I.B. 33-751-1

RECEIVING • INSTALLATION • MAINTENANCE

INSTRUCTIONS

De-ion® Grid

OIL CIRCUIT BREAKER

Outdoor Type GM-6A

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69 Kv 3,500,000 Kva

1200/2000 Amperes

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

NEW INFORMATION

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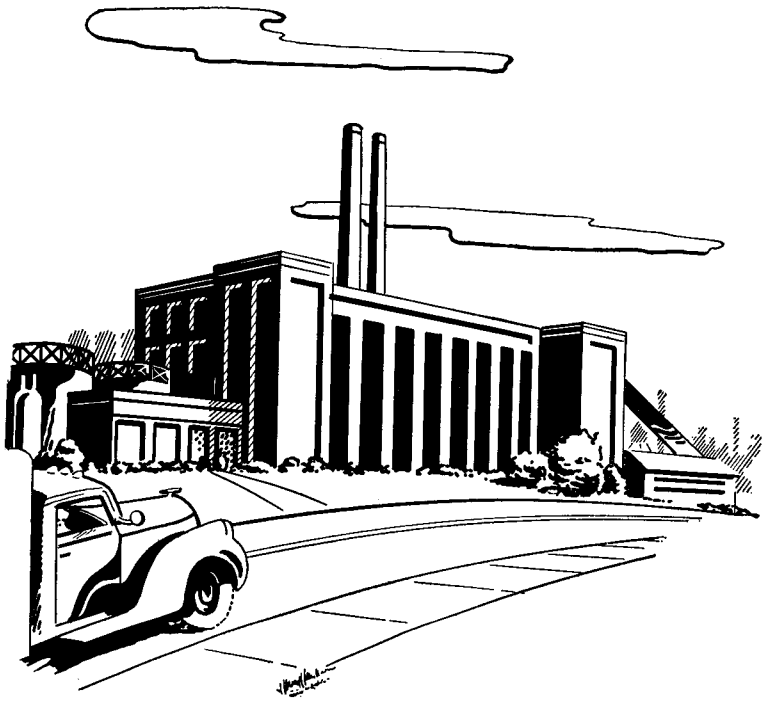

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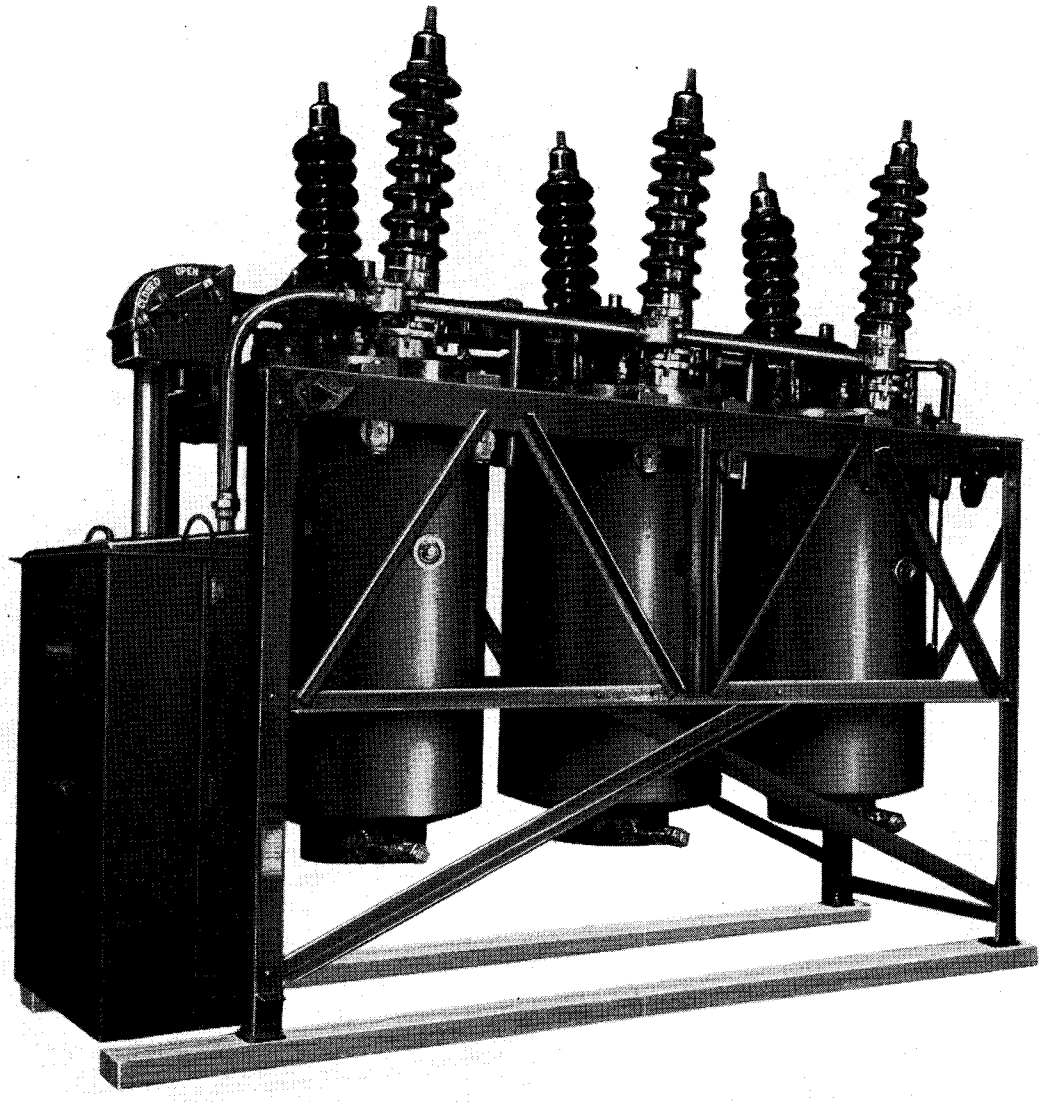

CLOSED
OPEN

TYPE GM-6A OIL CIRCUIT BREAKER
69 Kv

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

This instruction book applies to breakers of either 1200 or 2000-ampere rating. The voltage range stated above. Each breaker consists of three individual pole units mounted on a supporting framework and connected mechanically to each other and to a common operating mechanism (either solenoid or pneumatic) to provide simultaneous operation as a three-phase breaker. Each pole unit has a round steel tank bolted to a fabricated steel top which also provides support for the pole unit levers and entrance bushings. The stationary contacts and "De-ion" Grid interrupters are mounted on the lower ends of the bushings and the moving contact crossbar is carried on the lower end of a wood base Micarta lift rod. This lift rod is in turn suspended from the main lever of the pole unit mechanism.

Bushing type current transformers, when ordered, are supported from the underside of the pole unit top, one around each bushing.

●

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 outline dunder "Selecting Location", Page 9 of this book.

RECEIVING, HANDLING AND STORING

RECEIVING THE SHIPMENT

All Type GM-6A breakers are assembled and given complete commercial tests at the factory, after which they are carefully inspected and prepared for shipment by workmen experienced in the proper handling and packing of electrical equipment. Breakers covered by this instruction book are normally shipped completely assembled. The frame legs are shortened to permit shipment of the breakers (see Fig. 1.) without removing the condenser bushings and stationary contacts. Leg extensions are provided for each end of the breaker frame. When the breaker is installed, these extensions are fitted into place making for proper height. This split-frame construction is made rigid on installation by use of bracing members which are also utilized in shipment to strengthen the frame proper also shown in Fig. 1. Fig. 2 shows the leg extensions fitted in place.

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, claim for damage should be filed at once with the carrier (Transportation Company), and the nearest Westinghouse Sales Office notified promptly.**

UNPACKING PARTS AND ACCESSORIES

The majority of the following instructions will apply only when the breaker is shipped disassembled.

