal rods are tightened before operating the breaker.

Since a change in the toggle adjustment will affect the tail spring setting, it will be necessary to check this adjustment after such a change is made.

TOGGLE STOP (Ref. Fig. 5)

Toggle stop screws (504) are provided to prevent the toggles in the pole unit mechanisms from reaching the "On Center" or "Over Center" position. These screws (504) are set so that, with the breaker closed, there is a clearance of not less than 1/8" or more than 3/16" between the end of the stop screw (504) and the pad on the toggle crank (Dim. "B", Fig. 5). After any adjustment of the stop screw (504), it must be locked in position with the check nut (505).

OVERTRAVEL STOP (Ref. Fig. 2)

A combination overtravel stop and impulse spring is located on each pole unit directly over the lift rod. It is provided to absorb the closing impact and to prevent the moving parts from overtraveling sufficiently to cause damage.

When in correct adjustment, with the breaker closed, the dimension "C" between the bottom of the plunger housing (229) and the plunger (236) is 1/32" to 1/16". This adjustment can be checked by inserting a feeler between the coils of the spring (237).

If this adjustment must be changed, bend down the top of the locking strip (235) and loosen the checknut (234). Place a piece of flat stock in the slot in the top of the plunger housing (229) and turn this housing up or down until the proper clearance is obtained. Be sure the lock nut (234) is tightened and locked in place with the locking strip (235).

SHOCK ABSORBER (Ref. Fig. 2)

Hydraulic shock absorbers are located under oil within each of the circuit breaker tanks. During normal operating conditions, these shock absorbers are supplied with oil from the circuit breaker tanks through two vents in the absorber cylinders.

CAUTION: DO NOT OPERATE THIS BREAKER UNLESS SHOCK ABSORBERS ARE FILLED WITH OIL.

During test conditions (that is with the breaker contacts operating in air) these shock absorbers must be filled with oil (use oil furnished for circuit breaker tanks) and their vents sealed with pipe plugs provided.

CAUTION: WHEN TESTS HAVE BEEN COMPLETED AND BEFORE FILLING BREAKER TANKS WITH OIL, BE POSITIVE THAT THE PIPE PLUGS HAVE BEEN REMOVED FROM THE SHOCK ABSORBER VENTS.

This is to insure that sufficient oil for their proper operation will be maintained within the shock absorbers by the supply of oil within the breaker tanks.

NOTE: FAILURE TO OBSERVE THE ABOVE PRECAUTION MAY RESULT IN DAMAGE TO THE BREAKER WHEN TRIPPED.

The shock absorbers are so set that when the pad on the mechanism arm of any one pole unit just makes contact with the shock absorber plunger stem, the gap between the pad and the plunger stem on the remaining two poles will be not over 1/8". This is not adjustable.

STROKE

The stroke of the FZO-50-15F, 3000 Amp. breaker is 9½" plus or minus 1/2". The stroke is not adjustable.

BRUSH CONTACTS (Ref. Fig. 2, 3, and 8)

All contacts have been carefully adjusted at the factory and no adjustment of the ruptors or plungers should be necessary. However, all contact adjustments should be checked.

Care must be taken to avoid possible overflexing of the brushes by operation of the breaker before the adjustments have been checked and corrected if necessary.

Close the breaker with the maintenance closing device and check to see that each individual lamination of the brush (326) makes contact with the movable bridge (203) as shown on Fig. 8C. Fig. 8A shows insufficient brush pressure and 8B to much pressure

Note that the inside or shortest leaf just makes contact with the bridge.

The brush pressure is adjusted by changing the number of spacers (226) under the bridge (203).

PLUNGER CONTACTS (Ref. Fig. 3)

The contacts should be checked to be sure the plungers are centered in the openings in the ruptor and penetrate sufficiently into the stationary contacts without passing through the contacts far enough to hit the shunts. The check should be made with the ruptor pot (309) and throat removed.

Check to be sure the bottom of the hood casting (301) is level. Loosening the cap screws (311) will release this hood so it may be rotated on the sleeve(310) as required.

Using the maintenance closing device, slowly raise the movable member and check for contact alignment. Adjustment for this alignment can be made by loosening the plunger supports and moving them in or out in the slotted holes in the cross plate.

The penetration of the plungers into the contact assembly is 2" plus or minus 1/16" measured from the bottom of the contact assembly.

With the breaker in the closed position, measure the distance from the bottom surface of the contact assembly (305) to the top of the plunger support. Open the breaker, and to the measurement taken, add the required penetration of 2" plus or minus 1/16". The sum thus obtained is the distance from the top of the plunger support to the top of the plunger. Tighten the cap screws to lock the plunger in its support.

Check to be sure the stationary contact assembly can be moved approximately 1/32" in all directions in a horizontal plane, thus giving proper freedom of alignment to the contacts. Replace the ruptor pot (309) and check to be sure the plungers pass up through the throat without fouling or interference. Trouble at this point would indicate that the bottom of the ruptor hood is not level. Also check to see that there is at least 1/2" clearance between the bottom of the ruptor pot (309) and the top of the side plates with the breaker in the full closed position.

BREAKER OPERATION

With the breaker in the full closed position and all adjustments made, and with the shock absorbers filled with oil, the breaker may be tripped by hand, using the manual trip on the operating mechanism. This mechanism is mechanically trip-free and tripping by hand is safe even with the maintenance closing device in position.

BEFORE TRIPPING, REFER TO THE PARAGRAPH ON SHOCK ABSORBERS.

## CONTACT CLEANING

Before raising the tanks into place, clean all contact surfaces with a soft cloth soaked in a cleaning solution that will quickly evaporate without leaving a residue that would be detrimental to insulating oil. After the breaker has been in service for a period of time, a file or sandpaper may be required to dress the arcing contacts. Silver-plated contact surfaces should never be dressed. Unlike copper, any oxidizing of the silver contact surfaces will not affect the current carrying ability of the contacts.

All adjustments having been checked and corrected if necessary, the breaker is now ready for operation. Be sure the pipe plugs have been removed from the shock absorber vents and that the tanks are filled with oil and secured in place.

Refer to the nameplate on the operating mechanism for the pressure and/or voltage required for proper operation.

## SUMMARY OF BREAKER ADJUSTMENTS

| ADJUSTMENT | SETTING | MEANS OF ADJUSTMENT |
|---|---|---|
| Bell Crank | Same travel above & below center pin | Turnbuckle on vertical rod |
| Tailspring | Determined by speed analyzer | Washers under nut |
| Toggle | 7/16" to 1/2" | Horizontal rod clevis |
| Toggle Stop | 1/8" to 3/16" | Stop screw |
| Overtravel Stop | 1/32" to 1/16" | Screw housing up or down |
| Shock Absorber | Pad touches stem on one pole, within 1/8" on other two | Not adjustable |
| Stroke | 9½" plus or minus 1/2" | Not adjustable |
| Brush contact | Heel Lamination just touches bridge | Spacers under bridge |
| Plunger Contact | 2" plus or minus 1/16" penetration | Screwing plunger up or down |

CAUTIONS:

1. The breaker must not be electrically operated until all adjustments have been checked, corrected if necessary, and all fastenings made secure.

