I.B. 33-253-12A

Instructions for De-ion® Grid Oil Circuit Breakers

Outdoor Type GM

3-Cycle Interrupting Time		
Type	Kv	Kva
GM-6B	115	5,000,000
GM-5B	138	5,000,000
GM-5B	161	5,000,000
GM-5C	138	5,000,000

Westinghouse Electric Corporation

Power Circuit Breaker Division, Trafford, Pa.

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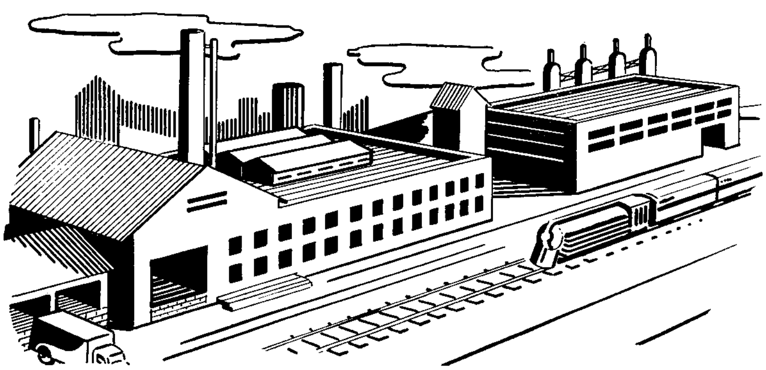

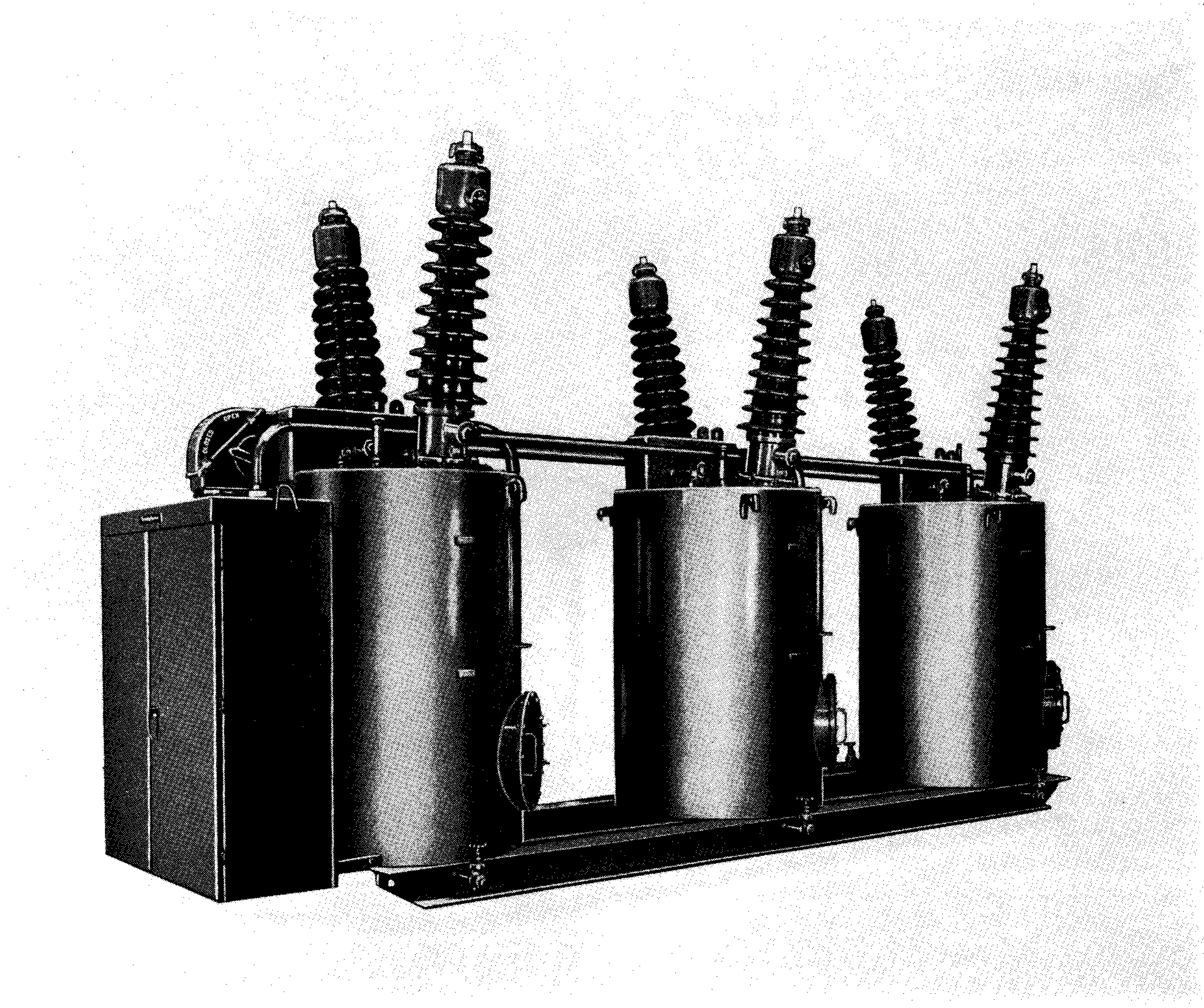

TYPE GM OIL CIRCUIT BREAKER

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

Basically, these oil circuit breakers consists of three individual pole unit 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.

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

All dimensions without tolerances shown on illustrations in this instruction book are for general information only and are not adjustment dimensions.

RECEIVING, HANDLING AND STORING

RECEIVING THE SHIPMENT

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

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

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

UNPACKING PARTS AND ACCESSORIES

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

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

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

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

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

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

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

Partially assembled breakers have no shipping bracket or blocking. The mechanisms on both partially assembled and fully assembled breakers are closed and latched and the trip free trigger locking bar inserted to prevent mechanism from unlatching.

HANDLING TANKS AND BUSHINGS

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

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

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

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

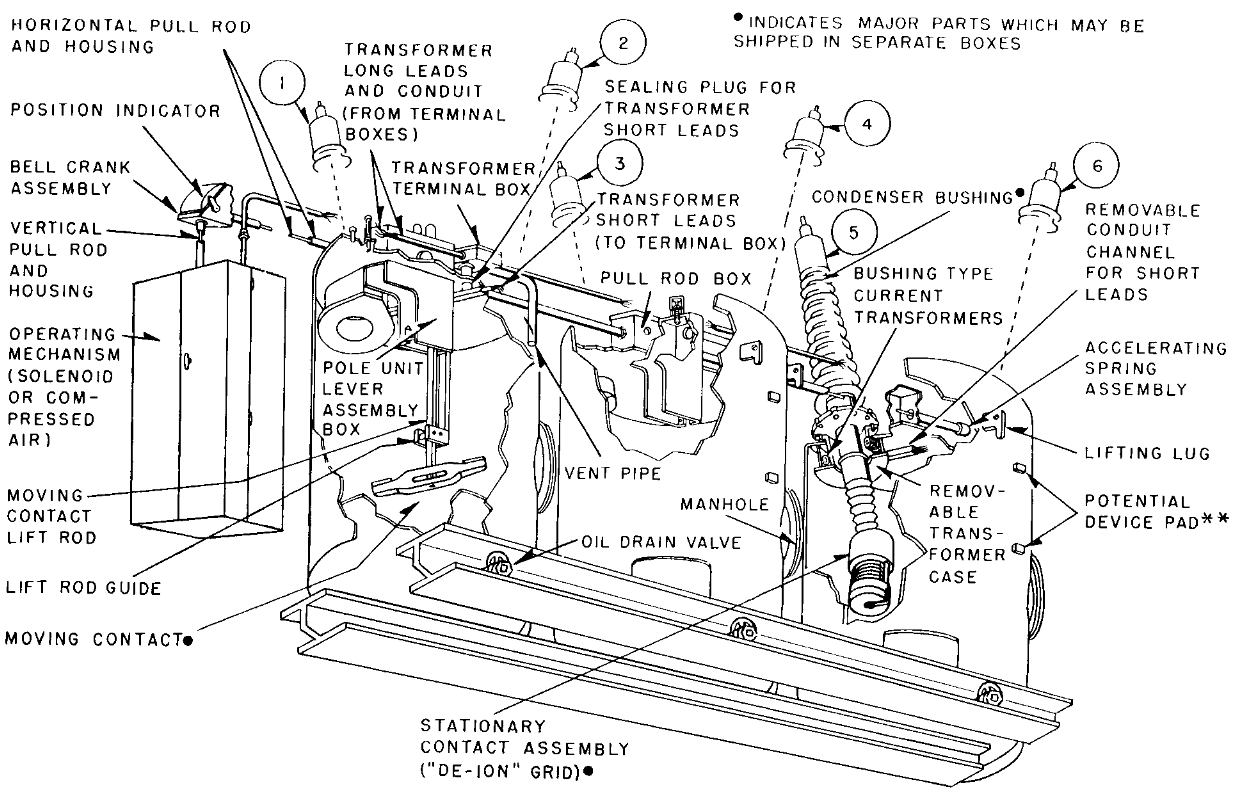
Before attempting to uncrate the bushings, read carefully the procedure steps outlined in Fig. 2. (Duplicate instructions are attached to each bushing crate.)

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

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

STORING BREAKER PARTS

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



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. Thirty-six (36) bolts, flat washers, and lock washers are all contained in a cloth bag and packed in the detail parts crate. Quantity of forty-eight (48) is supplied for 161kv breakers.

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).

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

One (1) Pint Can 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).

One (1) Wiring Diagram inserted in pocket on mechanism housing door.

Six (6) Terminal Connectors. Wrapped in weather proof 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, is placed in an envelope and shipped in the mechanism housing.

