INSTRUCTION BOOK

De-ion® Grid

OIL CIRCUIT BREAKER

Outdoor Type GM

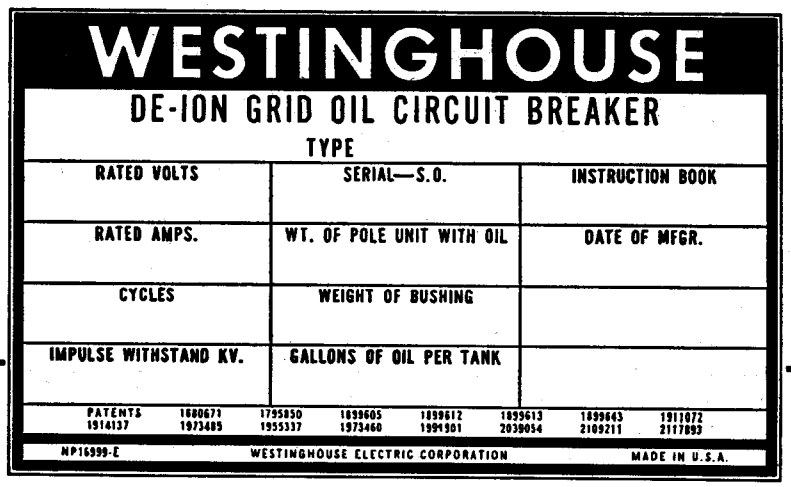
Westinghouse Electric Corporation

I.B. 33-805-2A

SPECIAL INQUIRIES

When communicating with Westinghouse regarding the product covered by this Instruction Book, include all data contained on the nameplate attached to the equipment.* Also, to facilitate replies when particular information is desired, be sure to state fully and clearly the problem and attendant conditions.

Address all communications to the nearest Westinghouse representative as listed in the back of this book.



* For a permanent record, it is suggested that all nameplate data be duplicated and retained in a convenient location.

RECEIVING • INSTALLATION • MAINTENANCE

INSTRUCTIONS

De-ion® Grid

OIL CIRCUIT BREAKER

Outdoor Type GM

Type	Kv	Kva
GM-4	138	3,500,000
GM-3	161	2,500,000
GM-4	161	3,500,000
GM-2	230/196	2,500,000
GM-2	230	2,500,000

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

SUPERSEDES I. B. 33-805-2

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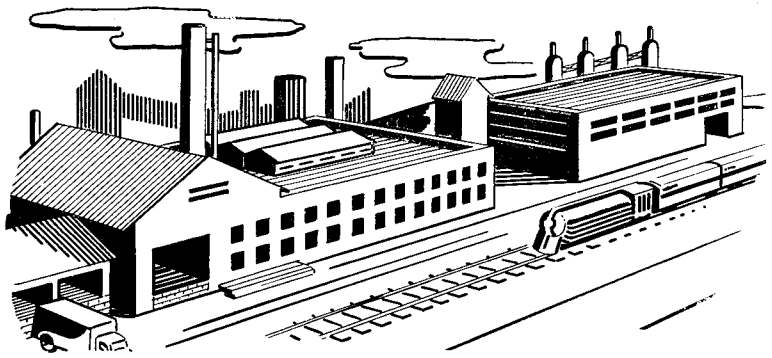
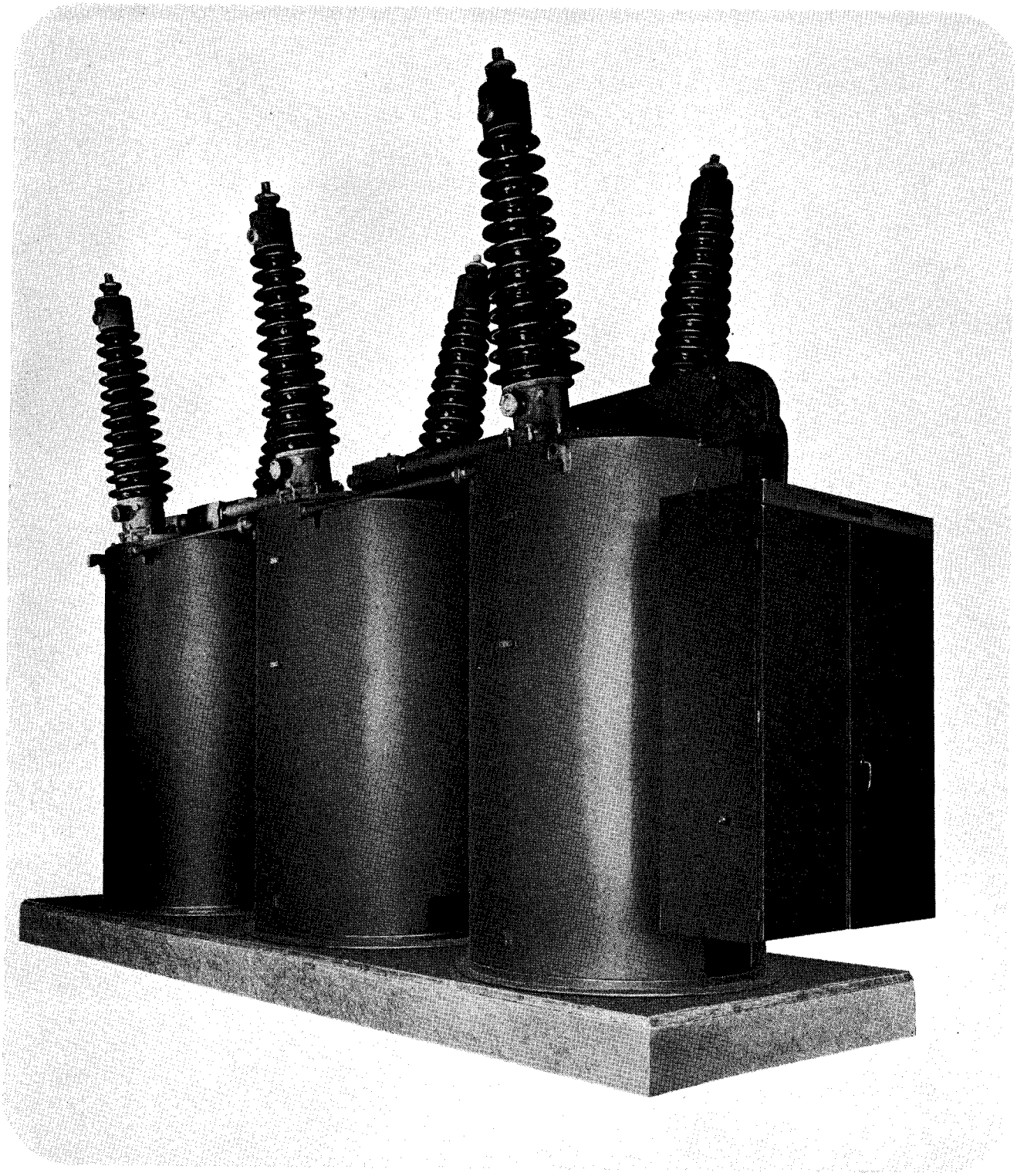
LIST OF ILLUSTRATIONS





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, sa outlined under Selecting the Location, page 10, of this book.

PART ONE

RECEIVING, HANDLING AND STORING

RECEIVING THE SHIPMENT

Type GM breakers, due to their size, are shipped partially dismantled as individual pole units. The condenser bushings, contacts and interpole connecting details are packed in separate crates as shown in Fig. 1.

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. 2 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.

Blocks and wire used to hold moving parts in the closed position during shipment must be removed. (Be sure to remove the wire that holds the mechanism triggers and latches from jarring loose during shipment.)

HANDLING TANKS AND BUSHINGS

The weight, with oil, of the heaviest tank (No. 1 pole unit with operating mechanism) 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

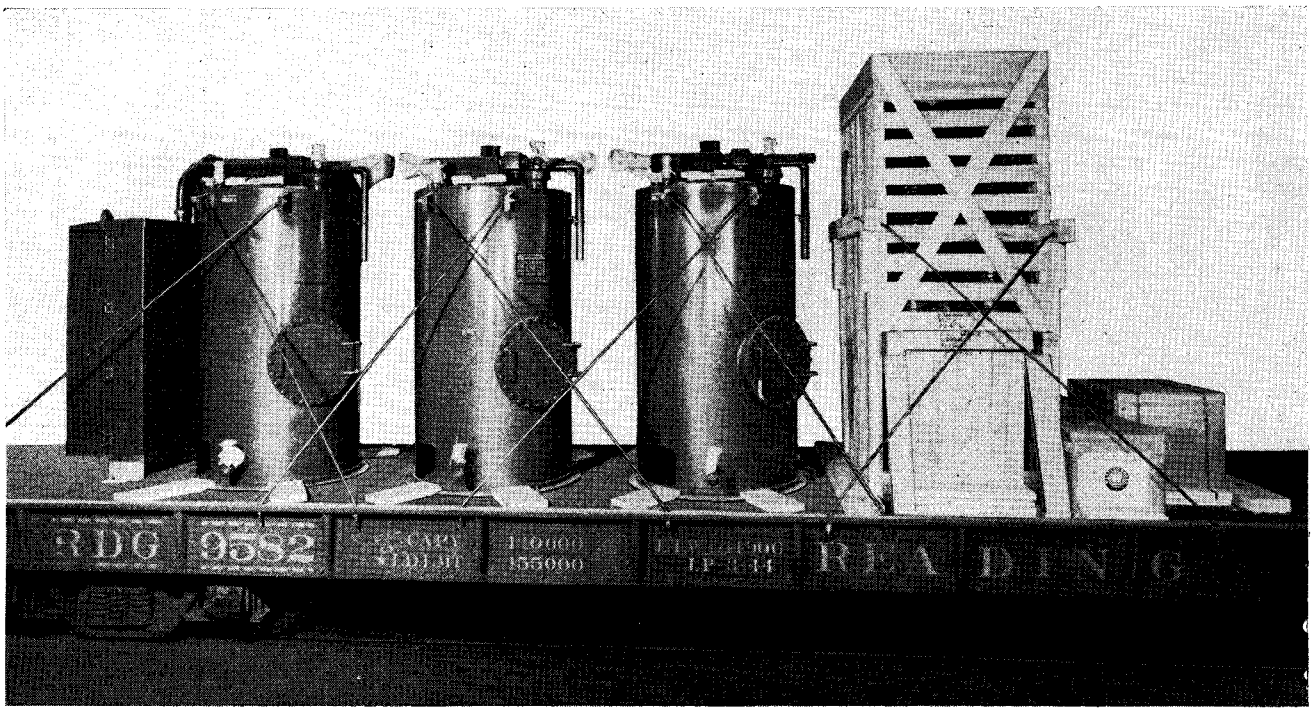
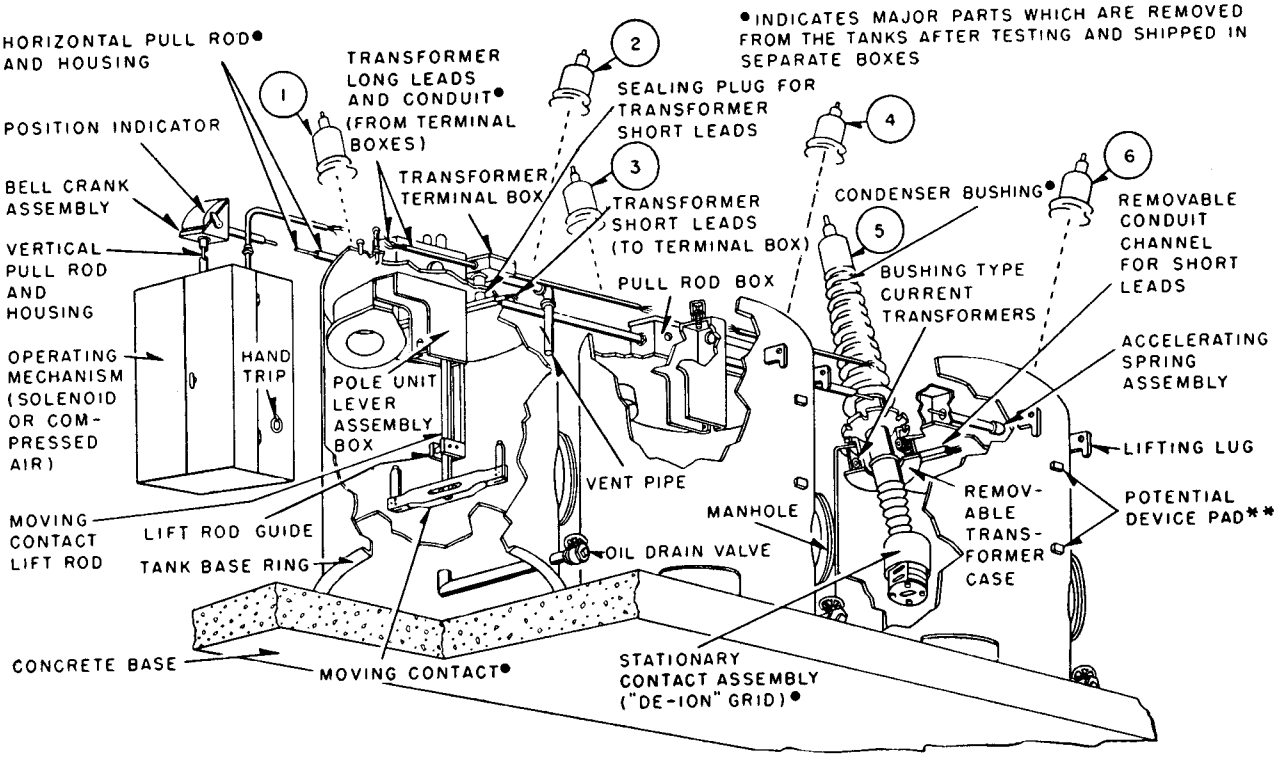


FIG. 1. Typical Loading Arrangement of a Complete Oil Circuit Breaker, Type GM



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).