2. The breaker is furnished with internal shock absorbers. They must be filled with oil and the pipe plugs inserted for limited operations in air. Do not trip the breaker without oil in the shock absorbers. In order to maintain sufficient oil in these absorbers, THE PLUGS MUST BE REMOVED before filling and raising the tanks.

## CARE OF INSULATING OIL

## OIL SPECIFICATIONS

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 D-117 AND: |
|---|---|---|
| Minimum Flash Point | 132 deg. C. (270 deg F) | |
| Minimum Fire Point | 149 deg. C. (300 deg F) | ASTM Std. Test D-92 |
| Maximum Pour Point | -40 deg. C. (-40 deg F) | ASTM Std. Test D-97 |
| Saybolt Viscosity at 37.8 deg. C (Seconds) | 50 to 63 | ASTM Std. Test D-88 |
| Specific Gravity at 15.6 deg. C | .85 to .91 | Pyknometer or Westphal Balance |
| Minimum Dielectric Strength (KV) | 27.5 | 1" Flat Disc Electrodes Spaced .1" apart |
| Maximum Neutralization Number | .03 | ASTM Std. Test-D-663 |
| Steam Emulsion Number (Seconds) | 25 | ASTM Std. Test D-157 |
| Maximum Color (NPA) | 1 | |
| Sludging | 6 weeks at 90 deg., No change in color | ASTM Std. Test D-670 |

This oil should be used in all Allis-Chalmers oil circuit breakers. In cases where it is not, the oil used must be approved by the company. Allis-Chalmers cannot assume responsibility for the successful operation of its oil circuit breakers unless the oil used has their approval. The use of "Inhibited" oil is not recommended.

## 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 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 dry gasoline, 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 mouthed 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 it 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 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 break downs should be made on each filling, the receptacle emptied and refilled with fresh oil from the original sample. After each break down, the cup should be rocked 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 26KV dielectric strength should not be put into an oil circuit breaker tank.

## ACIDITY

Oil which has been in use should be checked for acidity. If this acidity is .50 or more, the oil should be treated to remove the acids or replaced.

## 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 thoroughly 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 26KV in a standard test set.

CAUTION: 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 26KV.

## HOW TO MAKE GASKETED JOINTS

After a gasket has been in use for a period of time, it will become deformed or take a permanent "Set". Since it is the function of the gaskets to keep the breaker free of oil leaks and weatherproof, it is recommended that, once a gasketed joint is broken, the old gasket be removed and replaced with a new one.

When installing or replacing gaskets, it is essential that all metal gasket surfaces be dry and free of scale, grease, oil and rust. The surface should be scraped, rubbed with emery cloth and cleaned with gasoline or carbon tetrachloride.

One coat of gasket cement should be applied to the metal gasket seat and to the gasket surfaces that will come in contact with this seat. After the cement has dried to the stage where it is tacky, the gasket should be forced into its groove. The gasket should be held firmly in place until the cement has set.

The surface of the gasket that is not in the groove may be given a light coat of grease to facilitate breaking the joint at a future date.

When the gasket is firmly in place, the cover or bushing can be bolted into position. The bolts should be uniformly tightened in small increments. To prevent overstressing of the gaskets the flanges on manhole covers, tanks, and bushings are provided with stops so that these flanges pull down metal to metal. This construction automatically limits the compression of the gasket to its proper value.

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.

## HOW TO STOP OIL LEAKS

A great deal of care has been taken to make all Allis-Chalmers oil circuit breakers oil tight, and to prevent oil seepage through the joints. Every joint on Allis-Chalmers oil circuit breakers is carefully designed to give maximum tightness.. All tanks are filled with compressed air and while under this air pressure, the joints are covered with a special solution to detect any small leaks. Gaskets are made of special, high-grade materials, with machine-scarfed joints where required. Tanks on the frame mounted breakers and man-hole cover flanges on the floor or 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 "How to Make gasketed Joints".

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 soldering. For this purpose, an excellent hard solder, having a melting point of approximately 176 deg. C., known as "Iron-Fix" is recommended. It can be purchased from the Aluminum Fix Company, 1964 East 55th Street, Cleveland, Ohio, who also provide special soldering coppers and a special flux, together with specific instructions.

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

## FINAL CONNECTIONS & INSPECTION

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 to one of the frame legs on frame mounted breakers and on one side of each tank near the bottom on floor or 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. They should not be long enough to bottom before making the ground connection up tight.

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.

Before making any electrical connections, every precaution must be taken to see that all leads to be connected to the oil circuit breaker are dead.

All terminals must be fastened securely to the leads and tightly clamped to the connection studs.

To avoid heating, the connecting leads must have adequate current carrying capacity in accordance with standard practice.

Finally, check to make sure that the oil circuit breaker is properly set up and leveled on its foundation.

Be sure all pipe plugs have been removed from the shock absorbers.

Be sure all adjustments have been checked and corrected if necessary.

See that all bearing surfaces of the operating mechanism have been lubricated with light, non-gumming lubricating oil.

Inspect all insulation to see that no damage has resulted during the process of installing the breaker.

Test the wiring for possible grounds or short circuits.

Make sure that all current carrying parts outside the oil circuit breaker have an adequate current carrying capacity and are correctly insulated in accordance with standard practice.

See that all tanks are filled with good oil to the proper level as indicated by the oil gauges.

Make sure that the drain and fill valves are tightly closed and that their pipe plugs are securely in place.

## CINCINNATI SPEED RECORDER

The interrupting devices used on Allis-Chalmers oil circuit breakers depend on proper opening speed for their most efficient performance (See Adjustment Tabulation). A breaker that is opening too slow will not have proper electrical clearance to interrupt the arc within its rated time while too fast opening will not allow proper shock absorber reaction near the end of the opening stroke. Either of these conditions can cause serious damage to the equipment.

To facilitate checking the operating speed, all Allis-Chalmers oil circuit breakers have the top of the lift rod on the first pole tapped with a 10-32 thread. Provision is made for bringing a rod from this tapped hole out through the top of the breaker.

A stand is also furnished with each order for mounting a speed recorder. The top of the breaker and the stand are coordinated to facilitate mounting.

Before mounting the stand and the recorder, be sure all high tension leads to the breaker are dead and that provision has been made to have the shock absorbers filled with oil.

An excellent speed recording device that will readily fit the stand is the "Circuit Breaker Operation Analyzer" sold by the Cincinnati Clock and Instrument Company, 1060 Hulbert Street, Cincinnati, 14, Ohio. This device, when used in accordance with instructions furnished by its supplier gives a record of lift rod travel versus time.

Opening speed of Allis-Chalmers oil circuit breakers is listed as the average for the first four inches after contacts part. Locate a point on the opening chart corresponding to four inches below the contact part line. Draw a straight line through this point and the contact part point. The slope of this line is considered to be the opening speed of the breaker being tested.