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

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

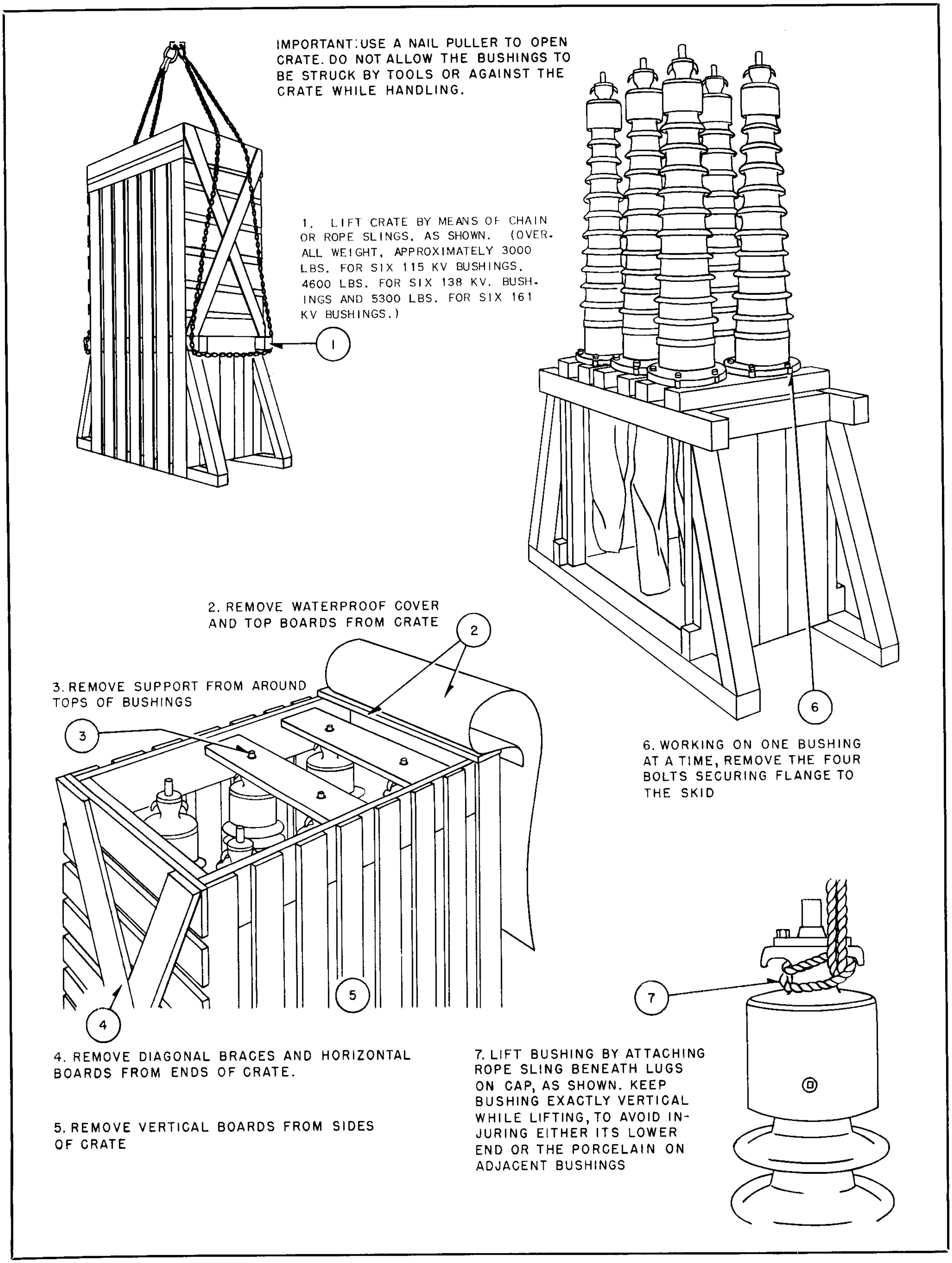


FIG. 2. Procedure for Uncrating Vertically Packed Condenser Bushings

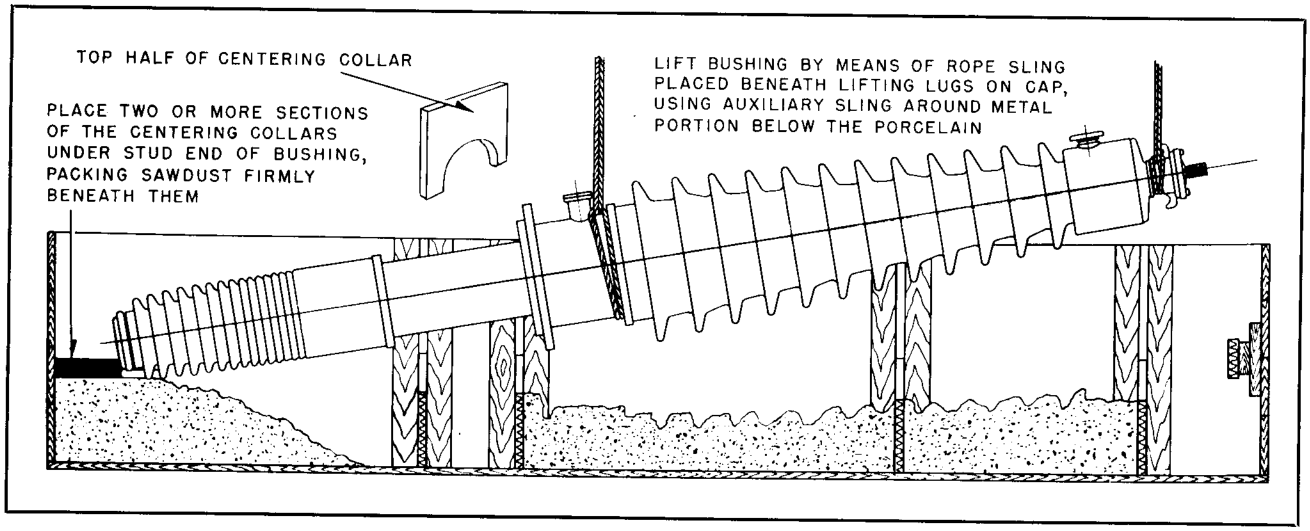


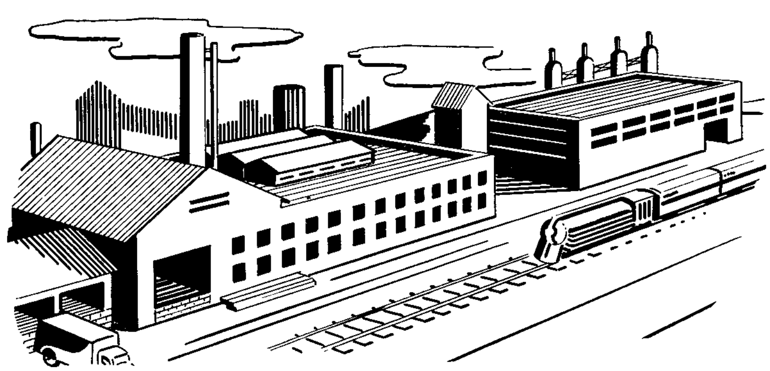
FIG. 3. Removing a Horizontally Packed Condenser Bushing from its Crate

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

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

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

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



INSTALLATION

SELECTING THE LOCATION

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

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

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

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

MOUNTING THE ASSEMBLY

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

The entire 3-pole H-beam mounted assembly may be leveled by shimming before clamping rigidly to foundation. Both fully assembled breakers and partially assembled breakers (without bushings and contacts assembled) have tanks accurately aligned at factory. In case of fully assembled breakers all mechnical alignment and adjustments have been made at factory. Upon securing to foundation shipping ties on mechanism and contact blocking in tanks should be carefully removed. The breaker should be opened slowly be means of hand closing device on mechanism and entire assembly carefully inspected for loose hardware and any damage incurred in transit. All defects should be corrected and hardware tightened thoroughly. Check all settings including bell crank, lift rod and toggle stops and stop clearances to make sure they are still correct. Refer to succeeding paragraphs. Contact alignment and adjustment should be checked per pages 15 and 18.

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

The bell crank assembly which is above the operating mechanism on the No. 1 pole unit; the function of which is to convert vertical movement of the operating mechanism into the horizontal movement of the pull rod assembly is properly set at the factory and should not need adjustment. The angle between

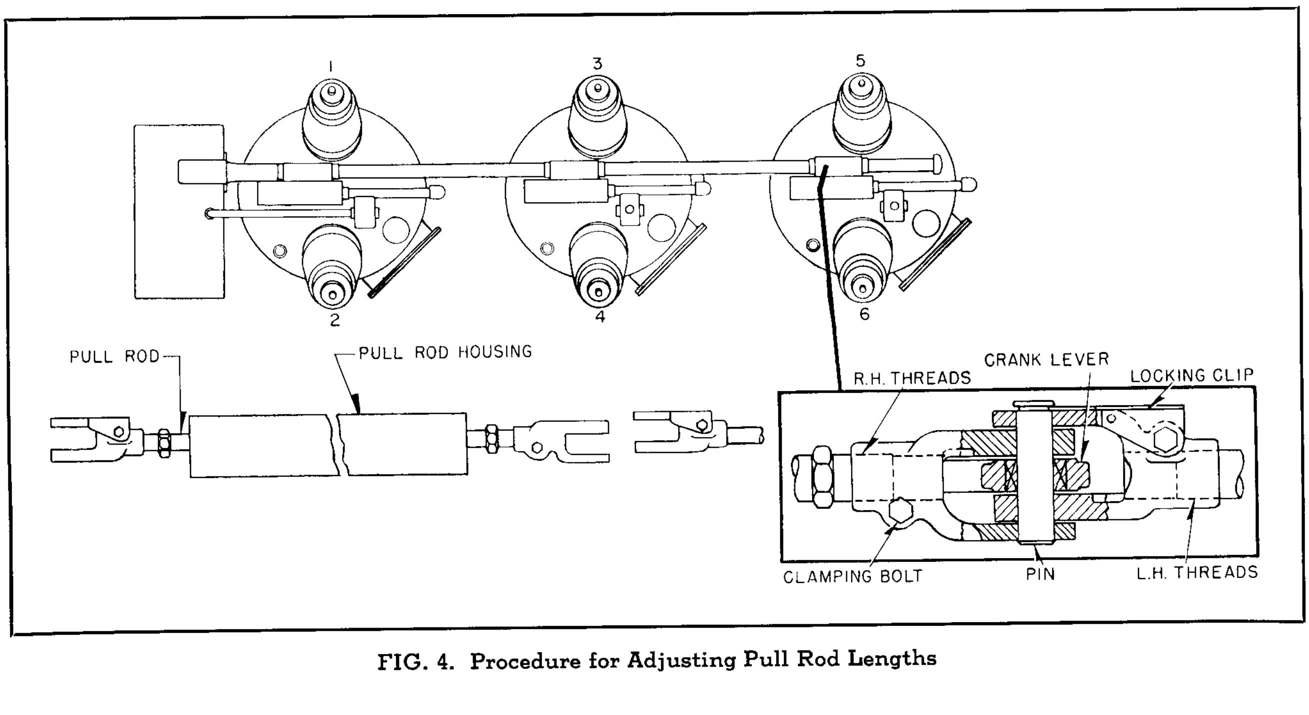


FIG. 4. Procedure for Adjusting Pull Rod Lengths

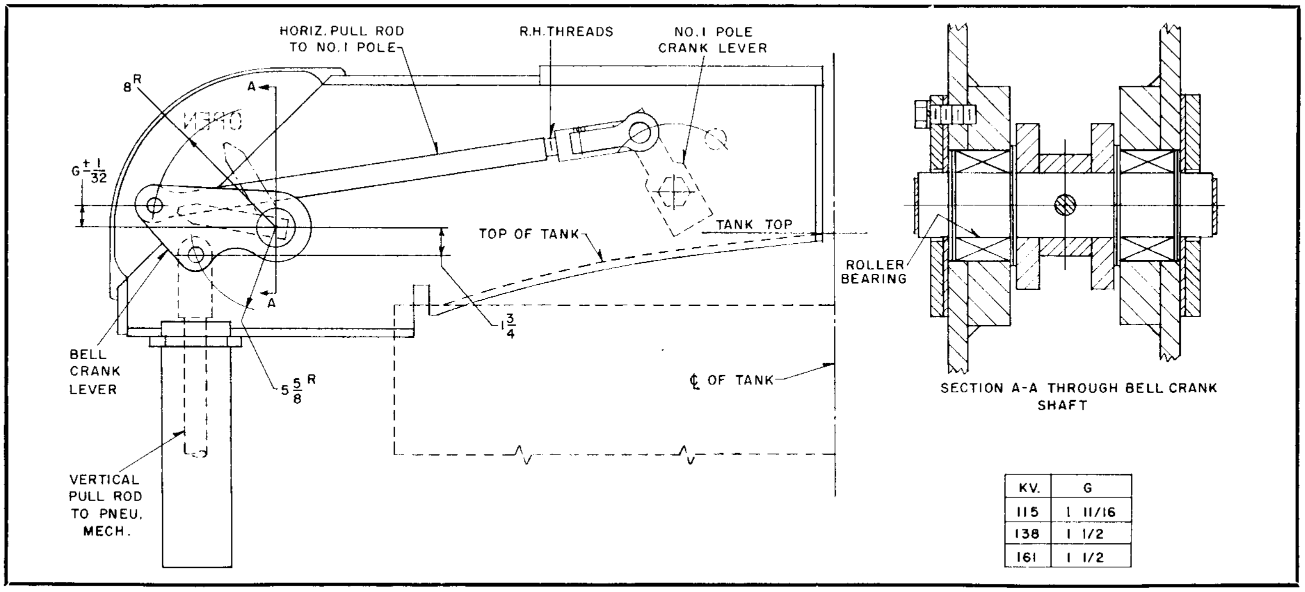


FIG. 5. Bell Crank Adjustments

the two arms of the bell crank lever is less than 90 degrees, so that additional mechanical advantage is gained at this point for the operating mechanism. With the operating mechanism closed and just latched (no overtravel), refer to Fig. 5 the dimension of the center of the pin through the horizontal pull rod above the centerline of the shaft should be per tabulation. If this is incorrect, adjustment may be made by loosening the clamping bolts on the rod ends and turning the rod. Since this rod has L.H. threads on the upper end and R.H. threads on the lower end, turning it into the lower rod end will shorten the rod, while backing it out of the lower rod end will lengthen it. A hex section near the lower end of the rod is provided for a wrench.

Since the mechanical advantage changes rapidly according to the setting of the bell crank lever, it is important to set this dimension carefully. However, it is permissible to change the vertical pull rod length slightly after all adjustments are complete, if it is found that the contact adjustment on all three poles needs a small simultaneous adjustment.

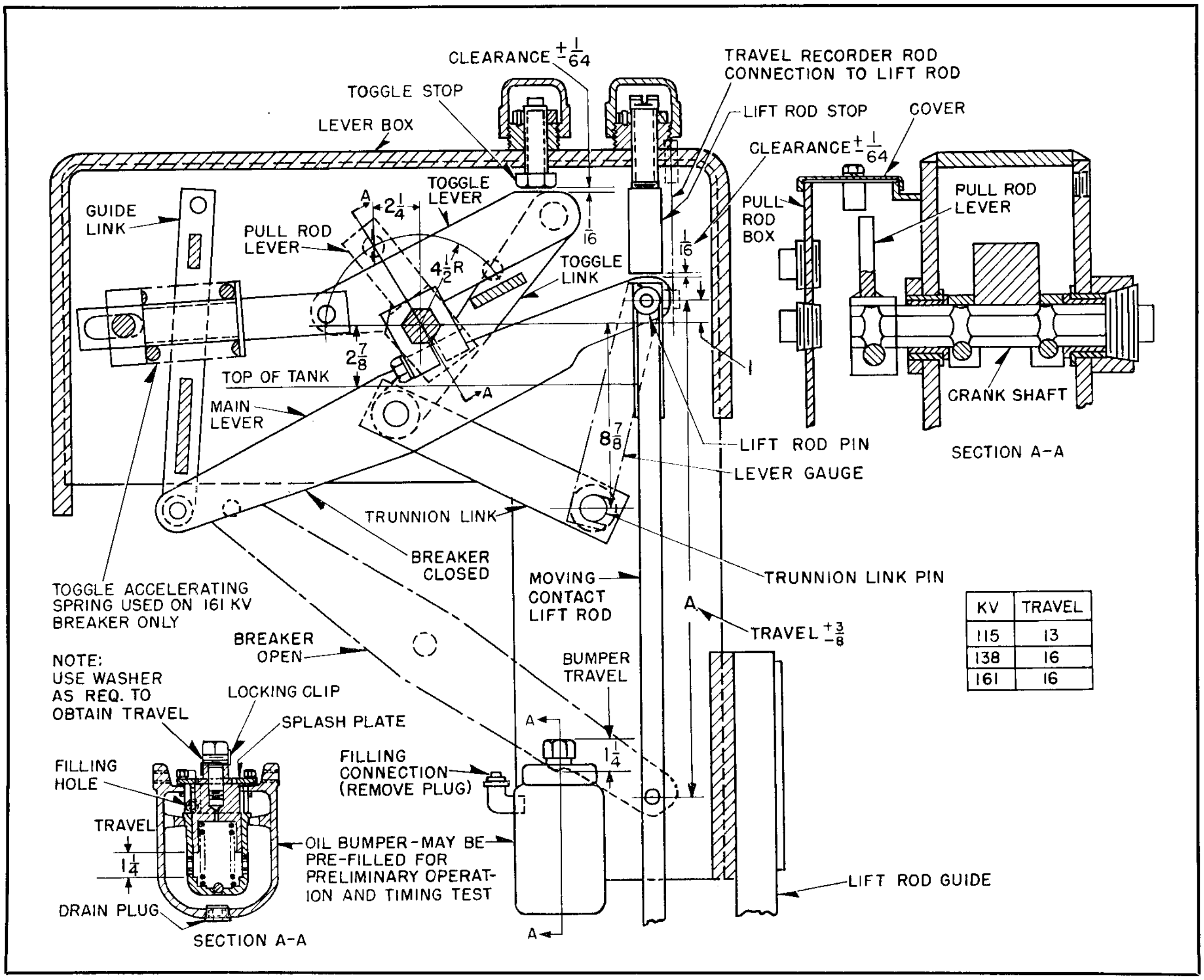
Also lift rod end and toggle stops have been set at the factory to properly position the lever system. With these stops properly set the clearances between the lift rod and its stop and the toggle lever and its stop have been set at $1/16'' \pm 1/64''$ by adjusting the lengths of the horizontal pull rods with breaker closed and just latched (no overtravel). The settings were made with normal accelerating spring load and contact loading, and the lever gauge in place between the main lever and trunion link pins. See Fig. 6 for location of the lever gauge. These clearances may be checked by removing pipe plugs in side of lever box. (See Fig. 6.) Close manually to check stops.