Four (4) Tie Rods. Wrapped in weatherproof paper and shipped in the detail parts crate.

Two (2) Conduit Pipes. Wrapped in weatherproof paper and shipped in the detail parts crate.

Two (2) Tie Pipes with Gaskets. Wrapped in weatherproof paper and shipped in the detail parts crate.

Twelve (12) Floor Clamps. Wrapped in weatherproof paper and shipped in the detail parts crate.

Two (2) Pull Rods. 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 in the detail parts crate (when ordered).

Bushing Type Current Transformers. Assembled in the breaker (when ordered). Wire for secondary leads is wrapped in weatherproof paper and shipped in the detail parts crate.

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. 2. Parts and Accessories Included in a Complete Circuit Breaker Shipment

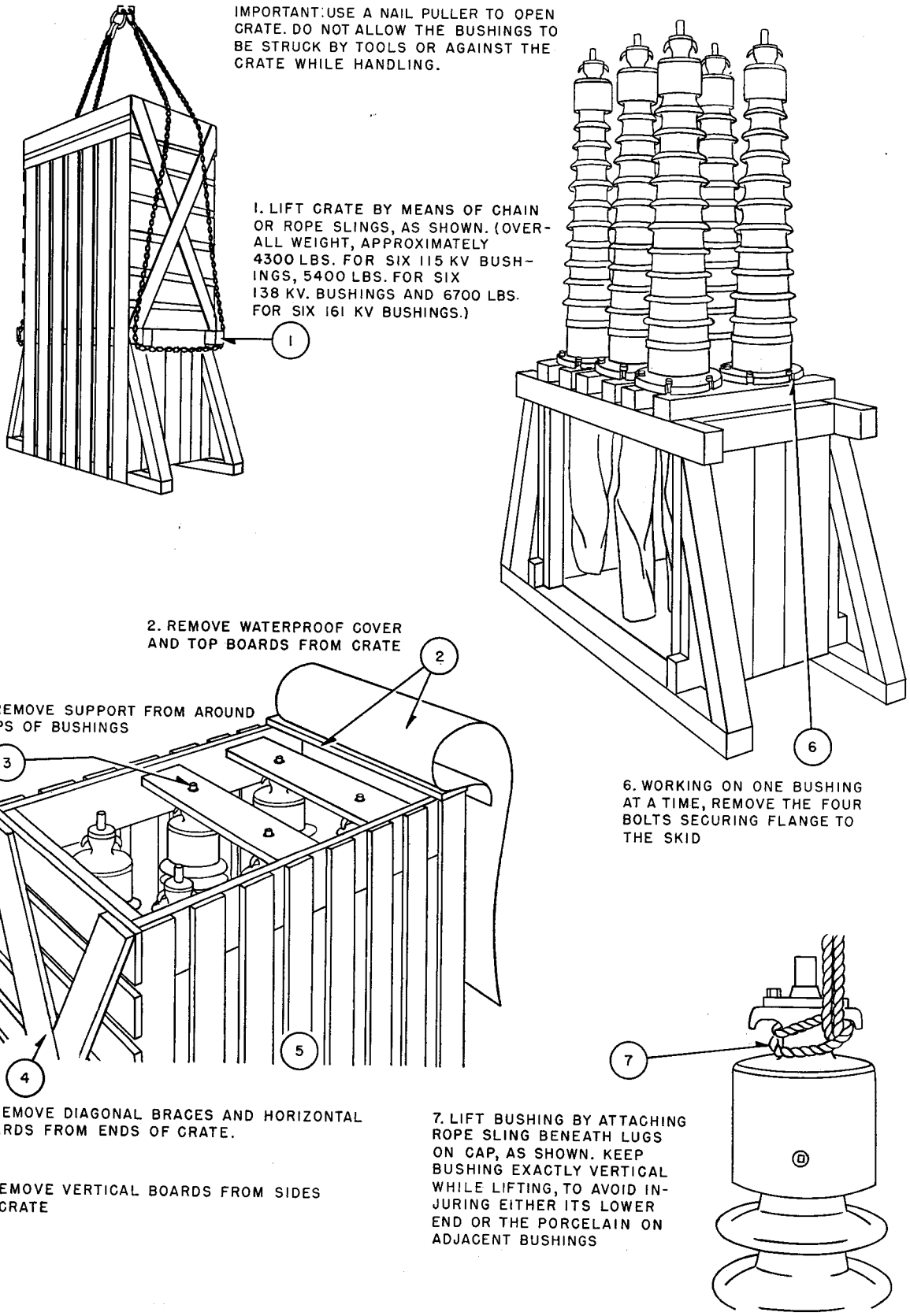


FIG. 3. Procedure for Uncrating Vertically Packed Condenser Bushings

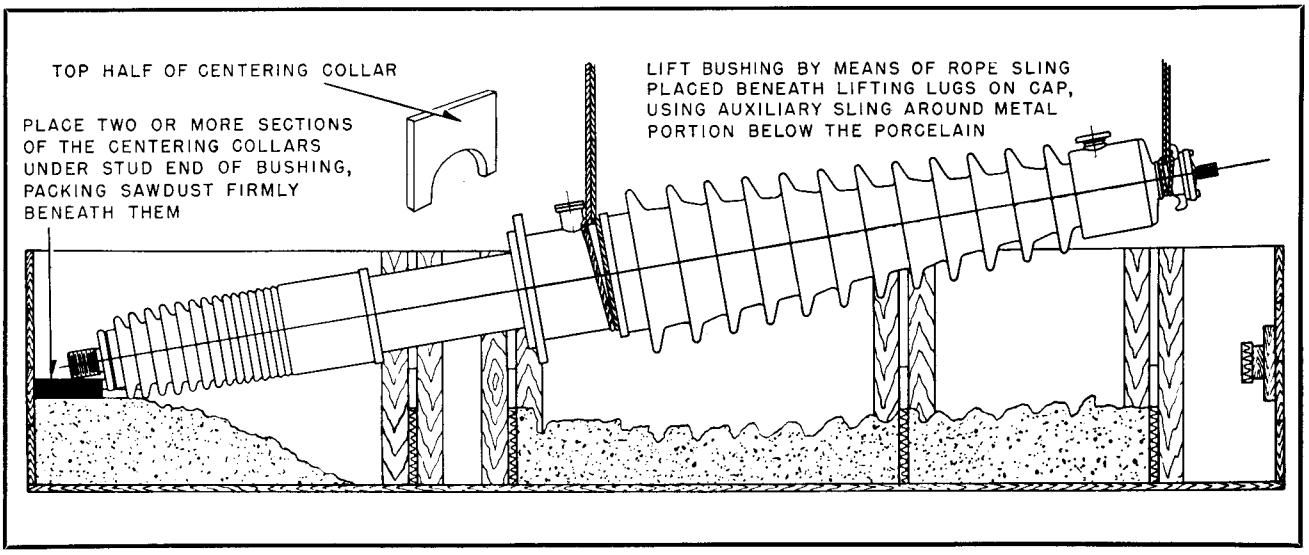


FIG. 4. Removing a Horizontally Packed Condenser Bushing from its Crate

to the side of the tanks will bear the weight of the entire pole unit (without oil).

Gallons of oil required is also shown on the nameplate. Oil weighs 7½ pounds per gallon. Weight of tank without oil may be determined by subtraction.

Condenser bushings (161 kv and smaller) 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. 3. (Duplicate instructions are attached to each bushing crate).

The larger 196 kv and 230 kv bushings are packed singly in boxes and shipped in a horizontal position. Smaller bushings are also packed in this manner when railroad clearances are limited, or when shipped separately in boxcars. For handling methods refer to Fig. 4 or the instructions attached to each bushing crate.

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

STORING BREAKER PARTS

All insulating parts, such as guides and "De-ion" Grid Stacks, must be stored in a dry place if the breaker is not to be immediately set up.

Lift Rods and Guides. Remove lift rods and guides from breaker (especially spare parts which may not be used for a long time) and store on a level surface or hang them in a vertical position to minimize the possibility of warping.

"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 fiber 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 any 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.

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 exactly 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.

When lining up the tanks, carefully follow the drilling plan sent in advance from the factory.

The following steps should now be taken:

Note: These steps may be eliminated if breaker is shipped mounted on I-beam skids. In this case, the entire 3-pole I-beam assembly is levelled and clamped to foundation.

Step 1. Move the No. 1 tank with the operating mechanism into position first. (See Fig. 5). Before the No. 2 tank is moved into place, insert the horizontal pull rod connecting the two poles, together with its housing, in the pull rod box of No. 1 pole. The special nuts should be on the ends of the housing, screwed as far onto the housing as possible. Before placing the nuts on the housing, place the cork Neoprene strip gaskets in the retaining grooves in the nuts. This is done by bending the gasket to form a ring, the narrow dimension of the strip forming the flat surface of the gasket, and inserting it in the retaining groove, using Westinghouse Cement No. 7247 to hold it in place. The joint where the ends of the gasket strip join should be adjacent to the flat side of the nut and when the end of the housing is inserted into the pull rod box of the pole unit, this side of the nut should be at the bottom, so that when tightened, the joint in the ring gasket will be at the bottom.

