



RECEIVING • INSTALLATION • MAINTENANCE

# INSTRUCTIONS

**De-ion<sup>®</sup> Grid**

## OIL CIRCUIT BREAKER

**Outdoor Type GM****5-Cycle Interrupting Time**

Type	Kv	Kva
GM-3B	115	1,500,000

**WESTINGHOUSE ELECTRIC CORPORATION**  
SWITCHGEAR APPARATUS DEPARTMENTS

EAST PITTSBURGH PLANT

EAST PITTSBURGH, PA.

NEW INFORMATION

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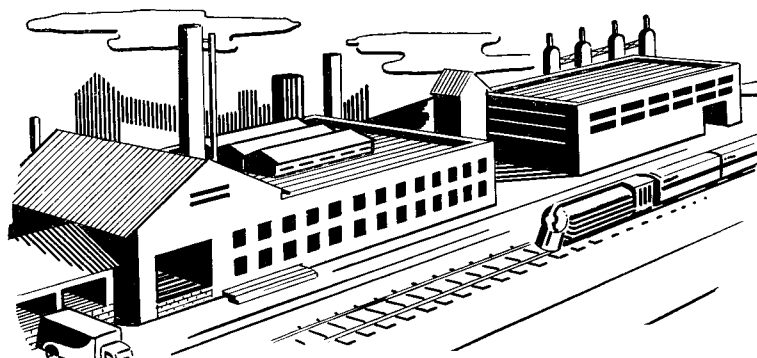
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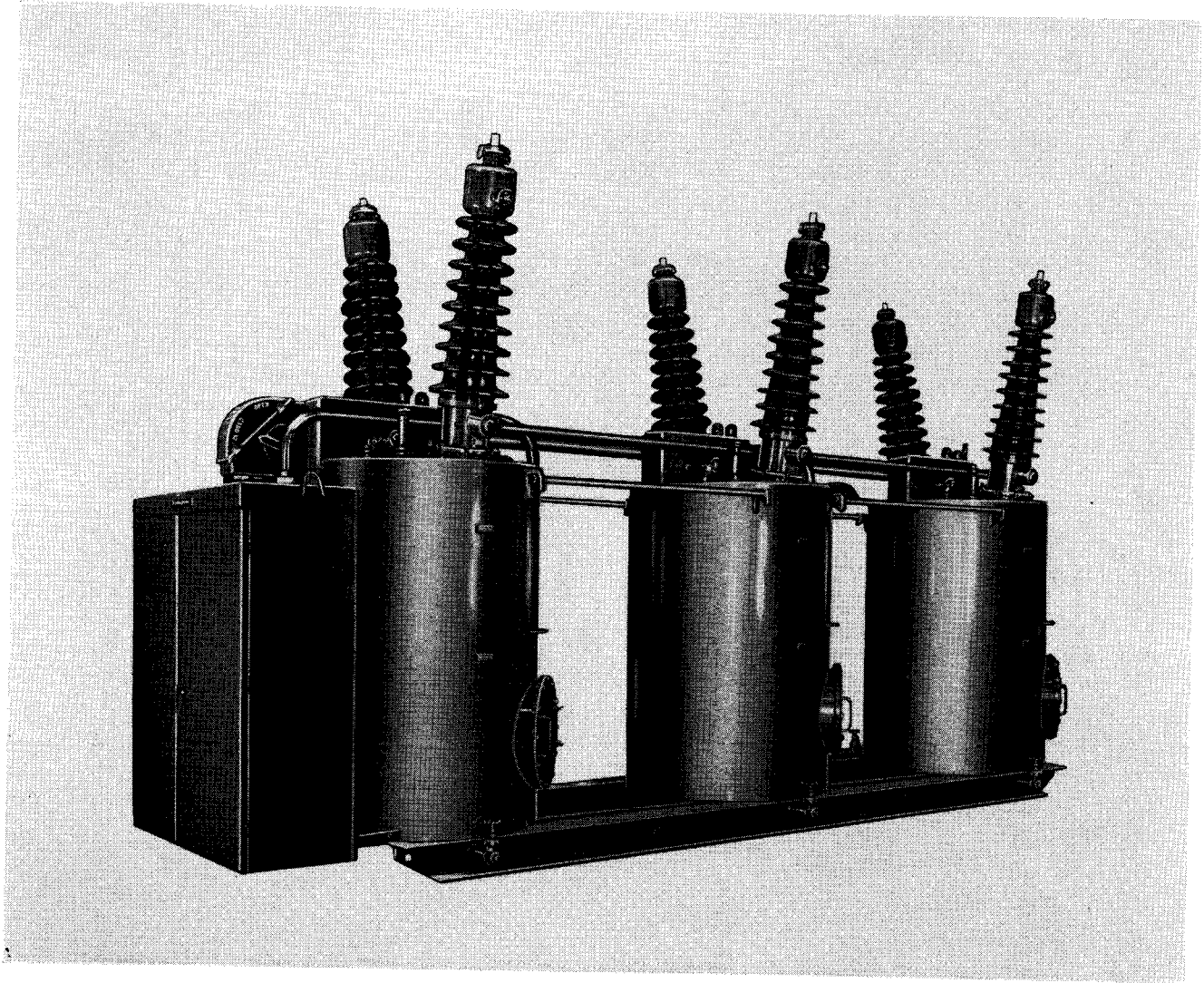
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## TYPE GM OIL CIRCUIT BREAKER

The oil circuit breaker is one of the most important units in the modern power transmission system, since the protection, stability and continuity of service of the entire system depend largely on the efficiency of its operation.

Basically, these oil circuit breakers consist of three individual pole units which are mechanically connected so as to operate simultaneously as a three-phase circuit breaker. The operating means for opening and closing the breaker is a mechanism of either the solenoid or the pneumatic type, located on the No. 1 pole unit. An individual operating mechanism on each pole may be used to operate each pole independently for single-pole reclosing duty.

Each pole unit consists of a circular tank of steel plate, with crowned top and bottom welded to the side plate; two outlet bushings of the condenser type which project through the tank top and are bolted to suitable outlet flanges; two interrupting units or grid stacks, one suspended from the lower end of each outlet bushing; one moving contact member which bridges the two interrupting units; one lever mechanism for operating the moving contact member; and (when ordered) bushing-type current transformers over the ground portion of the condenser bushings.

•

**Important:** Proper installation and maintenance are necessary to insure continued satisfactory operation of the circuit breaker. It should not be installed in places where it will be called upon to operate at voltages or currents greater than those given on the nameplate. The short circuit conditions to be imposed upon the breaker must not exceed those specified at the time the breaker was purchased. In addition, certain physical conditions must be carefully surveyed and planned for, as outlined under "Selecting the Location", page 10 of this book.

## PART ONE

# RECEIVING, HANDLING AND STORING

### RECEIVING THE SHIPMENT

Type GM breakers are shipped in three different ways. The standard method is partially assembled; that is with the three pole units welded to common H-beam base and condenser bushings and contacts packed in separate crates. When rail clearances and handling facilities permit breakers are shipped completely assembled with necessary internal shipping supports. In rare instances breakers are shipped dismantled as individual pole units.

When shipped as individual pole units see supplemental literature for installation instructions.

**Important:** Immediately upon receipt of a circuit breaker, an examination should be made for any damage sustained while in transit. If injury is evident, or indication of rough handling is visible, file a claim for damage with the carrier (transportation company), and promptly notify the nearest Westinghouse Sales Office.

### UNPACKING PARTS AND ACCESSORIES

Certain parts of the breaker are of insulating material and must be protected from moisture, dirt, and damage due to rough handling.

As they are removed from the crates, place the various parts of the breaker in proper position for mounting on the permanent foundation.

To avoid delay in assembly, arrange the parts so that they will be accessible and ready to put into place conveniently. Refer to Fig. 1 for identification of the components, parts, and accessories.

Immediately check all items against the shipping list as they are unpacked and identified.

Always search the packing material carefully for bolts, screws, nuts, etc., which may have loosened in transit.

For immediate reference, keep Instruction Books and tags near the items they describe.

In the case of fully assembled breakers remove pull rod box cover on No. 1 pole and remove shipping bracket on horizontal pull rod. Also remove blocking from contacts. Make a very thorough examination for any damage sustained while in transit.

Partially assembled breakers have no shipping bracket or blocking. The mechanisms on both par-

tially assembled and fully assembled breakers are closed and latched and the trip free trigger locking bar inserted to prevent mechanism from unlatching.

### HANDLING TANKS AND BUSHINGS

The weight, with oil, of the breaker is engraved on the nameplate on the No. 2 tank. This information should serve as a guide to the lifting capacity of the crane or hoist to be used. The lifting lugs attached to the sides of the No. 1 and No. 3 tanks will bear the weight of the entire breaker (without oil).

Gallons of oil required is also shown on the nameplate. Oil weighs  $7\frac{1}{2}$  pounds per gallon. Weight of tank without oil may be determined by subtraction.

Condenser bushings are usually shipped in groups of six to a crate. †They are rigidly supported in a vertical position by mounting flanges which are bolted down as in actual service. The bushings should be unbolted and uncrated singly.

Particular care must be taken when removing condenser bushings from their boxes, since the porcelain insulating sections may otherwise become chipped or damaged.

Before attempting to uncrate the bushings, read carefully the procedure steps outlined in Fig. 2. (Duplicate instructions are attached to each bushing crate.)

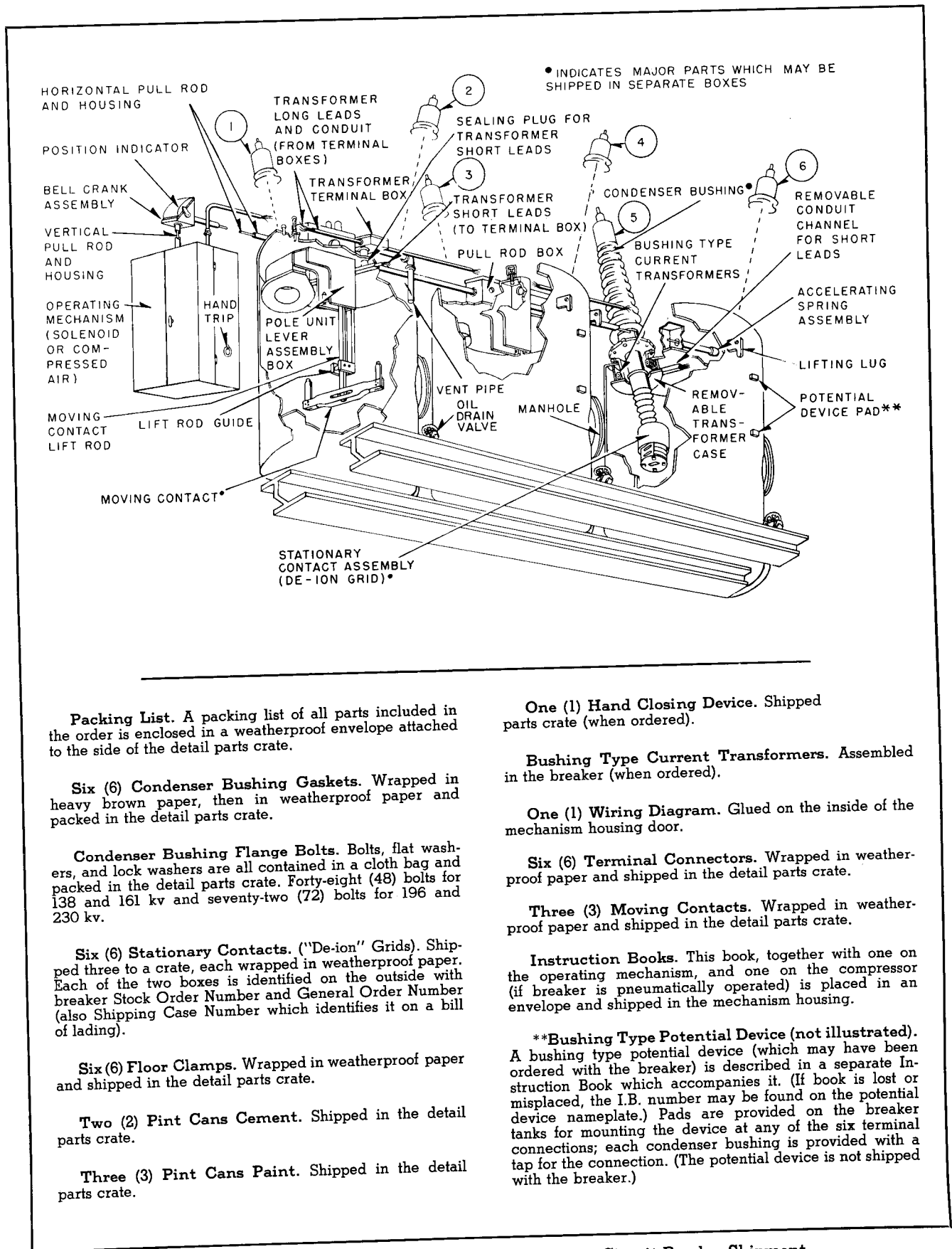
†Bushings not shipped on flatcars with other apparatus are packed singly in boxes and shipped in a horizontal position. For handling methods refer to Fig. 3.

**Important:** When using cable slings for supporting the apparatus, do not allow them to strike condenser bushings, since a strain on these may cause the porcelain sections to crack or break.

### STORING BREAKER PARTS

All insulating parts, such as lift rods, guides and De-ion Grid Stacks, must be stored in a dry place if the breaker is not to be immediately placed in service. In the case of fully assembled breakers, tanks must be filled with oil or 200 to 300 watts heat applied in each tank at safe distance from insulation so as to minimize condensation.

Spare lift rods or guides should be suspended in vertical position in a warm dry place.



**Packing List.** A packing list of all parts included in the order is enclosed in a weatherproof envelope attached to the side of the detail parts crate.

**Six (6) Condenser Bushing Gaskets.** Wrapped in heavy brown paper, then in weatherproof paper and packed in the detail parts crate.

**Condenser Bushing Flange Bolts.** Bolts, flat washers, and lock washers are all contained in a cloth bag and packed in the detail parts crate. Forty-eight (48) bolts for 138 and 161 kv and seventy-two (72) bolts for 196 and 230 kv.

**Six (6) Stationary Contacts. ("De-ion" Grids).** Shipped three to a crate, each wrapped in weatherproof paper. Each of the two boxes is identified on the outside with breaker Stock Order Number and General Order Number (also Shipping Case Number which identifies it on a bill of lading).

**Six (6) Floor Clamps.** Wrapped in weatherproof paper and shipped in the detail parts crate.

**Two (2) Pint Cans Cement.** Shipped in the detail parts crate.

**Three (3) Pint Cans Paint.** Shipped in the detail parts crate.

**One (1) Hand Closing Device.** Shipped parts crate (when ordered).

**Bushing Type Current Transformers.** Assembled in the breaker (when ordered).

**One (1) Wiring Diagram.** Glued on the inside of the mechanism housing door.

**Six (6) Terminal Connectors.** Wrapped in weatherproof paper and shipped in the detail parts crate.

**Three (3) Moving Contacts.** Wrapped in weatherproof paper and shipped in the detail parts crate.

**Instruction Books.** This book, together with one on the operating mechanism, and one on the compressor (if breaker is pneumatically operated) is placed in an envelope and shipped in the mechanism housing.