## MAINTENANCE

Allis-Chalmers oil circuit breakers are precision built machines, designed to operate rapidly and efficiently when it is required. Upon this operation, depends the safety of the operators and the successful functioning of the connected apparatus. Therefore, the circuit breaker must have regular, systematic and thorough inspection. The following points require special attention.

Be sure that the breaker and its operating mechanism are disconnected from all electric power before starting any inspection or any repair work.

It is recommended that the breaker be inspected mechanically and electrically at least once every six months. However, if the breaker has interrupted at or near its rated capacity, the current carrying parts and interrupting devices should be checked as soon as it can be conveniently taken off the line rather than waiting for its next routine inspection.

Inspect the operating and breaker mechanism periodically and lubricate all bearing surfaces regularly with a good quality, light, non-gumming lubricating oil having a pour point below -40 deg. centigrade.

See that the oil is kept at a proper level in the tanks and that the proper dielectric strength of the oil is maintained. It is recommended that the oil be changed or filtered once a year or more often, depending upon the severity of the service.

Operating the mechanism several times each month will insure continued free operation of the mechanical parts and reduce the accumulation of oxidized oil on the breaker contacts. It is recommended that this practice be followed by all users of oil circuit breakers.

On pneumatic or Pneu-draulic operated breakers, be sure that the pressure in the air tank or the accumulator has been bled off before inspecting or repairing any part of the breaker and its equipment. For additional information, refer to the special operator instruction book furnished.

## REPLACEMENT PARTS, GENERAL

When ordering replacement parts for an Allis-Chalmers oil circuit breaker it is very important to give complete information. This information should include:

(1) Number of pieces required,

(2) Reference Number,

(3) Instruction Book Number,

(4) Description of Part (Use instruction Book descriptions in so far as possible),

(5) Type of breaker,

(6) Rated amperes of breaker,

(7) Rated voltage of breaker,

(8) Breaker Serial Number (Found on the 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, Allis-Chalmers Mfg. Company 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 dimentioned sketch of the desired part will help to properly identify it.

Allis-Chalmers Mfg. Company recommends that a supply of repair parts be kept on hand so that emergency repairs can be made without waiting for a shipment of parts from the factory. A list of recommended spare parts is included in this book. Two columns on this list give the quantities recommended for an installation of one to five breakers and for an installation of five or more breakers.

Before removing any part to be replaced observe its function and adjustment. By so doing, it is usually possible to avoid any appreciable amount of adjustment after the installation of the part.

## FZO-50

### LIFT ROD (Ref. Fig. 2)

When a replacement lift rod (231) is furnished, it is shipped with the top clevis and the bridge supports riveted in place.

Remove the cap screws (212) and the plunger supports (211) and plunger (223). Remove the cap screws (225) and the side plates (241).

Remove the cap screws (240) and the bridges (203), being careful not to lose the spacers (226).

Remove the nuts on the cap screws (238) and one rod guide side plate (228), being careful not to lose the rollers (239) or their spacers.

Remove the pin (230) to free the lift rod (231).

Re-assembly is the reverse of the above.

Refer to Section 11 for adjustment of the bridge (203) and and the plungers (223).

CAUTION: DO NOT OPERATE THE BREAKER UNTIL AFTER THE BRUSHES HAVE BEEN PROPERLY ADJUSTED AS THEY CAN BE DAMAGED BY OVER-FLEXING.

### STATIONARY ARCING CONTACT (Ref. Fig. 3)

To change a stationary arcing contact (305) first, remove the clamp ring (303) and the pot (309) by removing the cap screws (322). Be careful not to lose the washer (307).

Remove the plate (315) by taking out the screws (316). Remove the cap screw (317) and take out the contact assembly (305), the shunt (333) and the shunt shield (302) as a unit.

Separate the contact assembly (305) and the shunt (333) by removing the cap screws (318). Lift off the washer (312).

Re-assembly is the reverse of the above.

When installing the contact assembly (305) in the hood (301), be sure the shunt (333) is in the position shown on Fig. 3 otherwise, it is possible for the shunt shield (302) to block the vent holes in the hood (301).

Refer to Section 11 for Instructions on Adjusting the Contacts.

MAIN STATIONARY CONTACT (Ref. Fig. 3)

To change a brush contact (326), it is only necessary to remove the cap screw (324), being careful not to lose the plates (323) (325), and (327).

When installing the new brush (326), the long side is toward the bottom as shown On Fig. 3). The short plate (327) is under the brush (326) and the long plate (325) on top.

Be sure to refer to Section 11, Adjustments, before operating the breaker.

CAUTION: DO NOT OPERATE THE BREAKER UNTIL AFTER THE BRUSHES HAVE BEEN PROPERLY ADJUSTED AS THEY CAN BE DAMAGED BY OVER-FLEXING.

HOOD (Ref. Fig. 3)

To replace a Ruptor hood (301), remove the Ruptor Pot (369) and clamp ring (303) by removing the cap screws (322).

Remove the contact assembly (305) and the brush (326) as outlined above.

Remove the cap screws (311) and slide the hood (301) off the sleeve (310).

Put the new hood (301) on the sleeve (310) and put the cap screws (311) loosely in place. Rotate the hood (301) until the bottom machined surface is level. Tighten the cap screws (311).

When installing the contact assembly (305) in the hood (301) be sure the shunt (333) is in the position shown on Fig. 3). Otherwise, it is possible for the shunt shield (302) to block the vent holes in the hood (301).

When installing the brushes (326), the long side is toward the bottom as shown on Fig. 3.

The short plate (327) is under the brush (326), and the long plate (320) on top.

Be sure to refer to Section 11, Adjustments, before operating the breaker.

CAUTION: DO NOT OPERATE THE BREAKER UNTIL AFTER THE BRUSHES HAVE BEEN PROPERLY ADJUSTED AS THEY CAN BE DAMAGED BY OVER-FLEXING.

RUPTOR THROAT (Ref. Fig. 3)

To change a ruptor throat (308), remove the cap screws (322), the clamp ring (303), and the pot (309), being careful not to lose the washer (307).

Lift out the tube (306), the washers (304), and the throat (308).

Re-assembly is the reverse of the above. After installing the Ruptor pot (309) and clamp ring (303), close the breaker slowly with the maintenance closing device and be sure that the plungers (223, Fig. 2) pass up through the throat (308) without interference.

BUSHING (Ref. Figs. 2 & 3)

Before a bushing can be removed, it will be necessary to remove the Ruptor (222). While this can be done without removing the Ruptor pot (309), necessary adjustments cannot be made with the pot (309) in place. Therefore, the following procedure is recommended.

Remove the cap screws (322), the clamp ring (303), and the pot (309), being careful not to lose the washer (307).

Measure and record the vertical distance from the bottom of the plate (315) to any convenient surface.

Remove the cap screws (311) and slide off the ruptor hood (301). Remove the sleeve (310).

Remove the cap screws (217) and lift out the bushing (215), being very careful not to damage the transformer (205) or the ground shield (216).

