Instructions for De-ion® Grid Oil Circuit Breakers

Outdoor Type GMB

TYPE	MAX. KV	KA	INTERRUPTING TIME
121GMB40	121	40	3 Cycles
121GMB63	121	63	3 Cycles
145GMB40	145	40	3 Cycles
145GMB63	145	63	3 Cycles

All possible contingencies which may arise during installation, operation, or maintenance, and all details and variations of this equipment do not purport to be covered by these instructions. If further information is desired by purchaser regarding his particular installation, operation or maintenance of his equipment, the local Westinghouse Electric Corporation representative should be contacted.

Westinghouse Electric Corporation
Power Circuit Breaker Division, Trafford, Pa. 15085

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LIST OF ILLUSTRATIONS

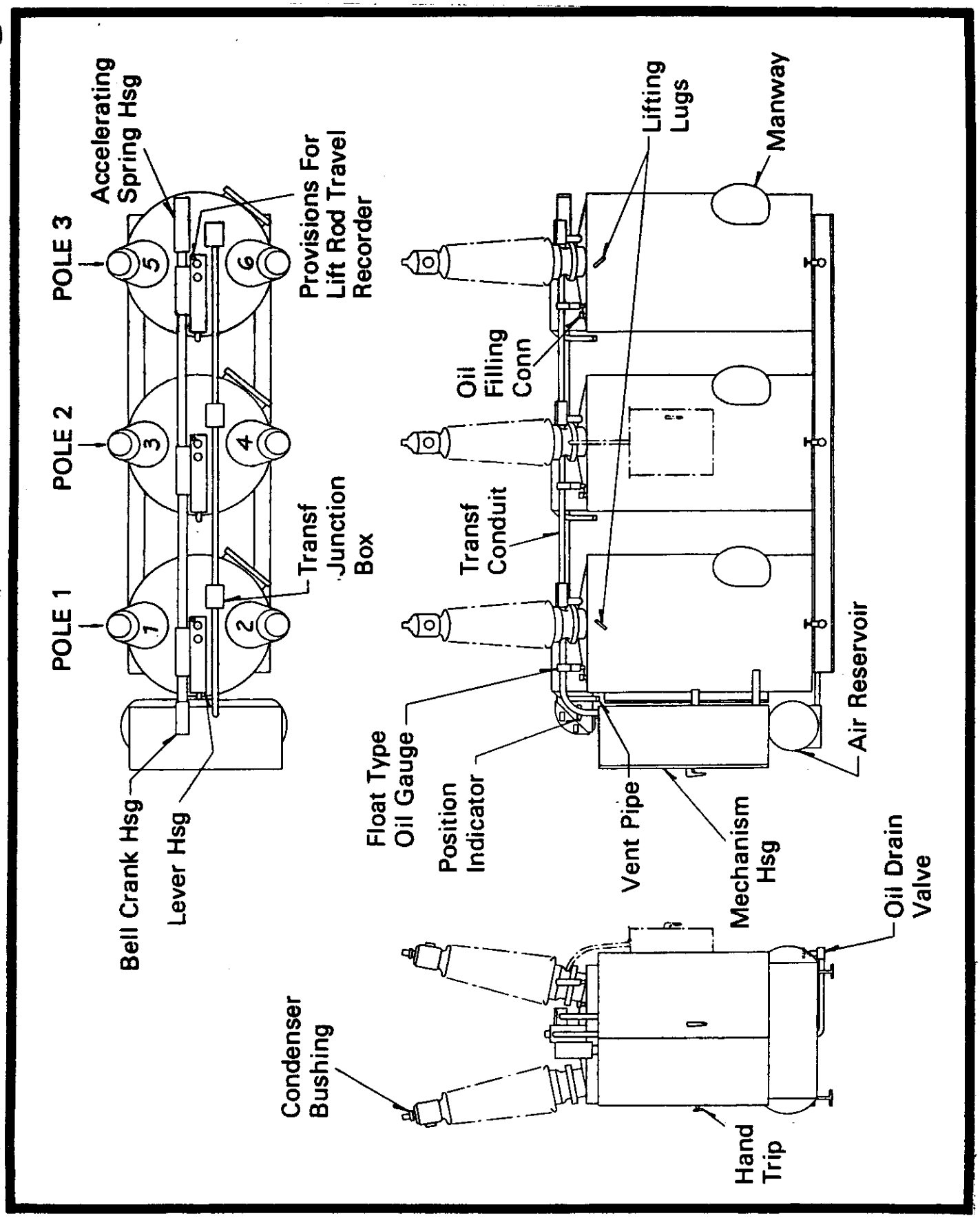

FIG. 1 - Breaker Outline

PREFACE

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.