**\*\*Bushing Type Potential Device (not illustrated).** A bushing type potential device (which may have been ordered with the breaker) is described in a separate Instruction Book which accompanies it. (If book is lost or misplaced, the I.B. number may be found on the potential device nameplate.) Pads are provided on the breaker tanks for mounting the device at any of the six terminal connections; each condenser bushing is provided with a tap for the connection. (The potential device is not shipped with the breaker.)

FIG. 1. Parts and Accessories Included in a Complete Circuit Breaker Shipment

## RECEIVING, HANDLING AND STORING

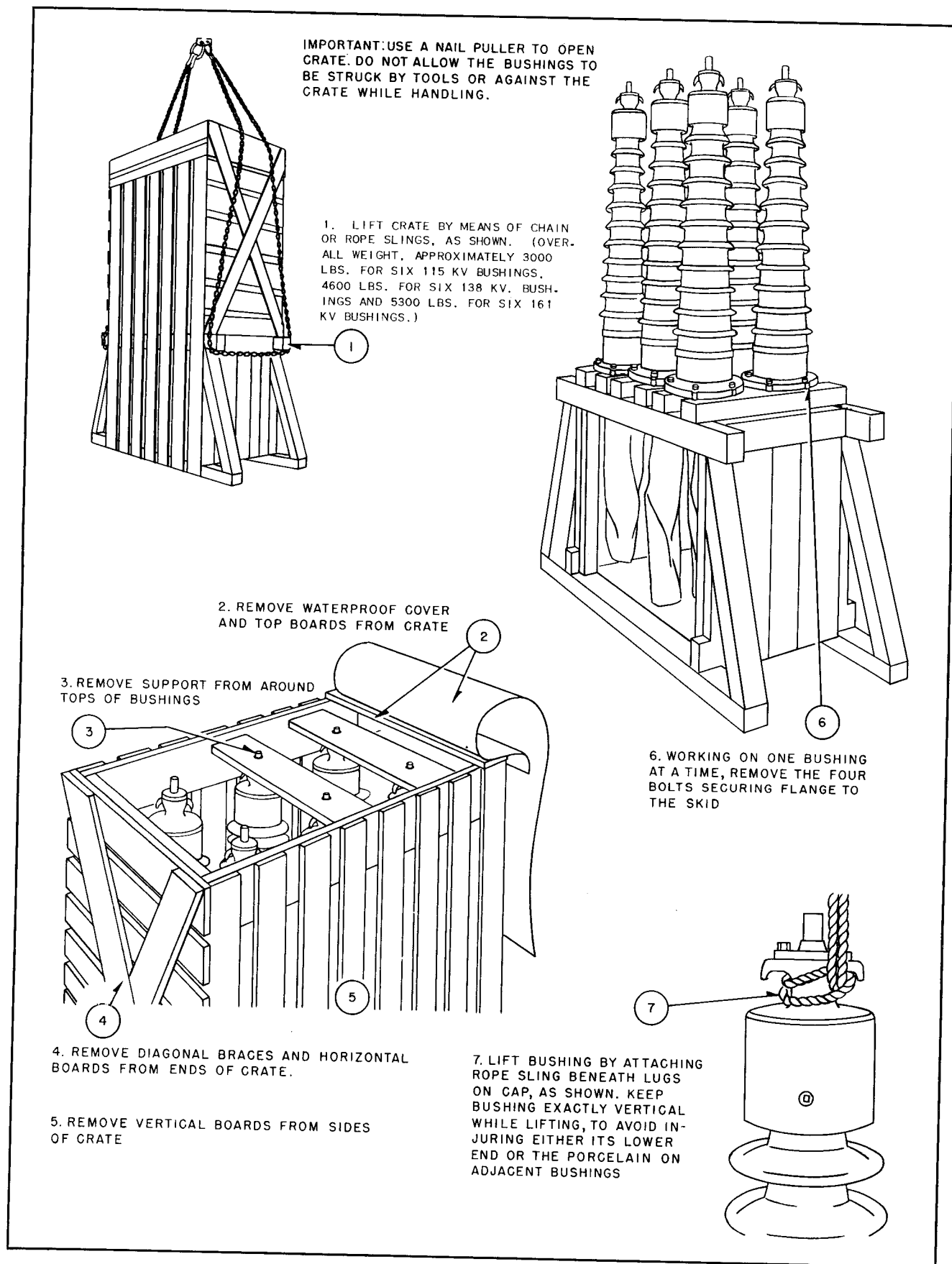


FIG. 2. Procedure for Uncrating Vertically Packed Condenser Bushings



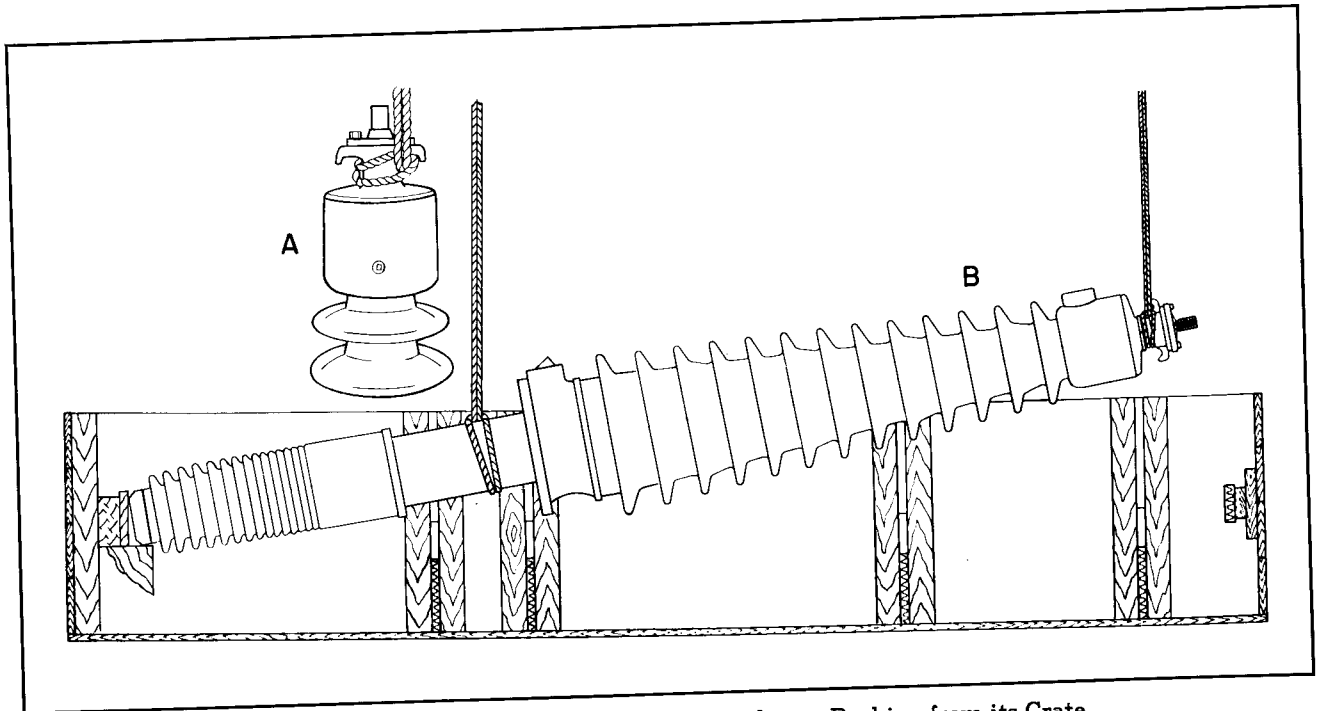


FIG. 3. Removing a Horizontally Packed Condenser Bushing from its Crate

**De-ion Grid Stacks.** *Do not remove the oiled paper covering from the De-ion Grid Stacks or allow them to become exposed to moisture at any time.* It is possible for the fibre in these stacks to absorb enough moisture, either from direct contact or from a humid atmosphere to swell and warp out of shape. Under extreme conditions, this swelling may break the stack tie rods. For this reason, if the stacks are to be stored for any length of time, or if the spare units are involved, they should be kept in containers filled with Wemco "C" oil.

**Condenser Bushings.** Condenser bushings are entirely encased in porcelain and are self-protected against moisture. They should be stored in a vertical position until ready to be installed in the breaker tanks.

**Operating Mechanism.** The operating mechanism housing is weatherproof, but the space heaters should be energized as soon as possible, even to the extent of using temporary wiring, in order to prevent corrosion due to moisture condensation inside the housing.

## PART TWO

# INSTALLATION

### SELECTING THE LOCATION

The oil circuit breaker should be located so that it will be readily accessible for cleaning and inspecting. Sufficient space must be provided for opening the mechanism housing doors and operating the hand closing device.

The breaker foundation should be sufficiently high so that water will not enter the operating mechanism housing during flood conditions.

The breaker should not be installed where salt water spray or sulphur steam is present.

See outline and drilling plan, supplied prior to shipment, for necessary clearance dimensions and foundation bolt location.

### MOUNTING THE ASSEMBLY

All circuit breakers must be set reasonably level so that the moving parts within the breaker can operate freely. Otherwise, friction will develop, and undue strains which may cause breakage or defective operation will be imposed upon the lift rods and other moving contact details.

The entire 3-pole H-beam mounted assembly may be leveled by shimming before clamping rigidly to foundation. Both fully assembled breakers and partially assembled breakers (without bushings and contacts assembled) have tanks accurately aligned at factory. In case of fully assembled breakers all mechanical alignment and adjustments have been made at factory. Upon securing to foundation shipping ties on mechanism and contact blocking in tanks should be carefully removed. The breaker should be opened slowly by means of hand closing device on mechanism and entire assembly carefully inspected for loose hardware and any damage incurred in transit. All defects should be corrected and hardware tightened thoroughly. Check all settings including bell crank, lift rod and toggle stops and stop clearances to make sure they are still correct. Refer to succeeding paragraphs. Contact alignment and adjustment should be checked per pages 14 to 18.

Partially assembled units in addition to having tanks properly aligned have interpole connecting pipes, operating rods, conduit, transformers and transformer leads already in place.

The bell crank assembly which is above the operating mechanism on the No. 1 pole unit; the function of which is to convert vertical movement of the

operating mechanism into the horizontal movement of the pull rod assembly is properly set at the factory and should not need adjustment.

When the breaker is closed, check the position of the bell crank. The dimensions should conform to the corresponding figure in Fig. 4.

If the position is incorrect, it may be shifted by lengthening the horizontal pull rod and shortening the vertical pull rod, or vice versa.

Re-check this setting before making final adjustments.

Also lift rod end and toggle stops have been set at the factory to properly position the lever system. With these stops properly set the clearances between the lift rod and its stop and the toggle lever and its stop

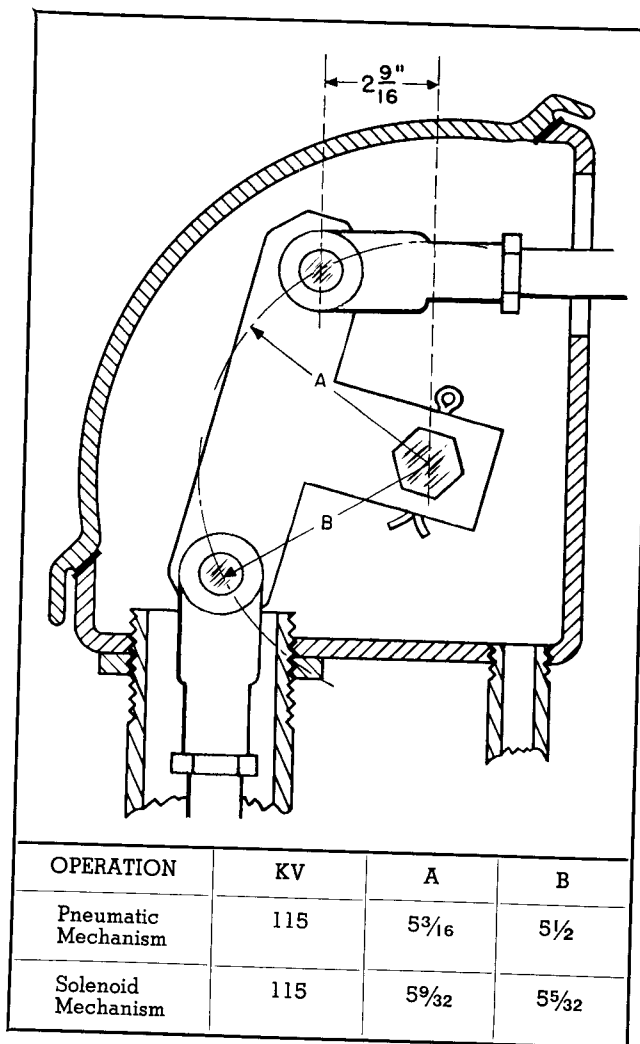


FIG. 4. Bell Crank Adjustments

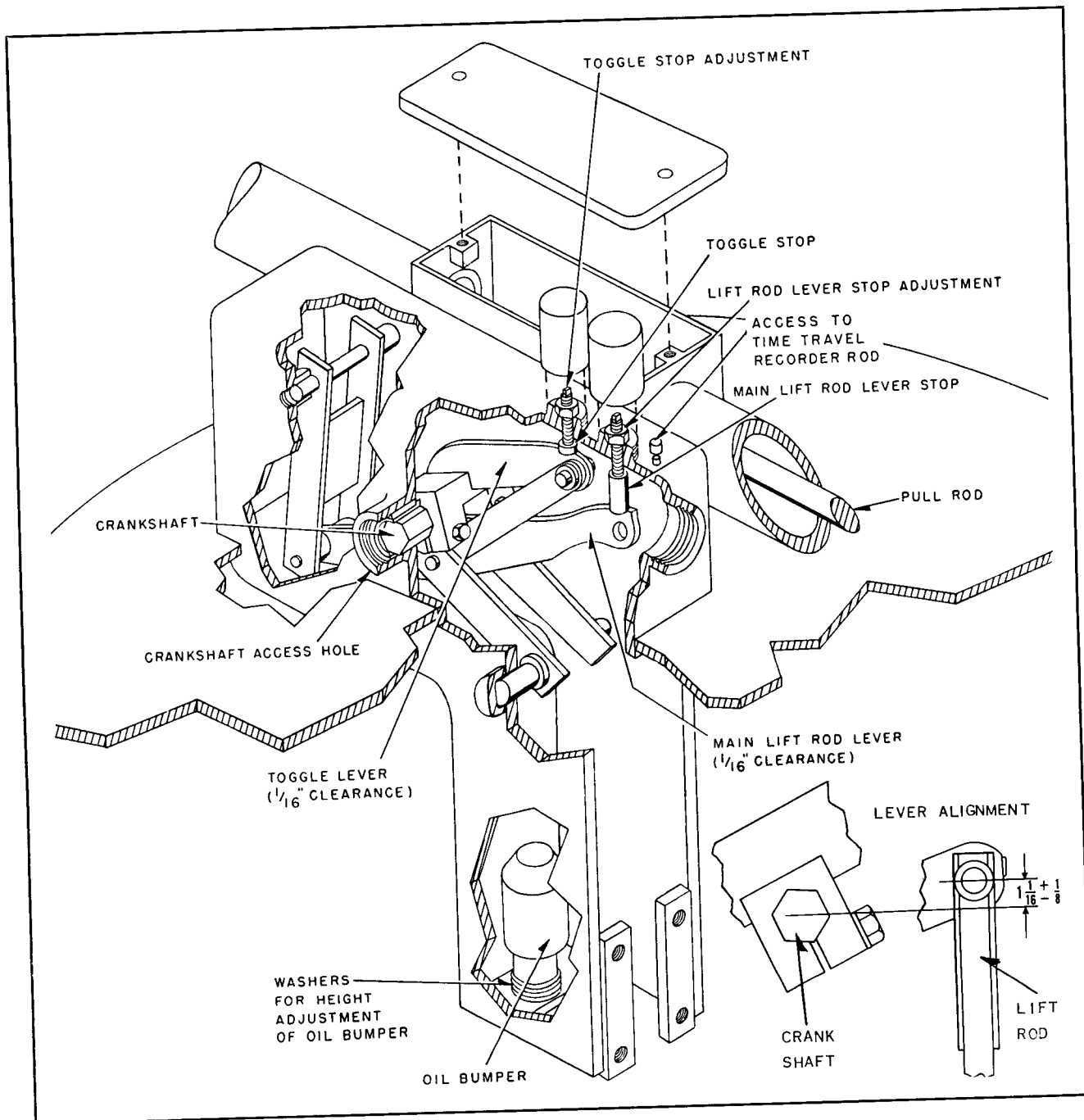


FIG. 5. Section View of Pole Unit Lever Mechanism

have been set at  $\frac{1}{16}$ " by adjusting the lengths of the horizontal pull rods with breaker closed and just latched (no overtravel). The settings were made with normal accelerating spring load and contact loading, so that stop clearances should check closely. These clearances may be checked by removing pipe plugs inside of lever box. (See Fig. 5.) Close manually to check stops.