Refer to Section 14, HOW TO MAKE GASKETED JOINTS, and remove and replace the mounting flange gasket (218).

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 Allis-Chalmers Mfg. Co., Boston Works 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 ddmage to the porcelain parts. Lifting eyes are provided on the mounting flanges of all bushings and they should be used for all lifting of the bushings. After removing the bushings from the crates, place them in a vertical position and thoroughly clean all exposed porcelain parts.

As these bushings are symmetrical, they can be installed in any position. However, for convenience when it is desired to obtain a bushing serial number, they are generally installed with the nameplates toward the outside of the breaker.

The bolts clamping the bushings against the apparatus cover opening should be tightened slowly and uniformly. 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.

Install the sleeve (310) and the hood (301), but do not tighten the cap screws (311) at this time.

Turn the sleeve (310) up or down on the bushing until the vertical distance from the bottom of the plate (315) to the selected reference point is the same as was originally recorded. Be sure the bottom machined surface of this plate is level and tighten the cap screws (311).

Refer to Section 11 and adjust the contact penetration and brush pressure.

CAUTION: DO NOT OPERATE THE BREAKER UNTIL AFTER THE BRUSHES HAVE BEEN PROPERLY ADJUSTED AS THEY CAN BE DAMAGED BY OVER-FLEXING.

Install the ruptor pot (309) and clamp ring (303). Close the breaker slowly with the maintenance closing device and be sure the plungers (223). Pass up through the throats (308) without interference.

## CURRENT TRANSFORMERS

### FZO-50

GENERAL (Ref. Figs. 2 & 3)

Allis-Chalmers Type FZO-50 breakers are normally equipped with six multi-ratio relaying accuracy bushing current transformers wired as shown on Fig. 7. However, a second transformer may be added to one or more bushings if desired.

In order to add or change a transformer, the ruptor and bushing will have to be removed, while the ruptor can be removed as a unit, necessary adjustments cannot be made with the pot in place. Therefore, the following procedure is recommended.

Remove the cap screws (322), the clamp ring (303), and the pot (309) being careful not to lose the washer (307).

If the bushing is to be replaced, measure and record the vertical distance from the bottom of the plate (315) to any convenient surface. If the original bushing is to be re-installed, this measurement is not necessary.

Remove the cap screws (311) and slide off the ruptor hood (301). If a new bushing is to be used, remove the sleeve (310), otherwise, do not disturb this sleeve (310).

Remove the cap screws (243) and lift out the bushing (215) and adapter (242), being careful not to damage the ground shield (216).

FIRST CONDITION

To change a top transformer or add a second transformer per bushing.

With the bushing and adapter removed, open the unilet cover (240) at the position where the work is to be done.

If a top transformer is to be changed, break the joints of the transformer to be replaced and cut off the lugs (250) on these leads.

If a top transformer is to be added, break the joints of the corresponding bottom transformer leads and cut off the lugs (250).

Loosen the gas baffle union (249) and pull the wires of any transformer to be removed through the gas baffle washers (248). The transformer (205) can then be lifted out of the well.

Install the new transformer (205) in the well with the polarity mark ( a white spot on the top of the transformer) in the "UP" position.

If this is a replacement transformer, feed the leads through the holes in the gas baffle washers (248).

If this is an additional transformer, remove and discard the gas baffle washers (248) and replace them with the new ones provided. Feed the leads of both the upper and the lower transformer through the holes in the gas baffle washers (248).

In both cases, make up the union (249) forming a gas seal. Attach the lugs (250).

By making up the joints in the unilet (245) with either the existing wires or with the new leads furnished with a transformer to be added, the transformers can be wired to their terminal blocks in the operating cabinet.

Refer to Section 14, "How to make gasketed joints" and remove and replace the bushing adapter gasket (244).

Install the bushing (215) and adapter (242) being careful not to damage the ground sleeve (216) or the transformers (205).

The bolts clamping the adapter to the breaker should be tightened slowly and uniformly. Do not attempt, on the first tightening, to set them all down as far as they will go. Such practice might distort the adapter flange or damage the gasket.

Install the hood (301). With the bottom surface of the plate (315) level, tighten the cap screws (311).

Refer to Section 11 and adjust the contact penetration and brush pressure.

CAUTION: DO NOT OPERATE THE BREAKER UNTIL AFTER THE BRUSHES HAVE BEEN PROPERLY ADJUSTED AS THEY CAN BE DAMAGED BY OVER-FLEXING.

Install the ruptor pot (309) and clamp ring (303). Close the breaker slowly with the maintenance closing device and be sure the plungers (223) pass up through the throats (308) without interference.

SECOND CONDITION

To change a bottom transformer, remove the bushing (215) and adapter (242) and top transformer (205) as described under the first condition. The bottom transformer can then be lifted out.

Reassembly will be the same as described under the first condition. Be sure to change the adaptor gasket (244).

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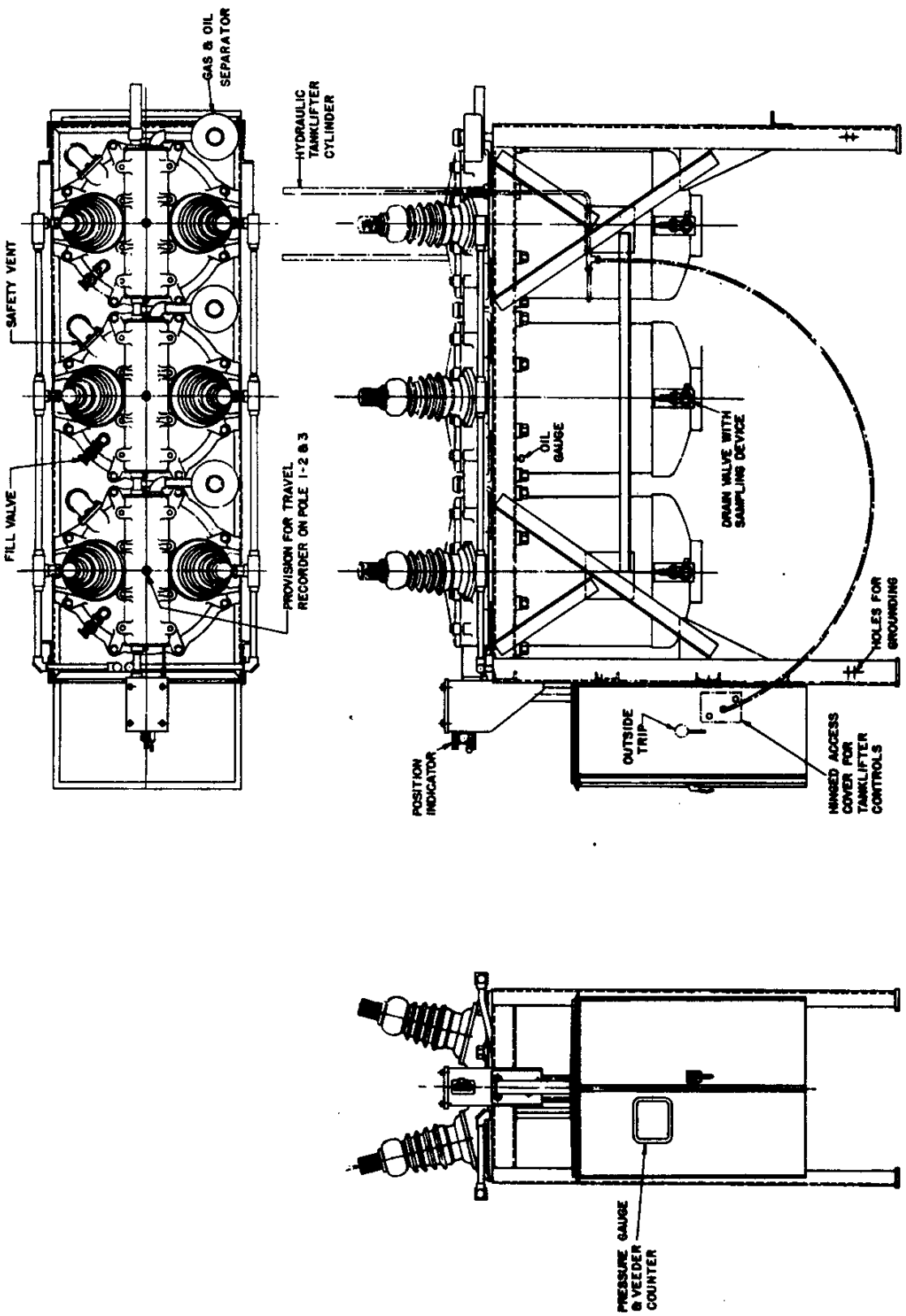