If for some reason the stop settings have been disturbed or there is any suspicion that they are not correct, check the position of the main lever and the trunion link with the lever gauge.

Once it has been determined that the stop settings are incorrect, they should not be changed in order to get the $1/16'' \pm 1/64''$ clearance. The correct procedure to get the proper clearance is to adjust the pull rod lengths between poles. If clearances on all three poles are off same amount the horizontal pull rod from the bell crank to No. 1 pole only need be adjusted.

Adjustment of the short rod between the bell crank and No. 1 pole is made in half-turn steps (R.H. threads) by removing the pin at the bell crank lever and loosening the clamping bolt on the rod end at No. 1 pole. When adjusting this rod, it may be found convenient to block the breaker part way closed by placing a block in one of the pull rod boxes.

If stop clearances are off various amounts adjustments should be made starting with No. 1 pole to get $1/16'' \pm 1/64''$ clearance at all lift rod and toggle stops. Refer to Fig. 6. Between the No. 1 and No. 2 and No. 2 and No. 3 poles it is not necessary to remove the pins in the crank levers. It will be noted that the rod end towards the front end (pneumatic mechanism end) of the breaker has R.H. threads while the other rod has L.H. threads, so that adjustment of the interpole lengths may be made by merely loosening the clamping bolts on the rod ends and turning the pull rod—it is not necessary to remove the pins in the crank



KV	TRAVEL
115	13
138	16
161	16

FIG. 6. Pull Rod Dimensions and Settings

levers. The rod has a hex section for a wrench near the end with R.H. threads—turning the rod into the rod end with R.H. threads will shorten it. The rod length between No. 1 and No. 2 is adjusted at the pull rod box on No. 2 pole, while the rod length between No. 2 and No. 3 pole is adjusted at the pull rod box on No. 3 pole. Refer to Fig. 4.

When it is necessary to disengage rod end at No. 3 pole it is necessary to relieve tension on the acceleration spring rod at the end of the No. 3 pole. (See Fig. 20.) To do this remove the spring housing cap, loosen the locking screw and back off the adjusting nut.

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

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

Note: Do not change the stop bolt settings to obtain proper clearance; these settings have been made at the factory. If the stop settings have been disturbed, or are suspected to be incorrect, check the position of the main lever and trunion link as described on page 11.

It will probably be necessary to make small readjustments in the pull rod lengths after the contact load has been added. However, it is advisable to tighten the clamping bolts on the rod ends at this time.

INSTALLING CONDENSER BUSHINGS

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

Procedure for installation is then as follows:

1. Lower the bushing into position, making sure that the potential device receptacle faces away from the center of the breaker. The bushing must be lowered with great care in order to avoid damaging either the insulating tube on the inside of the transformer, or the porcelain on the bushing itself.

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

2. Cement gasket to tank flange and apply vaseline over entire bushing flange gasket surface. The vaseline will permit shifting the bushing without damaging the gasket. Lower the bushing into place as per Fig. 8 with eccentrics located as per Fig. 9 or Fig. 10. Before tightening the holding bolts, the bushings should be accurately aligned with respect to the centerline of the tank and lower ends spaced the proper distance apart. (See Pole Unit End View drawing Fig. 12.) Two open end wrenches per order or station are furnished for adjusting bushing eccentrics. To assist in assembling breakers which are shipped dismantled refer to copy of drawing 127-A-538 (for 115 KV and 138 KV breakers) or 127-A-539 (for 161 KV breaker) filed in the pocket or inside of the mechanism housing door. On these drawings are noted the eccentric positions determined during factory assembly for test.

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

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

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

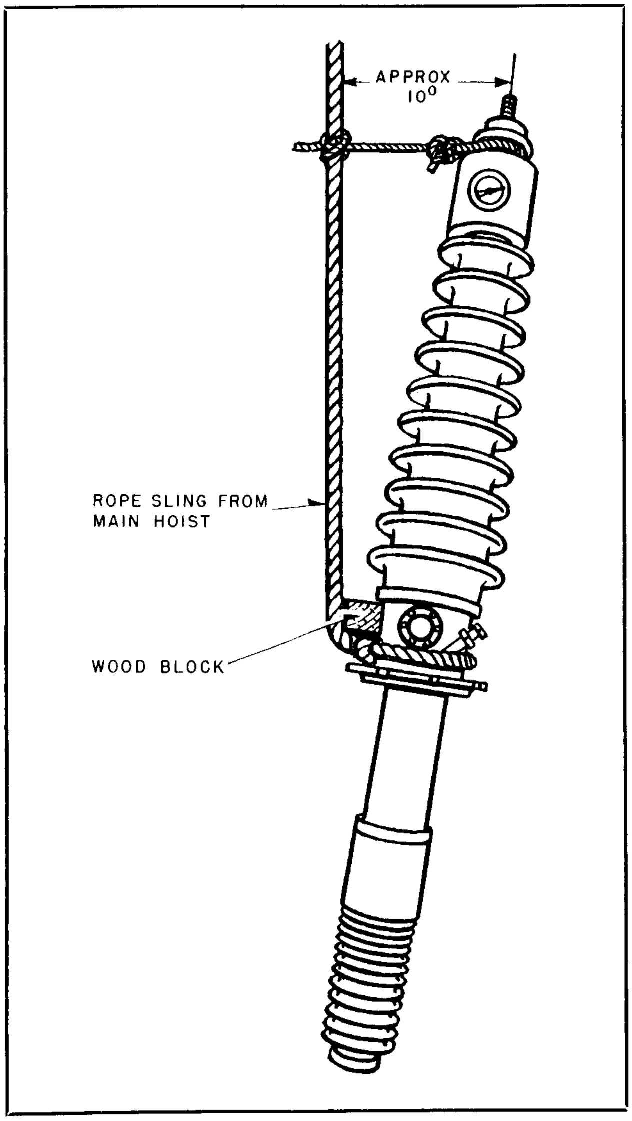


FIG. 7. Method of Suspending a Condenser Bushing at Proper Angle for Inserting Into Tank Top

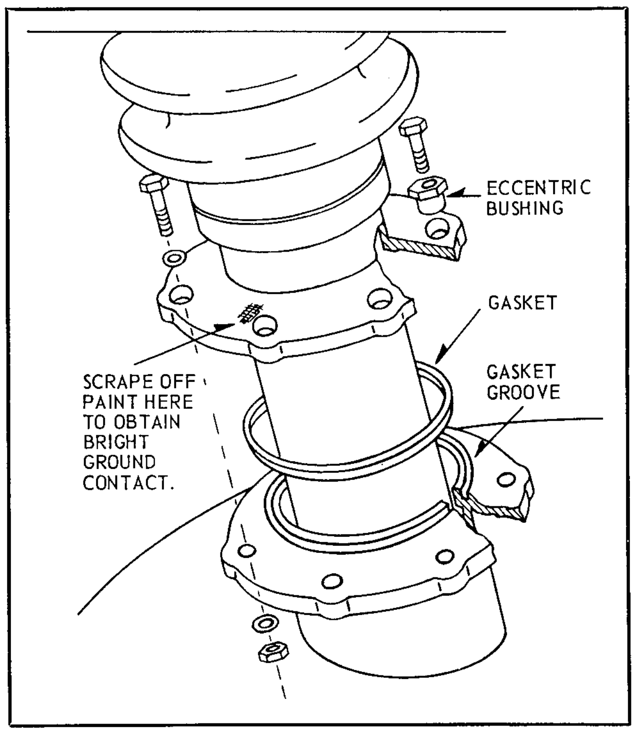


FIG. 8. Installing a Condenser Bushing

MOUNTING THE STATIONARY CONTACTS UNITS

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

To do this conveniently, remove Micarta shield (5) and upper metal shield (4) in the order stated. See Fig. 13. Then remove the contact foot (3) with flange (75). The flange and foot assembly is held to interrupter assembly by three bolts (39). Screw the flange and foot assembly on the condenser-bushing stud. Care must be taken to prevent cross-threading or damage to either threaded member. As indicated in the note on pole unit assembly Fig. 12 the flange (75) Fig. 13 is to be screwed on the bushing stud so the lower surface of flange is flush with or higher than lower end of threads on condenser bushing stud to obtain a gap of 1/16″ min. between flange (75) and contact foot (3) after final adjustment. The gap is necessary for locking the threads on flange and stud on pulling up the 8 bolts through the foot so the contact assembly cannot turn on the stud. Do not draw up bolts to final tightness as it may be desirable to shift the foot slightly in aligning the contact. The contact feet on the two bushings must be located at as nearly same height as possible. Assemble the stationary contacts on the feet. Do not tighten the bolts (39) or assemble the contact shields until the moving contacts have been assembled and final adjustment made.

MOVING CONTACTS

Before final alignment of the stationary contacts can be made, the moving contact must be assembled on the lift rod foot according ot 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. 11.

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

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

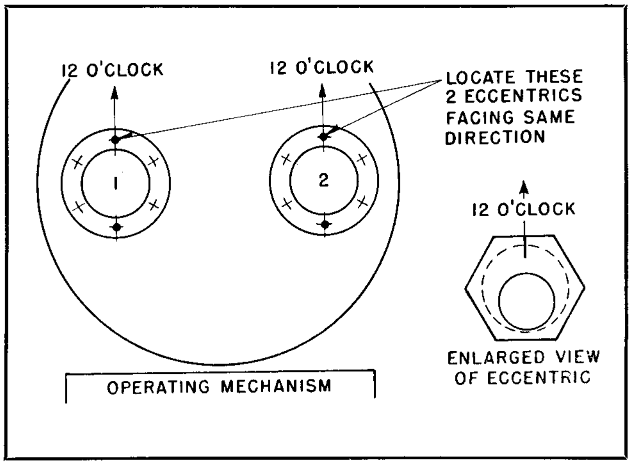


Fig. 9. Eccentric Locations for 115 and 138 Kv. Breakers

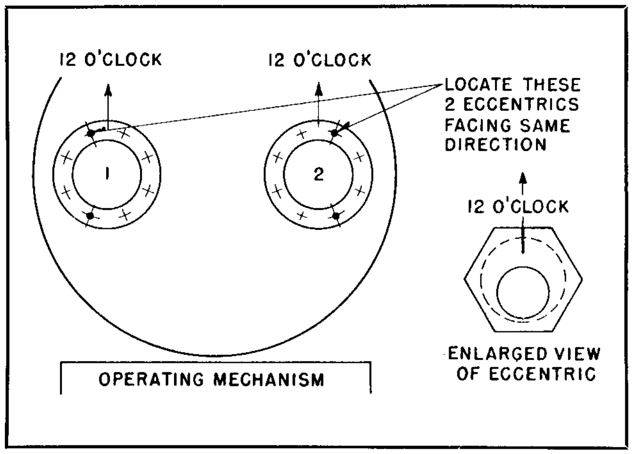


Fig. 10. Eccentric Locations for 161 Kv. Breaker

Note: The adjusting nuts are also used for the purpose of tipping the moving contact slightly to obtain simultaneous contact on the closing stroke of the breaker. Refer to "Securing Alignment", page 15.

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. 11 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 lift rod, and permits forward or backward adjustment of the lift rod. Tighten bolts securely when required position is attained.

Disconnecting the Lift Rod. The lift rod may be disengaged from its operating lever by removing cotter pin, washer, and main pin assembly as indicated in Fig. 11.