The complete circuit breaker described herein consists of three pole units that are tied together pneumatically and electrically to a common control housing. The operating means for closing the breaker is a pneumatic mechanism located on pole # 1. The opening force is provided by springs located on pole #3.

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

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

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

CAUTION

These instructions may not include every possibility which could endanger personnel through misuse or mishandling the breaker, it's components or parts during installation, maintenance, inspection or energization. All work should be done by experienced high voltage circuit breaker personnel.

PART I - RECEIVING, HANDLING AND STORING

Type GMB breakers are usually shipped completely assembled. However when shipping clearances or handling facilities do not permit shipment in this fashion, the bushings and interrupter assemblies are removed and packaged spearately. The contents of crates may be determined by checking each crate identification against the shipping list.

IMPORTANT: Immediately upon receipt of the circuit breaker(s), an examination should be made for any damage sustained while in transit. If damage 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 Power Systems Sales Office.

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

Unpacking Parts and Accessories

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

To avoid delay in assembly, as the parts are removed from the crates, arrange them so they will be accessible and ready to put into place conveniently. Refer to Figs. 10 and 11 for identification of the components, parts, and accessories. Place the various parts of the breaker in proper position for mounting on the permanent foundation.

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.

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

Handling Tanks and Bushings

The weight, with oil, of the breaker is engraved on the nameplate on the mechanism house door. 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).

The gallons of oil required per tank is also shown on the nameplate. Oil weighs 7 - 1/2 pounds per gallon, so that the weight of the breaker without oil may be determined by computation. Refer to outline drawing for breaker weight and oil volume.

Although the breaker is equipped with a sturdy skid base, rigging should be done with care to avoid undue strain. Moving should not be attempted with the breaker filled with oil. If the breaker is to be raised with jacks, lifting should be done uniformly on both beams to preclude twisting the base.

On breakers shipped partially assembled, the condenser bushings are usually shipped in groups of six to a crate. They are rigidly supported in a vertical position by their mounting flanges which are bolted down as in actual service. The bushings should be unbolted and uncrated singly. (See Figs. 2 and 3)

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

Before attempting to uncrate the bushings, read carefully the procedure steps outlined in Part II Installing Condenser Bushings. (Instructions are also attached to each bushing crate.)