FIG. 1

TYPICAL FZO-50 OUTLINE

DEC. 23, 1957

7I-400-998

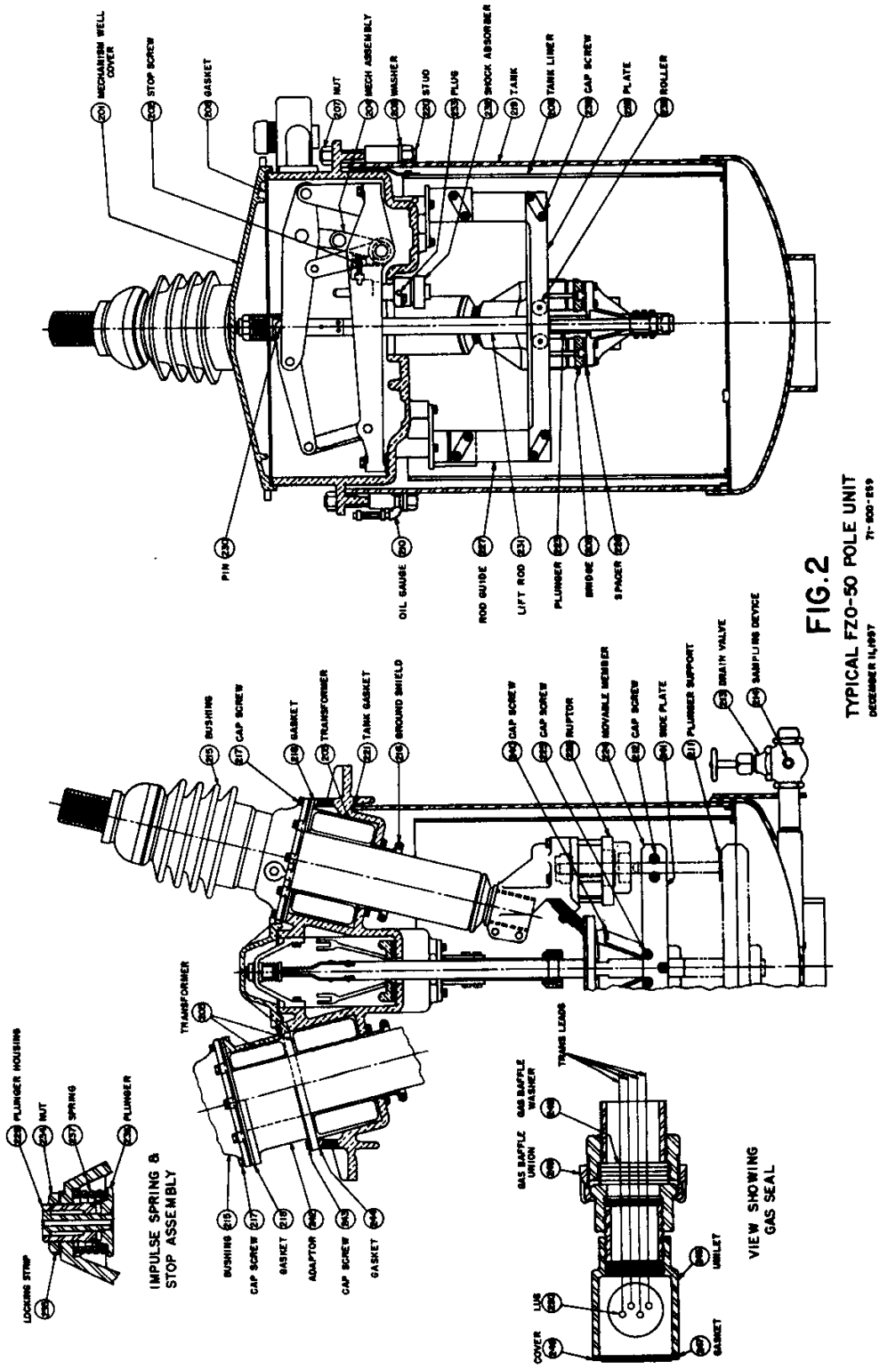


FIG. 2

TYPICAL FZO-50 POLE UNIT

DECEMBER 14,1967 71-500-259

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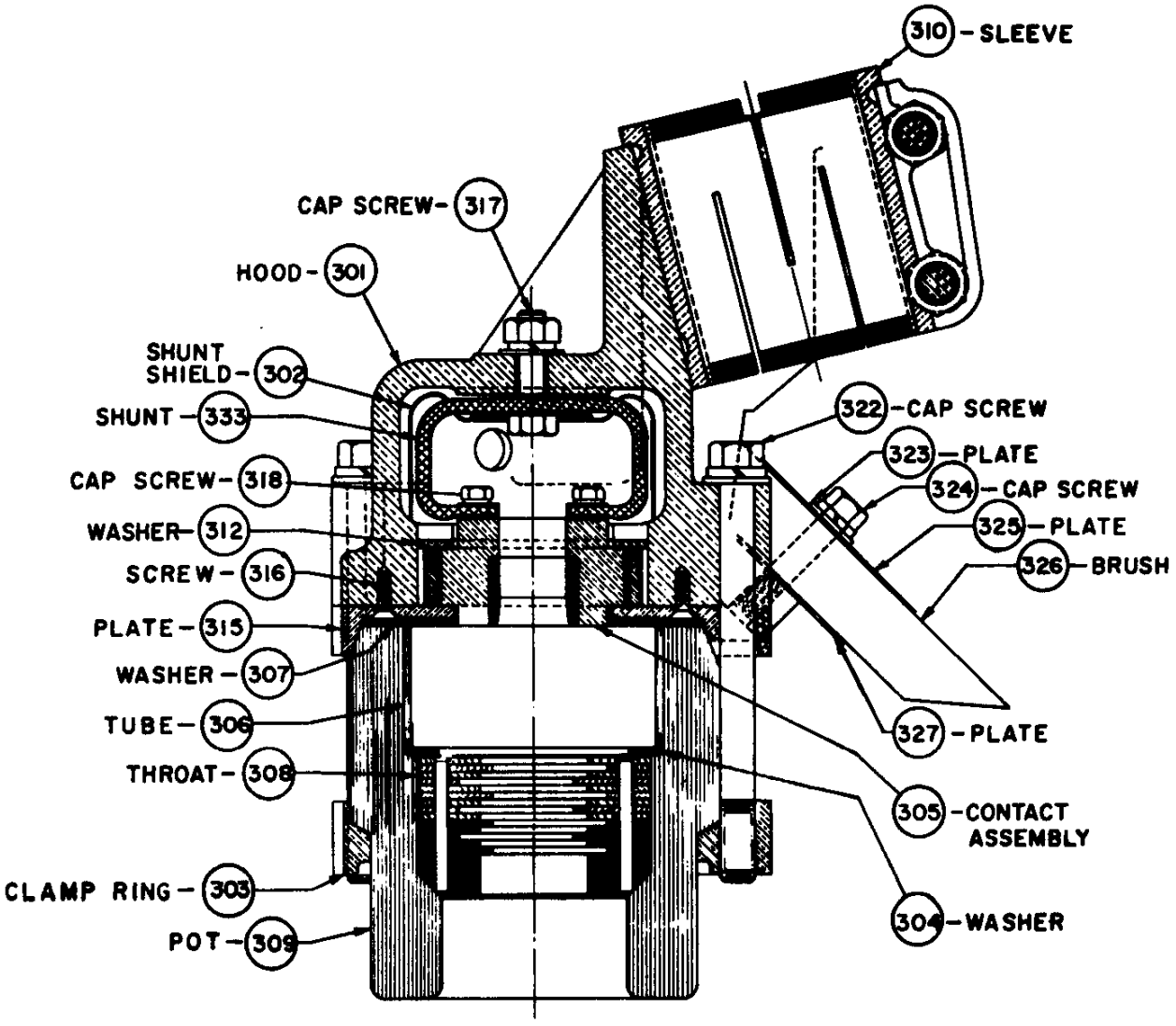
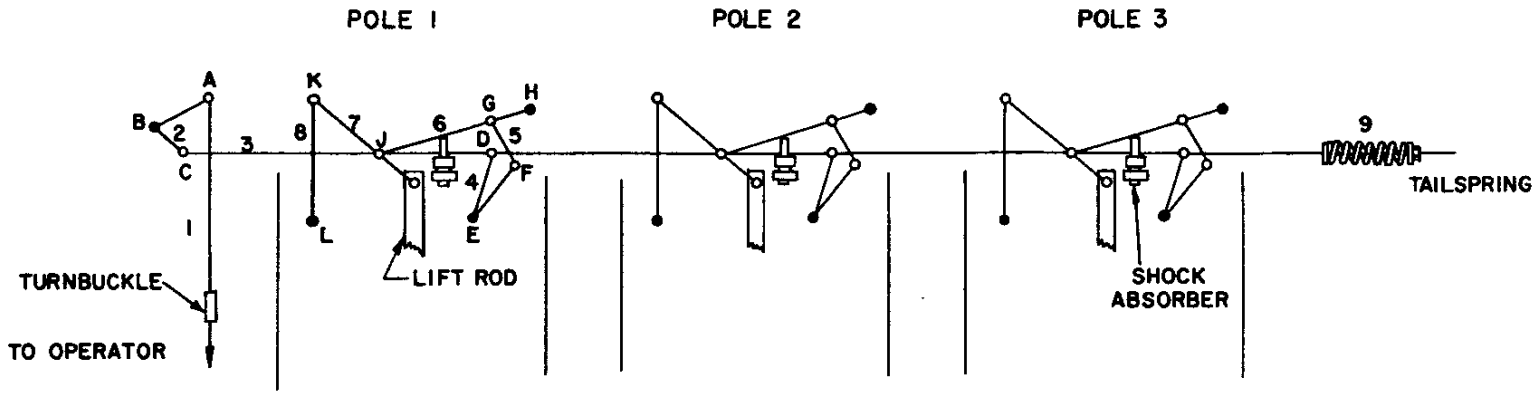