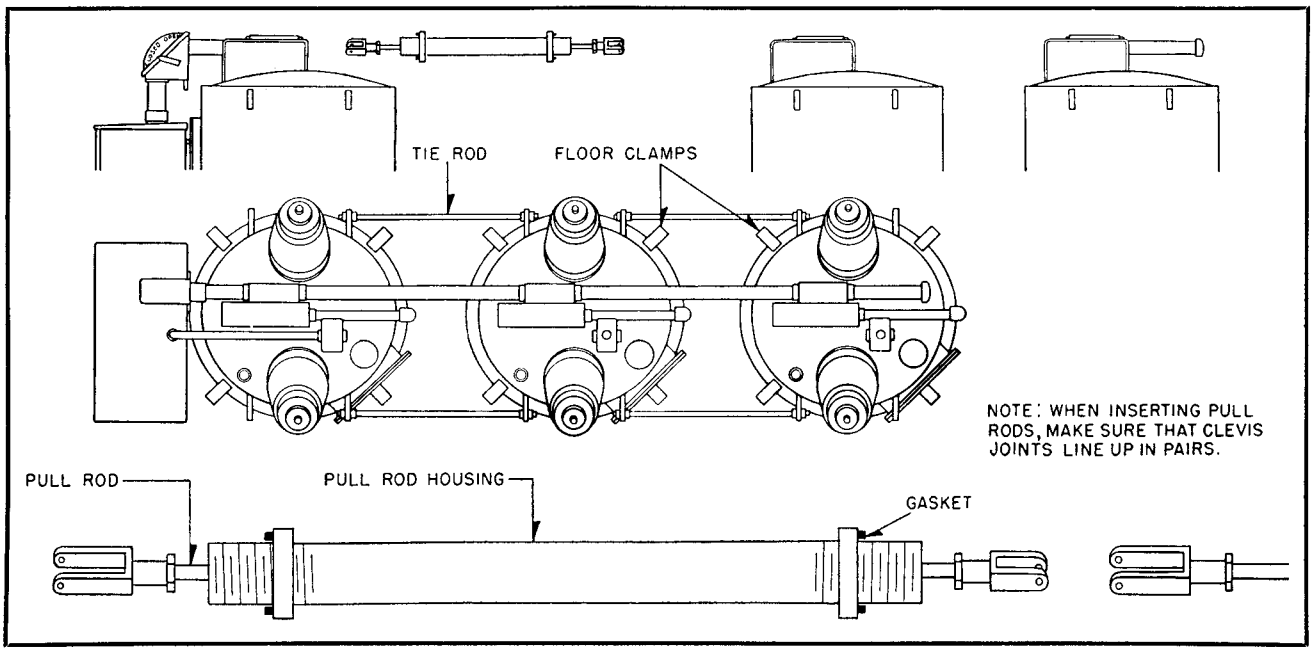


FIG. 5. Procedure for Aligning Pole Units and Making Pull Rod Connections

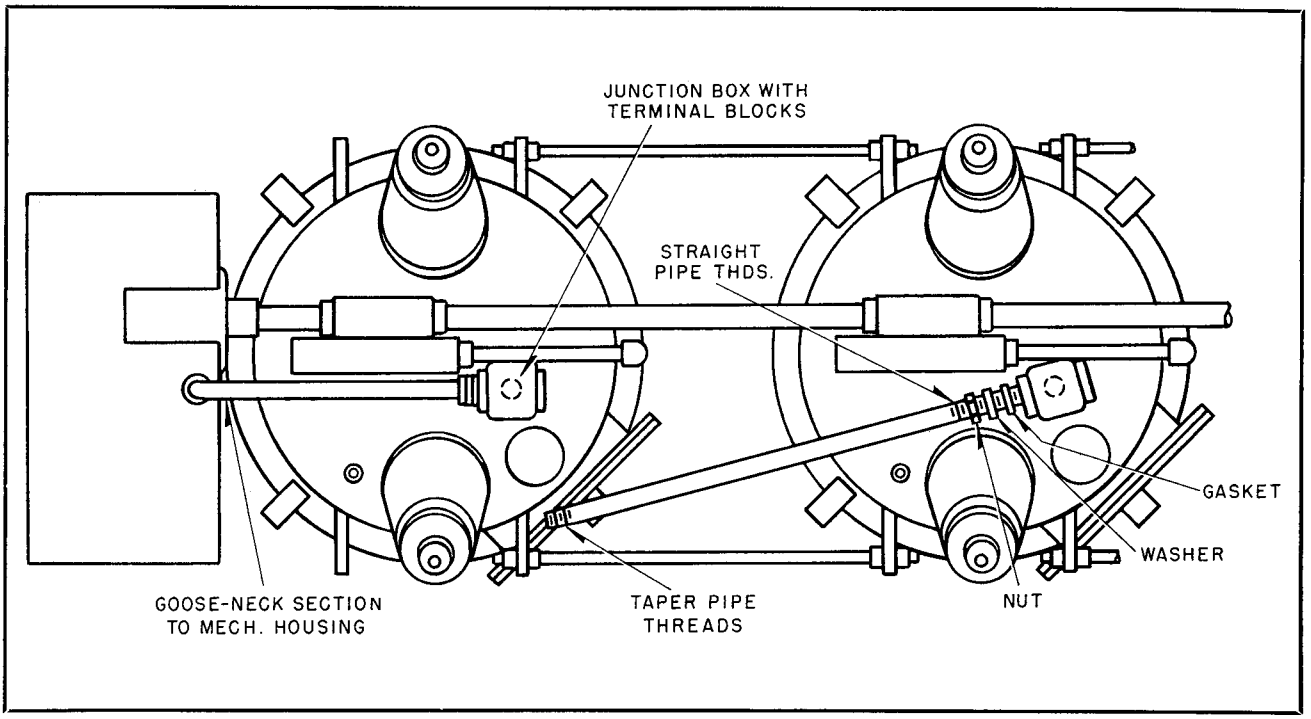


FIG. 6. Procedure for Assembling Transformer Lead Conduit

Step 2. Move the tank for No. 2 pole into position, guiding the end of the horizontal pull rod and housing from the No. 1 pole into position in the pull rod box of No 2 pole. Insert the horizontal pull rod connecting No. 2 pole with No. 3 pole and its housing in the other end of the pull rod box of No. 2 pole in the manner previously described; then move No. 3 pole into position.

Up to this time the foundation bolts on the various poles should not be tightened. Before doing so, align the pole units properly with respect to each other with all poles on the same center line and properly spaced. (See drilling plan). Likewise, each individual pole should be properly plumbed and levelled by the insertion of shims where necessary.

After this is satisfactorily accomplished, tighten the floor clamps securely, and assemble the tie rod braces between the poles. The nut on one end of the tie rod may be run up to the last threads, and this end put into place first. Tighten the nuts on these rods evenly and securely on both sides of the lifting lugs welded to the sides of the tanks.

Step 3. Tighten the nuts on the horizontal pull rod housings against the ends of the pull rod boxes on the pole units by rotating the housings in such a manner as to unscrew the nuts from the housings. It will be noted that the nuts will be prevented from turning when the housings are rotated by the sides of the pole unit lever boxes which are adjacent to one flat side of the nuts. Since one is a right hand thread and the other left hand, rotation of the housing in the proper direction will force the nuts apart, tightening their gaskets against the faces of the corresponding pull rod boxes.

Step 4. Assemble the inter-pole current transformer lead conduit, using the following procedure. See Fig. 6.

(a) Junction box on No. 1 pole and goose-neck section to mechanism housing are assembled at the factory and need not be disturbed. Loosen nut on under side of junction box on No. 2 pole and rotate box counter-clockwise about 15°—this may be done without disturbing current transformer lead connections to terminal blocks.

(b) Take one of the sections of interpole conduit and screw the lock nut on to the limit of the threads on the end with straight pipe threads, followed by the washer and gasket. Screw the pipe into No. 2 pole junction box as far as possible, and then rotate this box back to its normal position. If the other end of the pipe does not line up with No. 1 pole junction box, raise or lower No. 2

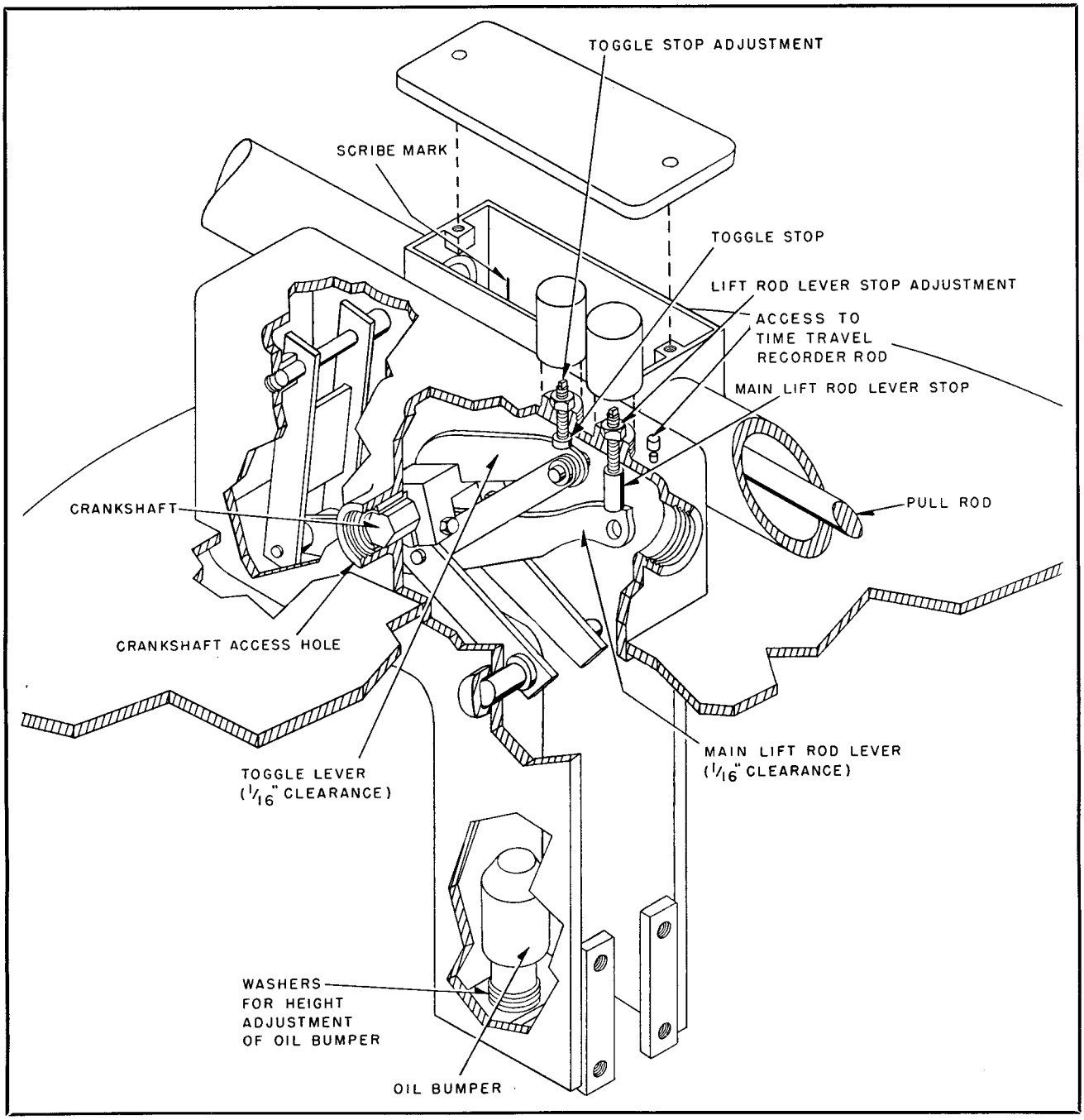


FIG. 7. Section View of Pole Unit Lever Mechanism

pole box as necessary. The junction boxes have a clearance hole in the bottom, with a nut inside, and a gasket, washer, and nut underneath to allow this adjustment.

(c) Back the conduit section out of No. 2 pole junction box and make up taper thread connection at No. 1 pole junction box, using Westinghouse cement No. 692. Apply Westinghouse cement No. 7247 to gasket at No. 2 pole junction box and tighten lock nut.

(d) Repeat above procedure for conduit section between No. 2 and No. 3 poles. In this case, No. 3 pole junction box will be rotated.

(e) Replace covers on junction boxes. The gaskets on these covers should be coated with

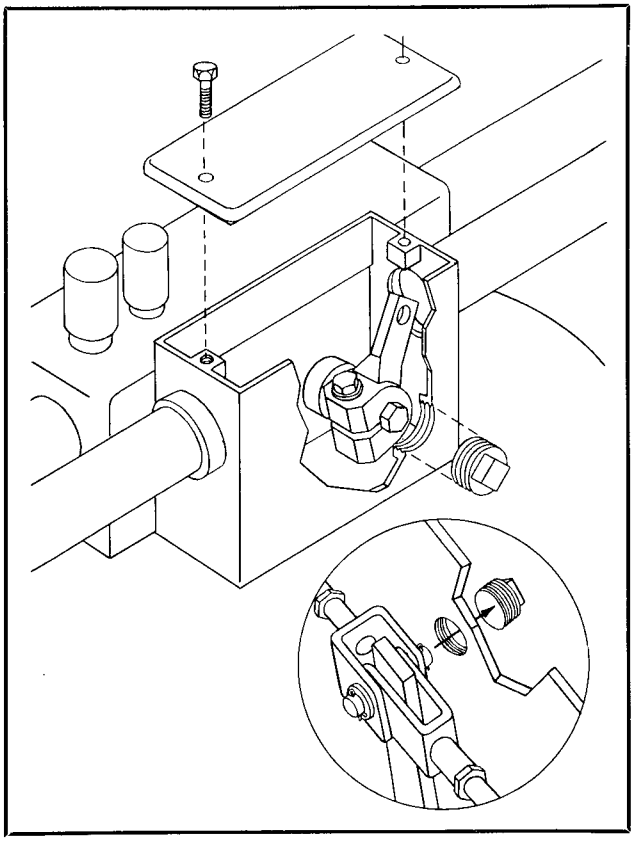


FIG. 8. Cutaway View of Pull Rod Housing Box Showing Pull Rod Lever. Inset Shows Access Plug and Clevis Joint Assembly

vaseline, since the covers may be removed occasionally.

MAKING THE PULL ROD CONNECTIONS

Starting with No. 1 pole, make the pull rod connections by aligning the clevis joints and inserting the pin. Be sure there is a shim washer between all moving surfaces and back of each cotter pin before finally inserting the retaining cotter pins. See Fig. 8.