Certain parts of the breaker are of insulating material and must be handled so that they are protected from moisture, dirt, and damage due to rough handling. Care should be exercised in the removal of crating and packing to prevent damage to the breaker by careless handling of crowbars or other tools.

If the breaker is to be installed immediately, the various parts should be removed from their

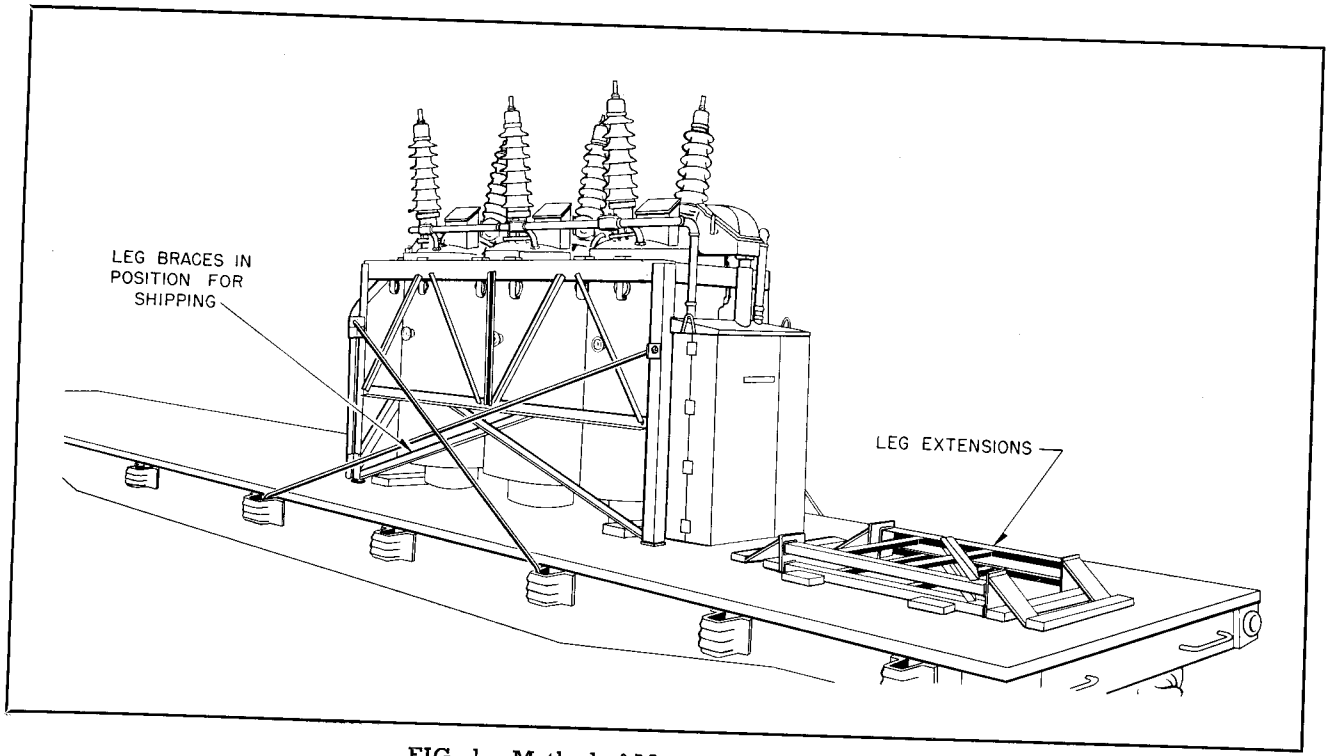


FIG. 1. Method of Mounting for Shipment

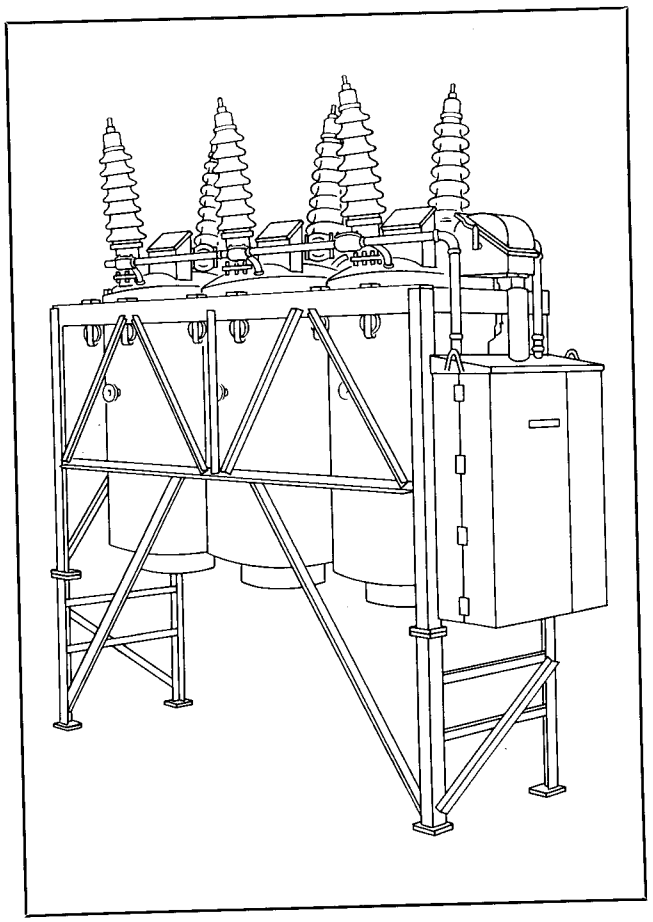


FIG. 2. The Leg Extensions in Place

crates and should be placed in proper position for mounting on the permanent foundation. In this connection it should be remembered that although like parts are interchangeable, assembly and final adjustment is expedited by reassembling parts in the exact location in which they were originally assembled. Parts which were removed from the breaker after factory tests are identified by markings which indicate the serial number of the breaker and the terminal or pole location. Terminals are numbered consecutively from left to right and from front to rear as one faces the breaker at the mechanism end.

Detailed instructions for unpacking condenser bushings are not given in this instruction book. When bushings are shipped separate as spare parts or as breaker parts, follow the unpacking instructions included in the shipment of bushings.

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

Be sure to remove the blocks and wires whcih were used to hold moving parts, mechanism triggers and latches in place during transit.

HANDLING PROCEDURE

The total weight of the breaker without oil is given on the nameplate located on the breaker frame. This information will serve as a guide to determine the lifting ability of the crane or other mechanism used to handle the breaker. Breakers may be lifted with a crane by hooking the hoist sling onto the breaker frame.

When using cable slings or chains for moving a breaker, care must be exercised to prevent such slings from striking or bearing against the condenser bushings, as any shock or strain on them may cause them to crack or break.

When transporting a breaker by car or truck, do not lash the breaker down by the condenser bushings. The skids on which the breaker is mounted for shipment should be kept under it until the breaker is installed. Care should be exercised at all times to prevent injury to the apparatus through shocks or jars due to rough handling.

Caution. These breakers have a high center of gravity and special precaution should be taken while handling to prevent them from tipping over.

STORAGE

After the breaker is unloaded and uncrated, immediate installation in its permanent location is recommended even though it may not be put into service for some time. If this is not practicable, it should be stored in a place where it can be protected from mechanical injury. In either case, the following precautions should be taken to prevent injury to and deterioration of the parts.

All internal insulating parts must be protected from moisture. This can be accomplished by immediately filling the breaker tanks with insulating oil. If this cannot be done, the condenser bushings, lift rods and guides and "De-ion" Grid stacks should be removed and stored in a dry place.