If for some reason the stop settings have been disturbed or there is any suspicion that they are not

correct, check the position of the toggle lever as indicated under "pole unit lever system" page 24.

Once it has been determined that the stop settings are correct, they should not be changed in order to get the  $\frac{1}{16}$ " clearance. The correct procedure to get the proper clearance is to adjust the pull rod lengths between poles. If clearances on all three poles are off same amount the horizontal pull rod from the bell crank to No. 1 pole only need be adjusted. Pull rod lengths are adjusted by disengag-

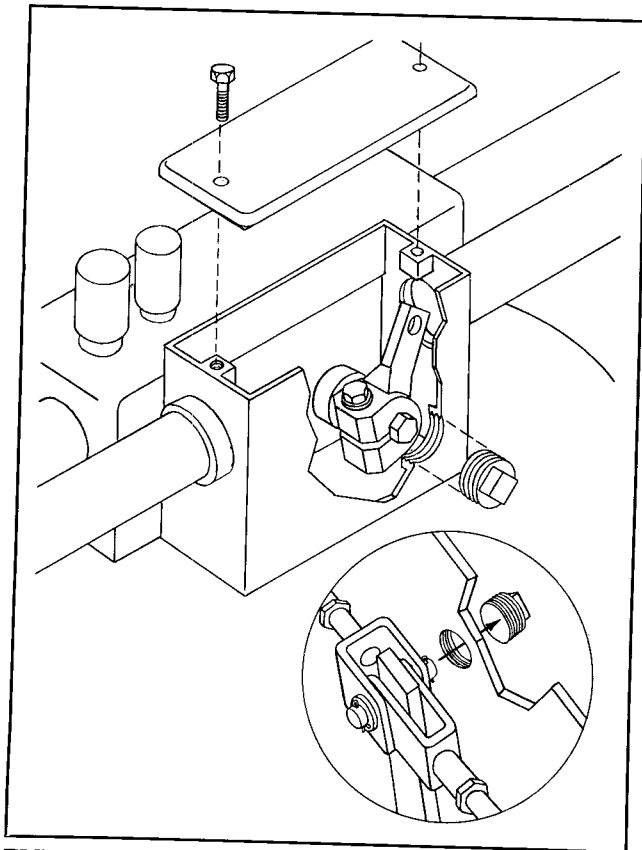


FIG. 6. Cutaway View of Pull Rod Housing Box Showing Pull Rod Lever. Inset Shows Access Plug and Clevis Joint Assembly

ing clevis joints and making half-turns of clevis rod ends while breaker is in open position.

If stop clearances are off various amounts, adjustments should be made starting with No. 1 pole to get  $\frac{1}{16}$ " clearance at all lift rod and toggle stops. Refer to Figs. 5 and 6.

In the case of pneumatic operated breakers when it is necessary to disengage rod end at No. 3 pole it is necessary to relieve tension on the acceleration spring rod at the end of the No. 3 pole. (See Fig. 18.) To do this remove the spring housing cap, loosen the locking screw and back off the adjusting nut.

After re-assembly be sure to move the spring adjusting nut back to its original position.

In the case of partially assembled breakers (shipped with contacts and bushings removed) it is not necessary to make fine adjustments of lift rod and toggle stop clearances at this time, since it will be necessary to re-check the stop clearances after the contact load is added.

*Note: Do not change the stop bolt settings to obtain proper clearance; these settings are made correctly at the factory and should not be changed. If the stop settings have been*

*disturbed or are suspected to be incorrect, check the position of the toggle lever as indicated under Pole Unit Lever System, page 24.*

## INSTALLING CONDENSER BUSHINGS

A suggested method for convenient handling of the condenser bushings when placing them in position in the tank tops is illustrated in Fig. 7. The bushing is raised by means of a cable or rope sling placed around the flange below the upper porcelain fitting, and an additional short sling looped around the top cap. The bushing should hang about 10 degrees from vertical.

Procedure for installation is then as follows:

1. Lower the bushing into position, making sure that the potential device receptacle faces away from the center of the breaker. The bushing must be

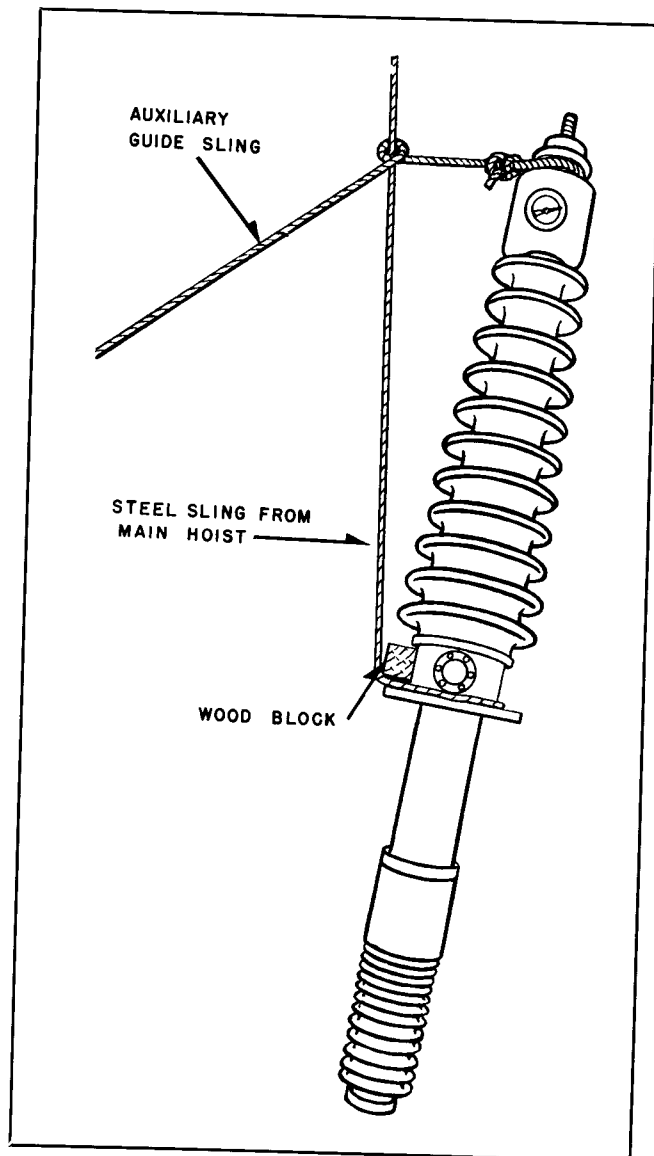


FIG. 7. Method of Suspending a Condenser Bushing at Proper Angle for Inserting Into Tank Top

**INSTALLATION****GM OIL CIRCUIT BREAKER**

lowered with great care in order to avoid damaging either the insulating tube on the inside of the transformer, or the porcelain on the bushing itself.

It is advisable to wrap a large sheet of fish paper, gasket material, or equivalent around the lower porcelain to prevent damage.

2. Cement gasket to tank flange and apply vaseline between gasket and condenser bushing. The vaseline will permit shifting the bushing without damaging the gasket. Lower the bushing into place as per Fig. 8 with eccentrics located as per Fig. 9. Before tightening the holding bolts, the bushings should be accurately aligned with respect to the centerline of the tank and lower ends spaced the proper distance apart. (See Pole Unit End View drawing Fig. 11.) Two open end wrenches per order or station are furnished for adjusting bushing eccentrics. To assist in assembling breakers which are shipped dismantled refer to copy of drawing 127-A-538 (for 115 KV and 138 KV breakers) filed in the pocket on inside of the mechanism housing door. On this drawing are noted the eccentric positions determined during factory assembly for test.

3. Make sure a bright ground contact is made between the bushing flange and the breaker tank before finally tightening down the flange bolts. This can be accomplished by scraping off the protective paint beneath one bolt head on each bushing flange. (See Fig. 8.) It is advisable to check this

ground by "lighting out", or using a bell ringer, between the bushing flange and the tank.

4. Make sure that the metal portion of the condenser bushing does not touch the transformer case at any point, since this would cause a short circuiting effect and throw the transformer off ratio.

5. Tighten all flange bolts *evenly* and *securely*, using a good socket wrench with extension.

### **MOUNTING THE STATIONARY CONTACT UNITS**

When the condenser bushings are in place, the stationary contact units should next be attached to the lower end of the bushing studs.

To do this conveniently, remove Micarta shield (5) and upper metal shield (4) in the order stated. See Fig. 12. Then remove the flange (75) from contact foot (3). Screw the flange on the condenser bushing stud. Care must be taken to prevent cross-threading or damage to either threaded member. As indicated in the note on pole unit assembly Fig. 11 the flange (75) Fig. 12 is to be screwed on the bushing stud so the lower surface of flange is flush with or higher than lower end of threads on condenser bushing stud to obtain a gap of  $\frac{1}{16}$ " min. between flange (75) and contact foot (3) after final adjustment. The gap is necessary for locking the threads on flange and stud on pulling up the 8 bolts (30) through the foot so the contact assembly cannot turn on the stud. Do not draw up bolts to final tightness as it may be desirable to shift the assembly slightly in final aligning of the contacts. The contacts on the two bushings must be located at as nearly same height as possible. Do not tighten the bolts (30) or assemble the contact shields until the moving contacts have been assembled and final adjustment made.

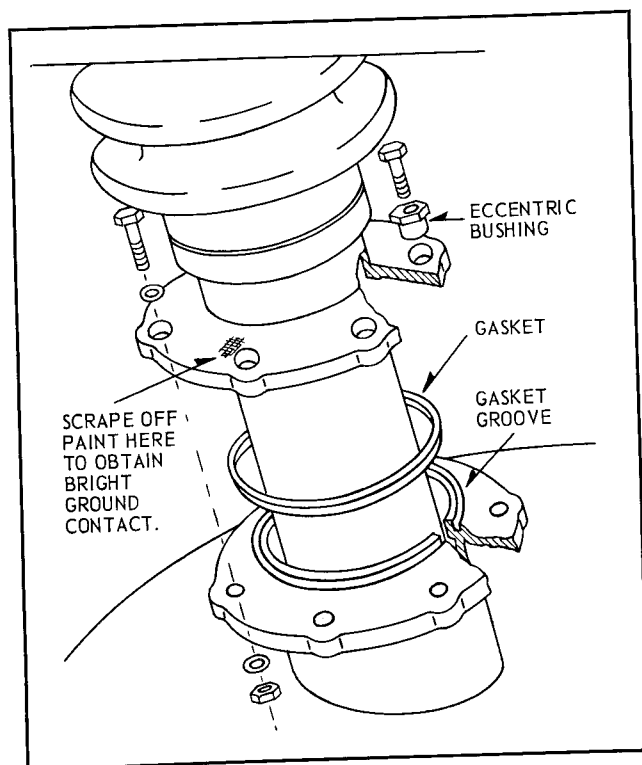


FIG. 8. Installing a Condenser Bushing

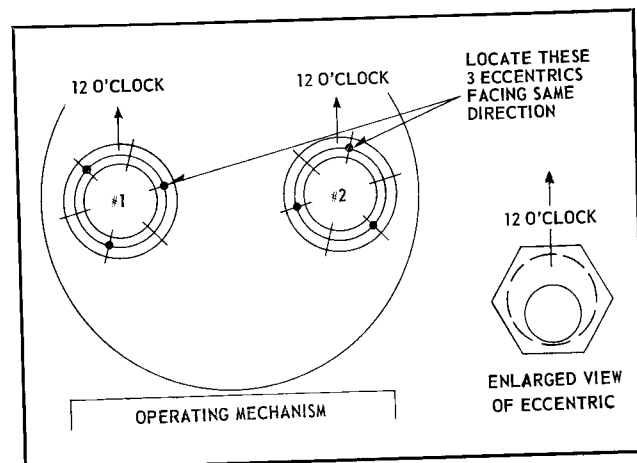


FIG. 9. Eccentric Locations for 115 and 138 Kv. Breakers

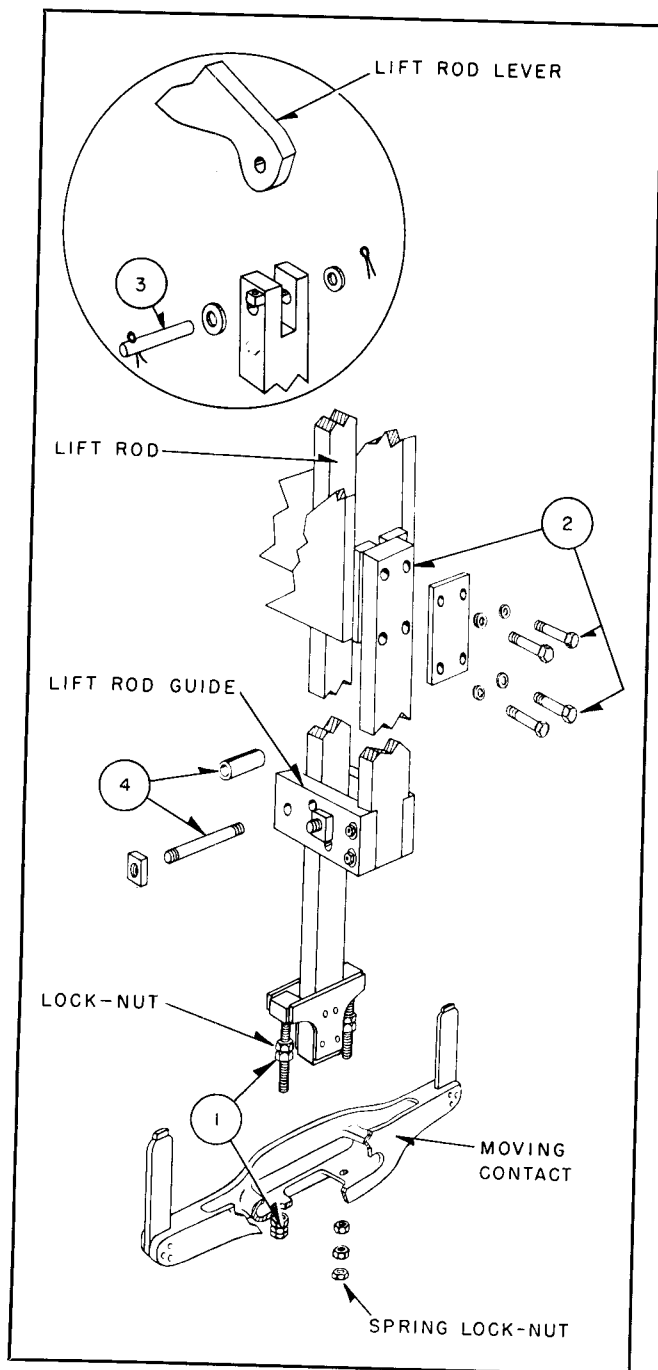


FIG. 10. Exploded View of Moving Contact Unit

## MOVING CONTACTS

Before final alignment of the stationary contacts can be made, the moving contact must be assembled on the lift rod foot according to the procedure outlined below. It is advisable to complete the assembly of the moving contacts on all three pole units at this time. See Fig. 10.