To connect No. 3 pole, it is necessary to relieve the tension on the accelerating spring at the end of the pole housing. (See Fig. 24, page 29). To do this, remove the spring housing cap, loosen the locking screw and back off the adjusting nut.

After the connection has been made, be sure to move the spring adjusting nut back to its original position.

Caution: Be sure the operating mechanism on solenoid-actuated breakers is in the latched position before attempting to remove the accelerating spring housing cap. This spring exerts considerable pressure on both the cap and the spring retaining collar when the operating mechanism is unlatched. (The cap may be easily replaced when the operating mechanism is in the latched position.)

With the breaker closed and just latched (no overtravel), remove pipe plugs in the side of the lever box opposite each lift rod and toggle stop. (See Fig. 7). Starting with No. 1 pole, adjust the horizontal pull rod lengths to get 1/16 inch clearance at all lift rod and toggle stops. Pull rod lengths are adjusted by disengaging clevis joints and making half-turns of clevis rod ends.

It is not necessary to make fine adjustments at this time, since it will be necessary to recheck 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 28.

ADJUSTING THE BELL CRANK LEVER

The bell crank assembly is mounted above the operating mechanism on the No. 1 pole unit. Its function is to convert the vertical movement of the operating mechanism into the horizontal movement of the pull rod assembly.

When the breaker is closed, check the position of the bell crank. (According to the type of mechanism and voltage rating of the breaker, the dimension identified as X should conform to the corresponding figure in the table in Fig. 9.).

If the position is incorrect, it may be shifted by lengthening the horizontal pull rod and shortening the vertical pull rod, or vice versa, as indicated in Fig. 9.

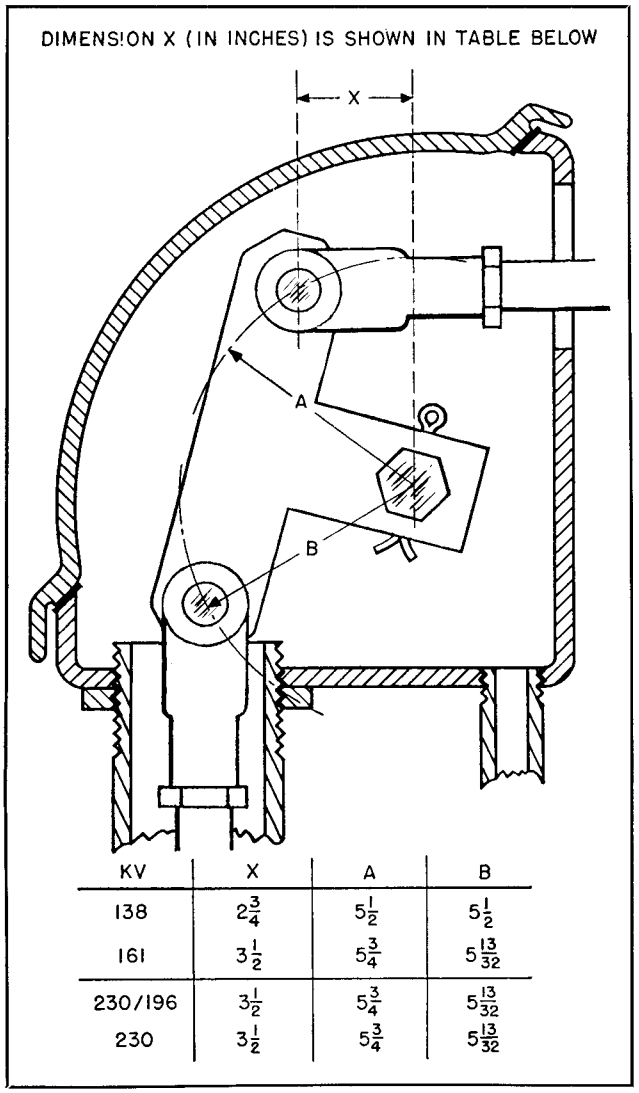
Re-check this setting before making final adjustments.

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. 10. 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.

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



KV	X	A	B
138	$2\frac{3}{4}$	$5\frac{1}{2}$	$5\frac{1}{2}$
161	$3\frac{1}{2}$	$5\frac{3}{4}$	$5\frac{13}{32}$
230/196	$3\frac{1}{2}$	$5\frac{3}{4}$	$5\frac{13}{32}$
230	$3\frac{1}{2}$	$5\frac{3}{4}$	$5\frac{13}{32}$

FIG. 9. Bell Crank Adjustments

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

2. Make sure the molded beveled gasket is in position before lowering the bushing all the way into place. (See Fig. 11).

It is not necessary to use cement on this gasket. Grease or vaseline, however, is recommended to prevent damaging the gasket when shifting the bushing for adjustment.

3. Align the bushings accurately with respect to the center line of the tanks. Space the lower ends the proper distance apart, using the lift rod as a point of reference, before tightening the holding bolts. (See Pole Unit Section Drawing, supplied with each order, and Fig. 14.) The beveled seat permits accurate alignment of the bushing, since it is possible to shift its position by loosening bolts on one side and tightening them on the other, according to the direction in which the bushing is to be moved.

4. 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. 11.) It is advisable to check this

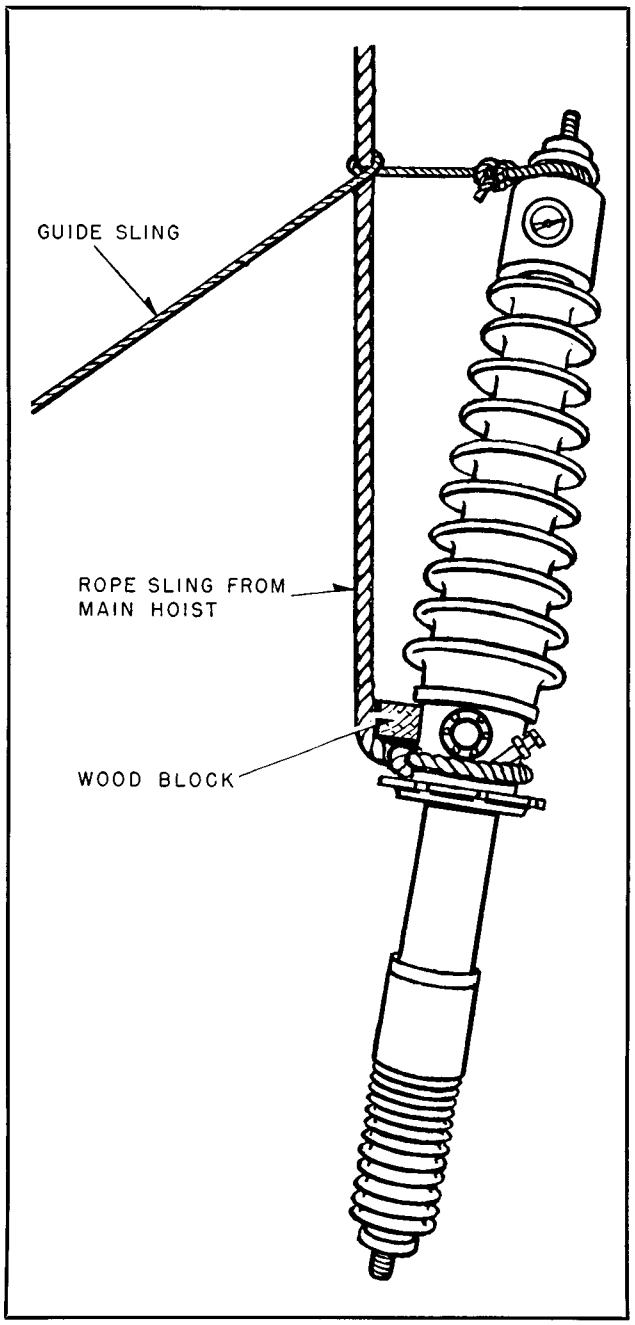


FIG. 10. Method of Suspending a Condenser Bushing at Proper Angle for Inserting Into Tank Top

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

5. 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.

6. Tighten down all flange bolts evenly and securely.

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 lower metal shield (3), Micarta shield (4), and upper metal shield (5) in the order stated. See Fig. 12. Then remove the contact foot (1), which is held in place by three bolts (2), and screw onto the condenser bushing stud. Carefully avoid cross-threading or damage to either threaded member.

Be sure that the contact feet on the two bushings in any one pole unit are located at exactly the same height and that each has full length of engagement on the threads.

The contact assembly may now be lifted into position and re-bolted to the contact foot. Do not tighten the clamping bolt on the contact foot or assemble the contact shields until the moving contacts have been assembled and adjusted.

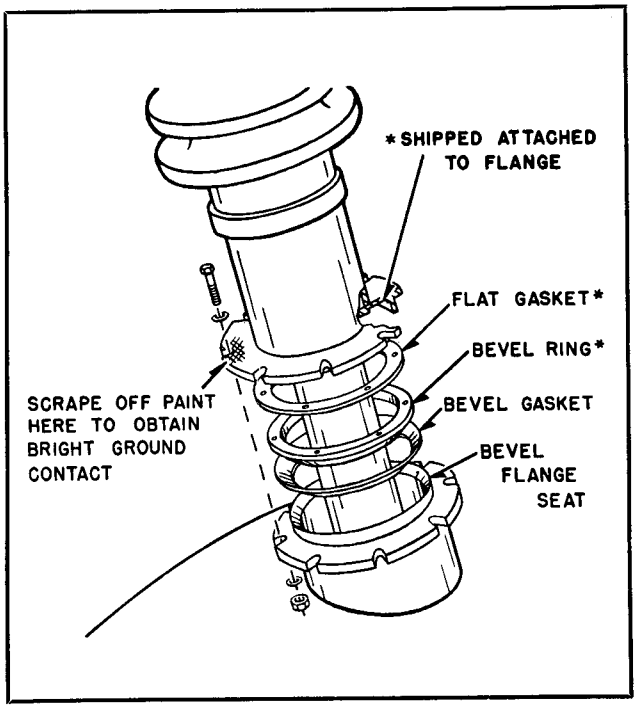


FIG. 11. Installing a Condenser Bushing

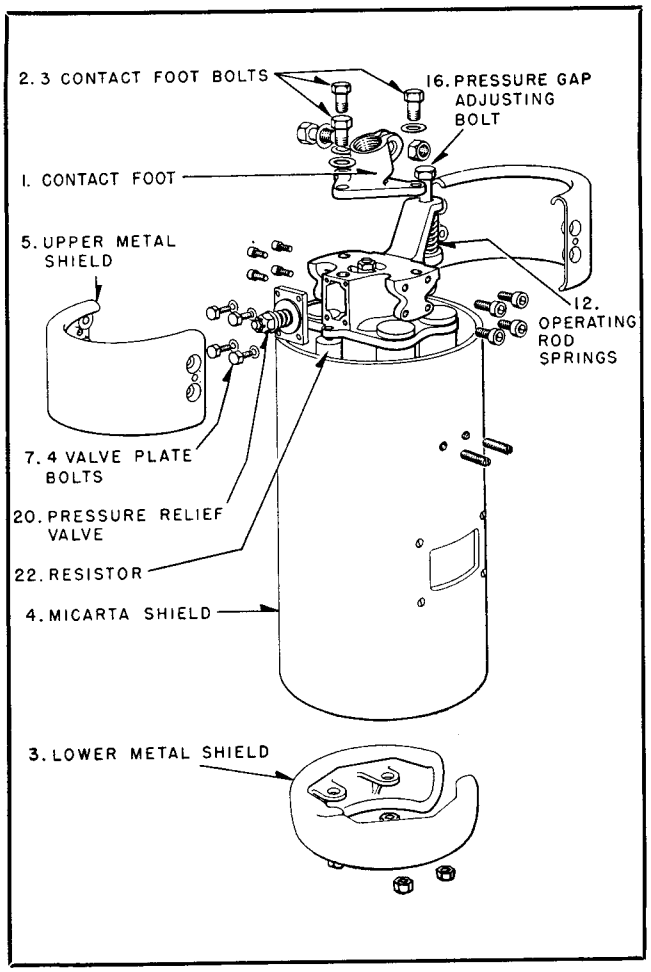


FIG. 12. Exploded View of Stationary Contact Unit

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. 13.