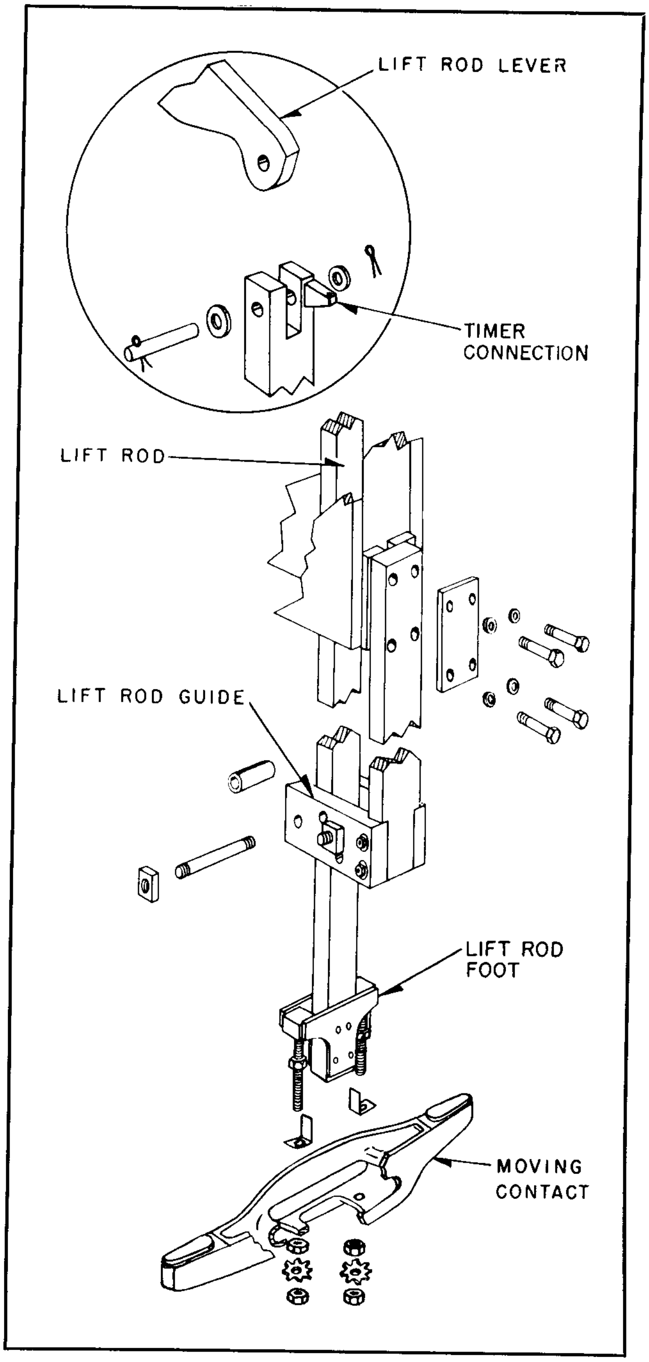


FIG. 11. Exploded View of Moving Contact Unit

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. 11. This allows clearance for rotation of the fully assembled stationary contact units.

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

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

SECURING ALIGNMENT

For the breaker to operate properly, it is absolutely essential that the moving contact crossbar be in alignment with the stationary contacts, and to engage them simultaneously. Refer to Fig. 13 and note the horizontal alignment dimension of $7/16'' \pm 1/8''$ for the end of the moving contact crossbar (2) where it enters the lower metal shield (6). Several methods are available for securing alignment and simultaneous touching of contacts:

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

2. By tipping crossbar on its lift rod to engage both lower stationary contacts simultaneously. This adjustment should be made only to compensate for small differences in height of the two stationary contact assemblies.

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

CONTACT ADJUSTMENT

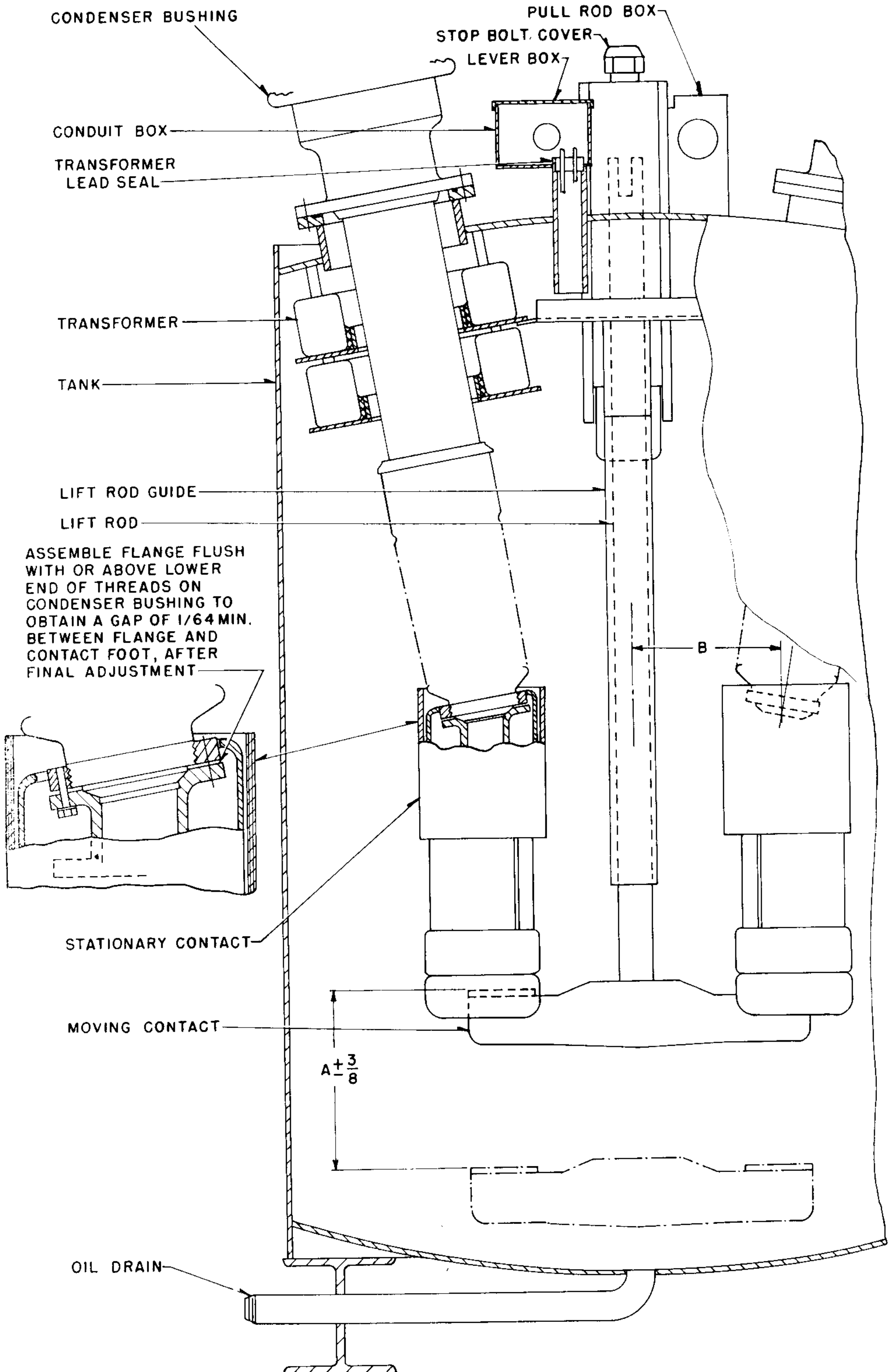
Refer to Fig. 13 for contact adjustments. Adjustment note on Fig. 13 gives a condensed procedure which is more fully explained as follows:

1. Remove Micarta shield (5) and inside half of upper metal shield (4). (Already off for initial installation.)

2. With the breaker closed and $1/16'' \pm 1/64''$ clearance obtained at all lift rod stops, adjust moving crossbar (2) on its lift rod so that the lower contact (21) is raised the "A" travel dimension shown in table on Fig. 13. The lower contact may be seen through a window in lower metal shield (6). It is suggested that the most accurate method of checking point of touching lower contact is by "lighting out" between it and crossbar (2).

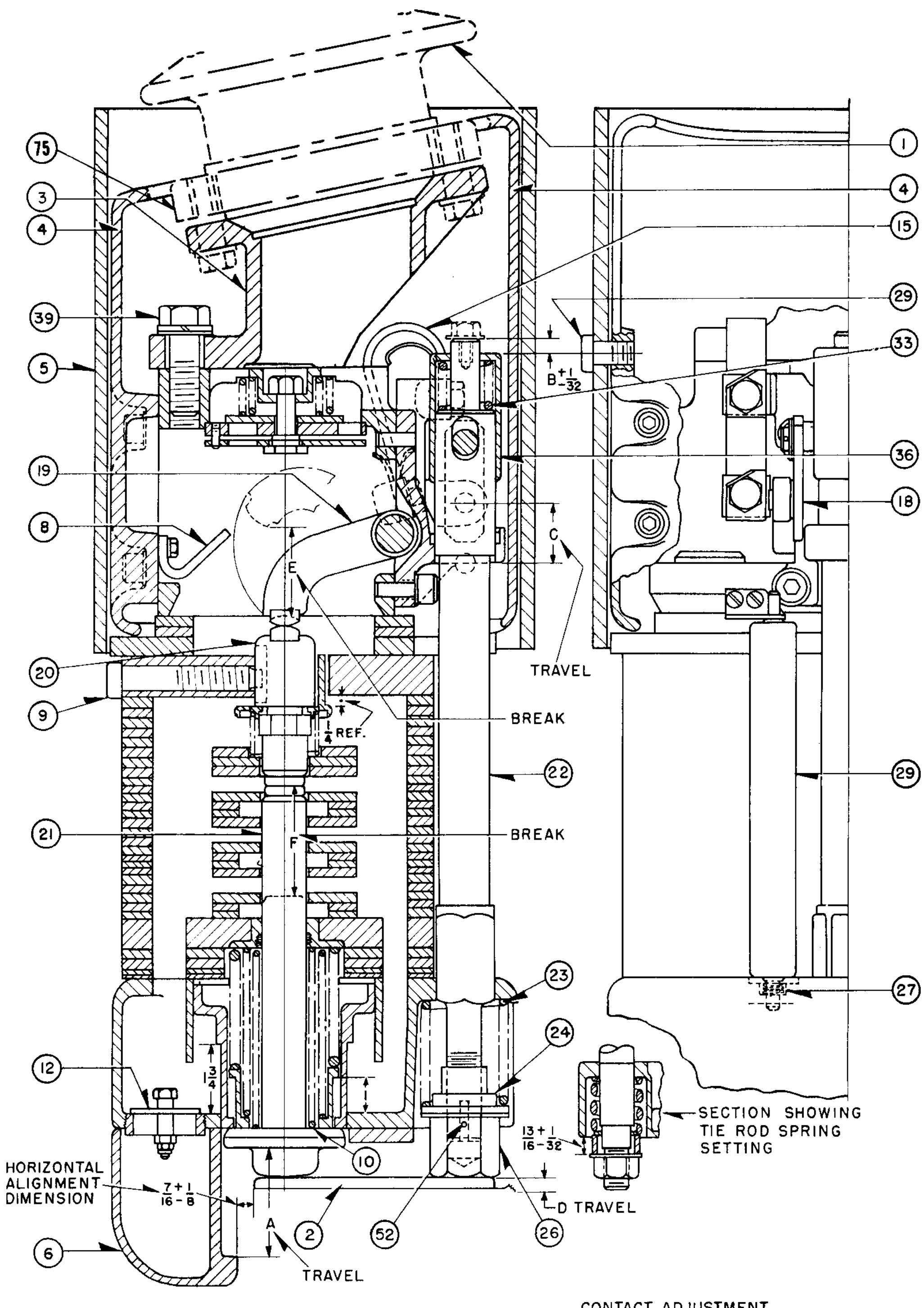
3. Adjust nut (26) at lower end of operating rod if necessary to obtain $3/8''$ contact spring compression measured at "B", which is the amount the upper end of the operating rod projects through sleeve (36). Lock the nut (26) at lower end of operating rod with cotter pin (52).

It is best to make the adjustments on each pole independently; this may be done by dropping the



TYPE	KV	A ± 3/8	B
GM-6B	115	13	10-13/32
GM-5B	138	16	13-1/2
GM-5C	138	16	10-13/32
GM-5B	161	16	12-17/32

FIG. 12. Section View of Pole Unit Assembly and Moving Contact Travel Dimensions



	A	B	C	D	E	F
115 KV	$2\frac{3}{4}$	$\frac{3}{8}$	$1\frac{1}{2}$	$1\frac{7}{8}$	$2\frac{1}{4}$	3
138 KV	$2\frac{3}{4}$	$\frac{3}{8}$	$1\frac{1}{2}$	$1\frac{7}{8}$	$2\frac{1}{4}$	3
161 KV	$3\frac{5}{16}$	$\frac{3}{8}$	$1\frac{21}{32}$	$2\frac{1}{32}$	$2\frac{1}{2}$	$3\frac{9}{16}$

CONTACT ADJUSTMENT

REMOVE SHIELDS 5 AND 4 (INSIDE HALF)
ADJUST MOVING CROSS-BAR (2) ON LIFT ROD TO LIFT LOWER CONTACT (21) *A" $\pm\frac{1}{64}$ FROM OPEN TO CLOSED POSITION OF BREAKER
ADJUST NUT (26) TO OBTAIN $\frac{3}{8}$" CONTACT SPRING COMPRESSION AT B.
LOCK NUT (26) WITH COTTER PIN (52)
*SEE TABLE.

FIG. 13. Stationary Contact Assembly Adjustments

lift rod in the other two poles. After the contacts in each pole have been adjusted in this manner, connect all lift rods and recheck the lift rod stop clearances. It will probably be found that the contact load has increased these clearances somewhat, and likely in differing amounts on each pole. *Do not change stop settings to compensate for this condition.* Instead, shorten the horizontal pull rod lengths, starting with No. 1 pole, as described under "Mounting the Assembly", pages 10, 11, 12.

After readjustment of the pull rods, it will be necessary to recheck the 3/8″ contact compression at "B" only. Small readjustment of the moving crossbar (2) on its lift rod may be necessary.

After all these adjustments are complete, check the clearance at all toggle stops. (See Fig. 6.) Reset toggle stops for 1/16″ ± 1/64″ clearance if necessary.

Open the breaker slowly by hand and check to see that the oil bumpers in each pole are struck simultaneously. The oil bumpers may be adjusted if necessary by adding or removing washers under the bolt head, as shown on Fig. 6. A tolerance of ± 3/8″ is permitted on moving contact travel in order to obtain simultaneous engagement of bumpers. See table on Fig. 6 for "A" travel applicable to this breaker.

CHECKING THE OPERATING MECHANISM

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

PRELIMINARY POWER CLOSING AND TIMING TEST

Considerable time in handling of oil may be saved if preliminary power closing and timing tests are made before filling tanks with oil. Normally it is not advisable to operate breakers without oil in the tanks, but these breakers have a reservoir type oil bumper which may be conveniently prefilled to permit this. However, these operations should be limited to just as few as possible, for without oil in the tanks neither the oil dashpots on the upper end of the stationary contact side operating rods nor the oil pumps on the lower end of the interrupters are effective to cushion the breaker closing operation.