**Assembling and Adjusting the Moving Contact.** The moving contact crossarm is assembled on the lift rod by first removing the lower

two adjusting nuts and lock washers from the studs at the lower end of the lift rod. Slip the cross-bar over the studs and replace the lower nut on each stud. Adjust the upper and lower nuts to secure horizontal alignment of the crossarm. Upper adjusting nuts may be reached by an open-end wrench through the wide slot in the face of the crossarm. Lower adjusting nuts and lock nut are set by means of a socket wrench used from beneath the crossarm.

After all adjustments are complete, replace the shakeproof lock washer and lock nut below the lower adjusting nut. Also bend locking clip on upper adjusting nut.

*Note: The adjusting nuts are also used for the purpose of tipping the moving contact slightly to obtain simultaneous contact on the closing stroke of the breaker. Refer to "Securing Alignment", pages 14 and 17.*

**Adjusting Vertical Alignment of the Lift Rod.** Oversize holes are drilled in the guide rod to provide for adjustment of the vertical alignment of the lift rod. To adjust, loosen the four bolts shown in Fig. 10 and shift lower end of guide slightly to the left or right as desired. A series of holes in the lower horizontal guide pieces accommodates a variation in thickness of the lift rod, and permits forward or backward adjustment of the lift rod. Tighten bolts securely when required position is attained.

**Disconnecting the Lift Rod.** The lift rod may be disengaged from its operating lever by removing cotter pin, washer, and main pin assembly as indicated in Fig. 10.

**Swinging the Lift Rod Out of Position.** The lift rod can be conveniently swung out of its vertical position by removing the guide pin and space collar as shown in Fig. 10. This allows clearance for rotation of the fully assembled stationary contact units.

The lift rod may be completely removed by first taking out the guide pin assembly described above and then disengaging it from the operating lever. When replacing the lift rod, be sure to have the projection (with No. 10—32 tap for travel recorder) on the upper end of the lift rod located beneath the small pipe beside the lift rod stop.

After the final adjustments have been made, the fiber nuts on the guide assembly should be screwed in place, using shellac on the threads to prevent loosening.

## SECURING ALIGNMENT

For the breaker to operate properly, it is absolutely essential that the moving contact blades center exactly in the stationary contact slots and enter them simultaneously. Several methods are

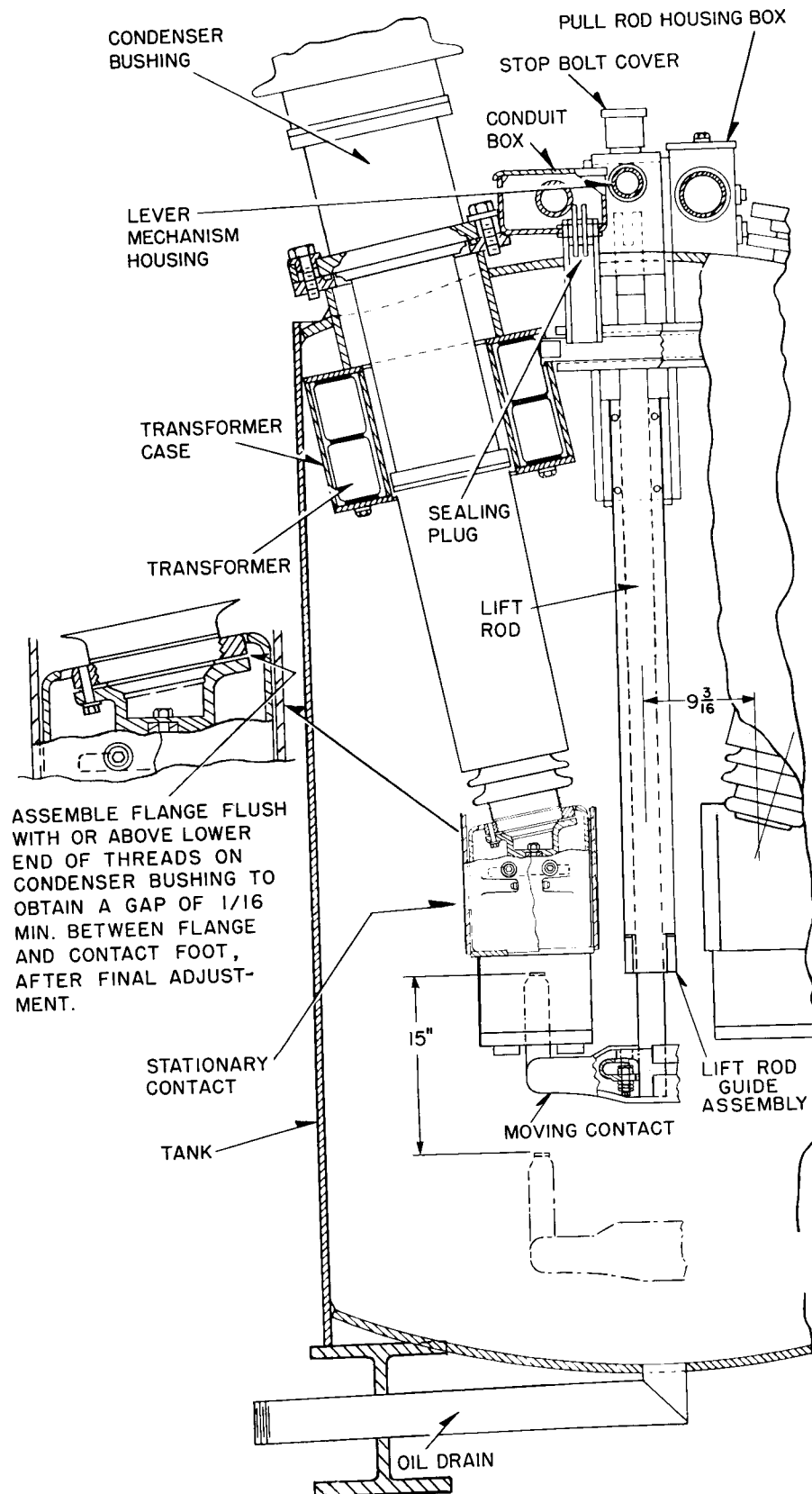


FIG. 11. Section View of Pole Unit Assembly and Moving Contact Travel Dimensions

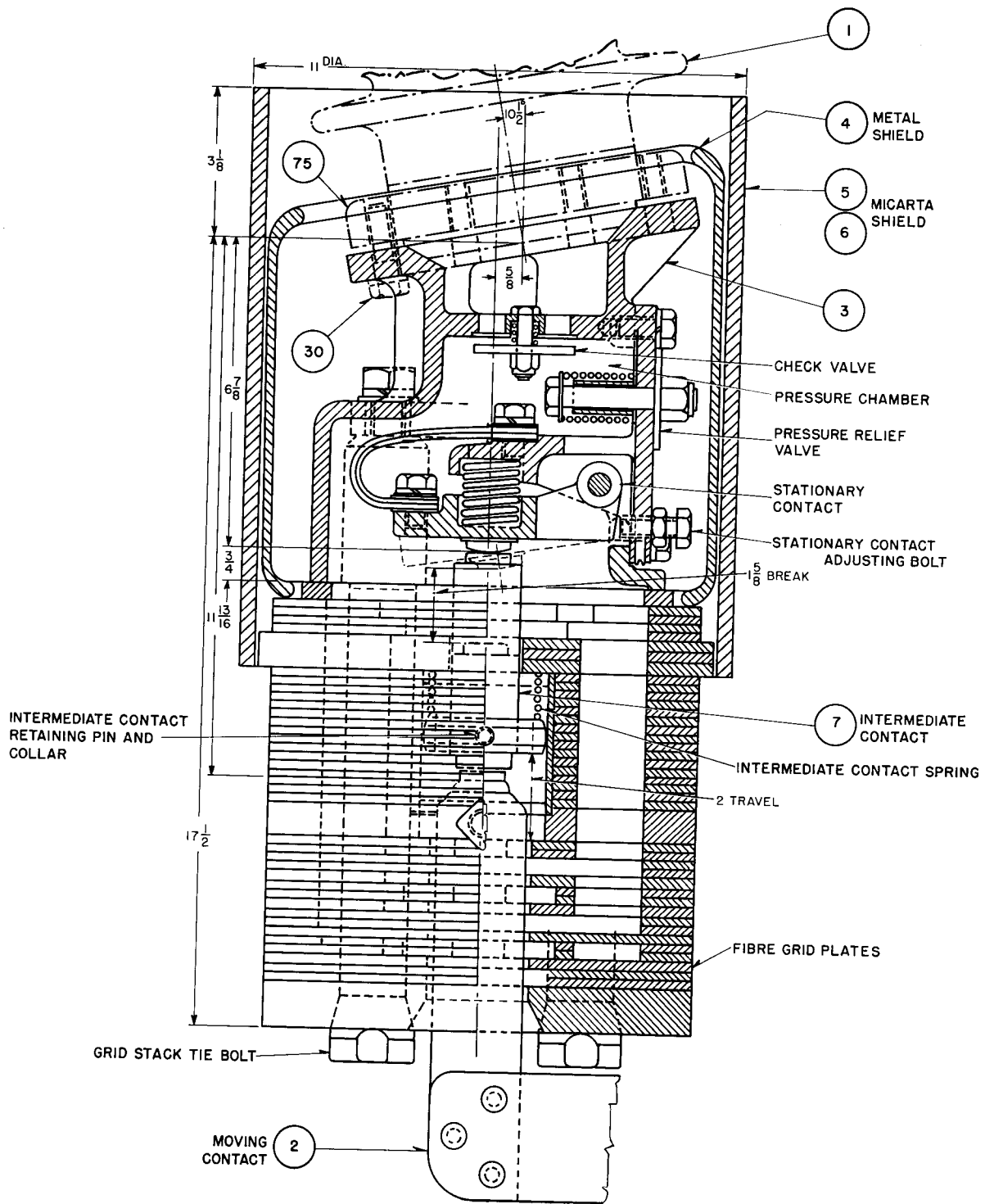


FIG. 12. Contact Assembly



available for securing alignment and simultaneous touching of contacts:

1. Slight shifting of stationary contact assembly on contact foot (3). Oversize holes in contact foot permit this adjustment.

2. Slightly tip the moving contact cross-bar to enter the stacks simultaneously. (See Fig. 10.) This should be done very carefully in order to prevent binding of contact blades after they enter the slots.

3. By slight shifting of the guide members to move the crossbar horizontally. If the alignment is still not correct, it may be necessary to shift the condenser bushings slightly.

**Important:** Do not attempt to level the stacks by inserting shims between the stacks and the stationary contact foot! This would allow burning gases to escape from the upper pressure chamber during an interruption.

### CONTACT ADJUSTMENT

The following instructions for adjustment of contact travel should be followed on each pole unit independently, starting with the No. 1 pole:

1. With the breaker in the open position, disconnect entire lift rod assembly (moving contact) on pole units No. 2 and 3. This may be accomplished by removing the pin which connects the lift rod with main lever of the pole unit mechanism. (See Fig. 10.)

2. Close the breaker slowly by hand until the contact circuit is just completed. This may be checked by "lighting out" between each contact foot and the moving contact, using a flashlight or bell ringer. If the moving contact cross-bar is level, and the grids are on the same level, both contacts will touch simultaneously.

3. Continue closing breaker slowly until either the breaker latches fully closed, or  $\frac{3}{8}$ " contact pressure travel is obtained. (See Fig. 21.) If the latter is the case, do not close the breaker any further until the moving contact is lowered with respect to its cross-bar, so as not to damage any contact parts. If the contact pressure travel is less than  $\frac{3}{8}$ " after the breaker latches, the moving contact must be raised on its lift rod. Adjust moving contact, keeping cross-bar level, until  $\frac{3}{8}$ " ( $\pm \frac{1}{32}$ ) contact pressure travel is obtained on both stationary contact assemblies.

*Note: The proper gap between the stationary and intermediate (floating) contact has been set at the factory and should not require adjustment. If there is suspicion that it should be checked, follow the procedure outlined on page 26.*

4. After the contacts in each pole have been adjusted separately, connect all lift rods and recheck the lift rod stop clearances of  $\frac{1}{16}$ " with breaker closed.

It will probably be evident that the weight of the moving contact and spring load has increased the clearances slightly, and it will be necessary to compensate for this by adjusting the pull rod lengths. Do not alter the factory-set stop positions to compensate for this condition.

Re-check the contact adjustments in each pole unit, this time without dropping the lift rods in the other pole units. If all three poles require the same correction, it may be made by adjusting the length of the horizontal pull rod connecting the bell crank lever to No. 1 pole. Do not alter the length of the vertical pull rod since this would disturb the previously checked setting of the bell crank lever.

With good adjustment the contacts will touch and part simultaneously in all three poles.

5. Open the breaker slowly by hand and check to see that the oil bumpers in all poles are struck simultaneously. The height of the oil bumpers may be adjusted by adding or removing washers as indicated in Fig. 5, page 11.

Measure the total moving contact travel from the latched position to the full open position (oil bumpers depressed). This travel should be  $15 \pm \frac{3}{8}$ ".