Do not remove the protective covering from the insulators until the breaker has been installed in

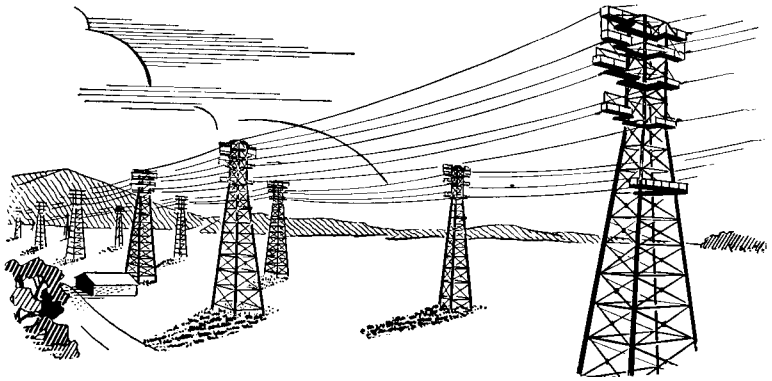
its permanent location and ready for service, all overhead work completed and all tanks filled with oil.

"De-ion" Grid Stacks. *The "De-ion" Grid stacks must not be exposed to moisture at any time.* The fibre in these stacks may absorb enough moisture, either from direct contact with water or from a humid atmosphere, to expand and warp it out of shape. Under extreme conditions this may even result in breakage of the stack tie rods. It is expressly recommended that the "De-ion" Grid stacks be stored under Wemco "C" oil.

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

Condenser Bushings. For storage of condenser bushings over a short period of time, such as that which may elapse between the time a breaker is received and is installed, it is permissible to store the bushings in a vertical position in a warm, dry place. However, when it is contemplated that bushings may be stored over a long period of time, such as is the case with spare parts, it is recommended that they be stored with their lower ends immersed in Wemco "C" oil.

Operating Mechanism. Machined parts of the operating mechanism, pinned joints, etc., should be protected against rust. This may be best accomplished for the solenoid or pneumatic operating mechanism by closing the mechanism housing and energizing the space heaters provided in it. This procedure is recommended even if it requires the use of a temporary wire circuit to the heaters. In case this is impracticable, all machined parts, including the pole unit operating mechanism, should be coated with grease or some rust inhibiting material. Additional protection may be obtained by use of silica gel, activated alumina or similar dehydrating agents. Two or three small bags of the material should be hung in the mechanism housing and several in each pole unit near the parts requiring protection. It should be remembered that complete protection may not be provided in spite of all of the above precautions and periodic inspections should be made to determine the condition of the apparatus.



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. Space should also be provided for the installation and operation of the windlass type tank lifter which is available as a breaker accessory.

The breaker foundation should be high enough to preclude the possibility of water entering the operating mechanism housing during flood conditions.

The breaker should not be installed where salt water spray, sulphur, steam, or other corrosive elements are in the atmosphere.

MOUNTING THE ASSEMBLY

All circuit breakers must be set perfectly level so that moving parts within the breaker can operate freely. Otherwise, friction may develop and undue strains may be imposed on the lift rods and other moving parts, leading to breakage and defective operation.

The foundation should be prepared prior to the arrival of the breaker. Consult the outline and drilling plan supplied for necessary clearance dimensions and foundation bolt locations.

Remove the breaker from its skids and place on the permanent foundation. The precautions in handling the breaker previously described under "Handling Procedure" should be adhered to. Insert shims, if necessary, under the legs of the breaker frame to get it properly plumbed and leveled before tightening the nuts on the foundation bolts. Since these are "split frame" breakers, mount the frame extensions on the foundation and place the breaker with the frame proper on these extensions. Bolt the frame and its extensions tightly together and put the frame-bracing members securely in place. These bracing members should be in place before final leveling of the breaker and frame and before finally tightening the foundation bolts.

The sequence for assembling breakers which have been disassembled is as follows: (Refer to Part III for adjustments):

1. Check pole unit lift rod and toggle stop clearance.

2. Mount condenser bushings in breaker tops.

3. Install stationary contacts and "De-ion" Grid interrupters.

4. Install moving contacts.

5. Check and adjust moving and stationary contacts and bushing alignment to obtain proper contact travel, alignment, and contact separation.

LINE CONNECTIONS

Line connections should be sufficiently flexible to prevent undue strains on the condenser bushings. Clamp type connectors are ordinarily used between the bushing stud and the line conductor. Cable conductors should be supported so that heavy loads will not be imposed upon the bushing. If tube conductors are used, they should be shaped and supported in such a way 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, preferably, an insert suitable for such a connection. The galvanic action resulting from a joint of aluminum to copper will in time cause considerable corrosion.

GROUNDING CONNECTIONS

Each tank top is provided with two $\frac{1}{2}$"—13 tapped holes located $1\frac{3}{4}$" apart for grounding purposes in accordance with AEIC (Association of Edison Illuminating Companies) specifications. Some operators prefer to ground the breaker frame and, if this is indicated in the breaker specifications, a grounding pad is supplied on one leg of the breaker

frame. The grounding conductor should be capable of carrying 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, as 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 cases in the top of each pole unit.

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 boxes on top of each pole unit. These leads are connected to the terminal blocks, corresponding to the ratio and connection diagram furnished.

Long leads are connected through the conduit 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 taps are also reproduced on the transformer nameplate, located on the inside of the mechanism housing door.

Caution. Be sure the correct 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.

CONTROL WIRING

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

The control wiring should be so installed 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 closing time of solenoid operated breakers and the tripping time of both solenoid and pneumatically operated breakers, thereby causing a slowing up of the interrupting time.

OPERATING MECHANISM

Read carefully the Operating Mechanism Instruction Book which is supplied in conjunction with this book. It will describe the operation of the mechanism supplied with the breaker. If lost or misplaced, Operating Mechanism I. B. number may be found on the nameplate inside the housing.

FINAL INSPECTION AND TESTS

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

1. All insulation and parts within the tank including the inside surface of the tank, must be wiped carefully to remove any dirt and moisture which may have collected. Do not use cotton waste for this purpose because lint may be introduced into the oil. When furnished, tank linings should be examined for possible mechanical damage.

2. 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.)

3. The latch faces should be coated with a thin film of rust inhibitor. This inhibitor should be carefully selected to be free flowing at all anticipated temperatures, should be 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 or overlap is obtained when the breaker is closed. (See Figures 4 and 5.)

5. Open the breaker slowly by hand. The movement of the breaker on opening and closing

should be free and without friction. See that binding does not occur in the movement of the lift rod through the guides or of the moving contact prongs into the "De-ion" Grids.

6. See that the breaker is properly set up and levelled on its foundation.

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

8. 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.

9. Check all pipe fittings and tighten any that may have become loose because of vibration or shock received during handling, lifting and transportation.

10. Inspect all insulated wiring to see that no damage has resulted from the process of installation. Test the wiring for possible grounds or short circuits.

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

12. 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".)

13. Check electrical operation of the breaker a few times after the tanks have been filled with oil and raised. It is recommended that the opening speed be checked by means of a graphic recorder, or at least a cycle counter.

Note: An opening adjacent to the lift rod stop, is provided in the top of each pole unit lever box. For operating a graphic recorder, a rod is inserted through this opening and screwed into a 10-32 tapped hole in the top of the lift rod. (See Fig. 8.)

In order to get proper interrupting performance the opening time should not exceed 2 to 3 cycles from the time the trip coil is energized until the breaker contacts part. Also moving contacts lift rod should have moved 4 to 5 inches 5 cycles after trip coil is energized. If this time is exceeded, 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. Too much contact compression.

D. Incorrect setting of pole unit lever system.

E. Incorrect trip armature setting on operating mechanism, (See Op. Mech. Instruction book.)

The last two conditions may be corrected by the procedure outlined under Part Three, "Operation and Adjustments."

14. Make final inspection for tightness of tank bolts.

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 matter. 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 feasible, protection against moisture must be provided.