The oil bumpers may be conveniently filled by removing the 1/2″ pipe plug in the elbow on the side of the bumper casting. (See Fig. 6.) Fill only until oil starts to appear in the elbow—any more oil will splash out on the first opening operation. The oil bumpers also fill automatically around the splashplate on top when the tanks are filled.

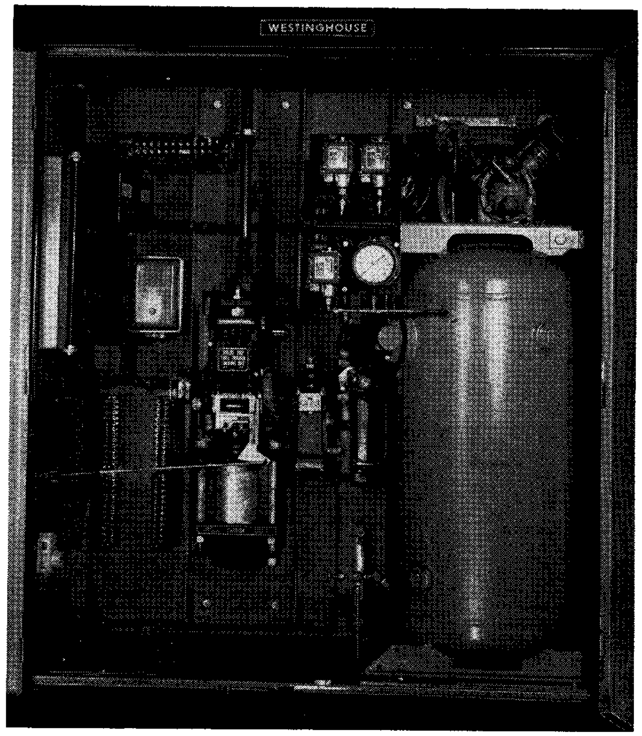


FIG. 14. Pneumatic Operating Mechanism

Pump up the air compressor just to the point where the low pressure cutout switch closes to complete the control circuit (see control diagram). The correct closing pressure for this switch may be obtained from the nameplate inside the mechanism housing. Crack the hand shut-off valve in the air line between the reservoir and the mechanism just enough to allow the breaker to close. The breaker will slam too hard at higher pressures with the valve wide open and without the cushioning effect of the dashpots and oil pumps on the interrupters.

If d-c control power is not available at time of breaker installation, power closing may be accomplished by using manual operating button on pneumatic control valve. (See mechanism instruction book.)

The pressure drop in the air reservoir should be about 10 psi for each closing operation. If much higher than this, the breaker will not operate enough times on one tank of air and is an indication of:

1. Too much contact compression.
2. Improper contact alignment.
3. Too much accelerating (tail) spring compression.

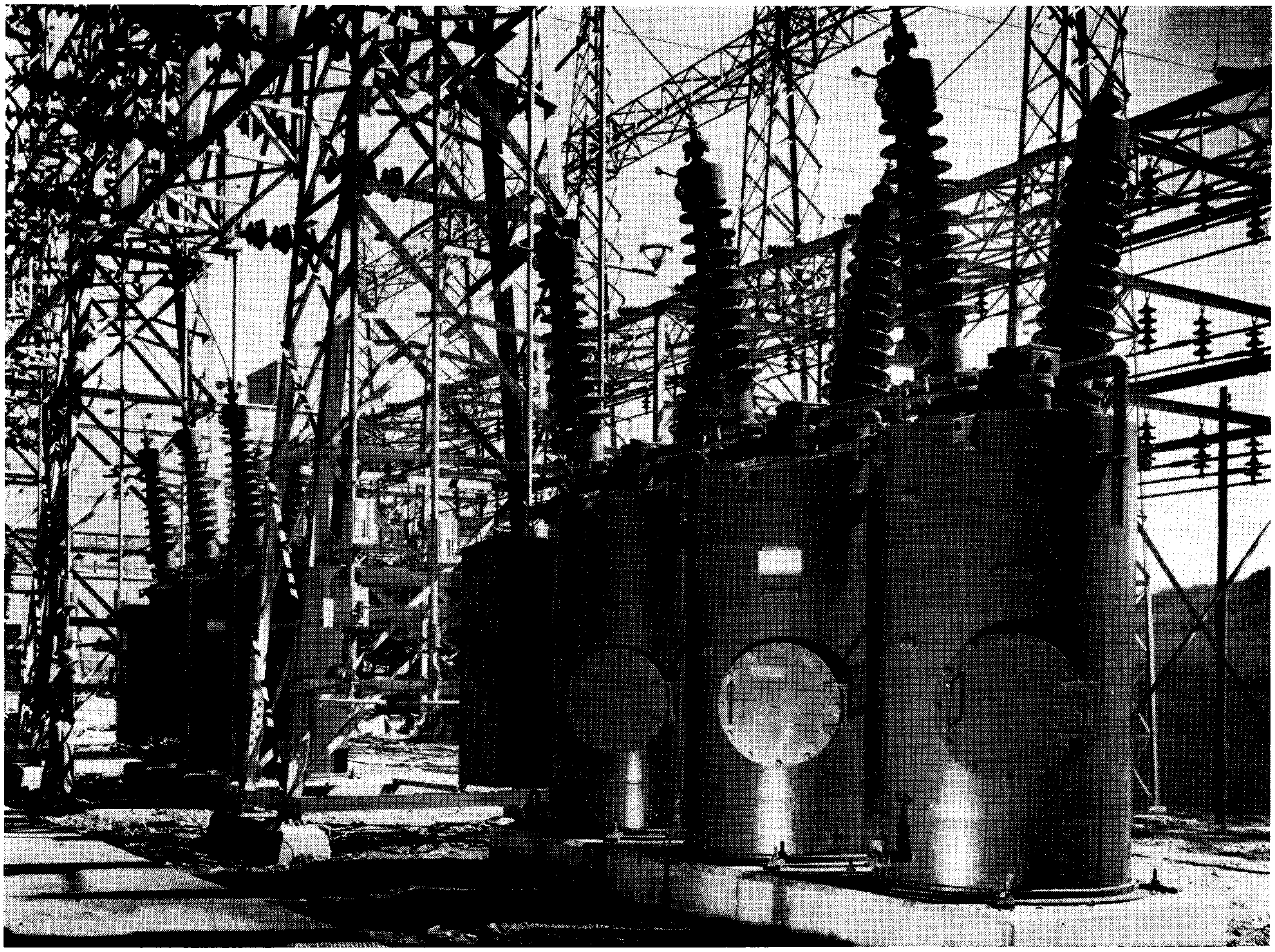


FIG. 15. Installation of Type GM Oil Circuit Breakers Showing Manholes for Inspection and Maintenance

4. Excessive air loss in pneumatic mechanism.

It is also desirable to make preliminary timing test of the breaker opening speed at this time—see "Operating and Timing Tests", pages 24 and 25.

After the operations, recheck all contact adjustments and stop clearances and make any necessary readjustments. After all contact adjustments are complete, assemble the metal and Micarta shields on stationary contacts per Fig. 13. When replacing metal shield (item 4, Fig. 17), *be sure to assemble outside half first.* This half forms part of the pressure chamber, and hence must fit snugly.

Apply shellac to the fiber guide clamping nuts to prevent them from loosening.

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

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

MAKING GROUND CONNECTIONS

Two ground pads are provided on the H-beam base. Each of these pads has two (1/2"—13) tapped holes located 1 3/4" apart according to AEIC (Association of Edison Illuminating Companies) specifications.

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

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

CONNECTING CURRENT TRANSFORMERS

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

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

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

Note: Do not confuse the polarity of the current transformers. Refer to the polarity, ratio and connection diagrams sent with each breaker which show how to connect the transformer circuit. Ratios corresponding to various transformer taps are also reproduced on the transformer nameplate, located on the inside of the mechanism housing door.