# FIG. 3

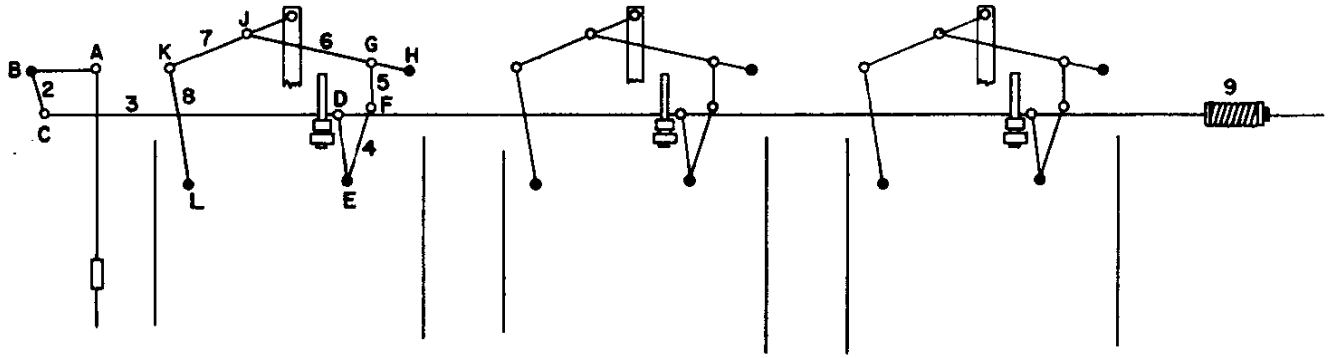
TYPICAL RUPTOR

12-16-57 71-206-434




BREAKER OPEN

●--FIXED CENTERS
○--MOVABLE CENTERS




BREAKER CLOSED

# FIG. 4

## TYPICAL FZO-50 MECHANISM

DECEMBER 27, 1957 71-301-674

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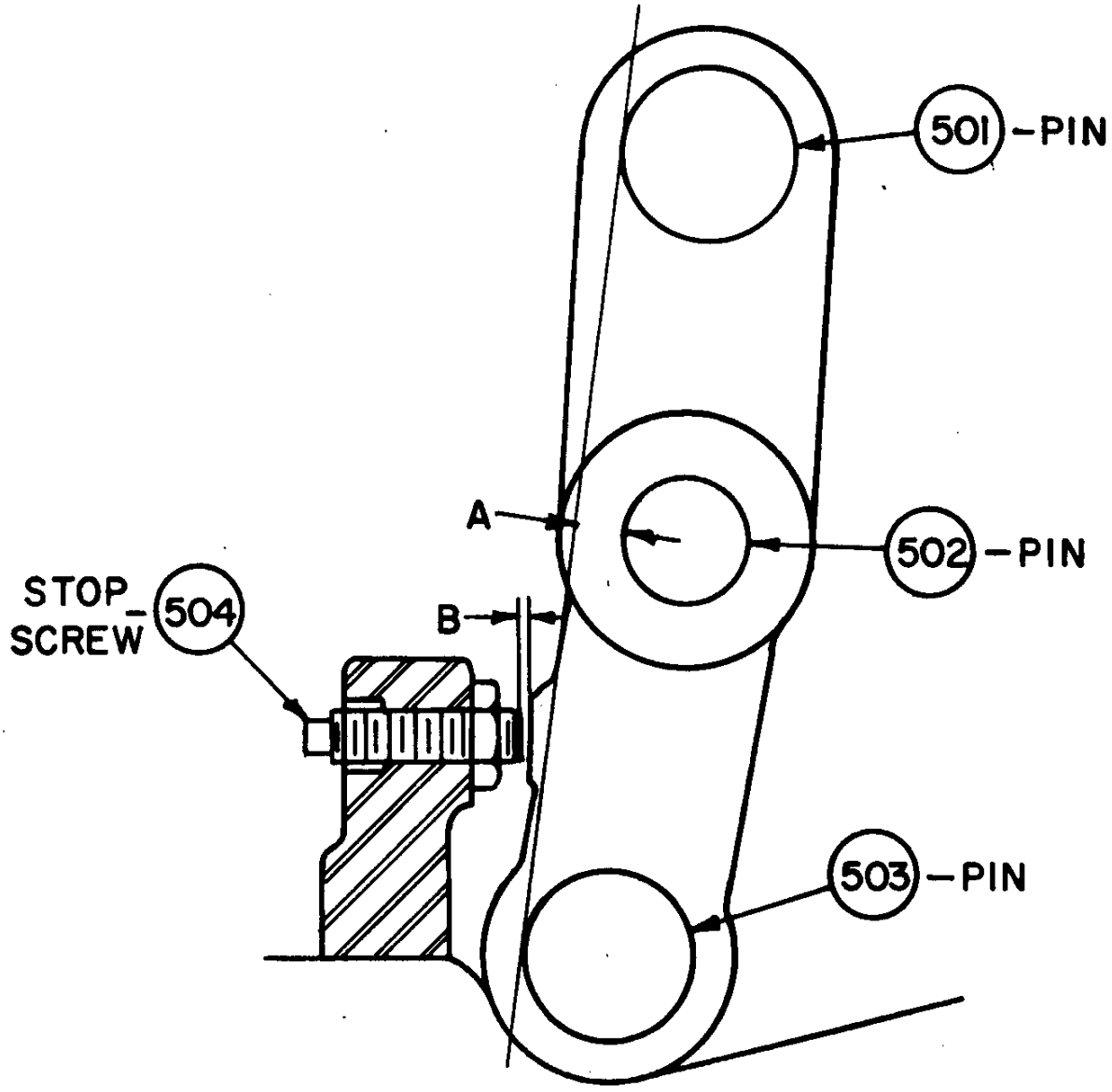