Precaution 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 breakers. 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. (For proper methods of handling and testing the oil, see Instruction Book 44-820-1, "Wemco C Insulating Oil for Electrical Apparatus".)

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. 3). 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. (Fig. 3 is a quarter-section drawing and thus shows only one half the nember of inlets and vents.)

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.

Fig. 3 applies to both the 1200 ampere and 2000 ampere rating for the interrupting unit. In addition, the 2000-ampere breaker has main contacts external to the interruptor as shown on Fig. 4. In order to insure that the main contacts part first without interrupting any current, the stationary arcing contact has 7/8-in. compression as compared to 3/8-in. compression for the 1200-ampere breaker. Another slight difference is that the pressure relief valve is at the rear of the top casting instead of in the stationary contact cover.

"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 lowering the tanks by using the provision made for attaching a "time-travel" recorder, as follows:

Referring to Fig. 8, 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 No. 10-32 tap directly below this hole, so that a 3/16-in. diameter rod with No. 10-32 threads on one end may be readily screwed into the lift rod projection when the breaker is closed.

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 3/16 in. rod. Continue to close the breaker until the mechanism latch snaps into place, and remove the load on the hand

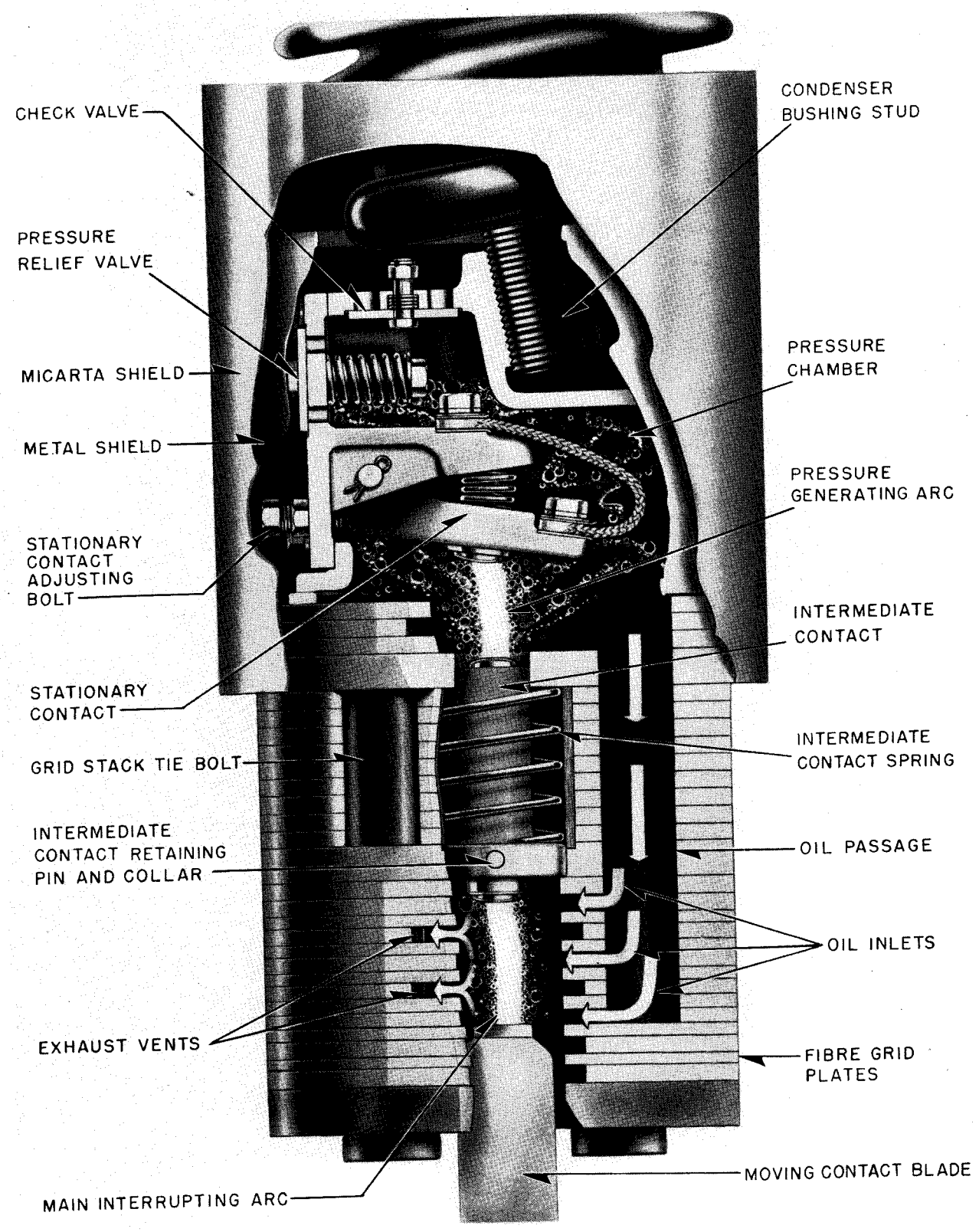
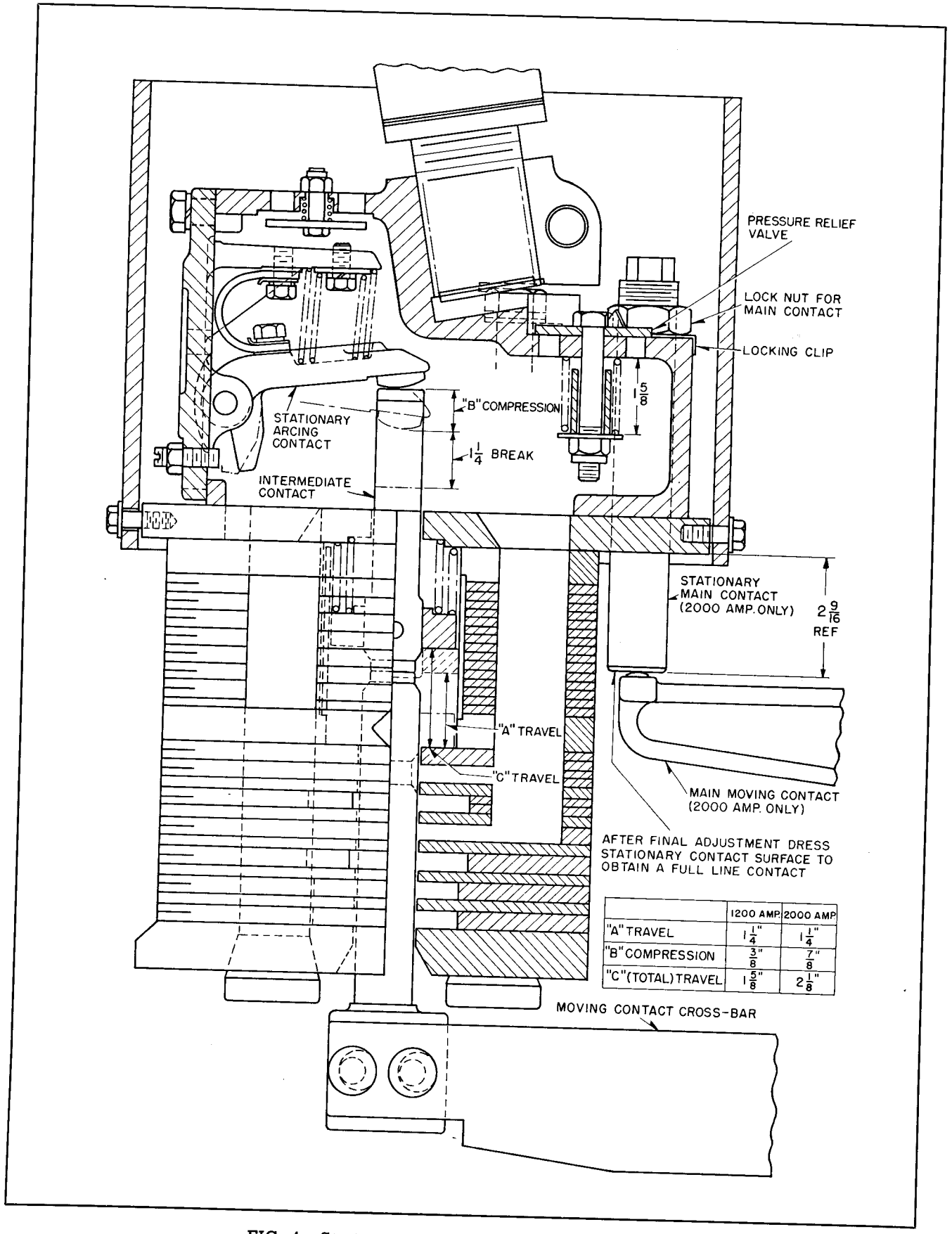