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

INSTALLING CONTROL WIRING

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

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

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

FINAL INSTALLATION INSPECTION

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

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

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

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

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

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

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

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

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

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

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

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

10. Check to see that all control wiring outside of the oil tanks is correctly insulated in accordance

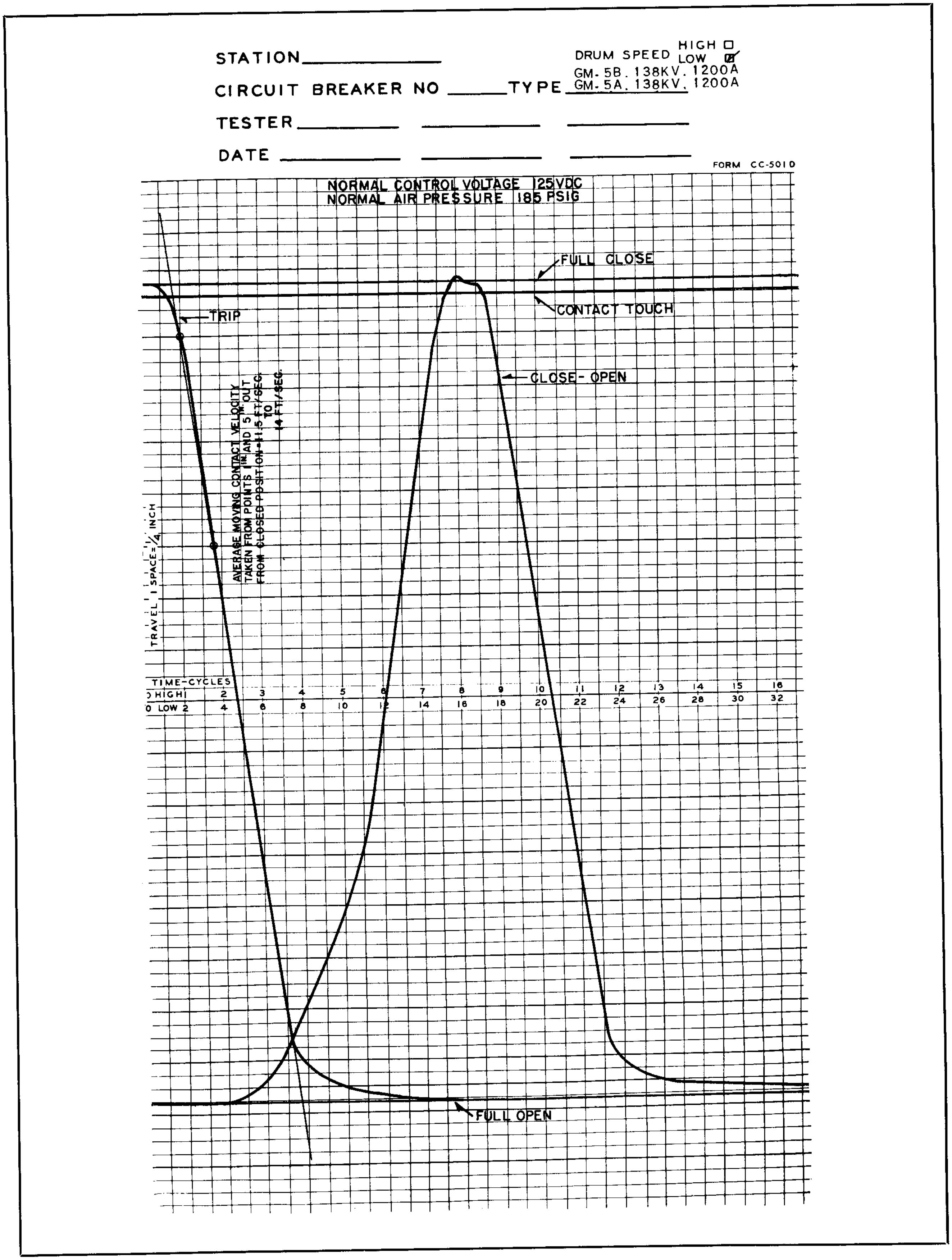


FIG. 16a. Typical Operations Timing Chart

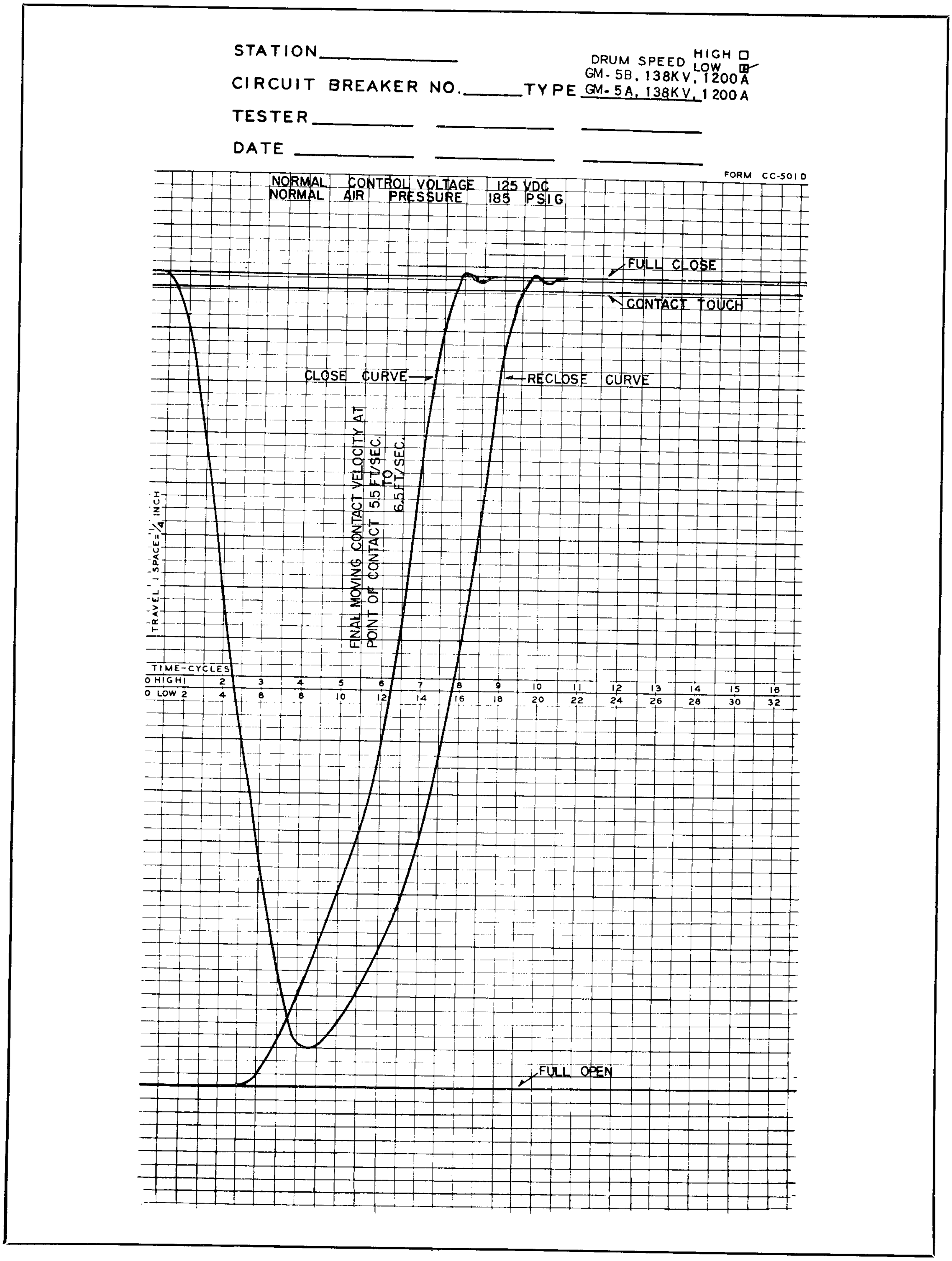


FIG. 16b. Typical Operations Timing Chart

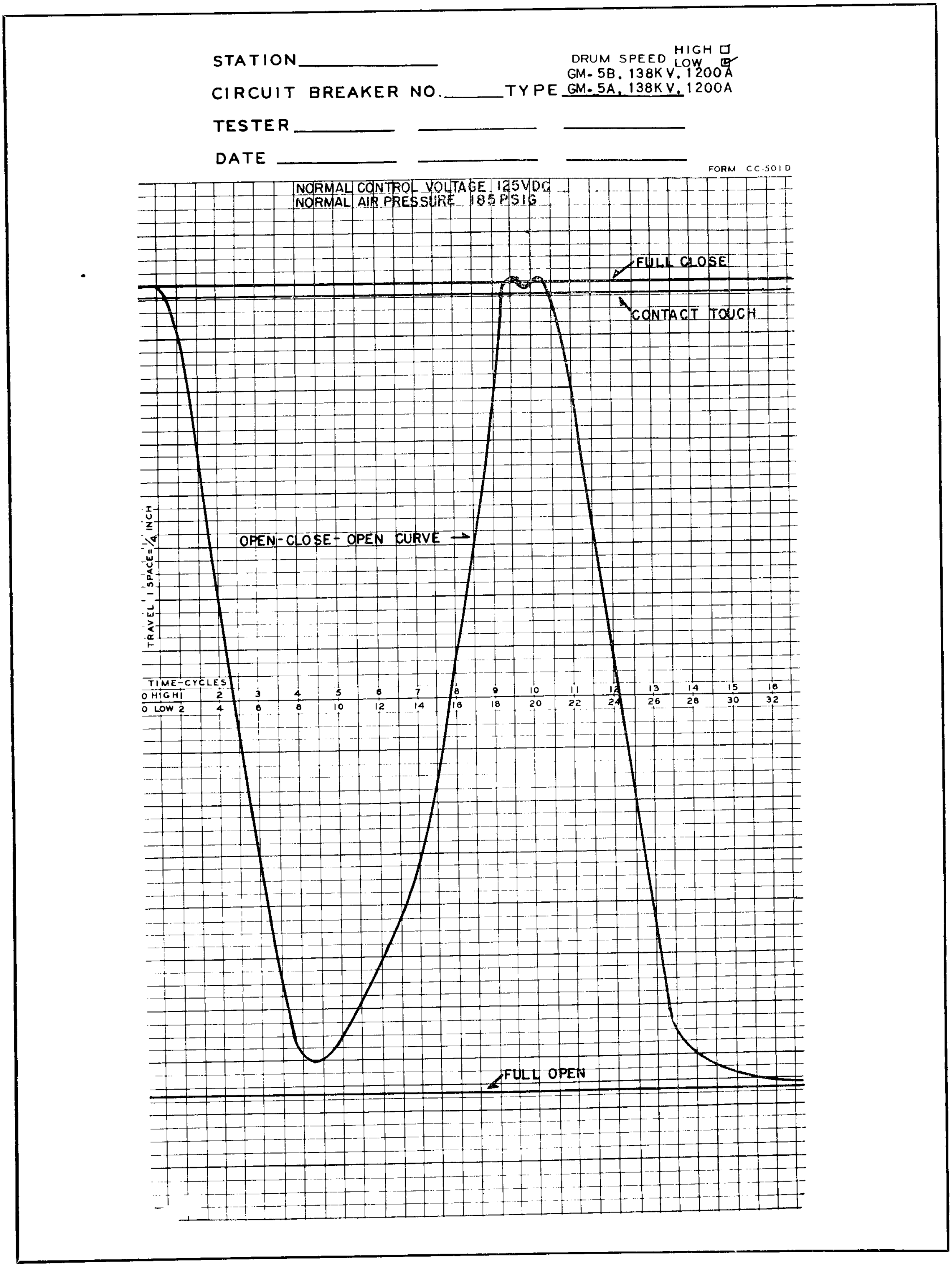


FIG. 16c. Typical Operations Timing Chart

with standard practice. See that all joints in the control circuits are made correctly.

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

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

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

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

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

PLACING OIL IN SERVICE

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

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

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

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

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

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

OPERATION AND TIMING TESTS
(Tanks Filled with Oil)

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

1. Too much contact compression.

2. Improper contact alignment.

3. Excessive air loss in pneumatic mechanism.

4. Excessive accelerating (tail) spring compression.

Check the opening time and reclosing time (if required) of the breaker with a graphic recorder, or preferably an oscillograph for best accuracy. In order to be sure of getting 3 cycle arc interruption, the time from energizing the trip coil until the contacts part should not exceed 1.5 cycles (60 cycle basis). Contact parting time on all three poles should be checked. Also the moving contact lift rod should have moved at least 3 inches 3 cycles after the trip coil is energized. If the breaker is slower than this, it may be due to any of the following reasons:

1. Too much contact compression.

2. Insufficient accelerating (tail) spring compression.

3. Incorrect setting of pole-unit lever system.

4. Incorrect trip armature setting on operating mechanism. (See operating mechanism instruction book.)

Refer to the typical graphic recorder curves, Figs. 16a, 16b, 16c. As indicated on the curve, Fig. 16a, the average velocity on opening operation of the moving contact through the arcing zone can readily be determined by the slope of the line through points 1" and 5" out from the full closed position and should be 11.5 to 14 feet per second.

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

As indicated on Fig. 16b, the velocity of the moving contact on closing should be from 5.5 to 6.5 feet per second at point of contact touch.

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

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

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

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 interrupters 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 fibre 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 (19) and the intermediate contact (20), and the main arc is drawn between the intermediate contact and the lower contact (21). On an interrupting operation, the contacts are rapidly opened by the breaker accelerating springs which act on the moving contact lift rod, by the spring (23) acting on the operating rod (22), and by the three springs inside the oil piston. 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 upper chamber "D" and force an oil flow into the interrupting break.

The oil passages may be seen on Fig. 17. The oil is forced into chamber "E" through passages (not shown) in the thick grid plate which guides the intermediate contact, and from there down either side of the grid into inlets on each side of the arc path as shown. The oil flow along the arc path deionizes the arc, and the arc products pass out of the grid through vents on either side of the grid. The position of the vents is staggered in height with respect to the inlets and are located 90 degrees around the grid. The name of this interrupter "Multi-Flow De-ion Grid" is readily apparent from this description—the interruption is due to the flow of fresh, un-ionized oil along the arc path through a multiple orifice arrangement. After the main arc is extinguished, the circuit is interrupted and hence the pressure arc can no longer be maintained.

In order to insure 3-cycle operation on low currents, an auxiliary oil flow piston is included, since the pressure generating arc is relatively less effective on low current interruptions. When the contacts open, the lower spring seat is released and the springs behind it force it downward to pick up the piston. There is no spring operating on the piston itself—this delayed action is intentional to permit the contacts to have sufficient break distance before the oil flow is started in order to reduce the probability of re-strikes on charging current interruptions. In connection with this, the interrupting gap reaches about 3/4" before the pressure generating gap is started. (This was called "practically simultaneously" previously, since this sequence of contact parting is not important on heavy current interruptions.)

Downward movement of the piston forces oil from chamber "F", up the oil passages on either side of the grid and into the inlets. Upward movement of the piston when the breaker closes tends to reduce the pressure in chamber "F" which allows refilling of oil through valve (12). Although the lower shield (6) appears to form a closed chamber in the section shown on Fig. 17, actually it is freely vented to the breaker tank. Chamber "C" on the insde of the piston also communicates freely with the tank through a passage not visible on Fig. 17, in order to permit unrestrained movement of the piston.

The auxiliary oil flow piston also functions to flush out the grid after a heavy interruption. In this case the operation is a little different—the pressure generated by the pressure arc is communicated to chamber "F" through chamber "E" and passages down either side of the grid. This pressure holds the piston up until the interruption is completed, and then operates by its own spring pressure to flush out the grid. To assist in refilling the grid with oil, the check valve in the top of the pressure chamber "D" provides a vent for any residual gas left inside, and also permits circulation of oil to keep the temperature rise down on normal flow. This valve closes automatically when the pressure in

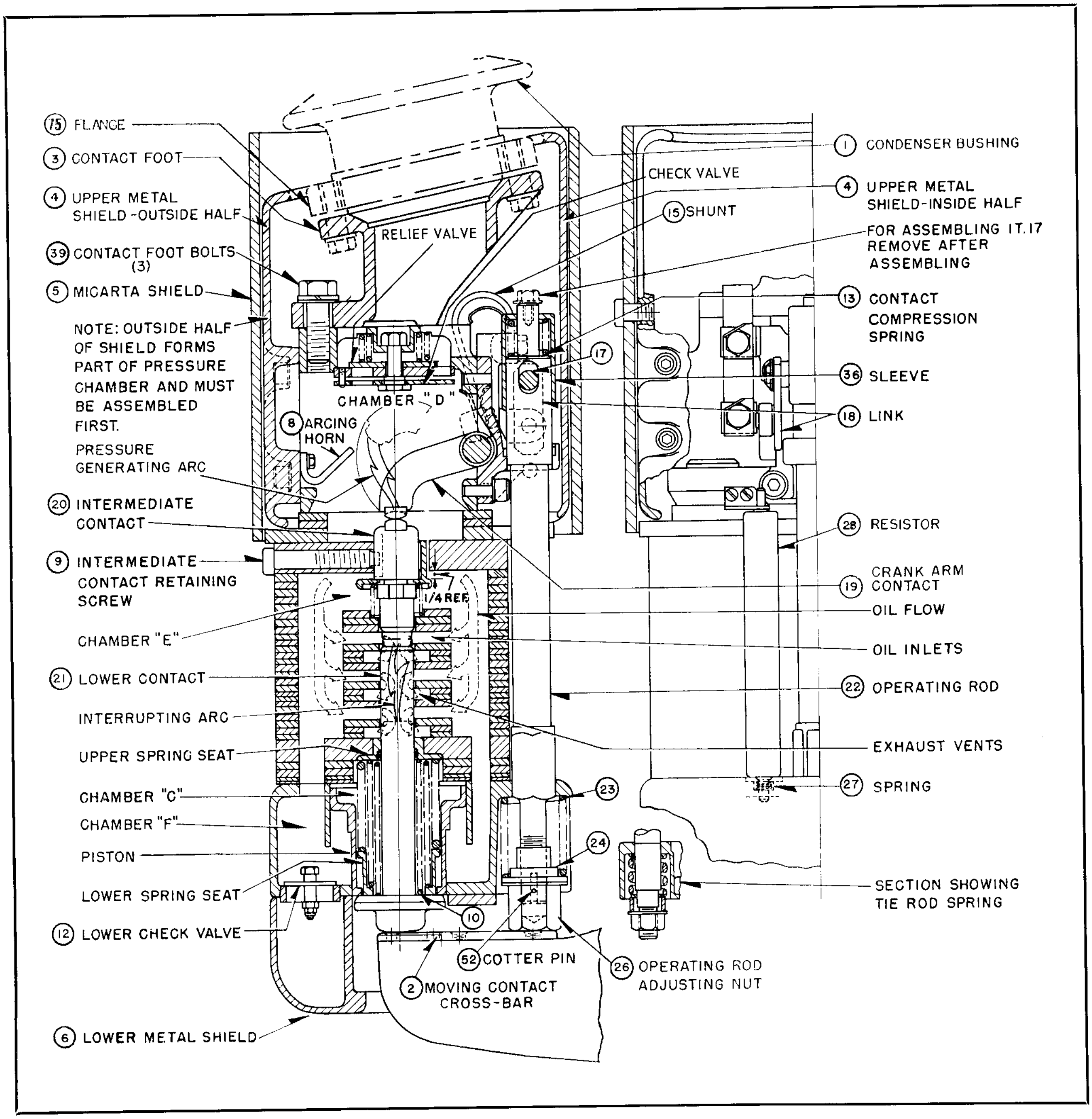


FIG. 17. Stationary Contact Assembly

chamber "D" builds up. As a protective feature, the spring biased relief valve above the check valve opens if the pressure in chamber "D" becomes too high. Arcing horn (8) serves to control the length of pressure arc.