Assembling and Adjusting the Moving Contact. The moving contact cross-arm is assembled on the lift rod foot by first removing the lower two adjusting nuts and lock-nuts from the studs at the lower end of the lift rod. Slip the cross-bar over the studs and replace the two nuts and spring lock-nut on each stud. Adjust the upper and lower nuts to secure horizontal alignment of the cross-arm. Upper adjusting nuts may be reached by an open-end wrench through the wide slot in the face of the

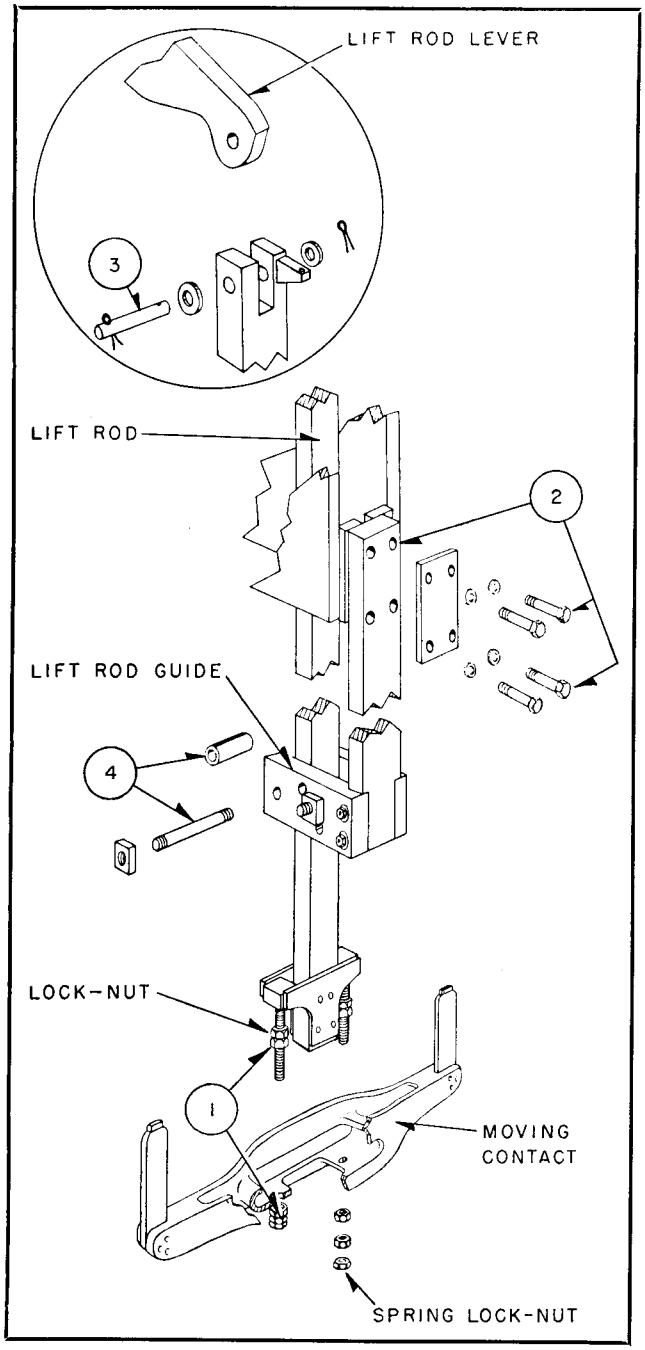


Fig. 13. Procedure for Installing the Moving Contacts

cross-arm. Lower adjusting nuts and lock-nut are set by means of a socket wrench used from beneath the cross-arm.

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 Methods of Securing Alignment.

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. 13 and shift lower end of guide slightly to the left or right as desired. A series of holes in the lower horizontal guide pieces accomodates a variation in thickness of the light 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. 13.

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. 13. 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.

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 suggested for securing accurate alignment:

1. Slightly rotate the stacks on the bushing studs until the slot faces are exactly parallel with the contact blades.

2. Shift the stacks with respect to the contact feet to center the contact blades in the slots. (Clearance holes around the contact foot bolts permit this adjustment).

3. Slightly tip the moving contact cross-bar to enter the stacks simultaneously. (See Fig. 13.) This should be done very carefully in order to prevent binding of contact blades after they enter the slots. Greater adjustments can be made by changing the height of one of the contact feet on the condenser bushing stud.

4. Shift the guide members slightly to move the cross-bar horizontally. Clearance has been provided around the bolts holding the guide members

so that they may be shifted as necessary to make the lift rod exactly vertical and centered between the stacks. (See Fig. 13).

5. If the lateral spacing between the stationary contacts is still not correct, it may be necessary to shift one or both condenser bushings slightly, as previously described under Installing Condenser Bushings, page 13.

Important: Make sure the bushing is resting properly on the molded beveled gasket before tightening the flange bolts after this adjustment.

ADJUSTING CONTACT TRAVEL

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. 13.).

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. (If contact is not made simultaneously, it may be necessary to raise or lower one of the stationary contact assemblies by turning it one or more complete revolutions on the condenser bushing stud. To provide clearance for this, the lift rod must be swung away from its normal position as shown in Fig. 13.)

3. Continue closing breaker slowly until either the breaker latches fully closed, or $\frac{3}{8}$-inch contact pressure travel is obtained. (See Fig. 18, page 24). 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 $\frac{3}{8}$ inch after the breaker latches, the moving contact must be raised on its lift rod. Adjust moving contact, keeping cross-bar level, until $\frac{3}{8}$-inch ($\pm \frac{1}{32}$) contact pressure travel is obtained on both stationary contact assemblies.

Note: The pressure gap and operating rod adjustments on the stationary contacts have been set at the factory and should not require adjustment. If there is suspicion that these adjustments should be checked, follow the procedure detailed in Operation and Adjustment, Part Three of this book. (Page 25 and Fig. 18, page 24).

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

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. 7, page 12).

Measure the total moving contact travel from the latched position to the full open position (oil bumpers depressed). This travel may be obtained from the pole unit drawing sent out on each order (also see Fig. 14). A tolerance of $-\frac{1}{2}$ inch undertravel shown on drawing is allowable, e.g. a travel of $23\frac{1}{2}$ to 24 inches is permissible if the specified travel is 24 inches.

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.

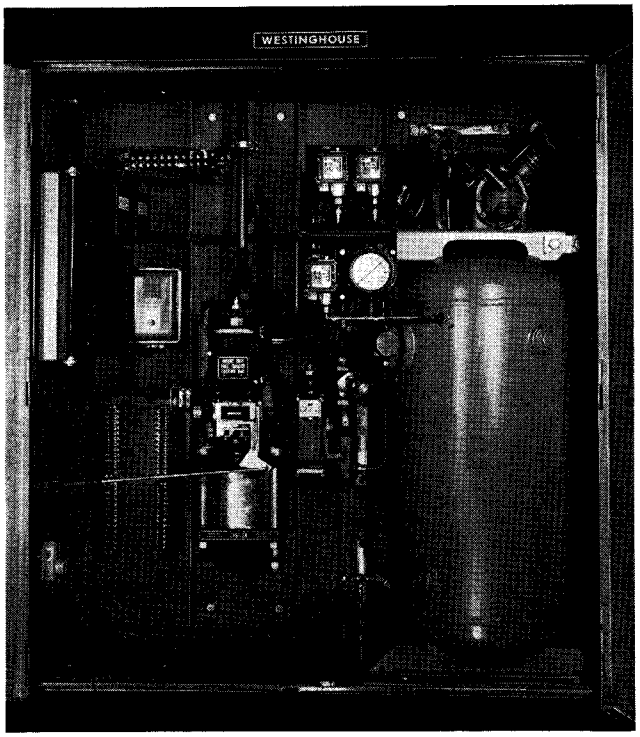


FIG. 15. Pneumatic Operating Mechanism

of breaker liberally with grease before replacing covers, in order to prevent rusting.

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

12. 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.

13. 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).

14. Check electrical operation of the breaker a few times after the tanks have been filled with oil. It is recommended that a cycle counter, or preferably a graphic recorder, be used to check the breaker opening speed. In order to be sure of getting 5-cycle arc interruption, the time from energizing the trip coil until contact parts should be not over 3 cycles (60-cycle basis). Copies of typical time-travel curves will be furnished on request.

If the opening time exceeds this figure, it may be due to any of the following reasons:

a. Excessive line drop in control wiring to breaker.

b. Not enough accelerating spring compression.

c. Incorrect setting of pole unit lever system.

Note: The last two conditions may be corrected by procedure outlined under Operation and Adjustment, Part Three of this book.

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

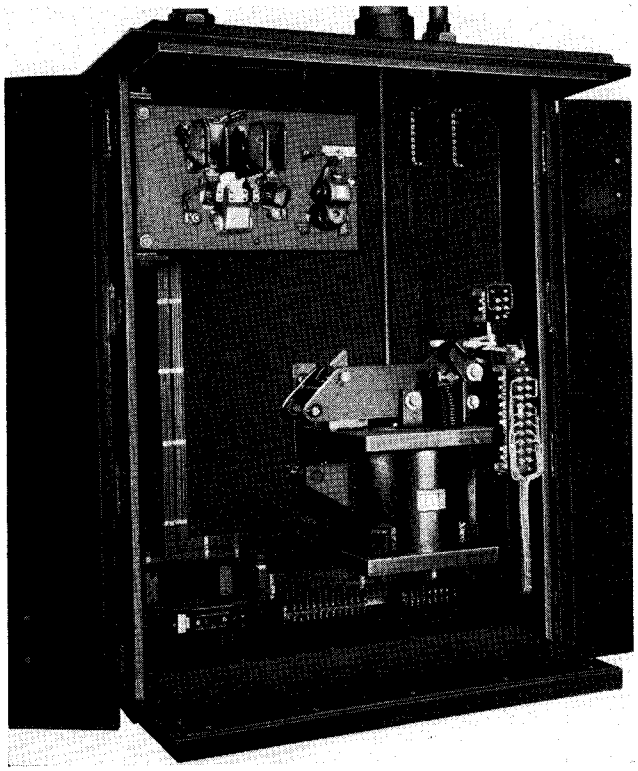


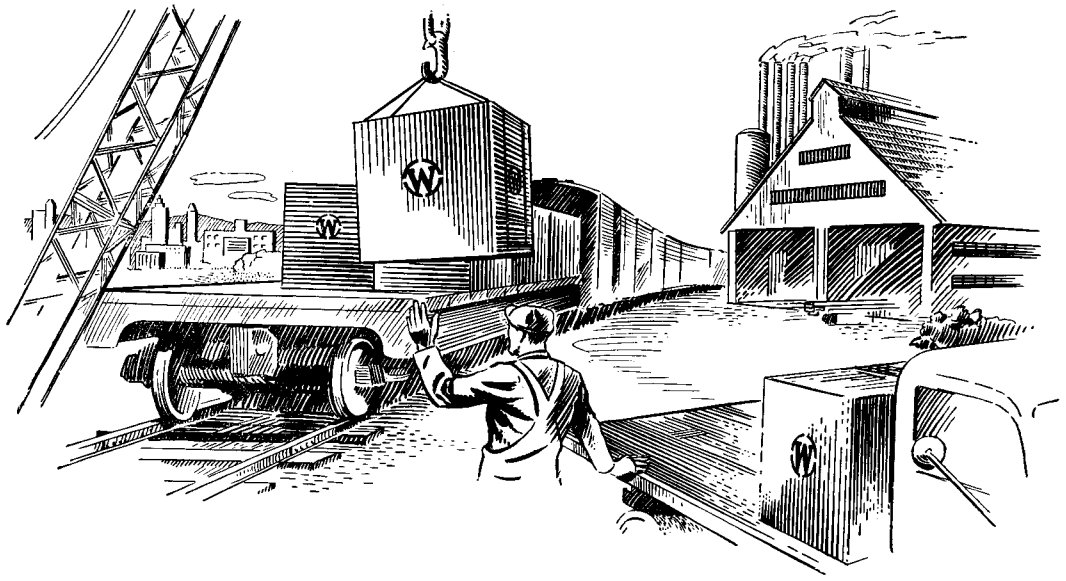
FIG. 16. Solenoid Operating Mechanism

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 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.

THE WESTINGHOUSE "DE-ION" GRID UNIT

The contact assembly shown in Fig. 17 consists of one interrupting unit per terminal (2 per pole) and a moving contact to bridge the two interruptors and complete the circuit.

Note: The numbers in the text refer to items shown in Fig. 17.

The interrupting unit (grid) is made up of fiber plates to form passages for the desired oil flow, with two contact breaks per unit. A pressure generating arc is formed between the crank arm contact (18) and the intermediate contact (9), and the main arc is drawn between the intermediate contact and the moving contact (8). On an interrupting operation, the contacts are rapidly opened by the accelerating spring (tail spring) on No. 3 pole acting on the moving contact lift rod and by the springs (12) acting on the contacts. The pressure arc and the main arc are drawn practically simultaneously. The function of the pressure arc is to build up a gas pressure in the upper chamber and force an oil flow into the interrupting break.