FIG. 3. Quarter-Section Cutaway of Contact Assembly



	1200 AMP.	2000 AMP
"A" TRAVEL	1 1/4"	1 1/4"
"B" COMPRESSION	3/8"	7/8"
"C" (TOTAL) TRAVEL	1 5/8"	2 1/8"

FIG. 4. Stationary Contact Assembly (Shown Closed)

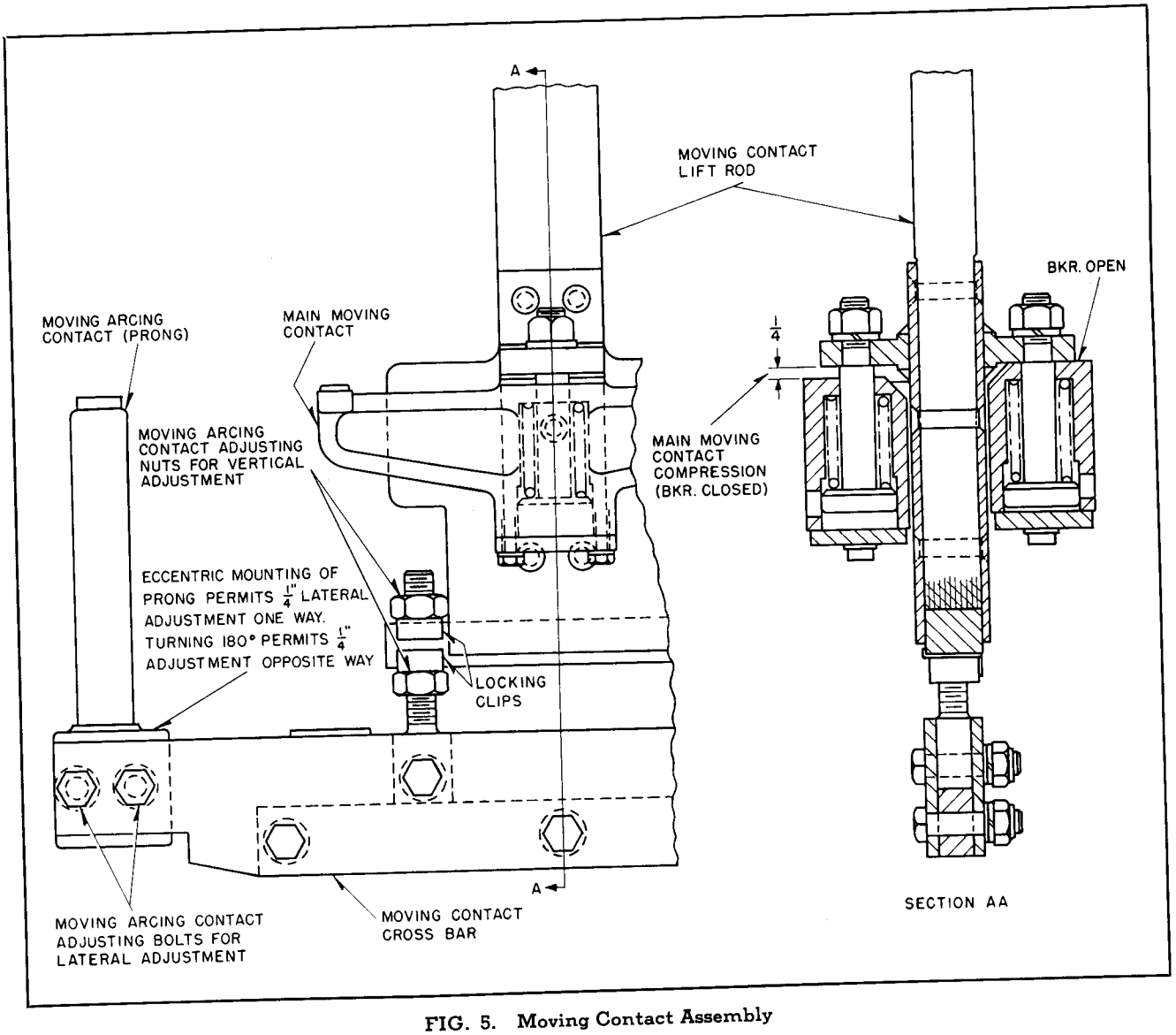


FIG. 5. Moving Contact Assembly

closing device. The travel of the 3/16 in. 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 11/32 in. to 13/32 in. contact compression for 1200 ampere rating, or 13/16 in. to 15/16 in. compression for 2000 ampere rating. If any pole shows less than 1/4 in. for 1200 ampere rating or 3/4 in. for 2000 ampere rating on routine inspections, the tanks should be lowered for a more complete inspection, and the necessary adjustments made as described under "Checking and Readjusting Intermediate Contact Travel", page 17.

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 metal shields from the grid assembly and tighten stop bolt until proper contact "lift" has been reestablished 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.

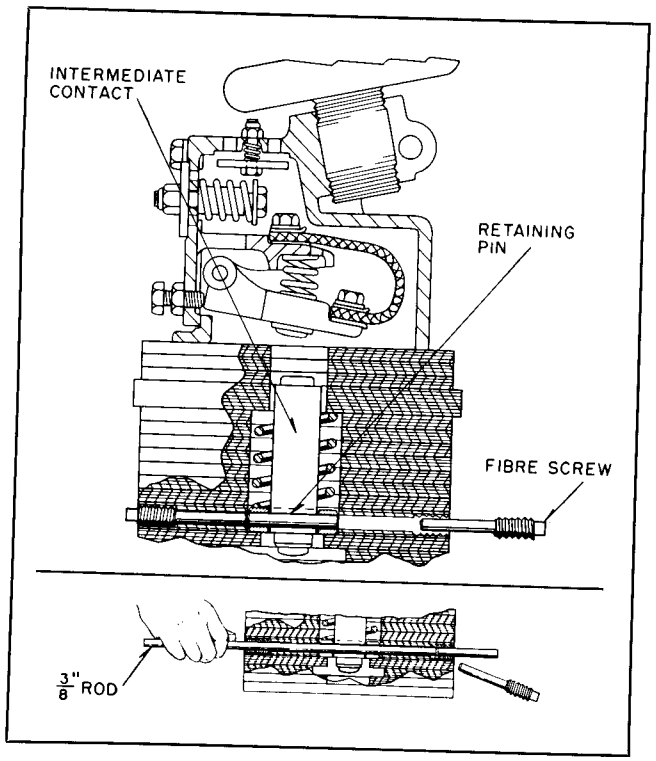


FIG. 6. Removing Retaining Pin from Intermediate Contact

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. 6.) 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, 3/8 in., or less, diameter (pin is 3/8 in. 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 Arcing Contact. The moving arcing contact is adjustable in the same manner for both the 1200 ampere and 2000 ampere ratings. Referring to Fig. 5, the moving arcing contact may be raised or lowered with respect to the lift rod in order to get the proper stationary contact lift. Locking clips are provided to secure the adjusting nuts on the lower rod end. Lateral adjustment is available to permit alignment of arcing contact prongs with holes in De-ion grid stacks at either end of moving contact crossbar.