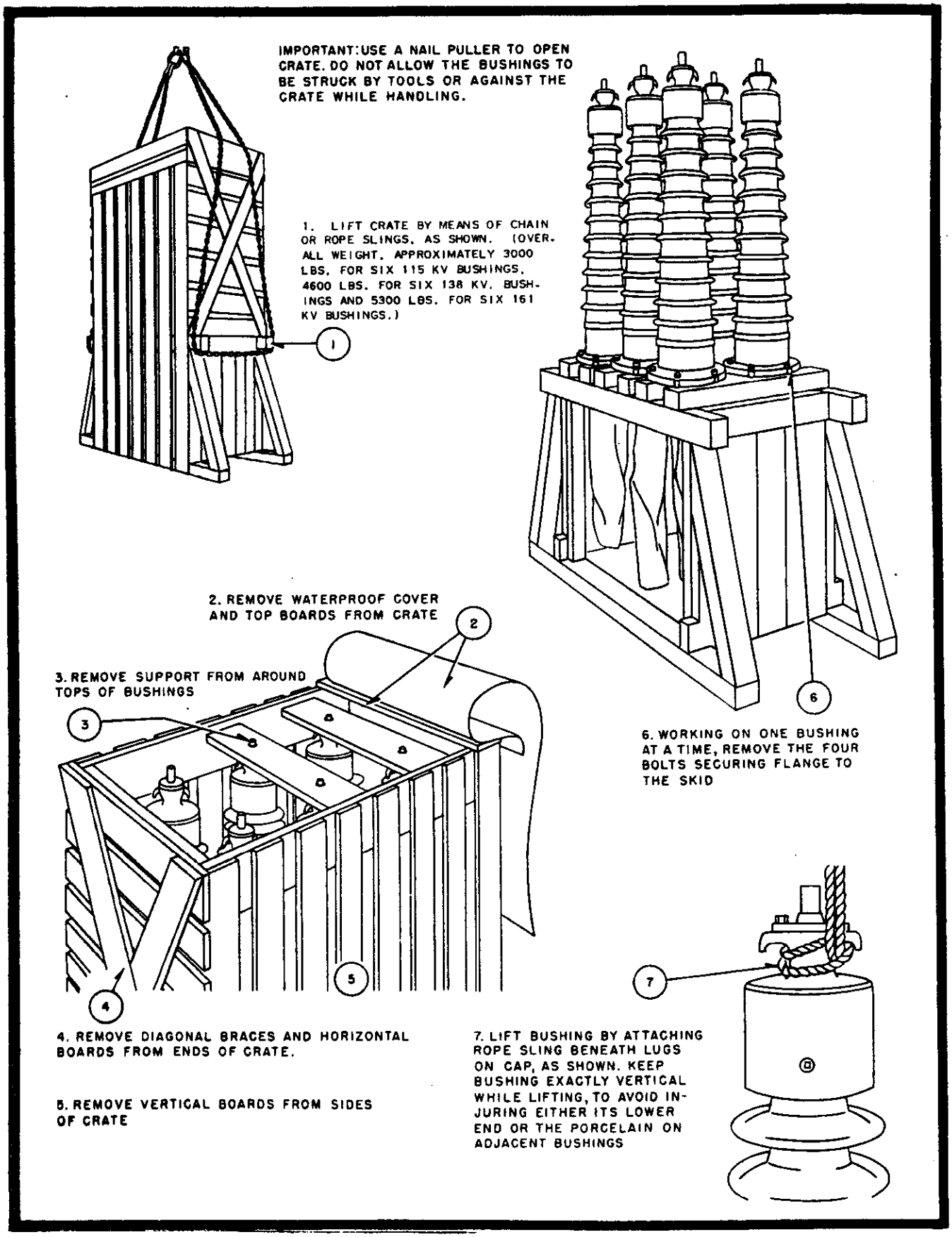

FIG. 2 - Procedure for Uncrating Vertically Packed Condenser Bushings

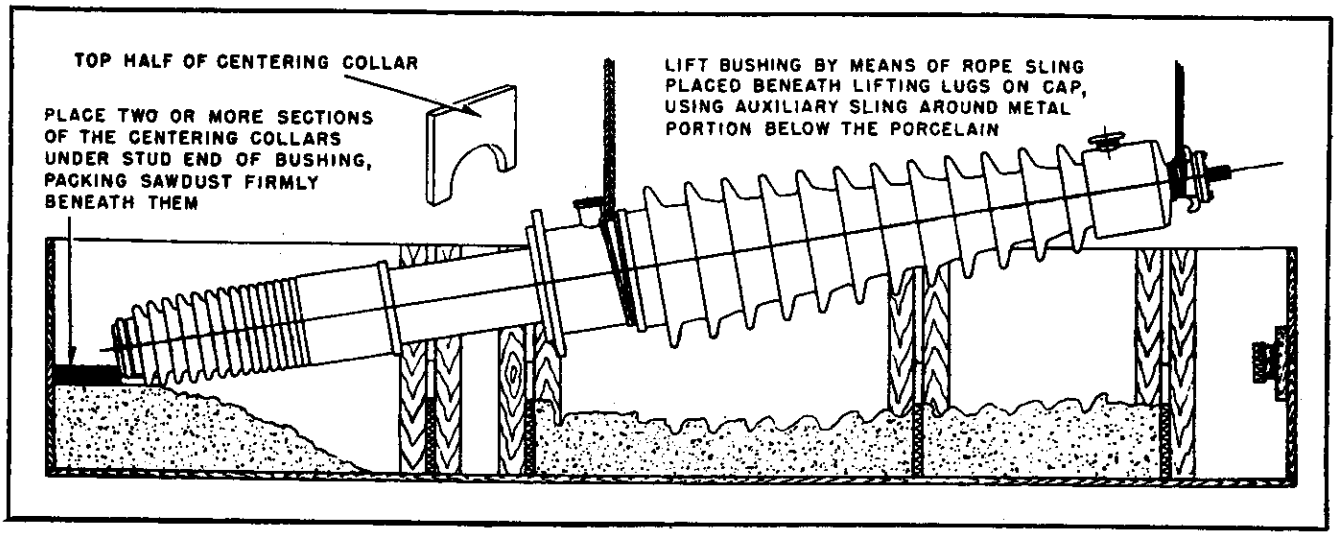

FIG. 3 - Removing a Horizontally Packed Condenser Bushing from its Crate

Breaker Storage

Even though the breaker will not be placed into service immediately, installation in its permanent location is recommended. If this is not practicable it should be stored in a place where it can be protected from mechanical damage. The following precautions should be taken in either case:

All internal non-metallic insulating parts must be protected from moisture. This can best be accomplished by filling the breaker tanks with "WEMCO C" insulating oil. If this is undesirable, an alternate possibility for short term storage up to (6) months is to place a 300 watt strip heater inside each tank. The vents in each tank should be sealed to prevent moisture from entering the tanks. Heaters should not be placed too close to the insulating parts in order to avoid scorching. Filling the tanks with oil is considered a must for storage over (6) months.

Storing Breaker Parts

All non-metallic parts of the breaker are of insulating material and must be properly handled as to be protected against moisture and dirt and damage by rough handling or improper storage. Condenser bushings are carefully packed in special boxes and should not be removed from the boxes until they can be put in position in the breaker. The condenser bushings are self - protecting against moisture, but other insulating parts such as lift rods, liftrod guides, and interrupter assemblies should be stored in a dry place. When storing lift rods and guides, for spare parts which may not be used for a long time, they should be placed on a flat surface or hung vertically to minimize the possibility of warping.

Interrupter Blocks

The bonded grid interrupter blocks are very susceptible to damage by absorption of moisture. Humidity control is exercised in manufacturing and when the breaker is shipped disassembled, they are packaged individually in polyethylene bags and in sealed cartons wrapped in waxed cloth which are impervious to mositure. Do not open these cartons before they are required. The cartons must be stored in a dry, sheltered location. If individual blocks are to be stored, they should be placed in containers of "Wemco C" oil.

Operating Mechanism

The operating mechanism house is weatherproof, but the space heaters should be energized as soon as possible, (at normal voltage -- see nameplate) even to the extent of using temporary wiring, in order to prevent corrosion due to moisture condensation inside the housings.

PART II - INSTALLATION

Selecting the Location

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

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

Mounting the Assembly

All circuit breakers must be set 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 moving contact details.

The entire 3 - pole H - beam mounted assembly may be leveled by shimming before clamping rigidly to the foundation. Both fully assembled breakers and partially assembled breakers (without bushings and contacts assembled) have tanks accurately aligned at factory. In case of fully assembled breakers all mechanical alignment and adjustments have been made at the factory. After securing to the foundation, the shipping ties on the mechanism, interrupter blocking in tanks, and horizontal pull rod block should be carefully removed. The breaker should be opened slowly by means of the hand closing device on the mechanism and the 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 lift rod and toggle stop clearances, lift rod travel and dashpot operation, to make sure they are still correct. Contact alignment and adjustment should be checked following the procedure in Part II - Contact Assembly and Adjustments.

Caution: To block accidental operation, be sure the safety pin for the trip free trigger is in place, use the hand closing jack, and close the airline valve as recommended in the mechanism instruction book.

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

Bell Crank Adjustment

The bell crank assembly is located above the operating mechanism on pole unit #1. Its function is to convert vertical movement of the operating mechanism into the horizontal movement of the pull rod assembly. The bell crank lever is set at the factory and should not require adjustment. The angle between 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.

Note: The bell crank setting should not be changed unless the pole unit lever systems are found to be considerably out of adjustment. The following information is supplied to aid in adjusting the bell crank in the event that it is required.

With the operating mechanism closed and just latched (no over-travel), referring to Fig. 4 the dimension of the center of the pin through the horizontal pull rod above the centerline of the shaft should be 1.5″ ± .031″. If this is incorrect, adjustment may be made (with the breaker in the open position) on the vertical pull rod 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 inside the mechanism cabinet is provided for a wrench.

Since the mechanical advantage changes according to the setting of the bell crank lever, it is important to set this dimension carefully.

If the bell crank lever is adjusted, the stop clearances and contact penetration must be checked.

Stop Clearance

Lift rod 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 toggle lever and its stop have been set at .063″ ± .015″ measured with the breaker closed and just latched (no overtravel). The settings were made with normal accelerating spring load and contact loading, and the lever checking gauge in place between the main lever and trunnion link pins. (See Fig. 4 for location of the lever checking gauge.) These clearances may be checked by removing pipe plugs on the side of lever box. Close manually to check stops (just latched - no overtravel) and insert a feeler gage through pipe plug holes in side of lever box.