Two other features on the interrupter are worthy of mention. The resistors (28) are shunted across each grid in order to distribute the voltage equally between the two interrupters in each pole. The resistance of these units is very high—for the 115 kv and 138 kv breakers they are 500,000 ohms each, or a parallel resistance fo 250,000 ohms per grid, 500,000 ohms per pole. For the 161 kv breaker the resistance of each unit is 650,000 ohms. Thus, the resistor current is but a fraction of an ampere which is broken within one cycle after the main interruption takes place. The large springs at the lower end of each stack tie rod shown in small partial section allow for expansion or contraction of the stacks, while still clamping the fibre plates firmly together. The length of the stack may change a small amount, according to the moisture content absorbed by the fibre plates.

The mechanical operation of the contacts may best be observed by examining a closing operation. (See Fig. 17.) The moving contact (2) first picks up the lower contact (21) to establish the resistor circuit, and also picks up the lower spring seat. Further movement picks up the operating rod (22) and piston in that order. As the operating rod moves upward, the hinged crank arm contact (19) moves downward until it touches the intermediate contact (20). At this point the intermediate contact is in its extreme upper position (closed position dimension of 1/4" is zero here), and there is a gap of approximately 3/4" between the lower end of the intermediate contact and the lower contact (21). The crank arm contact continues to move downward, pushing the intermediate contact ahead of it, until the latter touches the lower contact coming up thus completing the circuit through the grid. The final 1/4" of moving contact travel reverses the movement of the intermediate and crank arm contacts to their final position as shown on Fig. 13 and at the same time compresses the contact compression spring to the 3/8" dimension at "B". This reversal of movement is possible due to the fact that the crank arm contact is not rigidly connected to the operating rod (22). Instead, it is connected through a pair of links (18) to the sleeve (36) which is spring biased to the operating rod.

CONTACT ADJUSTMENT

Contact Inspection. Adjustment of the contacts has been fully explained on pages 15 and 18. Condensed instructions also appear on Fig. 13. These instructions should be followed when setting up the breaker, and for any subsequent adjustments necessary due to burning of contacts, etc.

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. 17, 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 which is ordinarily used for a time-travel recorder rod. However, this arrangement may also be used to measure contact compression by screwing a 3/16" diameter rod with No. 10-32 threads on one and 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 3/16" diameter rod and measure the travel between this point and the latched position of the breaker. A travel of 1/4" on this rod corresponds to 3/8" contact spring compression measured at "B" on Fig. 13. When the breaker is first set up, all 3 poles should check 7/32 to 9/32" contact compression measured on the lift rod as described. If any pole shows less than 3/16" 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.

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 contact (2) and the lower side of lower contact (21) may be easily observed when the breaker is open. The burning of these surfaces will ordinarily be very slight. The condition of the crank arm contact (19) and the upper side of the intermediate contact (20) may also be observed by removing upper metal shield (4). The condition of these contacts will be an indication of the condition of the lower side of the intermediate contact and the upper side of lower contact (21).

All of the contacts, except moving contact (2) and lower side of (21), 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 general inspections, the following points should also be checked on the contact assembly:

1. Check all nuts and bolts for tightness.

2. Try check valve in chamber "D" and valve (12) for freedom of movement. Valve (12) may be reached by removing lower metal shield, while the check valve may be reached by removing upper metal shield.

3. The 13/16" dimension for compression of the heavy springs at the lower end of the four stack tie rods should be maintained as shown in small section view on Fig. 13.

Contact Removal. If there is enough burning to warrant removal of the contacts, this may be done rather easily. The crank-arm contact (19) may be removed as an assembly with shunts and operating rod as shown on Fig. 19a by first removing the nut (26) and spring (23) at the lower end of the operat-

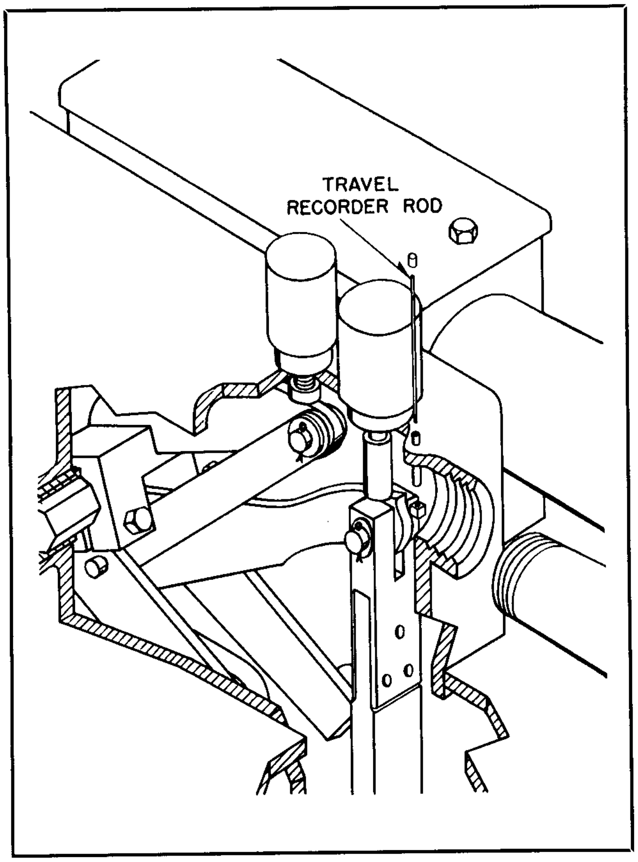


FIG. 18. Inserting Travel Recorder Rod Through Pole Unit Mechanism Housing

ing rod, and then removing the four bolts in the bearing plate at the upper end.

The intermediate contact (20) is a floating piece which is restrained by spring seat and Micarta screw (9) in heavy top plate of the grid stack. After the Micarta screw is removed, rotate the intermediate contact 90° after which contact may be pushed up from below and pulled out through the opening in one end of the pressure chamber box. To replace same use reverse procedure. Be sure that slot in the intermediate contact lines up with hole in heavy top plate before replacing the Micarta screw. In tightening down the screw use care so as not to snap it off.

The lower contact (21) may be removed, with its driving spring (10), by removing lower metal shield (6), which is fastened to the lower casting by four bolts, as shown by Fig. 19b.

It is expected that it will rarely be necessary to completely disassemble a grid stack. Extremely heavy interrupting duty, such as encountered in laboratory testing, would be required before it would be necessary to replace any of the fibre plates.

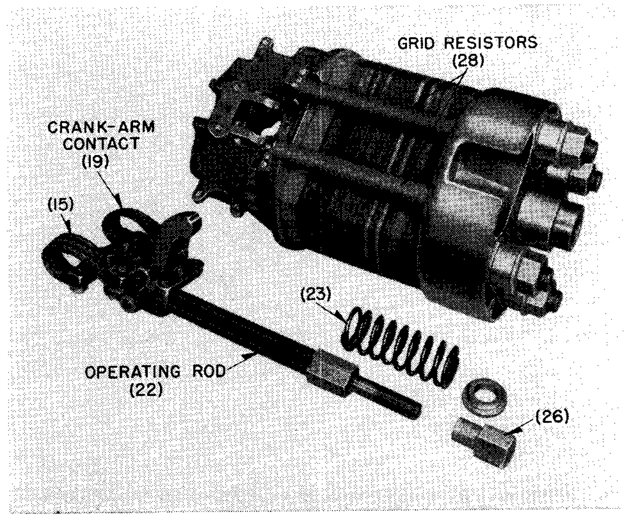


FIG. 19a. Removing Crank Arm Contact

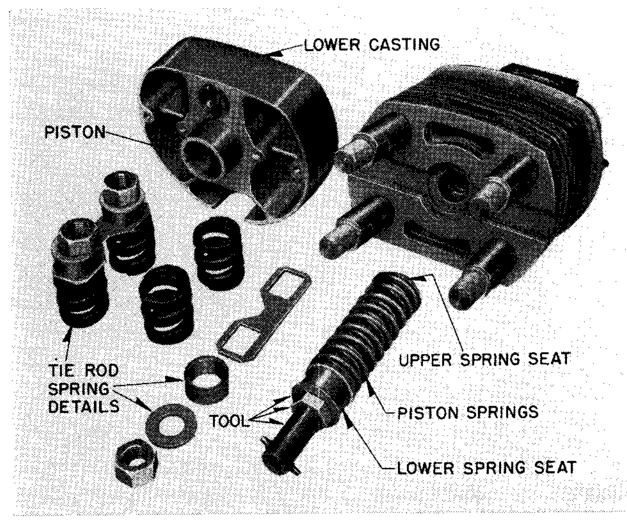


FIG. 19b. Removing Lower Contact

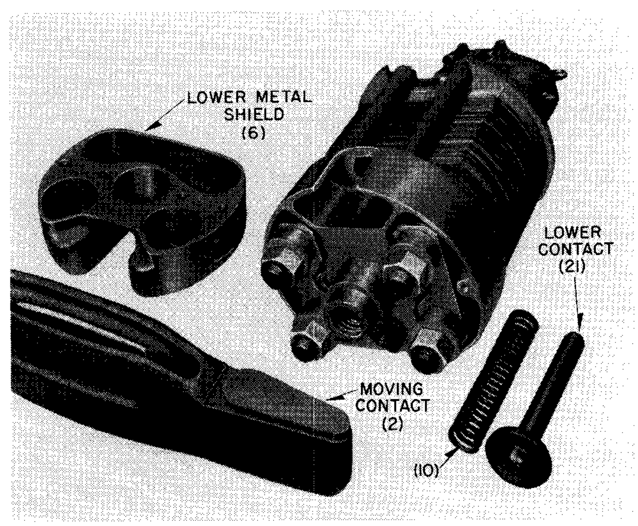


FIG. 19c. Final Disassembly

However, a piston spring compression tool is provided with each breaker order which will facilitate this operation. (See Fig. 19c.) This tool consists simply of a long threaded stud, a heavy steel washer, and a nut. With the lower contact (21) removed and the nut run down to the lower end of the tool, the upper end of the tool may be screwed into the upper spring seat. The nut (with washer on top) may now be advanced to pick up the lower spring seat. It is only necessary to raise the spring seat a small amount in order to relieve any pressure (transmitted through piston on the lower casting). The nuts and heavy springs on the four large stack tie rods may now be removed to allow the lower casting to be taken off. The tool with springs and spring seats may now be removed as a unit from the upper side of the lower casting—also the piston which is shown still hanging through the lower casting on Fig. 19c.

Grid Resistors. The condition of the voltage dividing resistors (28) may be conveniently checked without draining oil from the tanks. Merely open the breaker with the hand closing jack just far enough to part contacts and measure the resistance between top of bushing terminals. This will give the reading of two parallel sets of resistors in series. Since part of the resistor circuit is through the oil pump piston, there is a possibility of an oil film causing an open circuit on a low voltage test circuit. Jacking the breaker in or out a small amount will usually re-establish the circuit. See table below for proper resistance value. These values are per pole as well as per resistor, since there is a two parallel set in series. A $\pm$ 15 percent variation from these figures is permissible—greater variations should be cause for draining oil and making thorough investigation.

If it should be necessary to replace damaged grid resistor (22), care should be taken to match the resistance of the other units 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 pairs in each pole are matched within 10 percent. The resistor is made up of a number of individual blocks, so that a new unit may be made to match an old unit by interchanging the blocks.

BREAKER—KV	RESISTANCE—OHMS
115	500,000
138	500,000
161	650,000

POLE UNIT LEVER SYSTEM

The function of the lever system is shown schematically in Figs. 21a and 21b. (For full section view, refer to Fig. 6, page 12.)

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 oil bumper fills automatically when the breaker tanks are filled with oil, and has a reservoir which stays full after the tanks are drained to permit tripping without oil in the tanks.

The toggle accelerating spring is used only on the 161 kv breaker.

Adjustments. When the breaker is properly adjusted and has been closed by hand, there should be 1/16" ± 1/64" clearance at the toggle stops and lift rod stops. (See Fig. 6.) This clearance is necessary to permit the operating mechanism to overtravel and latch (see Figs. 21a and 21b), and to make sure that the closing movement is stopped by the operating mechanism without undue strain on any of the pole unit parts. If the toggle lever were permitted to go too far forward, the toggle link would strike the crankshaft, and the tripping speed would be slow. Conversely, if the toggle lever were too far back, the breaker would be difficult to close.

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

1. Close the breaker by power operation.

2. Check the position of the lift rod pin. The centerline of the lift rod pin should be 1" above the centerline of the main operating shaft (Refer to Fig. 6) with normal contact load. The 1" dimension may be obtained by changing the pull rod lengths. Use lever gauge to check proper position of pole unit levers.

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 1/16" is obtained.