It will be noted that the arcing contact prongs are eccentric with respect to their mounting bolts; in one position each prong may be adjusted laterally 1/4 in., or by turning around 180 degrees they may be adjusted an additional 1/4 in. If greater adjustment is needed, or if De-ion grid stacks are not plumb, this is an indication that the condenser bushings should be adjusted on their bevel seats. The gaskets on the bevel seats are not cemented (only grease or vaseline), so that this adjustment may be made without damaging the bevel gasket.

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

All of the arcing 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 1/16 in., but replacement will rarely be necessary.

2000-Ampere Main Contacts. This paragraph does not apply to the 1200 ampere rating. Adjustments on the main contacts should not be attempted until the arcing contact adjustment is verified as being correct. With the breaker closed and just latched, the main moving contacts (two per pole) should have 1/4 in. compression as shown by Section AA of Fig. 5. This is a composite view which shows closed position on left side and open position on right side. This compression is obtained by screwing the stationary main contacts up or down in the grid top casting. These contacts should be adjusted evenly, so that the main moving contact will touch simultaneously on both ends. Tighten lock nuts securely and bend locking clips back into place. Dress main stationary contacts after final adjustment if necessary in order to get full line contact.

Since the main contacts do not actually break any current, they should not require any dressing during maintenance periods except with fine emery cloth to remove oxidation.

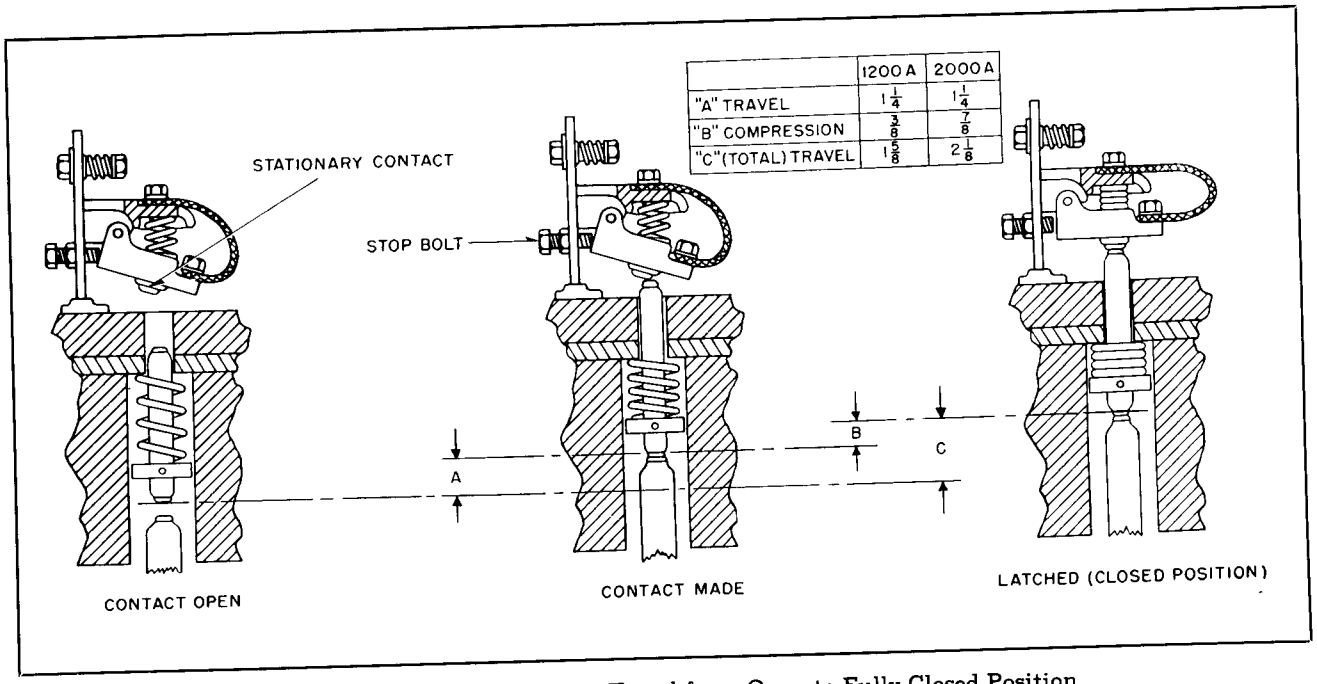


FIG. 7. Intermediate Contact Travel from Open to Fully Closed Position

Final Adjustment of the Breaker Contacts. After all parts are in place, operate the breaker slowly by hand and adjust the various parts with respect to each other until proper contact, pressure or engagement is obtained. (See Figs. 4 and 5). Correct adjustment of the pole unit lever systems must be made so that the moving contacts and lift rods move freely in the holes of the "De-ion" Grids and the lift rods in the lift rod guides. After this is done, tighten all bushing flange bolts evenly and securely, tighten lock nut holding contact foot to bushing, replace insulating shield on stationary contact assembly and check all nuts and bolts on the stationary and moving contacts for tightness.

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 Fig. 6). If both grids are on the same level and the moving contact crossbar 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 "A" travel per Fig. 7.

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 "break" gap between the intermediate and stationary contacts (breaker open) of 1¼ in.

4. The moving contact should move "B" travel (see Fig. 7) from the point where the intermediate contact touches the stationary contact to the latched position. This gives the proper 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 a little tighter during heavy interruptions.