The oil passages may be seen in Fig. 17. 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 arc path de-ionizes the arc, and the arc products pass out of the grid through exhaust vents on either side of the grid. The position of the vents is staggered in height with respect to the inlets and are located at 90 degrees around the grid. (See Fig. 20). The name of this interruptor, "Multi-Flow De-ion Grid" is readily apparent from this description. The interruption is due to the flow of oil along the arc path through a multiple-orifice arrangement. After the main arc is interrupted, the circuit is broken and hence the pressure arc goes out.

To assist in re-filling the grid with oil, a check valve (19) in the top of the pressure chamber provides a vent for any residual gas left inside, and also permits circulation of oil to keep the temperature rise down on normal current flow. This valve closes automatically when the pressure in the upper chamber builds up. As a protective feature, a pressure relief valve opens if the pressure in the pressure chamber becomes too great during an interruption.

In order to distribute the voltage equally between the two interruptors on each pole during an interruption, a very high resistance (22) is shunted across each stack. The resistor circuit is completed between the moving contact and the resistor in the following order: moving contact to metal bottom plate on stack through fingers (24) at bottom of stack slot; metal bottom plate to lower end of resistor through bracket and spring.

The mechanical operation of the contacts may best be observed by examining a closing operation. The moving contact blade first enters the fingers at the bottom of the stack slot to complete the resistor circuit. After the moving contact blade has passed part way through the stack slot, the cross-bar (8) picks up the side operating rod (11) which starts to move the crank arm contact (18) downward inside the pressure chamber while the moving contact is still moving upward. The moving contact picks up the intermediate contact (9) near the end of the closing stroke, and slightly later the crank arm contact also meets the intermediate contact. Further movement causes the crank arm contact to reverse its motion and compress the springs (13). The crank arm contact is not rigidly connected to the operating rod, but is connected through the springs (13). In order to get the independent motion described, there are two springs (13) which straddle the operating rod and are connected to the operating rod by projecting ears. The crank arm contact is forked at the rear end so that it also straddles the operating rod.

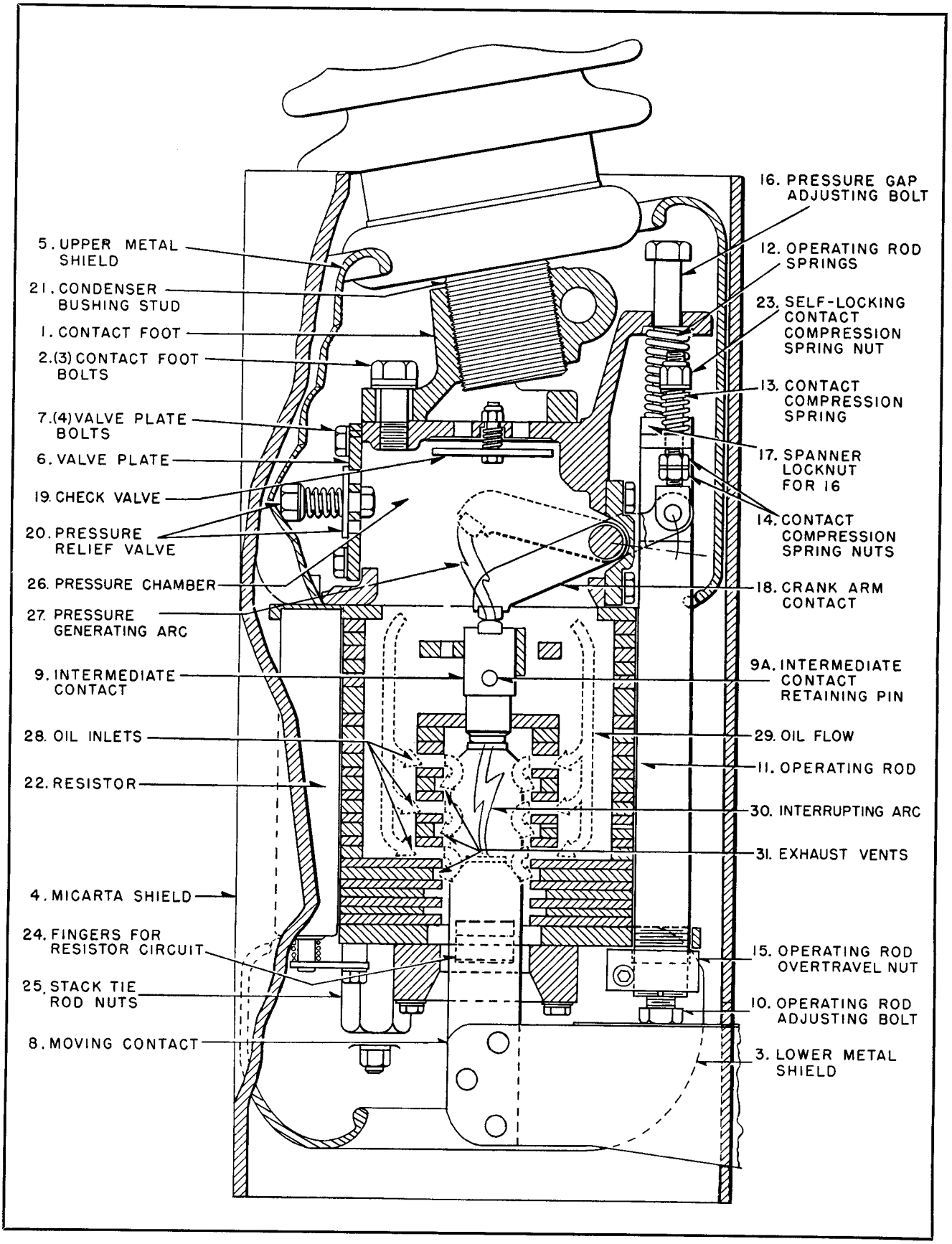
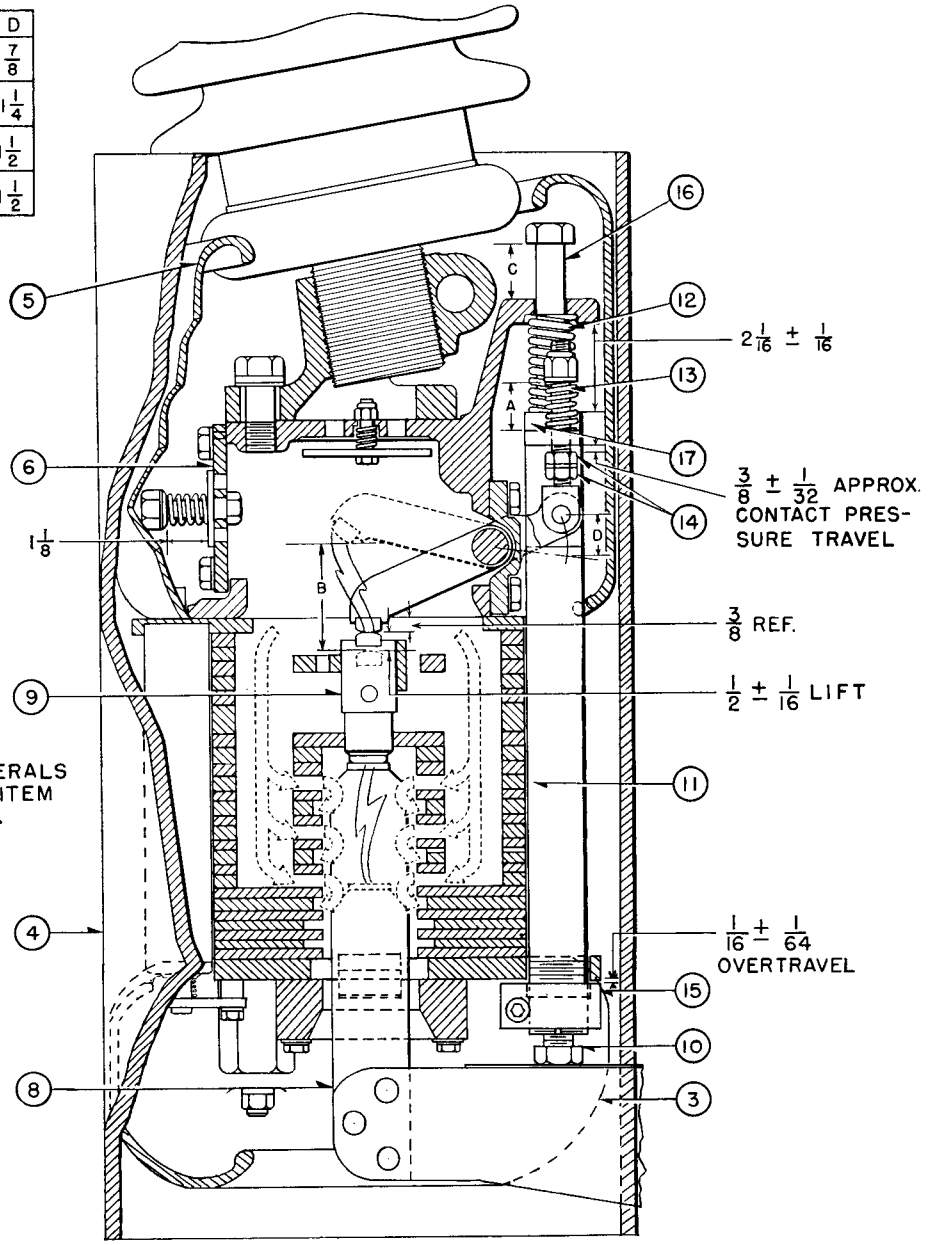


FIG. 17. Cutaway View of Contact Assembly

	A	B	C	D
138 KV	$1\frac{1}{4}$	2	$1\frac{1}{4}$	$\frac{7}{8}$
161 KV	$1\frac{1}{4}$	$2\frac{1}{2}$	$1\frac{5}{8}$	$1\frac{1}{4}$
230/196 KV	$1\frac{1}{4}$	3	$1\frac{7}{8}$	$1\frac{1}{2}$
230 KV	$1\frac{1}{4}$	3	$1\frac{7}{8}$	$1\frac{1}{2}$

NOTE: CIRCLED NUMERALS CORRESPOND WITH ITEM NUMBERS IN FIG. 17.



CONTACT ADJUSTMENT

REMOVE 3,4,5 AND 6.

CLOSE BREAKER AND ADJUST MOVING CONTACT (8) WITH RESPECT TO ITS LIFT ROD (FIG. 13) TO GET $\frac{1}{2}$ INCH LIFT OF INTERMEDIATE CONTACT (9).

ADJUST BOLT (10) AT LOWER END OF OPERATING ROD (11) TO GET $2\frac{1}{16} \pm \frac{1}{16}$ COMPRESSED LENGTH SHOWN OF OPERATING ROD SPRING (12).

ADJUST NUTS (14) FOR $\frac{3}{8}$ CONTACT PRESSURE TRAVEL.

CHECK COMPRESSED LENGTH (A) OF CONTACT COMPRESSION SPRINGS (13).

ADJUST OPERATING ROD OVERTRAVEL STOP NUT (15) FOR $\frac{1}{16}$ OVERTRAVEL CLEARANCE.

WITH BREAKER IN OPEN POSITION, ADJUST BOLT (16) LOCKED BY SPANNER NUT (17) FOR (B) PRESSURE GAP.

FIG. 18. Contact Adjustments

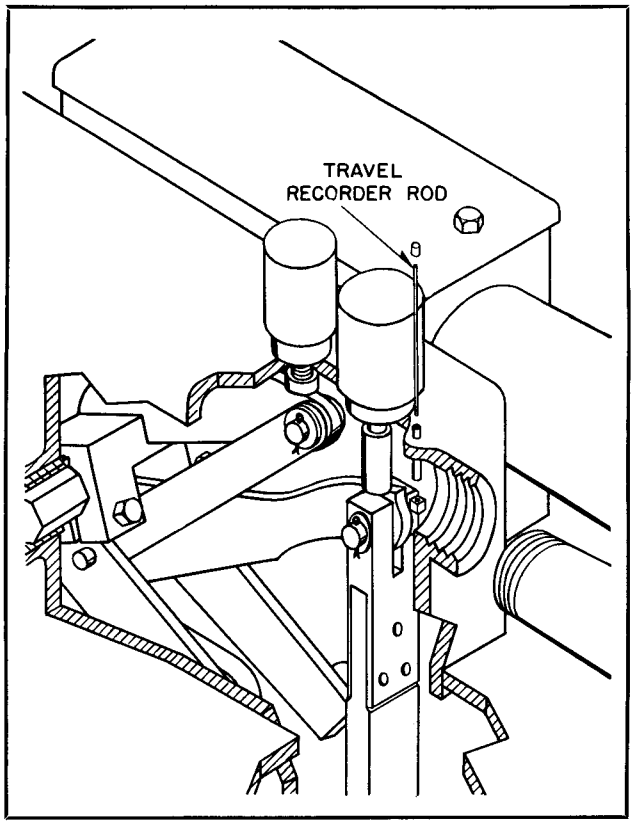


FIG. 19. Inserting Travel Recorder Rod Through Pole Unit Mechanism Housing

"DE-ION" GRID UNIT ADJUSTMENTS

Contact Inspection. On routine inspections, a fairly good idea of the condition of the contacts may be obtained by measuring the contact compression without draining the oil from the tanks. Referring to Fig. 19, connection may be made 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 which is ordinarily used for a time-travel recorder rod. However, this arrangement may also be used to measure contact compression by screwing a $\frac{3}{16}$-inch diameter rod with 10-32 threads on one end into the top of the lift rod.