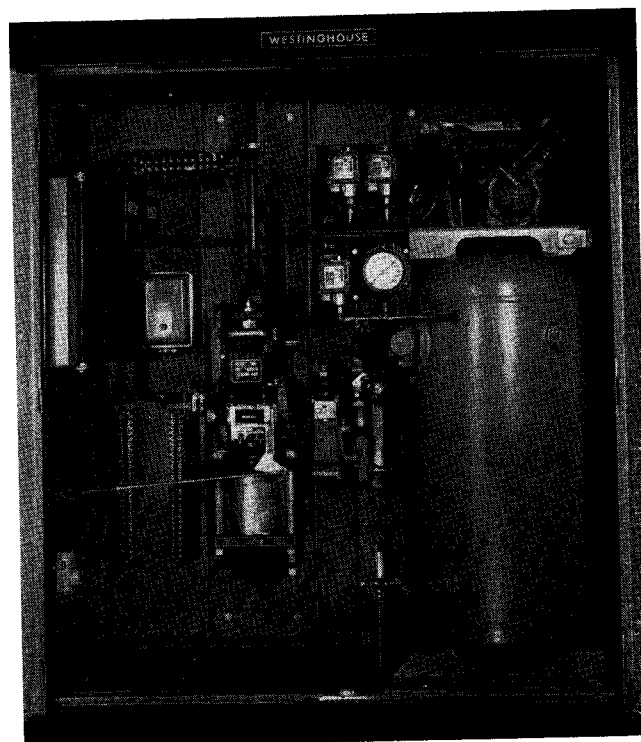


FIG. 13. Pneumatic Operating Mechanism

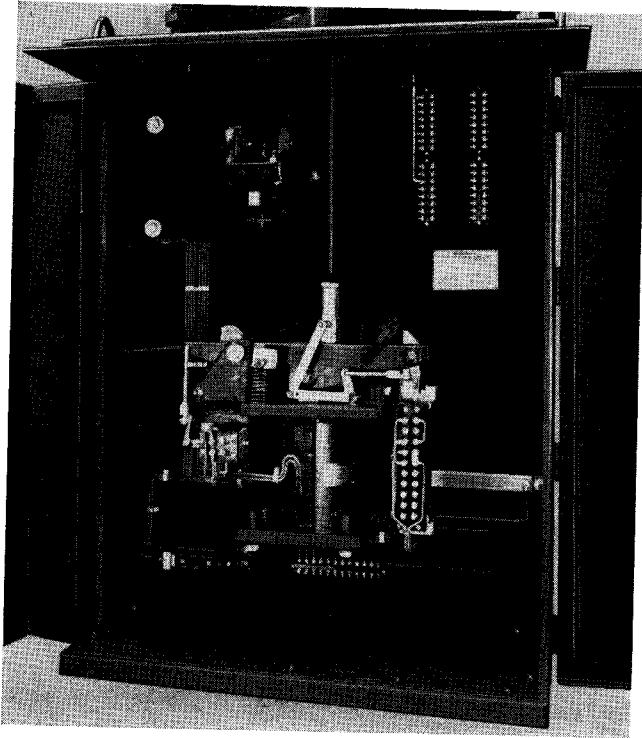


FIG. 14. Solenoid Operating Mechanism

**Important:** Do not trip the breaker without oil in the tanks. Use the hand closing device. Without oil, the oil bumpers are not effective to cushion the breaker opening stroke.

6. After all contact adjustments are complete, assemble the metal and Micarta shields on the stationary contacts. Apply shellac to the fiber guide clamping nuts to prevent them from loosening. Check to be sure that all nuts and bolts are securely tightened and cotter pins are in place.

### CHECKING THE OPERATING MECHANISM

Read carefully the Operating Mechanism Instruction Book which is supplied in conjunction with this book. (See Fig. 13 and Fig. 14.) Make sure the air compressor crankcase is filled with oil to the proper level. If the instruction book is lost or misplaced, Operating Mechanism I.B. number may be found on mechanism nameplate inside the housing.

### MAKING LINE CONNECTIONS

Line connections should be sufficiently flexible to prevent undue strains on the condenser bushings.

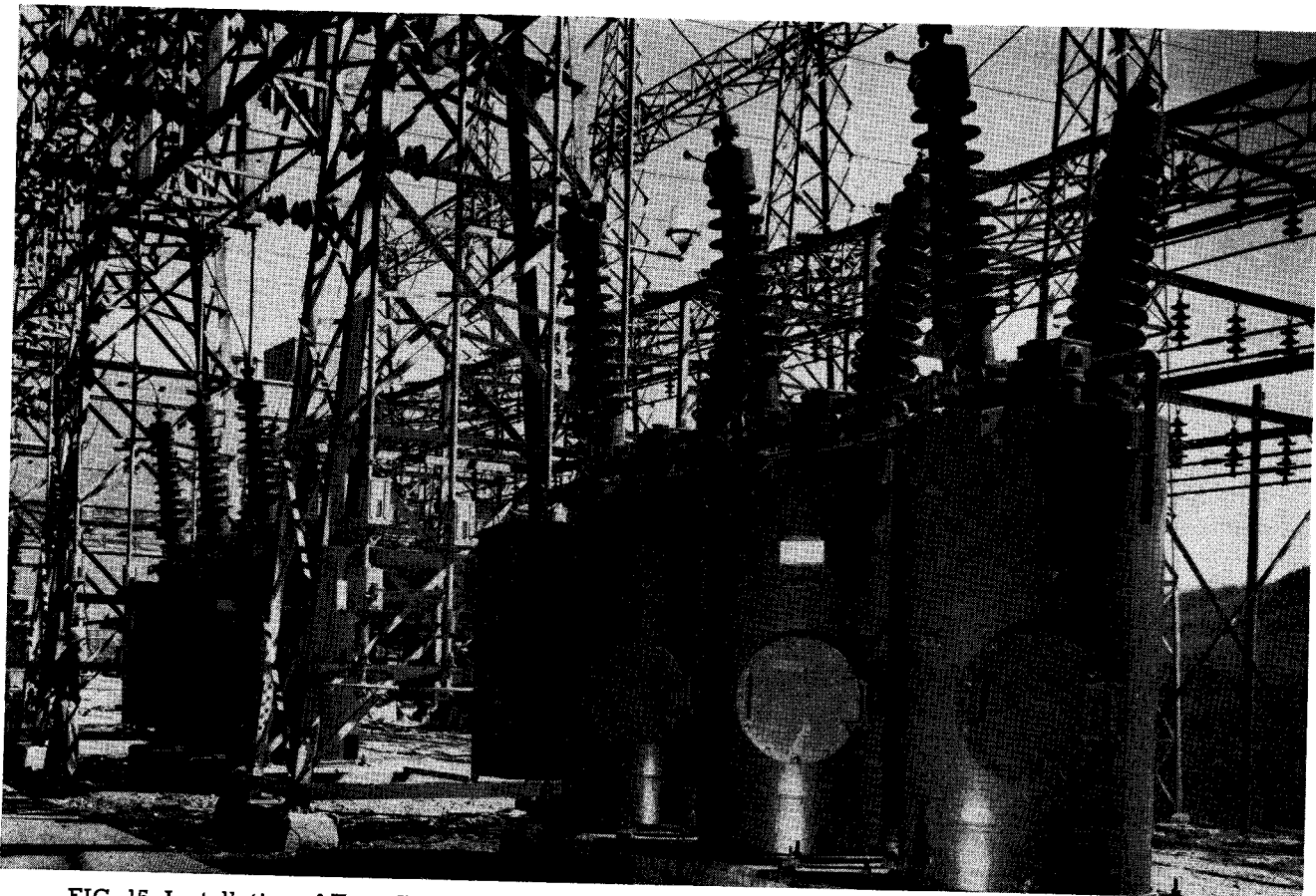


FIG. 15. Installation of Type GM Oil Circuit Breakers Showing Manholes for Inspection and Maintenance

Clamp type connectors are ordinarily used between the bushing stud and the line conductor. Cable conductors should be so supported that heavy loads will not be imposed upon the bushing. If tube conductors are used, they should be so shaped and supported that heavy expansion strains are not placed on the bushings. Conductor and connector should be of adequate current-carrying capacity to avoid heat being transmitted into the breaker bushing. All joints must be clean, bright, and free from burrs or surface roughness.

Do not connect an aluminum conductor to a copper alloy connector unless the latter has plating, or unless an inhibitor is used. The galvanic action resulting from a joint of aluminum to copper will in time cause considerable corrosion.

### **MAKING GROUND CONNECTIONS**

Two ground pads are provided on the H-beam base. Each of these pads has two (1/2"—13) tapped holes located 13/4" apart according to AEIC (Association of Edison Illuminating Companies) specifications.

The ground conductor should be of sufficient size to carry the maximum line-to-ground current for the duration of the fault.

**Caution:** A permanent low resistance ground is essential for adequate protection. A poor ground may be worse than none, since it gives a false feeling of safety to those working around the equipment.

### **CONNECTING CURRENT TRANSFORMERS**

Bushing type current transformers, supplied only when ordered, are mounted in transformer cases in the top of each pole unit tank.

Transformers are usually of the multi-ratio type, having four leads to provide a wide range of ratios. Short leads from all taps are carried in conduit through a Micarta seal plug to terminal blocks located in the weatherproof box on top of each unit. These leads are connected to the terminal blocks, corresponding to the ratio and connection diagram furnished.

The long leads provided should be pulled through the conduit and connected to the terminal blocks on top of the pole units at one end, and to the terminal blocks inside the mechanism housing on No. 1 pole at the other end according to the connection diagram. The desired ratio may be selected at the terminal blocks inside the mechanism housing.

*Note: Do not confuse the polarity of the current transformers. Refer to the polarity ratio and connection diagrams sent with each breaker which show how to connect the transformer circuit. Ratios corresponding to various*

*transformer taps are also reproduced on the transformer nameplate, located on the inside of the mechanism housing door.*

**Caution:** Be sure that the proper transformer connections are made, and a burden or short circuit placed across the terminals at the blocks, before the breaker is closed on the line. Otherwise, dangerous voltages may occur across the open secondary terminals.

### **INSTALLING CONTROL WIRING**

All control wires to the circuit breaker should be run in conduit where practicable. A diagram enclosed in a transparent envelope will be found in the pocket on the inside of the mechanism housing door. This diagram shows the proper connections for operating circuits and indicating lamps.

The control wiring should be installed so that trouble with one oil circuit breaker cannot be communicated to the control wiring on another breaker. The wire size should be selected to keep the voltage drop within reasonable limits. Excessive line drop will slow up the tripping time of the breaker, and hence, the interrupting time.

Check the control wiring to see that all connections are tight. Small nuts and clips may have become loose during transit and handling.

### **FINAL INSTALLATION INSPECTION**

After the breaker has been installed and all mechanical and electrical connections completed (except energizing the power line), make the following inspection and tests:

1. Carefully wipe all insulation and parts within the breaker tank, including the inside surface of the tank to remove any dirt or moisture which may have collected.

2. See that the breaker is properly set up and leveled on its foundation.

3. See that all bearings of the operating mechanism are free of dirt and packing materials and have been lubricated. (Excessive lubrication will pick up dirt.)

Coat the latch faces with a thin film of rust inhibitor. This inhibitor should be carefully selected to be free-flowing at all anticipated temperatures, non-hardening, and self-healing (so that it will not completely wipe off in one operation). A light graphite lubricant or other material with similar properties is suggested.

4. Close the breaker slowly by hand, checking to see that the lift rods and contacts are properly adjusted for correct alignment and that proper stationary contact compression is obtained when the breaker is closed.

Open the breaker slowly by hand. The movement of the breaker on opening and closing should be free and without friction; check particularly the lift rods through the guide members and the moving contacts in the stacks against binding.

5. See that clamping bolts on all rod ends for operating rods are securely tightened.

6. Check to see that all gaskets are in place and have not been damaged. All bolts and nuts on bushing flanges, tanks and connecting fittings must be evenly tightened so that moisture cannot enter the circuit breaker through any of these gasketed joints.

7. Pipe fittings may become loose because of vibration or shock received during handling, lifting, and transportation. They should be checked immediately after the breaker is installed and tightened when necessary.

8. Inspect all insulated wiring to see that no damage has resulted from the process of installation.

9. Test the wiring for possible grounds or short circuits.

10. Check to see that all control wiring outside of the oil tanks is correctly insulated in accordance with standard practice. See that all joints in the control circuits are made correctly.

11. Make sure that lock washers and lock nuts are secure and that locking clip is bent on moving contact where it attaches to lift rod.

12. Coat lift rod and toggle stop bolts on outside of breaker liberally with grease before replacing covers, in order to prevent rusting.

13. Make a final check for tightness of hardware on stationary and moving contacts, shunts, lift rods, pole unit levers, etc.

14. Apply vaseline to side of manhole cover gasket which presses against flange on tank, so that the door will open easily without damaging gasket at next inspection. Close door and draw down all bolts evenly until reasonably tight.

15. Fill tanks with clean, dry Wemco "C" oil and check dielectric breakdown of a sample taken from the bottom of the tank. (Follow detailed instructions under "Placing Oil in Service").

### PLACING OIL IN SERVICE

Precautions must be taken to insure absolute dryness and cleanliness of the apparatus before filling it with oil, and to prevent the entrance of water and dirt during the transfer of the oil to the apparatus.

When putting a new circuit breaker into service, see that the tank is free from moisture and foreign material. This may be done by flushing with clean insulating oil and wiping with clean dry cotton cloths. (Cotton waste is undesirable because of the

lint which may be introduced into the oil.)

The preparation and filling of outdoor apparatus should be done preferably on a clear, dry day. If this is not practicable, protection against moisture must be provided.

Precautions should be taken against the handling of oil at a temperature different from the container into which the oil is being poured, as condensation will occur and moisture will be introduced into the oil. Extra care must be taken if oil drums are stored in locations open to the weather. Sufficient clearance from ground is essential to permit circulation of air to prevent condensation.

Oil which has been used in lightning arresters contains water and harmful chemical impurities which cannot be removed without refining, and must not be used in circuit breakers.

Fill the oil tanks to the proper level with Wemco "C" oil. Oil which has a dielectric strength of less than 22,000 volts when tested by the usual methods should not be put into the circuit breaker. New oil may test considerably higher than this. However, unless tested under ideal conditions, the oil may appear to be worse than it really is, due to contamination of the sample when testing. (See Instruction Book 44-820-1A for proper methods of testing and handling.)

### OPERATION AND TIMING TESTS

#### (Tanks Filled with Oil)

Starting at normal air pressure (marked on mechanism nameplate) on the pneumatic mechanism, check the breaker for number of closing operations per tank of air with the compressor shut off. If all adjustments are correct, there should be at least five operations before the low pressure cut-off switch on the pneumatic mechanism opens the control circuit, and one or two more reserve operations beyond this. A jumper may be used to short out the low pressure cutoff switch (see control diagram) in order to count the number of operations after cutoff. If the number of operations is less than this, it is an indication of:

1. Too much contact compression.
2. Improper contact alignment.
3. Excessive air loss in pneumatic mechanism.
4. Excessive accelerating (tail) spring compression.

Check the opening time and reclosing time (if required) of the breaker with a graphic recorder. In order to be sure of getting 5 cycle arc interruption, the time from energizing the trip coil until the contacts part should not exceed 3 cycles (60 cycle basis). Contact parting time on all three poles should be checked. Also the moving contact lift

rod should have moved at least 5 to 6 inches 5 cycles after the trip coil is energized. If the breaker is slower than this, it may be due to any of the following reasons:

1. Too much contact compression.
2. Insufficient accelerating (tail) spring compression.
3. Incorrect setting of pole-unit lever system.
4. Incorrect trip armature setting on operating mechanism. (See operating mechanism instruction book.)

Refer to the typical graphic recorder curves, Figs. 16a, 16b. As indicated on the curve, Fig. 16a, the average velocity on opening operation of the moving contact through the arcing zone can readily be determined by the slope of the line through points 1" and 5" out from the full closed position and should be 9 to 11 feet per second.

In addition to showing time and travel characteristics, the opening curve gives a good indication of the efficiency of the oil dash pots which cushion the breaker moving contacts at the end of the opening stroke.