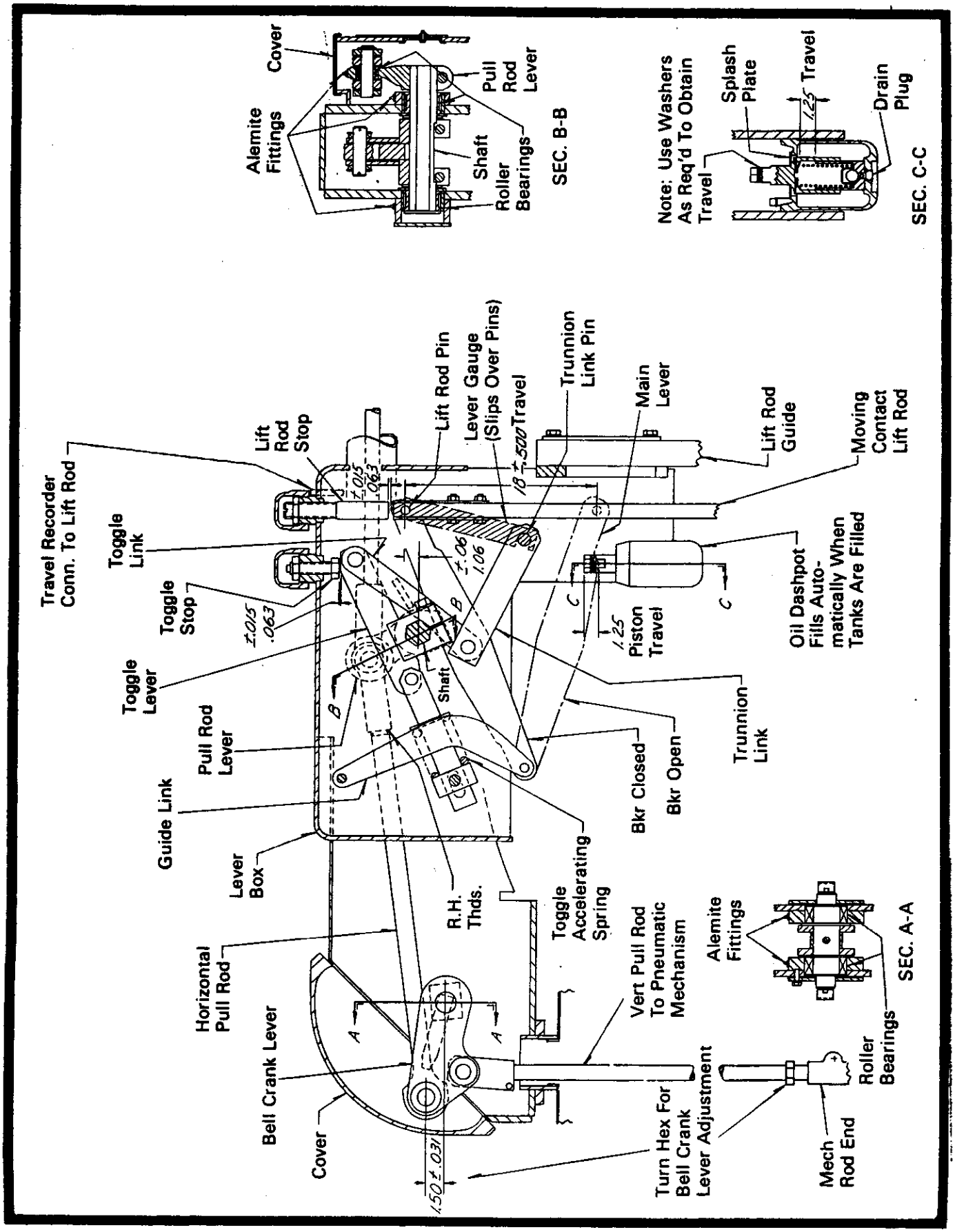

FIG. 4 - Bell Crank and Lever Assembly

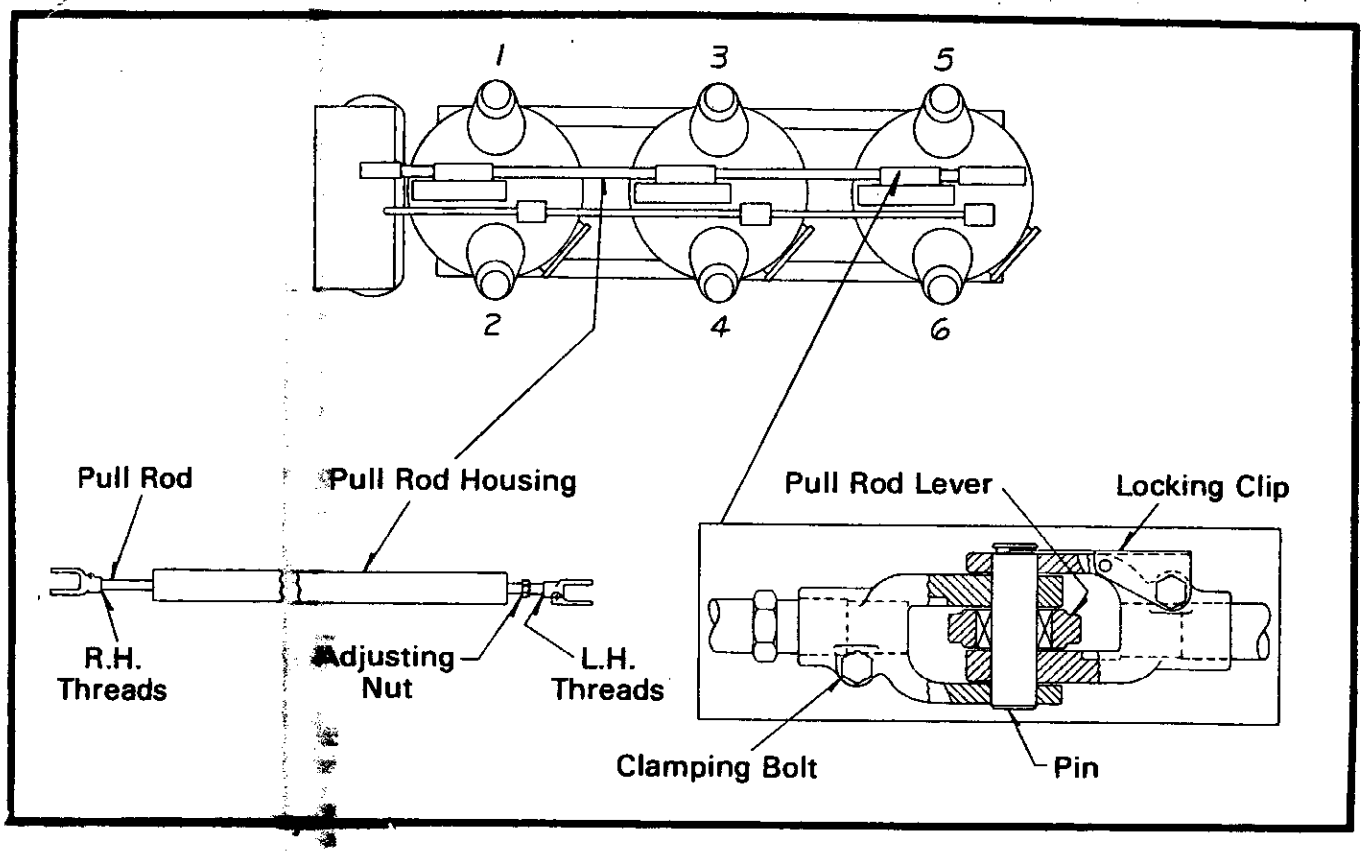

FIG. 5 - Pull Rod Adjustment

Pull Rod Adjustment

If the stop clearances are incorrect, the stop bolts should *not* be disturbed in order to get the .062" ± .015" clearance. The position of each pole unit lever system should first be checked using the lever checking gage (see figure 4). If it fits into position properly the stop bolts may be adjusted to obtain proper clearance. If the lever checking gage does not fit into position, the correct procedure to obtain proper fit is to adjust the pull rod lengths between poles. If the fit of the lever checking gage on all three poles is 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 the fit of the lever checking gage is off various amounts, adjustments should be made starting with No. 1 pole. Refer to Fig. 5. It is not necessary to remove the pins in the crank levers between the No. 1 - No. 2 and No. 2 - No. 3 poles. 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 end 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 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. 5.

In the case of partially assembled breakers (shipped with interrupters 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 recheck the stop clearances after the interrupters are installed and adjusted.