Close the breaker slowly by hand until the contacts just touch as checked by "lighting out" between bushing terminals. Check the position of the $\frac{3}{16}$-inch diameter rod and measure the travel between this point and the latched position of the breaker. A travel of $\frac{1}{4}$ inch on this rod corresponds to $\frac{3}{8}$-inch contact pressure travel (Fig. 18).

When the breaker is first set up, all 3 poles should check $\frac{7}{32}$ to $\frac{9}{32}$ inches contact compression measured on the lift rod as described. If any pole shows less than $\frac{3}{16}$-inch compression on routine inspections measured in this manner, the oil should be drained from the tanks for a more complete inspection, and the necessary adjustments made.

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.

Regardless of the condition of the contacts as indicated by the above method, the breaker should be given a thorough inspection at least once a year, and even more often if the breaker is subject to several heavy interruptions or a large number of operations. The condition of the moving contacts may, of course, be easily observed when the breaker is open. The condition of the crank arm contact (18) and the upper side of the intermediate contact (9) may also be observed by removing the valve plate (6). (See Fig. 17). The condition of these contacts will be an indication of the condition of the lower side of the intermediate contact.

All of the contacts are faced with tungsten alloy. This alloy is especially resistant to arcing, so that deterioration will not be very rapid. It is expected that the contact faces may be smoothed off with a file a good many times before replacement is necessary.

When making a thorough inspection, the following points should also be checked on the contact assembly (See Figs. 17 and 18):

1. Check all nuts and bolts for tightness, including the large nuts (25) on the lower end of the tie rods which hold the fiber plates of the stack together. The upper end of these tie rods have a taper fit which may draw down a little tighter on heavy interruptions. Some contact designs use heavy compression springs on the lower end of each stack tie rod. The compressed length of these springs should be $2\frac{5}{8}$ inches for 138 kv grids, and $2\frac{1}{2}$ inches for 230/196 and 230 kv grids.

2. Check bolts (16) at top of operating rod assembly for tightness. This bolt is locked by spanner nut (17).

3. Examine the check valve (19) in top of pressure chamber for freedom of movement. This valve may be reached through opening behind valve plate (6).

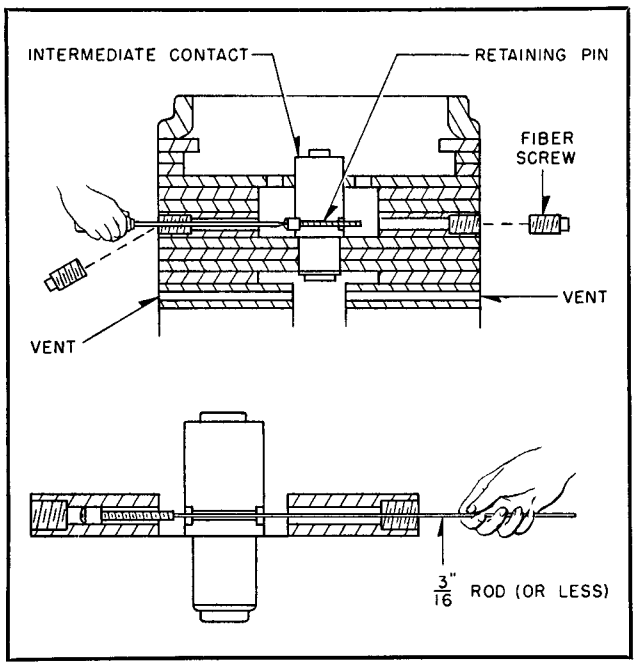


FIG. 20. Removing Retaining Pin from Intermediate Contact

Contact Removal. If there is enough burning to warrant removal of the contacts, this may be done in the following manner:

The crank arm contact may be removed by first removing the side operating rod, and then removing the crank arm bearing plate. The intermediate contact is a floating piece which is restrained only by a shoulder and a pin (9A). A hole through the side of the stack located at 90 degrees to the cross section in Fig. 17 is provided for access to this pin, which lines up with the contacts in the open position. See Fig. 20. By removing the Micarta screws on each end of this hole, a screwdriver may be inserted from one end to unscrew the pin (9A), which may then be removed by pushing through the hole from the opposite side of the stack with a rod $\frac{3}{16}$-inch in diameter or less. The intermediate contact is guided, so that the pin (9A) will always line up with the hole when the contacts are in the open position. The pin may be assembled from either side of the grid; a shake-proof lock washer is pressed into both sides of the intermediate contact. A light directed into the hole will show from which side of the grid the pin is assembled.

After the pin is removed, the intermediate contact may then be pushed up from below and pulled out through the hole behind the valve plate (6). When re-assembling the intermediate contact, make sure that the pin is screwed all the way in by lifting the contact to see if it falls back into place easily. If it does not, it is an indication that the pin is not screwed in far enough, and is catching on the grid plates.

If a number of contacts are replaced, it would be advisable to check the contact compression a short time after the new contacts have been installed. New contacts tend to flatten slightly until they have been operated a number of times, which may result in a slight loss of compression.

Pressure Gap and Operating Rod Adjustments. During thorough breaker inspections, or when any contacts are replaced, all contact adjustments should be checked and re-adjusted if necessary. Refer to Figs. 17 and 18 and proceed as follows on each stationary contact assembly individually:

1. Remove lower metal shield (3), Micarta shield (4), and upper metal shield (5) in the order stated; remove also valve plate assembly (6) by removing four bolts (7). (Do not remove elastic stop nut on valve (20) itself).

2. Close the breaker slowly by hand until the moving contact (8) just touches the intermediate contact. This may be checked by "lighting out" between the moving and intermediate contact, using either a light or a bell ringer. The intermediate contact may be reached by removing one of the fiber screws in the side of the grid (see Fig. 20) and inserting a piece of stiff wire. Mark the moving contact blade with reference to the bottom of the grid, and make another mark $\frac{1}{2}$ inch below the first mark on the blade.

3. Continue closing the breaker until the closing mechanism is latched. The lower mark on the blade should now line up with the reference mark on the bottom of the grid ($\frac{1}{2}$-inch lift of intermediate contact); if not, adjust the moving contact on the lift rod until it does. The moving contact cross-bar may be tipped slightly to allow simultaneous touching of intermediate contacts on both stationary contact assemblies. However, this should be done very sparingly in order to prevent binding of the moving contact blades in the grid slots. Greater adjustments can be made by changing the height of one of the contact feet on the condenser bushing stud.

4. Adjust the bolt (10) at the lower end of the operating rod (11) to get $2\frac{1}{16}$ inches $\pm\frac{1}{16}$ compressed length of operating rod spring (12) shown (not including counter-bore in casting). Bolt (10) is locked by overtravel nut (15).

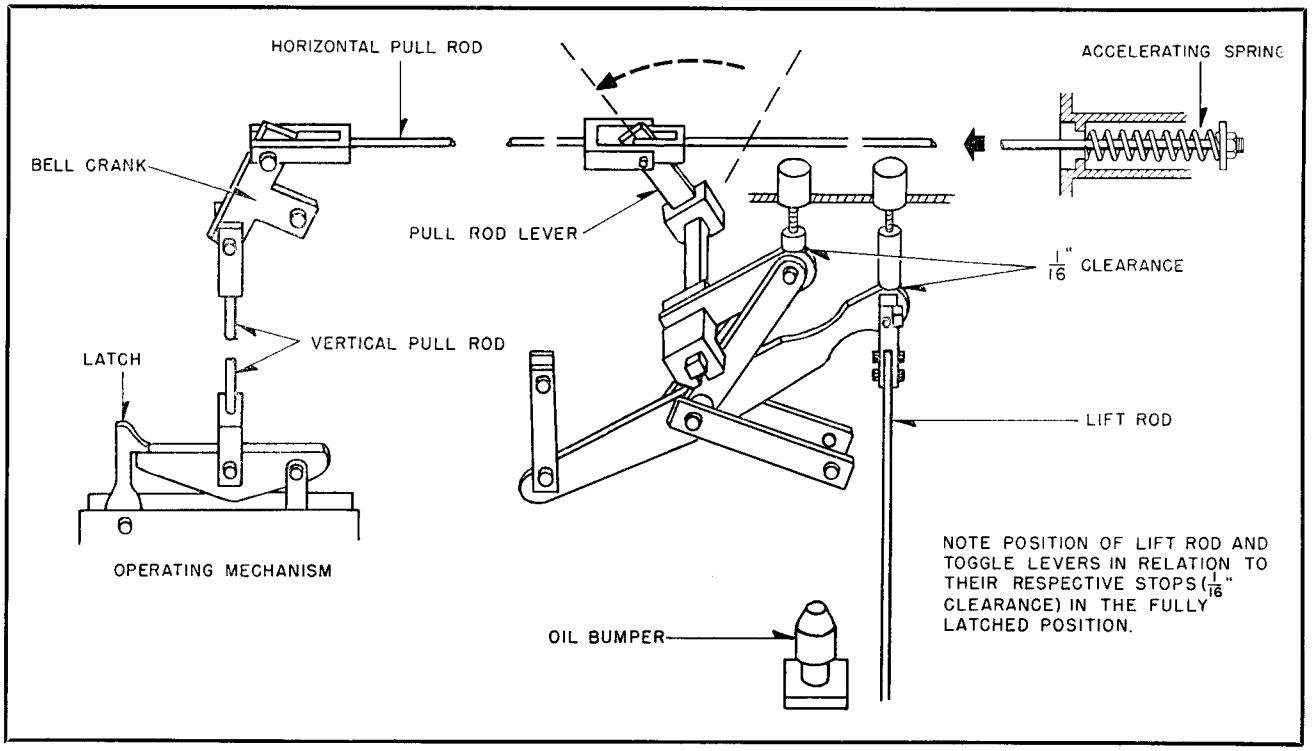


FIG. 21. Closing Stroke of Pole Unit Lever Mechanism

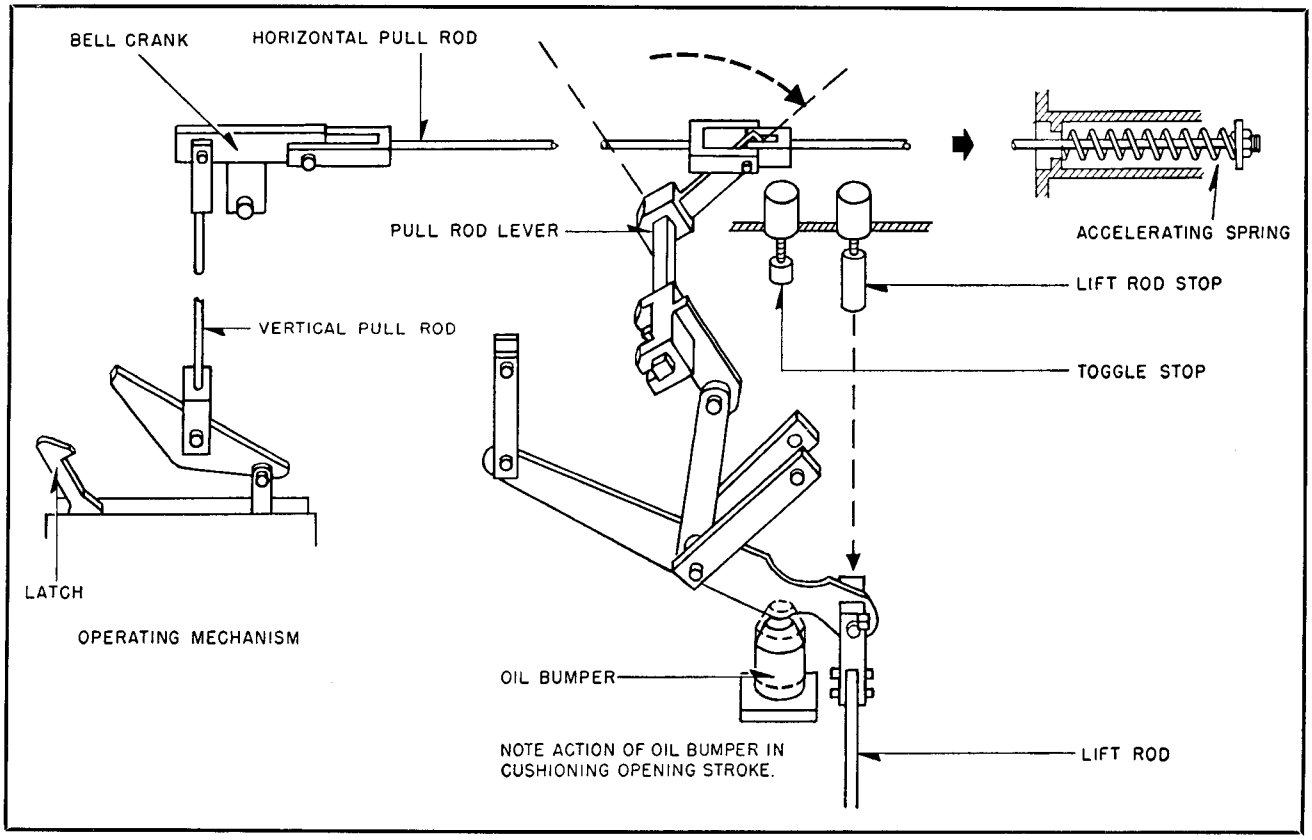


FIG. 22. Opening Stroke of Pole Unit Lever Mechanism

5. Adjust the contact pressure travel for $\frac{3}{8}$ inch by the nuts (14) as shown, locking these nuts securely to each other. Corresponding to this adjustment, adjust the self-locking nut (23) to secure dimension A (see table—Fig. 18) for compressed length of contact spring (13).