As indicated on Fig. 16a, the velocity of the moving contact on closing should be from 8 to 12 feet per second at point of contact touch.

In connection with oscillograph timing, an element may be used with a resistance slide wire to indicate moving contact lift rod travel. The slider may be connected in the same manner as a graphic recorder to the lift rod through the tank top by removing the small pipe cap beside the cap over the lift rod stop. A projection on the upper end of the lift rod is provided with a 10-32 tap, so that a  $\frac{3}{16}$ " diameter rod with 10-32 threads on one end may be passed through the tank top and screwed into this tapped hole.

If the breaker is to be used for high speed reclosing duty, the reclosing time may be adjusted by means of the "bb" contact on the 2-pole auxiliary switch. See control diagram and pneumatic mechanism instruction book for further explanation.

Before the final closing to place the breaker in service, make sure the switches on the pneumatic mechanism control panel for the control power and compressor supply are in the "ON" position, and that the hand valve between the compressor reservoir and the mechanism is wide open. Check for normal operating pressure and power and close the breaker. *Do not close the breaker on a live line with the hand closing jack.* This device is intended for breaker adjustment only, and operates much too slowly for closing the breaker on a live line.

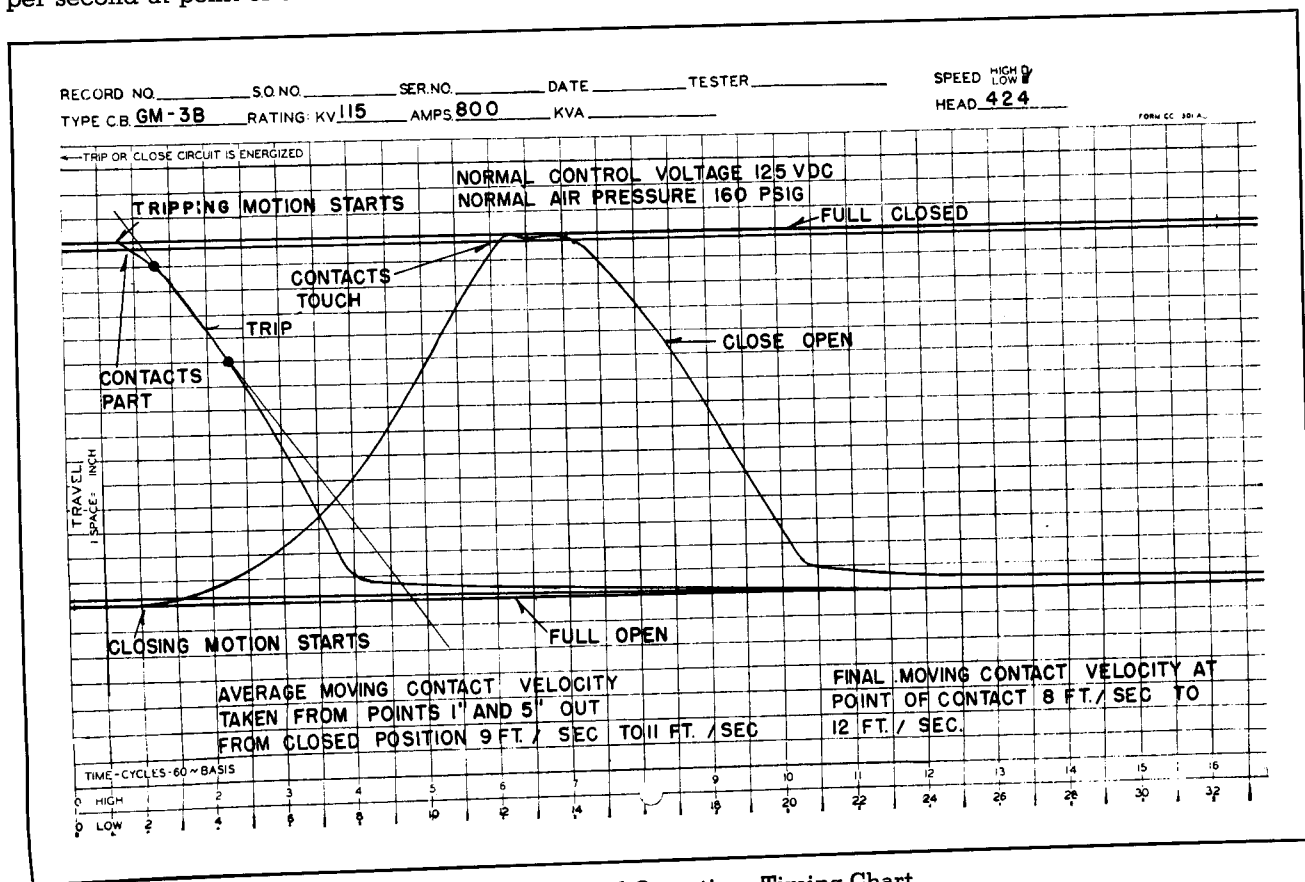


FIG. 16a. Typical Operations Timing Chart

# INSTALLATION

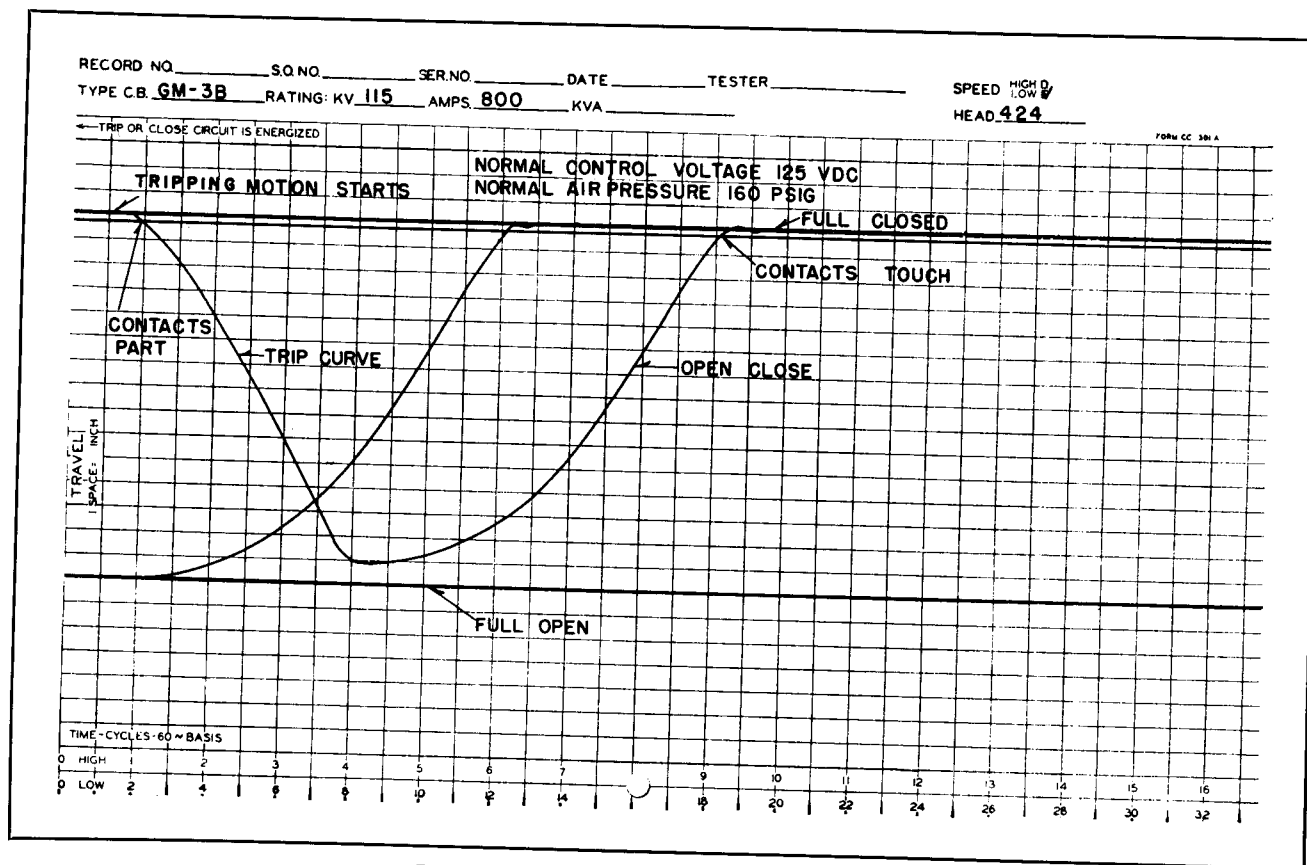


FIG. 16b. Typical Operations Timing Chart

## PART THREE

# OPERATION AND ADJUSTMENT

In case of trouble with any part of the circuit breaker, it is necessary to understand thoroughly the construction and adjustment of the individual parts. In general, it is advisable to work only on a part which needs attention and not disturb the rest of the apparatus. The various parts and adjustments are described in the approximate order in which they are assembled at the factory.

### "DE-ION" GRID UNIT

The Westinghouse multi-flow "De-ion" Grid is an interrupting unit consisting of a stack of fibre plates drilled and arranged to form passages for the desired oil flow, with two contact breaks per unit. A pressure generating arc is formed between the stationary (upper) contact and the intermediate (floating) contact, and the main arc is drawn between the intermediate contact and the moving contact.

On an interrupting operation, the contacts are rapidly opened by the accelerating spring (tail spring) on No. 3 pole unit, and the springs behind the stationary contacts. The pressure arc is drawn first until the intermediate contact reaches the end of its travel (under action of its own spring) and the main interrupting arc is drawn. The function of the pressure arc is to build up a gas pressure in the upper chamber and force an oil flow along the main interrupting break.

The oil passages may be seen in the contact assembly illustration (Fig. 12). The oil is forced down either side of the grid and then into inlets on each side of the arc path. The oil flow along the main arc path deionizes the arc, and the arc products pass out of the grid through exhaust vents on either side of the grid stack. The vents are staggered in height with respect to the inlets and are located 90° around the grid.

The interruption is due to the flow of oil along the main arc path through this multiple-orifice arrangement. After the main arc is interrupted, the circuit is broken and, as there is no longer current flow to maintain it, the pressure arc goes out.

The check valve in the top of the pressure chamber is provided to refill the grid with oil and allow any residual gas to escape after an interruption. It also permits circulation of oil to keep the temperature rise down on normal current flow. This valve closes automatically and remains closed while the gas pressure in the upper chamber is building up. As a protective feature, a safety valve

is provided which opens if the gas pressure in the pressure chamber becomes too great during an interruption.

### "DE-ION" GRID UNIT ADJUSTMENTS

**Stationary Contact.** On routine inspections, a fairly good idea of the condition of the contacts may be obtained by measuring the stationary contact compression. This may be done without draining the oil from the tanks by using the provision made for attaching a "time-travel" recorder, as follows:

Removing the cap over the lift rod stop will reveal a small hole which is directly over a .190-32 (10-32) tapped hole in the upper end of the contact lift rod. (See Fig. 17.) When the breaker is closed, a  $\frac{3}{16}$ " diameter rod ("time-travel" recorder), threaded on one end to match the tapped hole, may be passed through the small opening and screwed into the top of the lift rod.

Open the breaker with the hand closing device until the contacts have parted as checked by "lighting out" between bushing terminals. Now close the breaker slowly until the contacts just touch, and mark the position on the  $\frac{3}{16}$ " rod. Continue to close the breaker until the mechanism latch snaps into place, and remove the load on the hand closing device. The travel of the  $\frac{3}{16}$ " rod between the point of initial contact and the fully closed position is identical with the stationary contact compression, or "lift".

**Caution:** Before working on a breaker which has just been disconnected from the line, make sure that the condenser bushings have been discharged by grounding the terminal end. Serious shock to workmen may otherwise result.

When the breaker is properly adjusted, all three poles should check  $\frac{1}{32}$ " to  $\frac{3}{32}$ " contact compression. If any pole shows less than  $\frac{1}{4}$ " compression on routine inspections, the oil should be drained from the tanks for a more complete inspection, and the necessary adjustments made as described under Checking and Readjusting Intermediate Contact Travel, page 26.

If any pole shows more than normal contact compression, it is an indication that the stationary contact stop bolt has loosened and allowed the contact arm to drop below its normal position. To correct this condition, remove the Micarta and

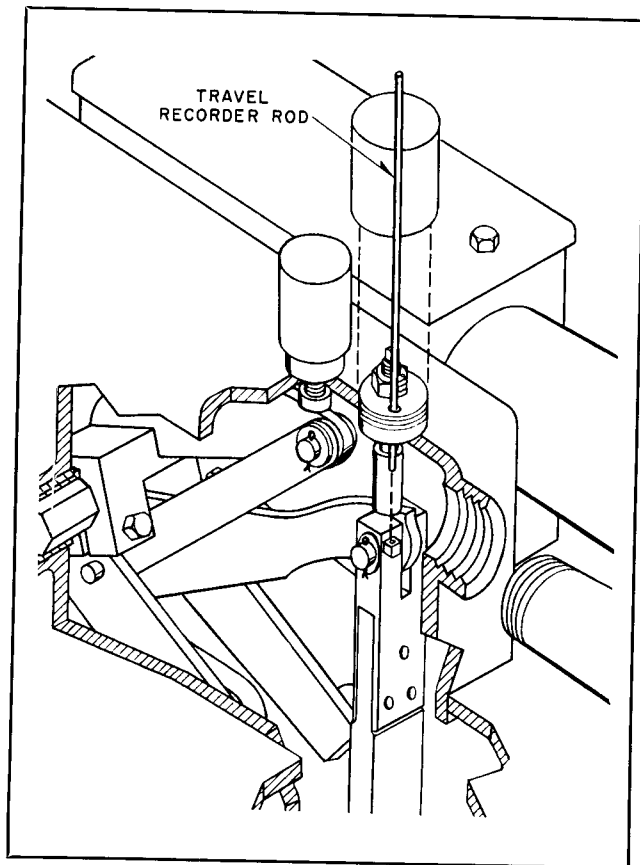


FIG. 17. Inserting Travel Recorder Rod Through Pole Unit Mechanism Housing and Attaching to Lift Rod

metal shields from the grid assembly and tighten stop bolt until proper contact "lift" has been re-established as described under Checking and Readjusting Intermediate Contact Travel.

The stationary contact may be easily removed for inspection by first removing the Micarta and metal shields and then unbolting the cover plate on the side of the contact foot.

**Intermediate Contact.** When the stationary contact assembly is removed, the upper side of the intermediate contact may be seen. The condition of this contact surface will be an indication of the condition of the lower side of the intermediate contact.

If there is enough burning to warrant removal of the intermediate contact, it may be done in the following manner:

Remove the long fibre screws in opposite sides of the grid. (See Fig. 20.) The intermediate contact is fastened by a loose pin to a surrounding ring which provides a spring seat and keeps the intermediate contact in its proper position. When the breaker is open, this loose pin will line up with the holes uncovered by the fibre screws, so

that it may be driven out with a long rod,  $\frac{3}{8}$ ", or less, diameter (pin is  $\frac{3}{8}$ " diameter).

When the stationary contact is removed, the intermediate contact may be pushed up from below and pulled out through the upper chamber in the contact foot.

**Moving Contact.** The condition of the moving contacts may be easily observed when the breaker is in the open position.