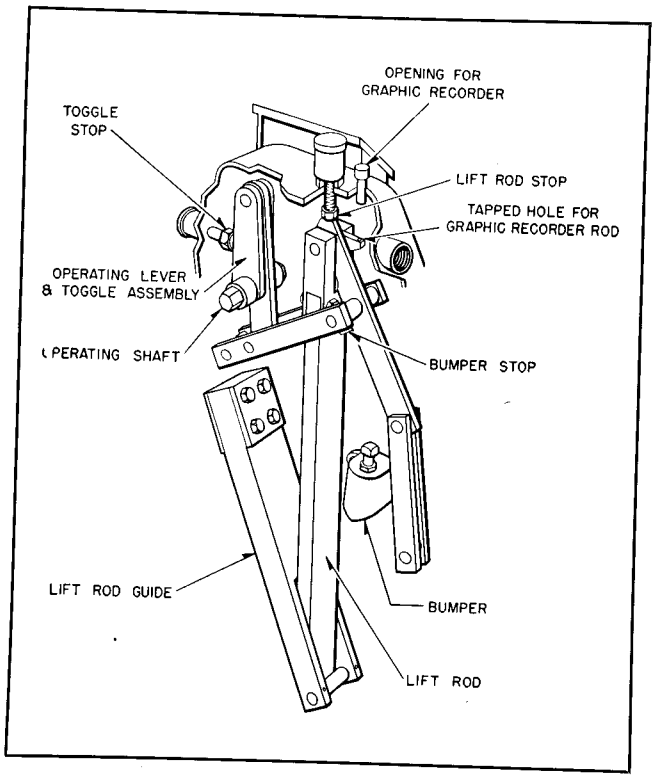


FIG. 8. Pole Unit Lever Assembly of the 69-Kv Breaker

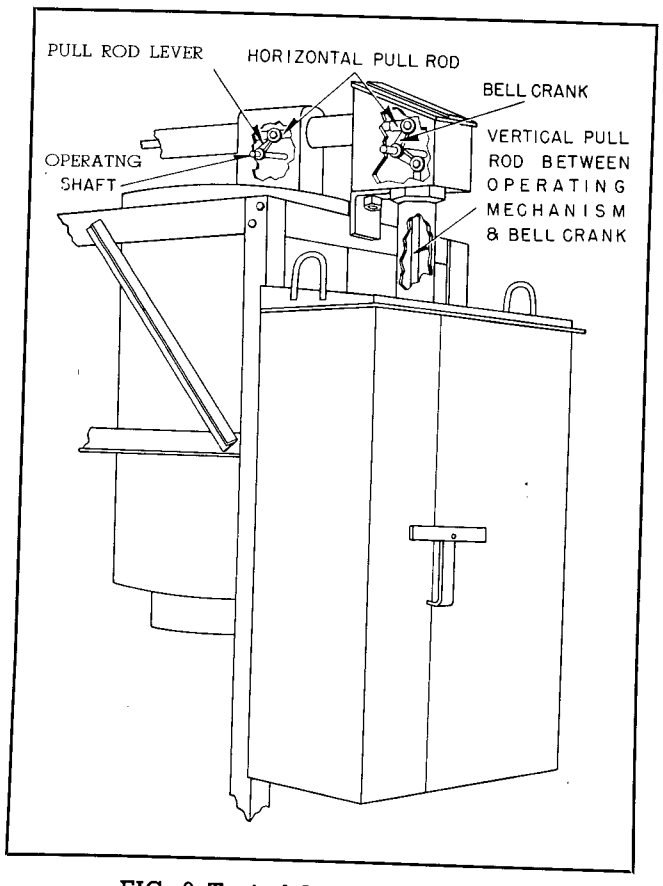


FIG. 9. Typical Operating Mechanism

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.

Pole Unit Lever Mechanisms, Interpole Pull Rods and Operating Bell Crank. The vertical motion (of the moving part) of the operating mechanism is translated into the vertical motion of the pole unit lift rods through (and in the following succession):

1. The vertical lift rod joining the operating mechanism and the bell crank.

2. The bell crank.

3. A horizontal pull rod which connects the bell crank to pull rod levers of the pole units.

4. The pole unit lever assemblies. These are actuated by levers on operating shafts on which the above mentioned pull rods are mounted. (See Fig. 8.)

The horizontal pull rod is a solid bar drilled at the proper places for connection to the pull rod levers at the pole units. Consequently there is no adjustment of this assembly, and proper operation of the lever mechanisms of the three pole units with respect to each other is obtained by positioning of the pole units on the breaker frame. The proper relationship of motion of the operating mechanism to the pole unit lift rods is obtained by adjusting the length of the vertical pull rod which connects the mechanism and the bell crank.

For this adjustment, the upper rod end is moved in and out; the final adjustment being secured by tightening a lock nut bearing against the rod end. The position of the toggles in the pole unit lever mechanisms, when the breaker is closed, is an indication of the condition of this adjustment. It should be close enough to center to lighten the contact load when closing the breaker, but not too close to center as to delay separation of the contacts during the opening stroke. A stop is provided and is set at the factory to indicate the correct adjustment.

After the complete linkages have been assembled and properly adjusted, the pole unit lift rod stops and pole unit toggle stops are set for 1/16 in. clearance and locked in position.

This complete assembly is made, adjusted and checked by operation at the factory and should require no further adjustment. If any one or all of the stops do not show the adjustment indicated in the

preceding paragraph, they should not be changed until the complete linkage has been thoroughly checked and it is determined definitely that their position has changed and is improper.

Bumpers. A hydraulic bumper is provided in each pole of the breaker to stop the contact travel at the end of the opening stroke, cushioning the shock resulting from this action. At the open position, the pole unit levers of the three poles should rest against their respective bumpers which, in turn, should all be fully depressed. These bumpers are set and locked in position at the factory. This setting is correct for the proper contact travel and to act simultaneously in the three poles. It should not require adjustment in the field. If, on inspection, it is found that one or two of the bumpers are out of adjustment and are not carrying their proper share of the load, the complete pole unit lever system including the bumpers, should be carefully checked to determine whether or not some of the parts may have been damaged or forced out of adjustment.

The bumpers depend upon the presence of oil from the circuit breaker tank for their cushioning action and are therefore largely ineffective, in this respect, when the breaker is tripped with the tank lowered or not filled to the proper level with oil. Consequently, tripping the breaker under these conditions should be avoided except in cases of absolute necessity.

Bell Crank Lever. Referring to Fig. 10, the bell crank lever used in the Type GM-6A breaker has an additional function besides converting vertical motion to horizontal motion. The angle between the two arms of the lever is less than 90 degrees, so that additional mechanical advantage is gained at this point for the operating mechanism. With the

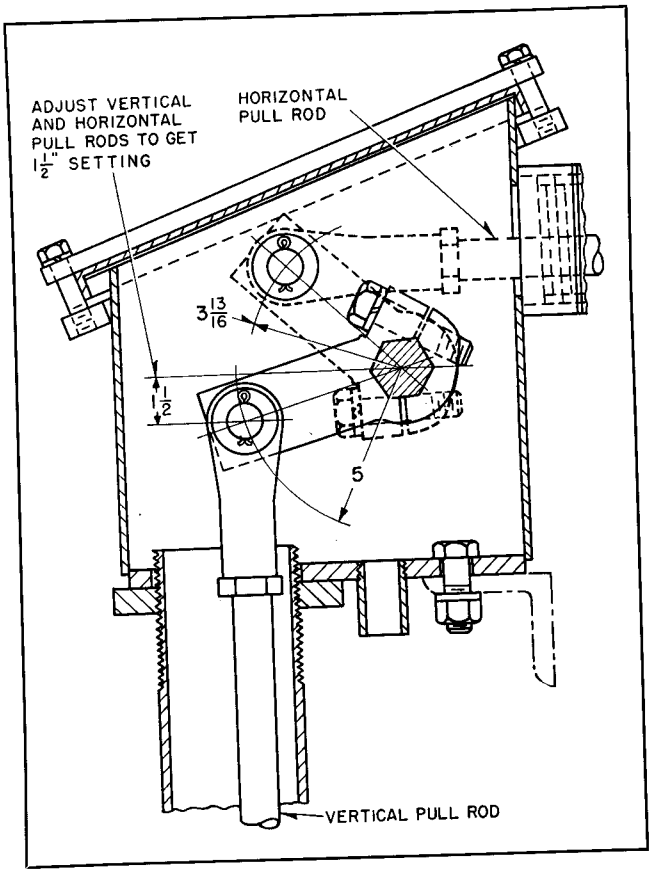
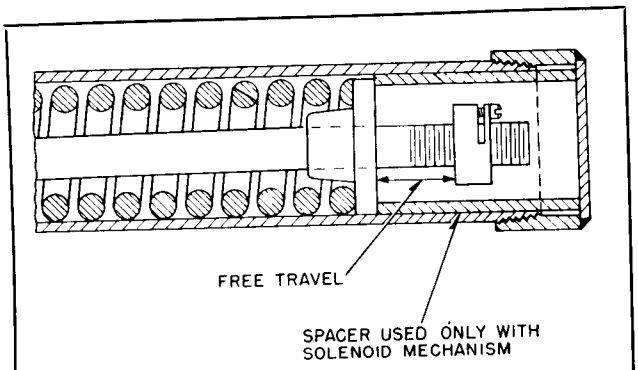