FIG. 5

TYPICAL TOGGLE SETTING

NOV. 12, 1957 71-109-013

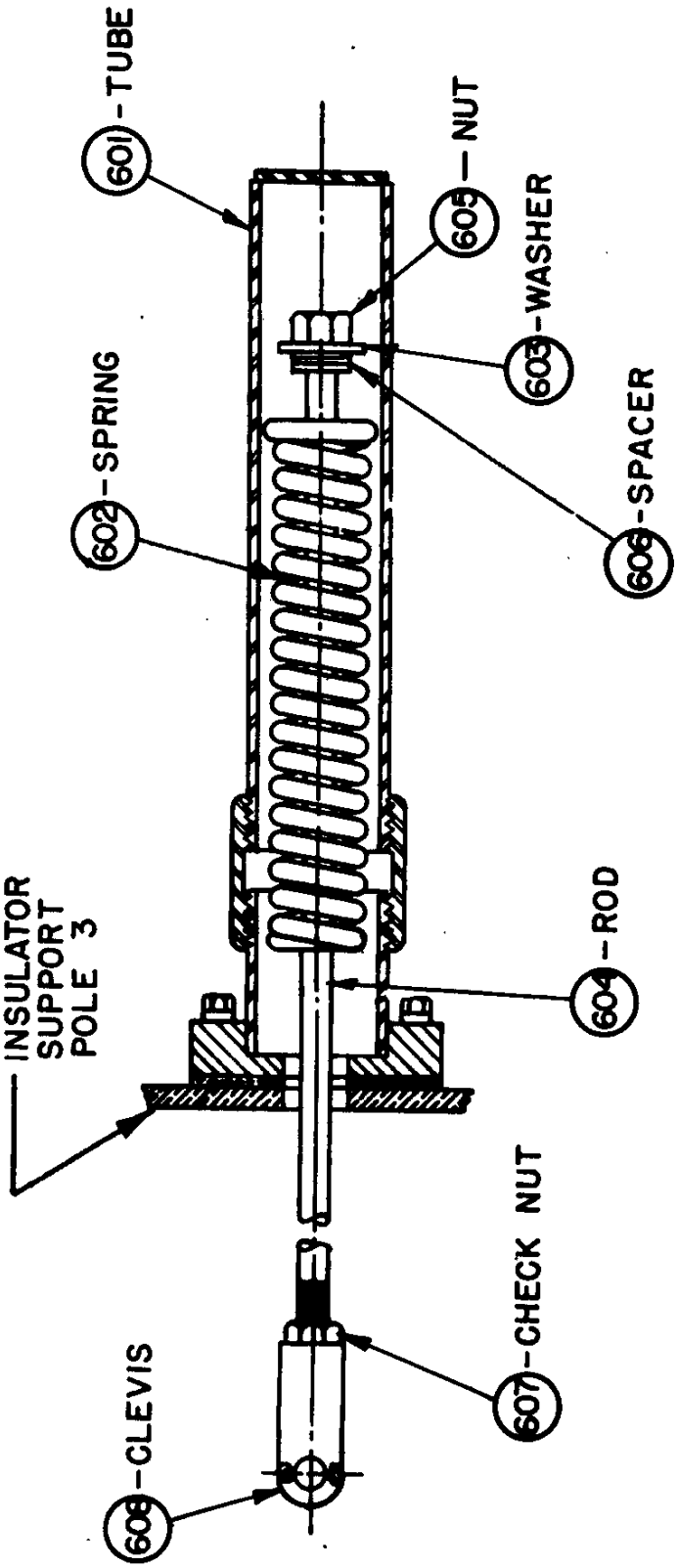



FIG. 6

TYPICAL TAILSPRING ASSEMBLY

DEC. 23, 1957 71-206-449

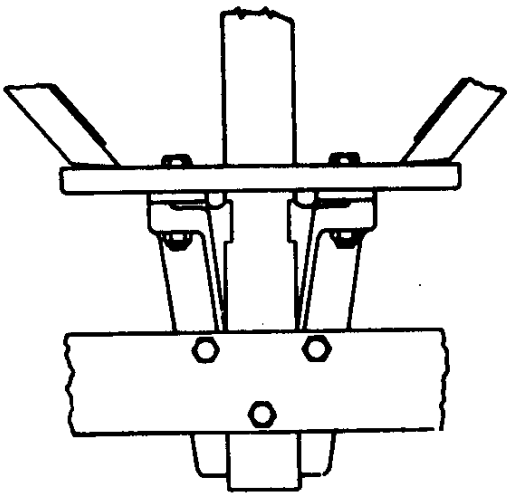


FIG. 8A