All of the contacts are faced with tungsten alloy, which is especially resistant to arcing, so that deterioration will not be very rapid. Excessive filing of contact faces is not recommended; remove only roughness or projecting particles. Contacts should be replaced when pitting reaches a depth of  $\frac{1}{16}$ ", but replacement will rarely be necessary.

## POLE UNIT LEVER SYSTEM

The pole unit lever mechanism, located on the top of each tank, operates the lift rod which carries the moving contact. This is simply a lever system designed to give a straight line motion with the proper mechanical advantage at the end of the closing stroke. Included as part of the lever system is an oil bumper which cushions the opening stroke over the last portion of the stroke.

The function of the lever system is shown schematically in Figs. 22a and 22b. (For full cutaway view, refer to Fig. 5, page 11.)

**Adjustments.** When the breaker is properly adjusted, and has been closed by hand, there should be  $\frac{1}{16}$ " clearance at the toggle stops and lift rod stops. (See Fig. 5.) This clearance is necessary, to permit the operating mechanism to overtravel and latch (see Figs. 22a and 22b), and to make sure that the closing movement is stopped by the operating mechanism without undue strain on any of the pole unit parts. If the toggle lever were permitted to go too far forward, the toggle link would strike the crankshaft, and the tripping speed would be slow. Conversely, if the toggle lever were too far back, the breaker would be difficult to close.

*Note: The stops have been carefully set at the factory and should not be changed unless there is a reasonable suspicion that they have been disturbed. In that case, they may be checked or corrected by the following procedure:*

1. Close the breaker by power operation.
2. Check the position of the lift rod pin. The centerline of the lift rod pin should be  $1 \pm \frac{1}{16}$ " above the centerline of the main operating shaft (refer to Fig. 5) with normal contact load. The



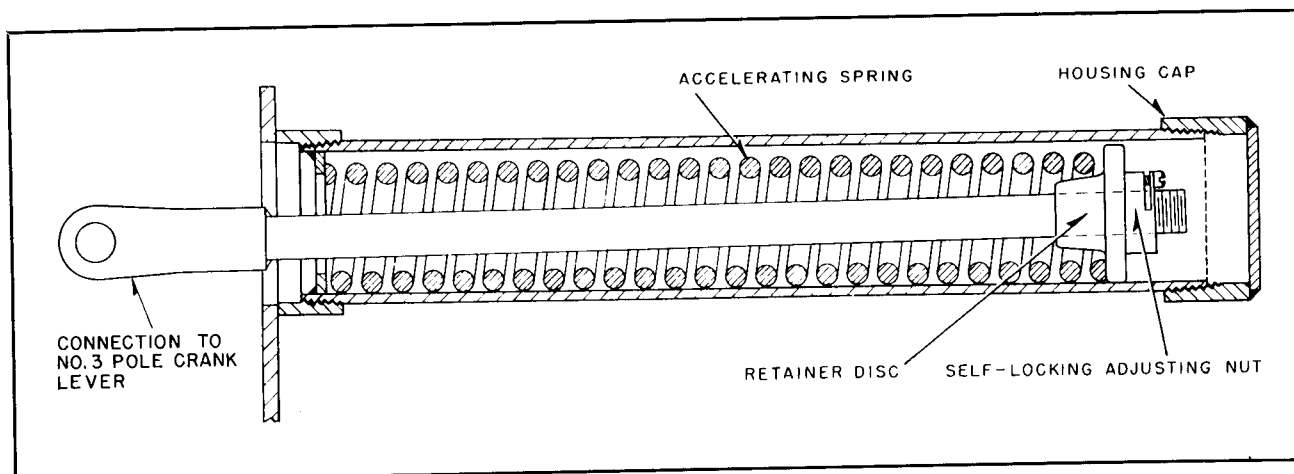


FIG. 18. Accelerating Spring Used with Pneumatic Mechanism

$1 \pm \frac{1}{16}$ " dimension may be obtained by changing the pull rod lengths.

3. Check the clearance at the toggle and pull rod stops with a feeler gauge. If incorrect, loosen the lock-nuts on the stud bolts and adjust the stop position until the proper clearance of  $\frac{1}{16}$ " is obtained.

*Note: Be sure lock-nuts are securely tightened after adjustment has been completed.*

### ACCELERATING SPRING

To provide sufficient opening speed through the arcing zone, an additional spring (the accelerating spring) is mounted on No. 3 pole. When the pneumatic operating mechanism is used, this spring operates on the horizontal pull rod to provide acceleration over the entire opening stroke. See Fig. 18. The pneumatic mechanism can exert as much pull (subject to throttling) in the open position as in the closed position; thus the accelerating spring load is needed over the entire stroke as a counterbalancing force.

When the solenoid mechanism is used, there is some free travel during closing before the accelerating spring is "picked up" (see Fig. 19), due to the fact that the solenoid mechanism has minimum pull in the open position. In addition, a balance spring is used (see Fig. 19) with the solenoid mechanism to counterbalance the dead weight of the contacts, levers, etc., when the breaker is open.

**Adjustments.** If it is necessary to adjust the acceleration of the breaker, remove cap at end of pull rod housing and back off or tighten the adjusting nut to establish correct opening time as indicated by counter test described under Final Installation Inspection, page 19. Be careful when tightening spring adjustment; too much compression may cause spring to run "solid", or make the breaker hard to close. It is advisable to check by hand closing before operating breaker electrically.

For breakers equipped with a solenoid mechanism, compression of the balance spring eases the closing effort. Too much compression, however, will raise the moving contacts off the oil bumpers, and thereby reduce the contact stroke.

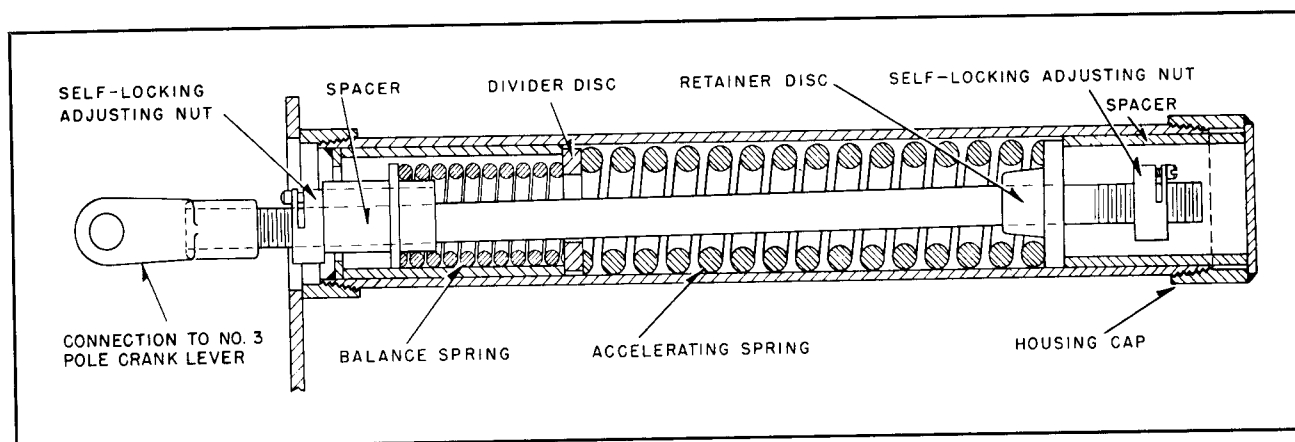


FIG. 19. Accelerating Spring Used with Solenoid Mechanism

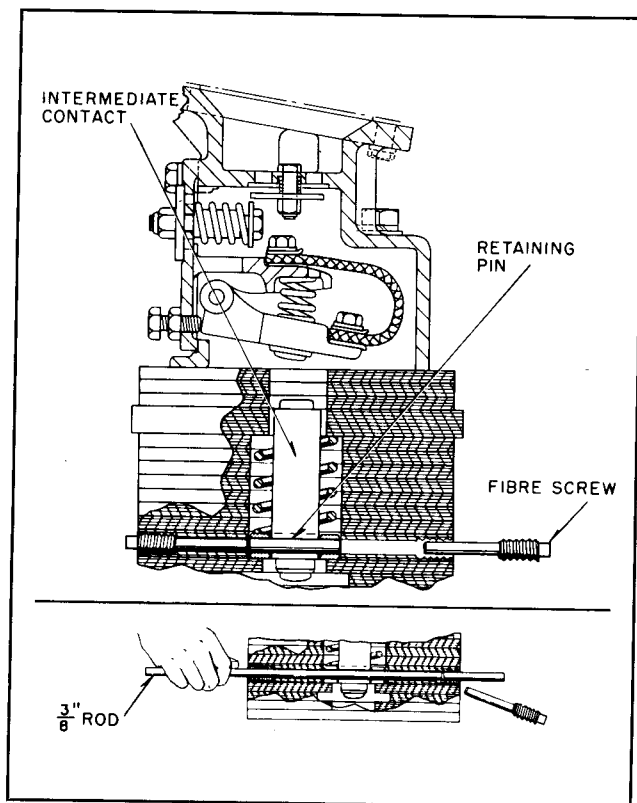


FIG. 20. Removing Retaining Pin from Intermediate Contact

**Caution:** Be sure breaker (with solenoid mechanism) is in the closed position before removing or replacing spring housing cap. Considerable pressure is exerted against this cap when a breaker of this type is in the open position.

## CHECKING AND READJUSTING INTERMEDIATE CONTACT TRAVEL

During thorough breaker inspections, or when any contacts are replaced, the intermediate contact travel should be checked on each grid, and readjusted if necessary. This may be done as follows:

1. Close the breaker slowly by hand until the moving contact just touches the intermediate contact. This may be checked by "lighting out" between the moving and intermediate contact, using either a flashlight or a bell ringer. The intermediate contact may be reached by removing one of the fibre screws in the side of the grid, and inserting a piece of stiff wire. (Refer to insert, Fig. 20.) If both grids are on the same level and the moving contact cross-bar is level, the moving contact should touch both intermediate contacts simultaneously.

2. Mark the position of the moving contact, replace the fibre screw, and continue to close the breaker slowly by hand. Stop the closing movement after the moving contact has moved  $15/8$ ". See Fig. 21.

3. At this point adjust each stationary contact stop bolt until the stationary contact just touches the intermediate contact. (This may be checked by "lighting out" between each contact foot and the moving contact.) This adjustment will give the proper gap between the intermediate and stationary contacts (breaker open) of  $15/8$ ".

4. The moving contact should travel  $3/8$ " from the point where the intermediate contact touches the stationary contact to the latched position. This