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

Lift Rod and Lift Rod Guide

(Partially Assembled Breakers Only)

In partially assembled oil circuit breakers the lift rods and lift rod guides are installed for shipment. The following procedure can be used where the lift rods and lift rod guides have not been installed at the factory.

1. Lift rod assembly should have main crossarm, pump crossarm, top bracket, and lift rod bolted together as shipped. Moving contact and pump buttons should not be assembled at this time. Refer to Figure 8.

2. Remove the pump crossarm from the assembly.

3. Place the partial assembly in the tank and hang from main lever with pin and necessary hardware as shown in Figure 8. Note that timer connection bracket is placed toward the rear of the breaker.

4. Re-assemble the pump crossarm to the lift rod assembly and install pump buttons. Top of button should be .38" from top of pump crossarm.

5. Mount the lift rod guide with four .625" - 11 × 3.5" bolts and .625" lockwashers to the lever frame. See Fig. 10.

6. Use the hand jack on the mechanism and manually raise the lift rod approximately 6" from the open position.

7. With lift rod assembly hanging free, with no tools or any object on any part of the assembly to alter the balance, adjust the guide box assembly to center the lift rod clearances to the guide box rollers. This is done by selecting the proper holes on the guidebox to position the rollers. Approximately .06" clearance should exist on all sides of the lift rod.

Installing Condenser Bushings

(Partially Assembled Breakers)

A suggested method for convenient handling of the condenser bushings when placing them in position in the tank tops is illustrated in Fig. 6. 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 11.0 degrees from vertical.

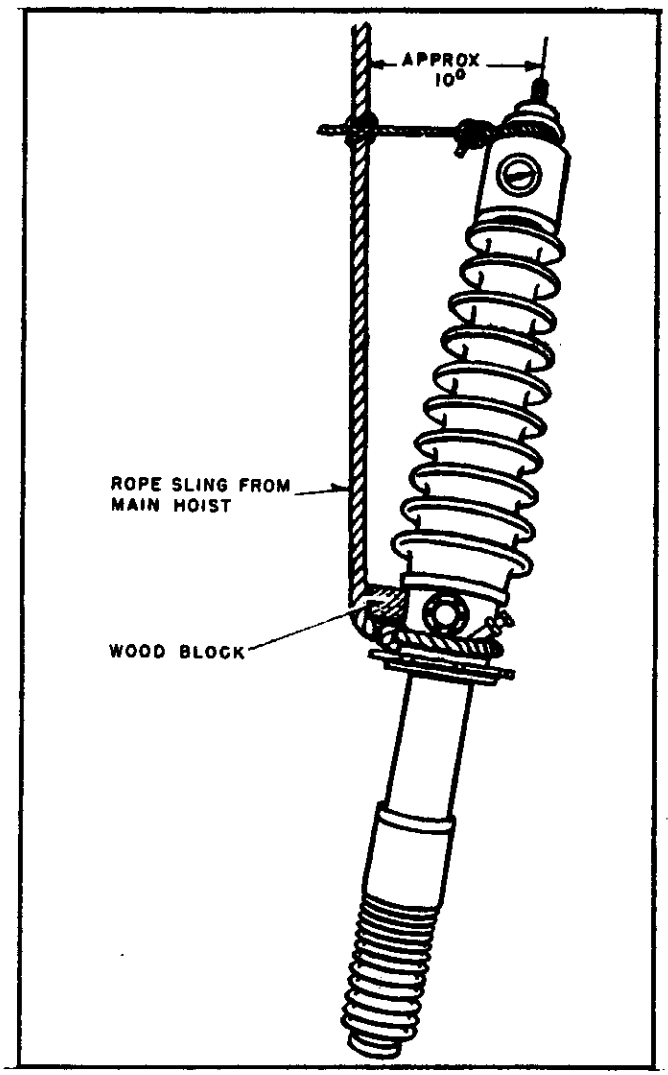

FIG. 6 - Method of Suspending a Condenser Bushing at Proper Angle for Inserting into Tank Top

The procedure for installation is as follows:

1. Apply petrolatum (vaseline) over entire bushing flange gasket surface. The petrolatum will permit shifting the bushing without damaging the gasket.