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

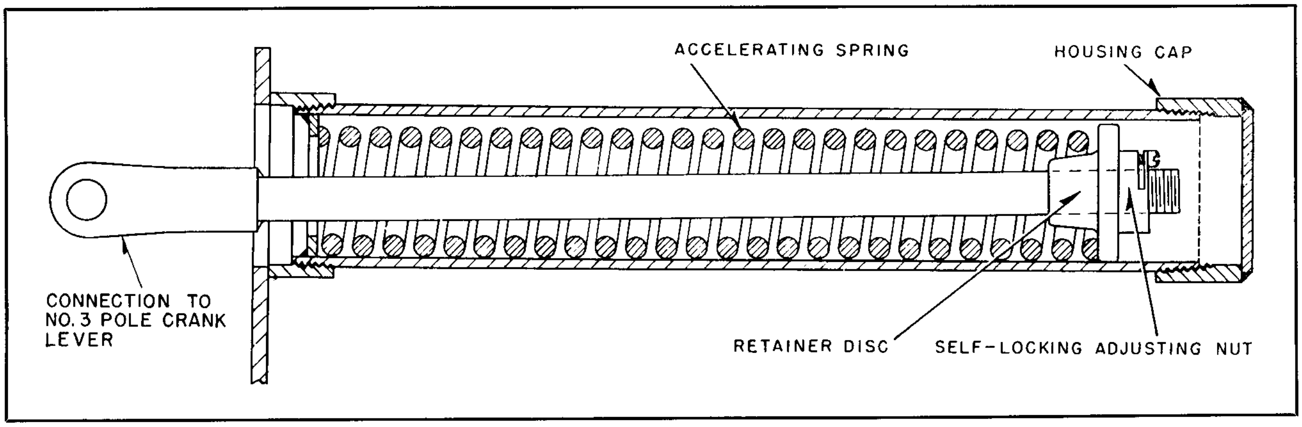


FIG. 20. Accelerating Spring Used with Pneumatic Mechanism

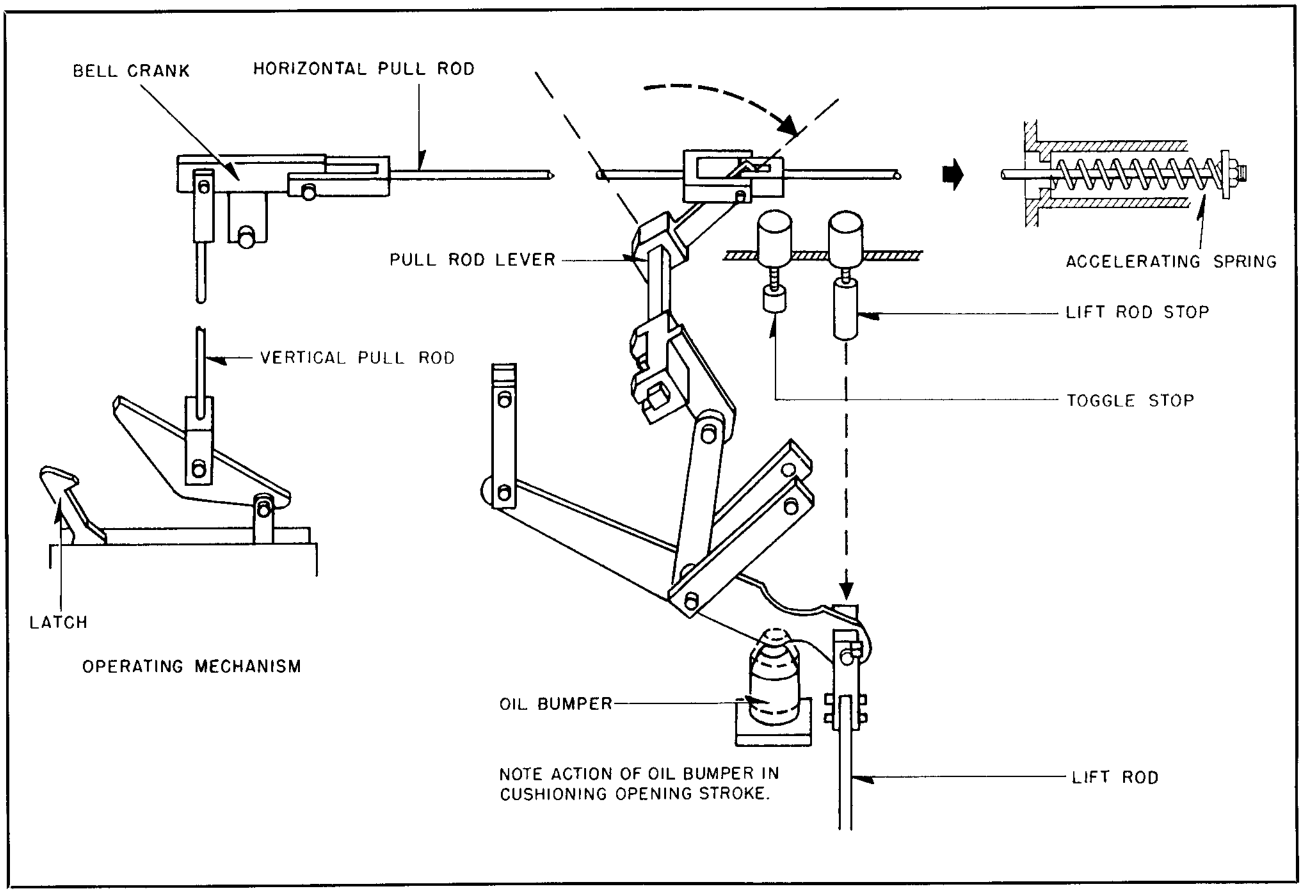


FIG. 21a. Closing Strokes of Pole Unit Lever Mechanism

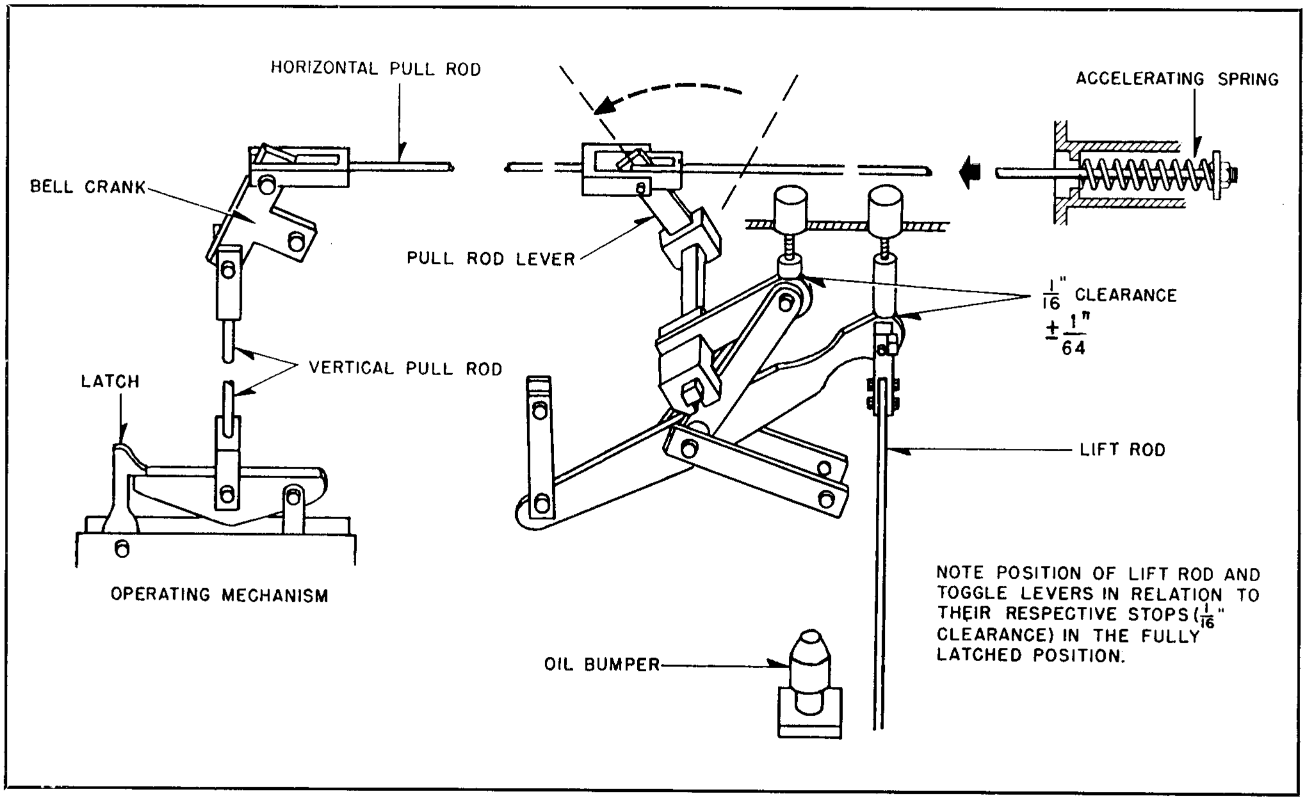


FIG. 21b. Opening Stroke of Pole Unit Lever Mechanism

ACCELERATING SPRING

To provide sufficient opening speed through the arcing zone, an accelerating spring is mounted on no. 3 pole. When the pneumatic operating mechanism is used, this spring operates on the horizontal pull rod over a large part of, and in some cases, over the entire opening stroke. See Fig. 20. Thus this mechanism, which can exert as much force in the open position as in the closed position, picks up some accelerating spring load comparatively early in the closing stroke.

Adjustments. If it is necessary to adjust the acceleration of the breaker, remove cap at end of pull rod housing and back off to tighten the adjusting nut to establish correct opening time as indicated by timer test described under "Operation and Timing Tests", page 24 and 25. 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.

PART FOUR

MAINTENANCE

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

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

1. Time.

2. Number of switching and testing operations.

3. Number of overload and fault operations.

4. Severity of fault operations.

5. Condition of oil.

6. Cleanliness of atmospheric surrounding breaker.

7. Accumulated experience of breaker characteristics and duty.

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

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

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

ROUTINE INSPECTION PROCEDURE

The suggested Routine Inspection procedure is as follows:

1. Check mechanical operation of breaker. See operating mechanism instruction book for specific procedure on operating mechanism.

2. Check dielectric strength of oil.

3. Measure contact compression—see "Contact Inspection", page 28, on how to check without draining oil.

4. Measure resistance of voltage dividing resistors on interruptors—see "Grid Resistors", page 27, on how to check without draining oil.

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

GENERAL INSPECTION PROCEDURE

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

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

1. Close the breaker by power with the operating mechanism before draining oil from the tanks.

2. Check clearance at overtravel stop above main lift rod and at toggle stop on pole unit lever system. (See "Pole Unit Lever System", page 30 and Fig. 6.)

3. Remove the static shields from the stationary contact assembly. Note the condition of the contact faces. A slight amount of burning on the contacts is not detrimental, as long as the electrical conductivity or contact adjustment has not been changed. If the burning is severe, however, the contacts should be removed and reconditioned or replaced. (See "Contact Removal", page 28.)

4. Note the condition of all parts now accessible. Check for loose bolts, nuts, spring cotters, damaged parts of any kind.

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

6. Clean the lower porcelains on bushings with clean cloth wet in clean oil. Clean surfaces of Micarta lift rods and guides in same manner. Clean all carbon from grid stack.

7. Check the pole unit mechanism for loose bolts and nuts and for missing spring cotters.

8. Check the operating mechanism in the same manner. Lubricate bearings with a few drops of lubricating oil.

9. Check latches to see that faces are in good condition. (See Operating Mechanism Instruction Book.) Apply rust inhibitor to latch faces. The inhibitor should be free flowing at all anticipated temperatures, non-hardening, and self-healing (so that it will not completely wipe off in one operation). A light graphite lubricatn 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. Refer to Fig. 5 and grease the two roller bearings on the bell crank shaft. The two alemite fittings for these bearings should be lubricated with a pressure gun, using Westinghouse grease No. 9921-4. This grease has been especially selected to be free flowing over a wide temperature range.

16. 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.

17. Check tripping at reduced voltage to insure safety margin.

Note: If it is necessary to make any re-adjustments, it is recommended that a recheck of the operating speed be made, as indicated under "Operation and Timing Tests", page 24.

CARE OF OIL

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

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

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

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

CONDENSER BUSHINGS

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

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

BUSHING CURRENT TRANSFORMER

If it should be necessary for any reason to repalce 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.

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

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

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

OIL GAUGE

A float type oil gauge which screws into each tank top is provided. See Fig. 22. The gauge is marked for normal oil level at 25 degrees C. Fluctuations on either side of normal will be noted with temperature changes.

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 are given in a separate instruction book which accompanies this book. If the Operating Mechanism Instruction Book is lost or misplaced, the I.B. number may be found on the nameplate inside the housing.

RENEWAL PARTS

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

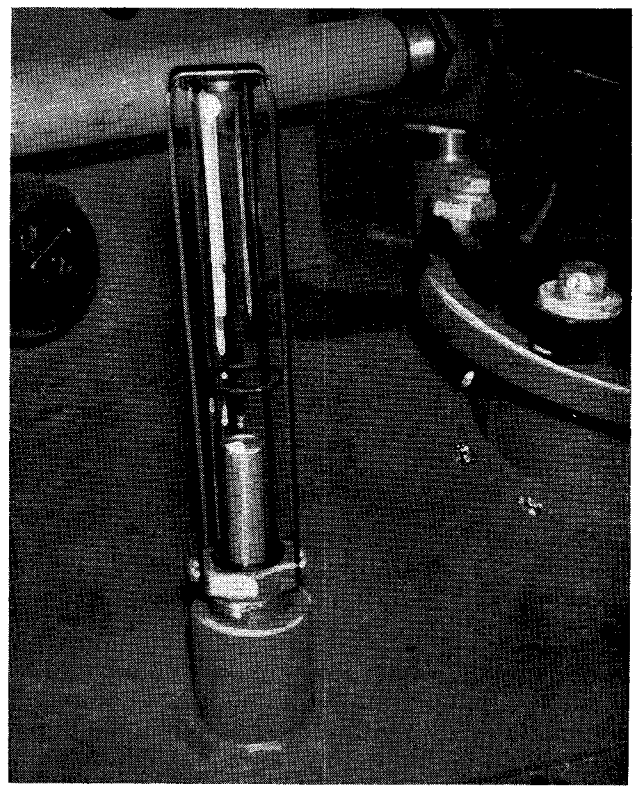


FIG. 22. Oil Guage

MEMORANDUM

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