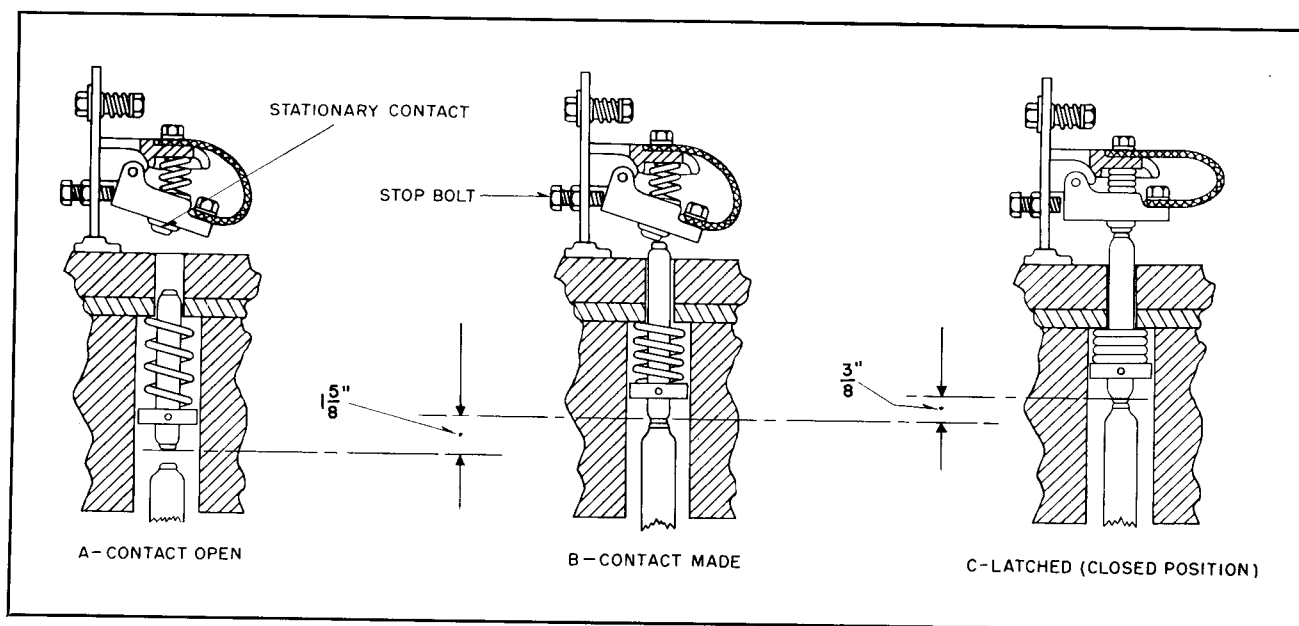


FIG. 21. Intermediate Contact Travel from Open to Fully Closed Position

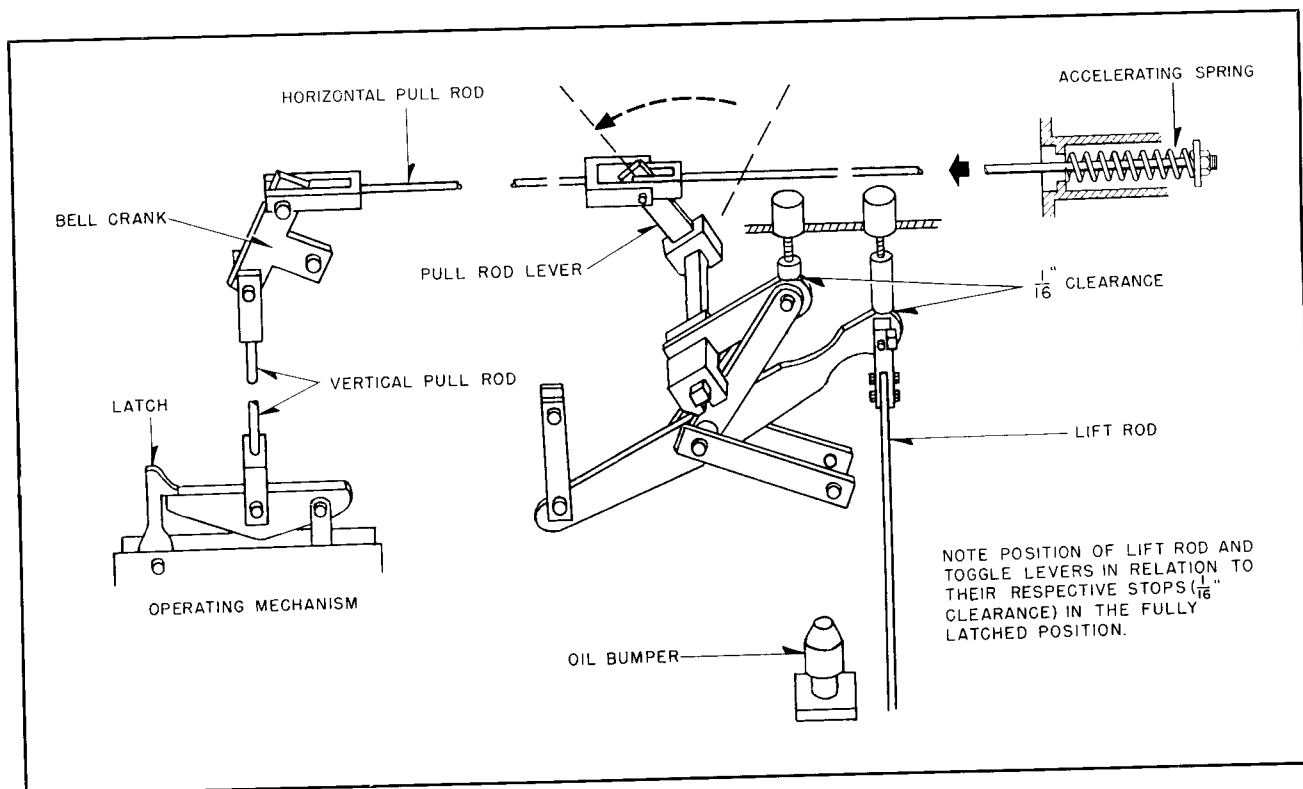


FIG. 22a. Closing Strokes of Pole Unit Lever Mechanism

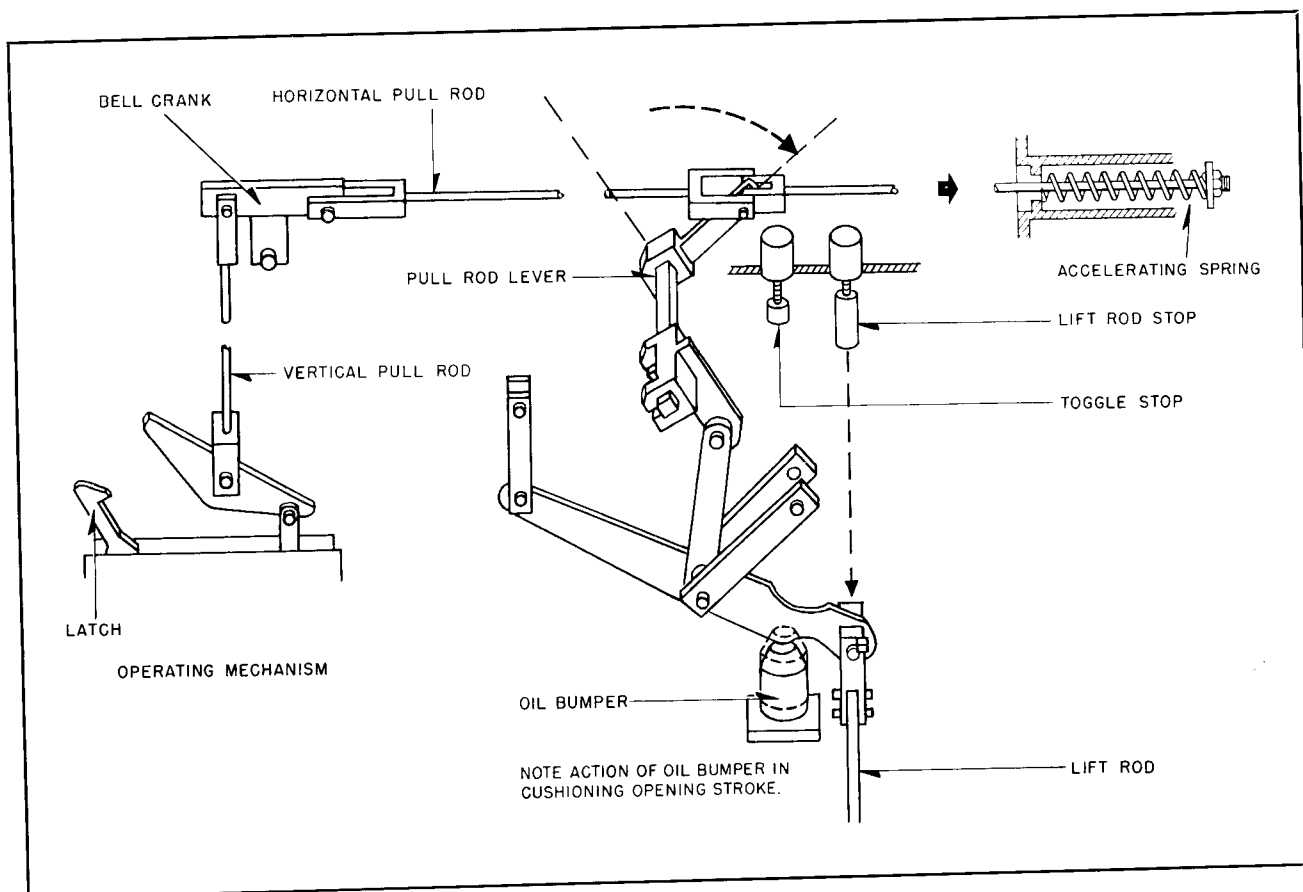


FIG. 22b. Opening Stroke of Pole Unit Lever Mechanism

gives the proper  $\frac{3}{8}$ " compression for the stationary contacts, as previously explained.

When making inspection, the following points should also be checked on the contact assembly:

1. Check all nuts and bolts for tightness, including the large nuts on the upper end of the tie rods which hold the fibre plates of the stack together.

The lower end of these tie rods have a taper fit on the heavier grids which may have drawn up little tighter during heavy interruptions.

2. Make sure check valve in top of pressure chamber has freedom of movement. This valve may be reached when the stationary contact is removed.

## PART FOUR

# MAINTENANCE

It has become the practice of operating companies to establish a system of regular inspection of their apparatus. Oil circuit breakers especially, due to the nature of their function, should be operated on a planned maintenance program. It is recommended that each new breaker be given a one year "shake-down" period to prove the initial installation and to establish the duty to which it is likely to be subjected. After this one year period, the oil should be drained from the tanks, and a thorough inspection made as outlined under General Inspection Procedure. It is our standard practice to recommend that each breaker be given such a General Inspection once a year. It is recognized, however, that many breakers operate so seldom that such yearly inspections may not be necessary, and on the other hand that some breakers are subjected to severe duty which makes more frequent servicing necessary.

Many companies compile detailed operating data on individual breakers, and from such information and past experience on various types of breakers are able to set up an inspection and maintenance program which fits more closely the duty performed. Following are some of the factors to be considered in setting up such a tailor-made inspection schedule:

1. Time.
2. Number of switching and testing operations.
3. Number of overload and fault operations.
4. Severity of fault operations.
5. Condition of oil.
6. Cleanliness of atmospheric surrounding breaker.
7. Accumulated experience of breaker characteristics and duty.

Where an inspection schedule other than the yearly General Inspection is set up, we recommend that each breaker be given a Routine Inspection once yearly and that it be given a General Inspection at least once every three years. The significance

of the two types of inspection are developed in the following paragraphs.

Regardless of what type maintenance program is adopted, it is further recommended that frequent visual inspections be made by operators touring the switchyard in order to catch any obvious abnormal condition. It is also considered good practice to operate the breaker from the switchboard at regular intervals to insure the integrity of all electrical circuits, as well as proper mechanical functioning of the breaker.

**Caution:** Before working on a breaker which has just been disconnected from the line, make sure that the condenser bushings have been discharged by grounding the terminal end. The larger bushings have a rather high capacity which may cause serious shock to workmen.

### ROUTINE INSPECTION PROCEDURE

The suggested Routine Inspection procedure is as follows:

1. Check mechanical operation of breaker. See operating mechanism instruction book for specific procedure on operating mechanism.
2. Check dielectric strength of oil.
3. Measure contact compression—see "De-ion Grid Unit Adjustments", page 23, on how to check without draining oil.

It naturally follows that any abnormal condition found during the Routine Inspection should be cause for draining the oil and giving the breaker a thorough General Inspection.

### GENERAL INSPECTION PROCEDURE

General Inspection of the breaker requires that the oil be drained from the tanks. Before any parts are disturbed, the following adjustments should be checked to give an indication of the condition of the breaker as removed from service for the inspection.

**Caution:** Open the control circuit at the breaker before entering tanks, so that accidental breaker operation cannot occur. On pneumatically-operated breakers, take the additional precaution of closing hand valve between compressor tank and mechanism.

1. Close the breaker by power with the operating mechanism before draining oil from the tanks.
2. Check clearance at overtravel stop above main lift rod and at toggle stop on pole unit lever system. (See "Pole Unit Lever System", page 24).
3. Remove the static shields from the stationary contact assembly. Note the condition of the contact faces. A slight amount of burning on the contacts is not detrimental, as long as the electrical conductivity or contact adjustment has not been changed. If the burning is severe, however, the contacts should be removed and reconditioned or replaced. (See "Contact Removal", page 26.)
4. Note the condition of all parts now accessible. Check for loose bolts, nuts, spring cotters, damaged parts of any kind.
5. Close the breaker slowly by hand and check the contact adjustment.
6. Clean the lower porcelains on bushings with clean cloth wet in clean oil. Clean surfaces of Micarta lift rods and guides in same manner. Clean all carbon from grid stack.
7. Check the pole unit mechanism for loose bolts and nuts and for missing spring cotters.
8. Check the operating mechanism in the same manner. Lubricate bearings with a few drops of lubricating oil.
9. Check latches to see that faces are in good condition. (See Operating Mechanism Instruction Book.) Apply rust inhibitor to latch faces. The inhibitor should be free flowing at all anticipated temperatures, non-hardening, and self-healing (so that it will not completely wipe off in one operation). A light graphite lubricant is suggested.
10. Check air system on pneumatic mechanism for leaks.
11. Check control wiring for loose connections.
12. Check gasket joints, conduit and tank fittings to make sure no water can enter the breaker.
13. Check dielectric breakdown strength of oil.
14. Check oil bumper cylinders to be sure they are not jammed.
15. Replace oil and check closing and tripping operation, using all usual relays and circuits involved in the operation of the breaker. Be sure all relay or pressure switch contacts are clean.
16. Check tripping at reduced voltage to insure safety margin.

*Note: If it is necessary to make any re-adjustments, it is recommended that a recheck of the operating speed be made, as indicated under "Operation and Timing Tests", page 20.*

### **CARE OF OIL**

Wemco "C" oil is recommended for all circuit breakers. Westinghouse cannot assume responsibility for circuit breaker operation if an inferior grade of insulating oil is used, or if the dielectric strength of the oil is not properly maintained.

All oil used in circuit breakers is subject to deterioration in service due to carbonization and to the presence of water, even under the most favorable conditions. It is therefore essential to provide for periodic inspection and test, and to purify the oil whenever necessary to maintain its good condition. The more handling which insulating oil receives, the greater are the chances for it to become contaminated, unless adequate precautions are taken.

When the dielectric strength of the oil drops to 20,000 volts, the oil should be looked upon with suspicion, and in no case should it be allowed to drop below 16,500 volts when tested by one of the usual methods with electrodes 1" in diameter spaced 0.1" apart.

It is essential that the proper oil level be maintained in the circuit breakers. Considerable variation may be caused by changing temperature or possible leakage of oil. Low oil levels may cause flashover of bushings or failure to handle heavy interruptions properly. Oil bumpers may be uncovered and fail to provide proper cushioning effect.

### **CONDENSER BUSHINGS**

Maintenance and power factor testing of condenser bushings should be given consideration during breaker inspection. Instruction Leaflet 33-354-1 is sent with each condenser bushing. This leaflet should be studied for complete recommendations on maintenance of bushings.

When placing bushings in breaker, do not permit the metal flange on the bushing to touch the metal support which holds the transformer in place. This has the effect of a short circuit turn around the transformer, and affects the ratio.

### **BUSHING CURRENT TRANSFORMER**

If it should be necessary for any reason to replace a current transformer, first remove the stationary contact from the contact foot so that the transformer may be slipped down over the condenser bushing.

The transformer may be disconnected at the terminal box on top of the pole unit; however, before it can be removed, it is first necessary to loosen the compression seal inside the terminal box. This seal consists of a sandwich of two Moldarta pieces with

## MAINTENANCE

a slice of Neoprene rubber in between, through which the transformer leads are threaded.

When replacing the transformer, make sure that the end of the transformer carrying the white polarity mark is facing upward, and that the packing on top, bottom, and around the transformer is in place. Also, see that the transformer is not thrown off ratio by allowing the case to touch the metal grounding band on the condenser bushing.

Tighten the compression seal inside the terminal box until the wires are held snugly. With this arrangement, it is not necessary to use any sealing compound as previously used on Type GM breakers.

**Caution:** Be sure that the proper transformer connections are made and a burden of short circuit placed across the terminals at the blocks in the mechanism housing before the breaker is closed on the line. Otherwise, dangerous voltage may appear across the open secondary terminals.

### OIL GAUGE

A float type oil gauge which screws into each tank top is provided. See Fig. 23. The gauge is marked for normal oil level at 25°C. Fluctuations on either side of normal will be noted with temperature changes.

The gauge glass is gasketed to insure weather tightness. Should it be necessary to replace a gauge glass, remove the old glass, clean the guard thoroughly, assemble the gasket at top and bottom of the glass, and tighten cap so that the glass is held in proper position.

### OPERATING MECHANISM

Complete instructions for operation and maintenance of the operating mechanism are given in a separate instruction book which accompanies this

book. If the Operating Mechanism Instruction Book is lost or misplaced, the I.B. number may be found on the nameplate inside the housing.

### RENEWAL PARTS

A list of renewal parts recommended to be maintained in stock will be furnished on request. When ordering renewal parts, specify the name of the part, using the name given in Fig. 1 of this book. Identify the breaker by including the type, amperes, volts and Shop Order (S.O.) Number, as stamped on the nameplate.

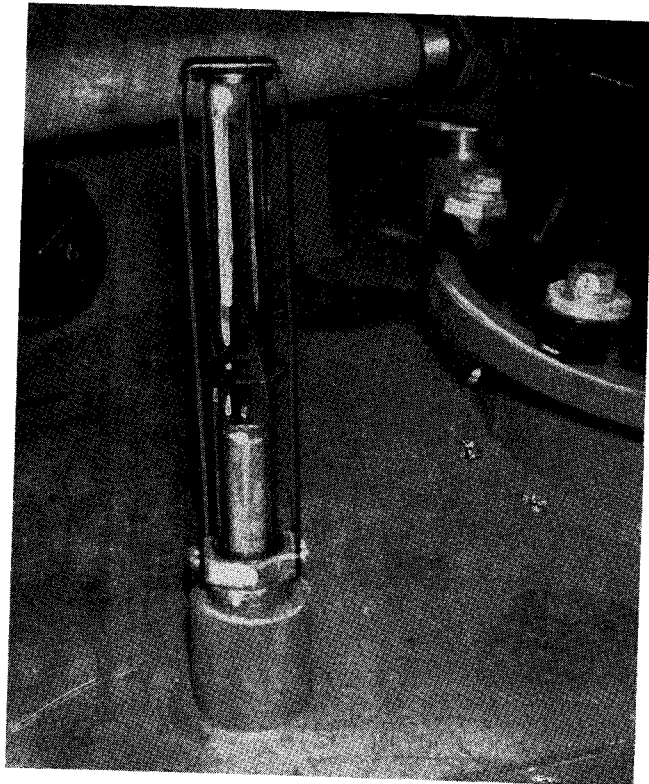


FIG. 23. Oil Gauge

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