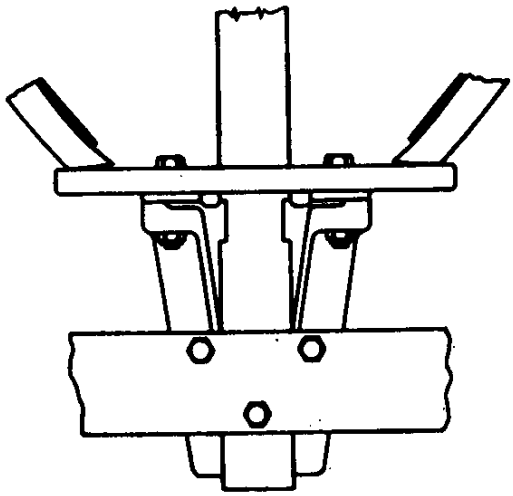


FIG. 8B

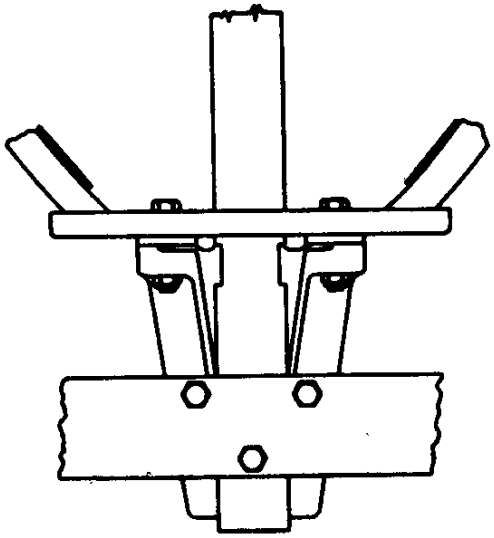
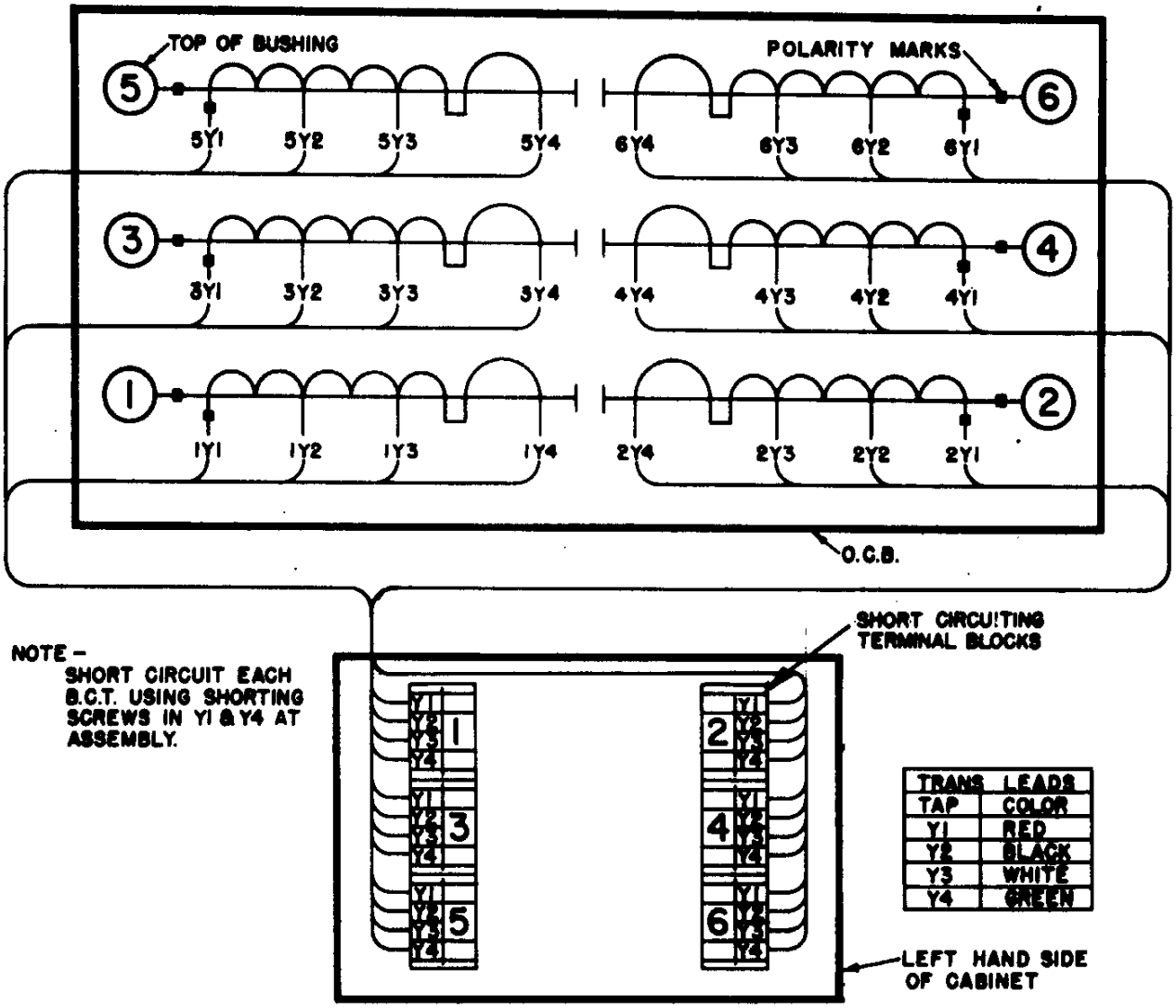


FIG. 8C

*Illustration CB-629*




# FIG. 7

## TYPICAL BUSHING CURRENT TRANSFORMER DIAGRAM

DEC. 30, 1957 71-109-325