FIG. 10. Bell Crank Adjustments



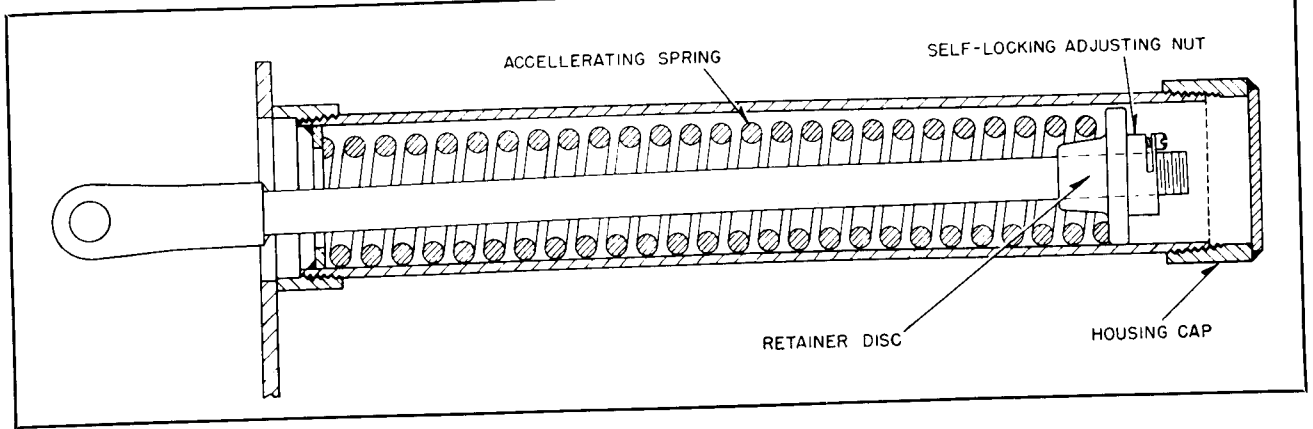


FIG. 11. Accelerating Spring

operating mechanism closed and just latched (no overtravel), shorten the vertical rod and lengthen the horizontal rod (or vice versa) in equal amounts to get the 1½ in. setting shown on Fig. 10.

Since the mechanical advantage changes with the setting of the bell crank lever, it is important to set the 1½ in. dimension carefully.

Accelerating Spring. An accelerating spring (Fig. 11) is mounted on the number three pole of the breaker for the purpose of accelerating the opening stroke of the contacts. It operates on an extension of the horizontal pull rod. In the solenoid operated breakers, the spring is arranged so that it also provides free travel in the open position, thus aiding in the initial movement of the closing stroke. This spring is set at the proper compression at the factory and it should not be changed unless the timing and operation test dictates otherwise.

For pneumatically operated breakers, this spring is arranged to operate over the whole opening stroke, whereas with solenoid operated breakers, it operates through the first part of the stroke only. Thus, at the start of the closing stroke when it is least efficient, the solenoid operated mechanism has only the dead weight of the contacts to overcome.

The pneumatically operated breaker, which is capable of exerting full force at any point in the closing stroke (except as limited by throttling of incoming air), operates against both the dead weight and spring load throughout the closing stroke.

Caution. When working on a solenoid operated breaker, be sure the breaker is in the closed position before removing or replacing the accelerating spring housing cap. Considerable force is exerted by the spacer against this cap when a breaker of this type is in the open position.

Condenser Bushings. If it is necessary to install or replace condenser bushings, refer to the instructions which are included when the bushings are received. Extreme care should be taken to prevent damage to the Micarta insulation of the bushing, and also to prevent the bushing stud from striking the current transformer, damaging its insulation. Do not permit the metal flange of 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 its ratio.

Make certain the bevelled weatherproofing gasket is in place between the bushing flange and the seat on the breaker top. No cement is required for this gasket. The bevelled faces on the flange and seat permit the accurate alignment which is necessary to obtain proper correllation of the moving and stationary contacts. After the moving and stationary contacts and "De-ion" Grid structures are properly aligned with each other, check the bushing flange bolts to be sure they are tightened uniformly around the flange. While inspecting the bolts, check to be sure the gasket is properly located to insure a moistureproof seal between the flange and the breaker top.

Caution. When working on a breaker which has just been in service, be sure the condenser bushing has been discharged by grounding the terminal end. The capacity of the larger bushings is sufficient to cause serious shock to a workman if accidentally discharged through him.

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 may 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 12, 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 op-

erated breakers, take the additional precaution of closing the hand valve between compressor tank and mechanism.

1. Close the breaker by power with the operating mechanism before lowering the tanks.

2. Check stop clearances at the top of the lift rod and at the toggle stop of the pole unit mechanism.

3. Inspect the stationary contact assemblies to determine the condition of the contact surfaces and the contact setting. A slight amount of burning on the contacts is not detrimental as long as the electrical conductivity and contact setting have not been materially changed. If the burning is severe the contacts should be removed and reconditioned or replaced.

4. Note the condition of the moving contacts, reconditioning or replacing them if necessary.

5. Note the condition of all parts now accessible. Check the bolts, nuts, spring cotters, etc., and tighten where necessary. Repair or replace any damaged parts.

6. Close the breaker slowly by hand and check the contact adjustment.

7. Clean the lower ends of the bushings and the Micarta lift rods and guides with a clean cloth dampened with clean oil. Clean carbon from the grid stacks.

8. Check the operating mechanism for loose nuts and bolts and for missing spring cotters. Lubricate bearings with a few drops of lubricating oil.

9. Check latches to see that faces are in good condition and are properly adjusted. (See Instruction Book for Operating Mechanism.) 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 wipe completely 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 the oil.

14. Check oil bumper cylinders to be sure they are not jammed.

15. Raise and secure tanks after replacing oil if required. Check closing and tripping operations, using all usual relays and circuits involved in the operation of the breaker. Be sure all relay and pressure switch contacts are clean.

16. Check closing and tripping at reduced voltage to insure safety margin.

Note: If it is necessary to make any readjustments, it is recommended that a recheck of the operating speed be made as indicated under "Final Inspection and Tests", page 10.

CARE OF OIL

Wemco "C" oil is recommended for use in all circuit breakers. Westinghouse cannot assume responsibility for circuit breakers 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 it in good condition. The more handling the insulating oil receives, the greater are the chances for it to become contaminated, unless adequate precautions are taken.

It is recommended that operators prepare a schedule for inspection based on operating conditions. Reference to the station log of the operation of the circuit breakers, together with the record of dielectric tests of the oil, should determine the frequency of inspection and test. This period between successive inspections should never be longer than six months. 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 in a standard test cup with electrodes spaced 0.1 in. apart. It is essential that the proper oil level be maintained in the circuit breakers. Considerable change 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.

Attention is called to Westinghouse Instruction Book 44-820-1. This book covers the care and maintenance of oil and should be referred to before any attempt is made to test or purify the oil.

CONDENSER BUSHINGS

Maintenance and power factor testing of condenser bushings should be given consideration during breaker inspection. An instruction leaflet is sent with each condenser bushing. This leaflet should be studied for complete recommendations on maintenance of bushings.

Important: 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 TRANSFORMER

If it should be necessary for any reason to replace a current transformer, the stationary contact and "De-ion" Grid should be removed first so that the transformer may be slipped down over the condenser bushing.

The transformer may be disconnected at the terminal block in the junction box on top of the pole unit. Before it can be removed, it is first necessary to melt the sealing compound at the Micarta seal plug. This plug will probably be damaged beyond use, making it necessary to use a new plug with the new transformer, Care should be taken to see that the packing on top and bottom of the transformer is in place.

Be sure to place the end of the transformer carrying the white polarity mark upward. Also, see that the transformer is not thrown off ratio by allowing the case to touch the metal grounding band on the condenser bushing.

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 ma e 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. 12. The gauge is marked for normal oil level at 25 degrees C. Fluctuations on either side of normal will be noted with temperature changes.

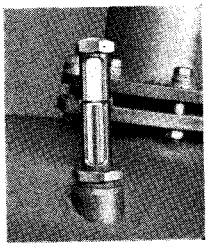


FIG. 12. Oil Gauge

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 the glass, and tighten cap so that the glass is held in 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. Identify the breaker by including the type, amperes, volts and Shop Order (S.O.) Number, as engraved on the nameplate.