6. Adjust the overtravel stop nut (15) for $\frac{1}{16}$-inch clearance when the breaker is in the normal closed position. This is a clamping nut which may be locked by tightening the small screw on the side.

7. With the breaker in the open position, adjust the bolt (16) in the upper end of the side operating rod (locked by spanner nut (17)) to get dimension B, the gap between the crank-arm contact (18) and the intermediate contact (9). This gap may be observed through the opening uncovered by the valve plate (6). Lock the bolt securely with the spanner nut after this adjustment has been made.

Grid Resistor. If it should be necessary to replace a damaged grid resistor (22), care should be taken to match the resistance of the other unit in the same pole so that the voltage will be distributed equally between the two grids. The table below gives the resistance of these units when new; the resistance may differ from these values considerably (due to aging) as long as the two units in each pole are matched within 10 percent. The resistor assembly is made up of a number of individual blocks, so that a new unit may be made to match an old unit by interchanging half of the blocks.

BREAKER KV	RESISTANCE—MEGOHMS
138	1.0
161	1.0
230/196	1.5
230	1.5

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. 21 and 22. (For full cutaway view, refer to Fig. 7, page 12).

Adjustments. When the breaker is properly adjusted, and has been closed by hand, there should be $\frac{1}{16}$-inch clearance at the toggle stops and lift rod stops. (See Fig. 7) This clearance is necessary to permit the operating mechanism to overtravel and latch (see Figs. 21 and 22), 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 hand operation.

2. Align the center of the pin in the upper end of the pull rod lever with the yellow mark scribed on the wall of the pull rod housing box by changing pull rod lengths. (See Fig. 7).

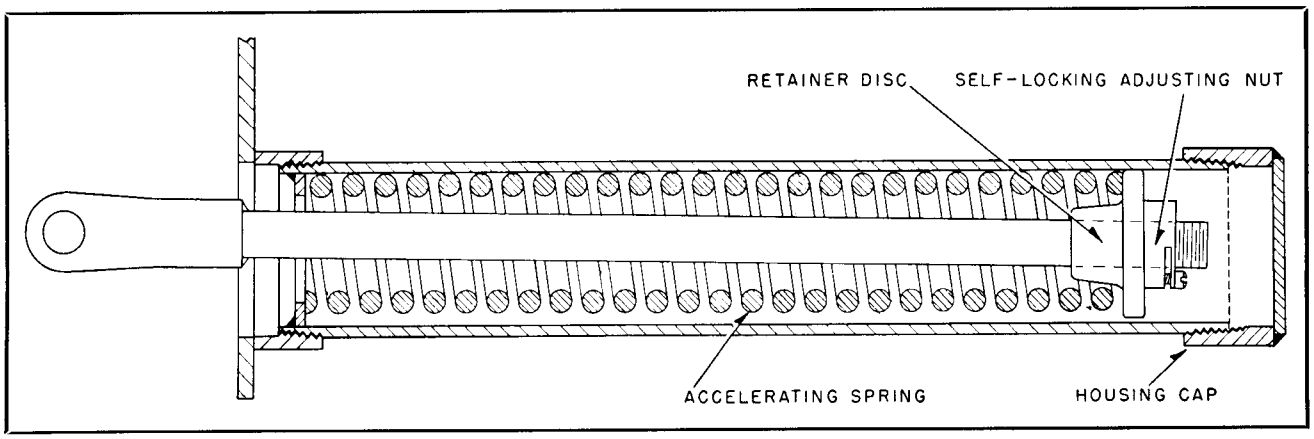


FIG. 23. Accelerating Spring Used with Pneumatic Mechanism

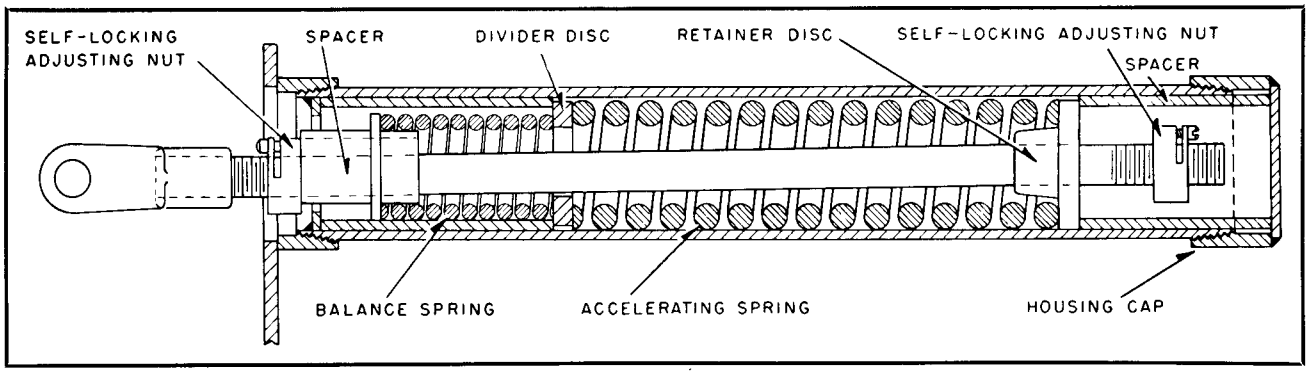


FIG. 24. Accelerating Spring Used with Solenoid Mechanism

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 $\frac{1}{16}$ inch is obtained.

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

ACCELERATING SPRING

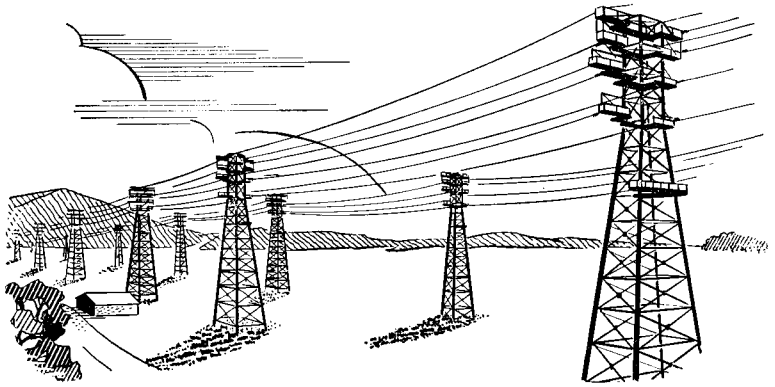
To provide sufficient opening speed through the arcing zone, an additional spring (the accelerating spring) is mounted on No. 3 pole. When the pneumatic operating mechanism is used, this spring operates on the horizontal pull rod to provide acceleration over the entire opening stroke. See Fig. 23. The 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. 24), due to the fact that the solenoid mechanism has minimum pull in the open position. In addition, a balance spring is used (see Fig. 24) 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 20, item 14. 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.

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.



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 atmosphere 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 that 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 could cause serious shock to a workman.

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 25, on how to check without lowering tanks.

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

GENERAL INSPECTION PROCEDURE

General inspection of the breaker requires that the tanks be lowered on the breaker. 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 starting to inspect or work on the breaker parts, 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 28.)

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 Adjustments, Part Three of this book).

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. Lubricate pins and bearings with a few drops of lubricating oil.

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 and have proper adjustment. (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 readjustments, it is recommended that a re-check of the operating speed be made with a cycle counter or graphic recorder, as indicated in item 14, page 20, under Final Installation Inspection.

CONDENSER BUSHINGS

Maintenance and power factor testing of condenser bushings should be given consideration during breaker inspection. Instruction Leaflet 33-155-1 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 circuiting turn around the transformer, and affects the ratio.

BUSHING CURRENT TRANSFORMERS

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

On older breakers it is necessary to chip out the sealing compound at the Micarta seal plug. This plug will probably be damaged beyond use, so that it will be necessary to use a new plug with the new transformer.

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. No sealing compound is used with the compression seal. On older breakers, replace the sealing compound (Westinghouse Compound 618) at the seal plug in order to prevent leakage of gas into the mechanism housing. This compound flows readily at 225 degrees Centigrade.

Caution: Be sure that proper transformer connections are made and a burden or 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. 25. The gauge is marked for normal oil level at 25 degrees C. Fluctuations on either side of normal will be noted with temperature changes.

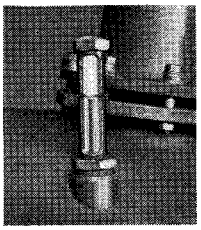


FIG. 25. Oil Gauge

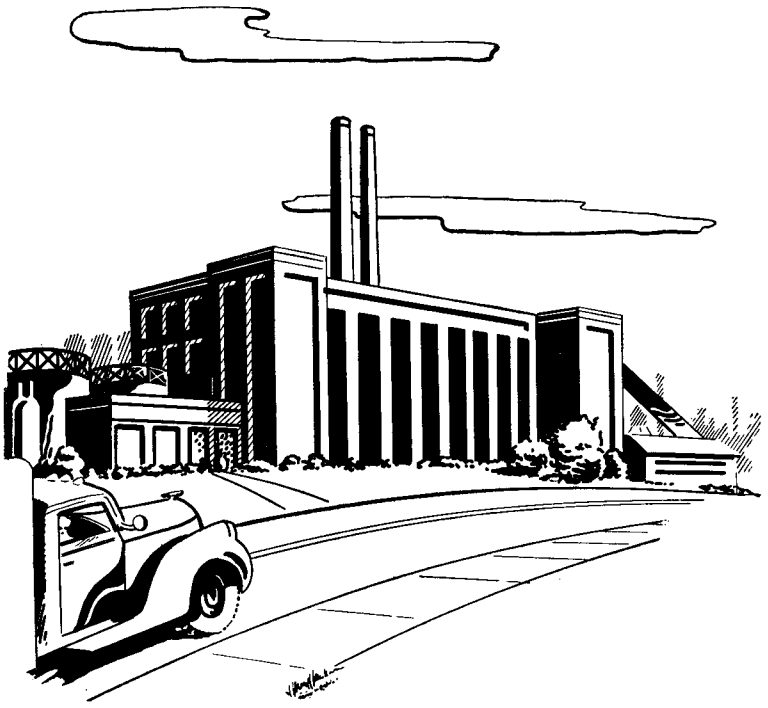
The gauge glass is gasketed and sealed with a plastic cement to insure weather tightness. Should it be necessary to replace a gauge glass, remove the old glass and cement, clean the guard thoroughly, assemble the gasket at top and bottom of he glass, and tighten cap so that the glass is held n proper position. Then fill bottom end of guard with Westinghouse Cement No. 672 when reassembling, so that water will not enter the tank at this point.

OPERATING MECHANISM

Complete instructions for operation and maintenance of the operating mechanism (either solenoid or pneumatic) 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. 2, of this book. Identify the breaker by including the type, amperes, volts and Shop Order (S.O.) Number, as engraved on the nameplate.



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