2. Lower the bushing into place as shown in Fig. 6 with eccentrics located as in Fig. 7B. When positioning the bushing be sure that the potential device receptacles face away from the center of the breaker. The bushing must be lowered with care in order to avoid damaging either the inside of the current transformer or the lower insulator on the bushing itself. It is advisable to wrap a large sheet of fish paper, gasket material, or equivalent around the lower insulator to prevent damage.

3. Figure 7A illustrates the assembly of the flange mounting bolts through the eccentrics. There are 2 eccentrics per bushing. These should be positioned according to Figure 7B. A flat washer is used in place of the eccentrics on the remaining bolts.

4. Before tightening the .75" - 10 × 3.5" bolts align the bushings as follows - see Figure 9. See Fig. 17 for details of the tools.

a. Bolt the bushing adjustment plate and plumb bob assembly to the lower bushing terminal.

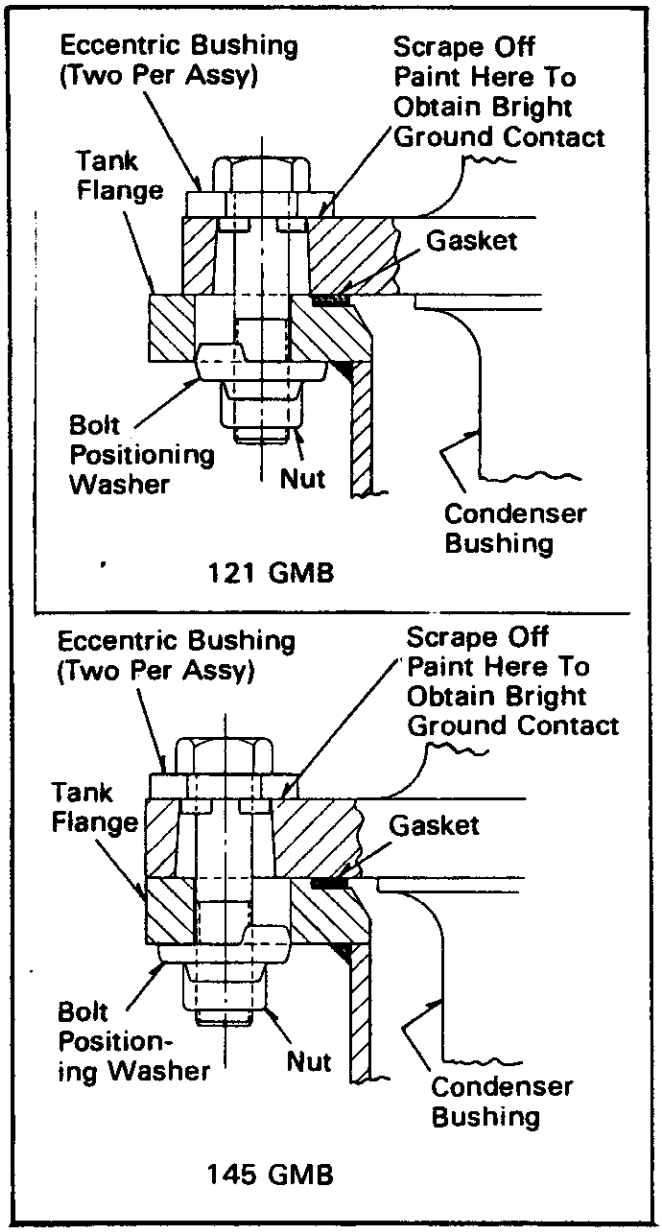

FIG. 7a - Installing a Condenser Bushing Type GMB

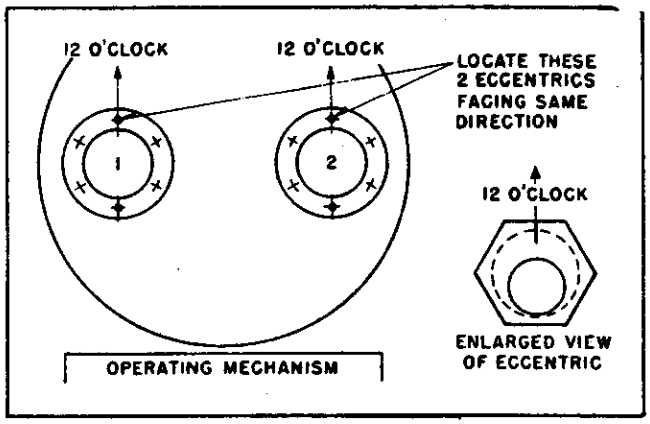

FIG. 7b - Bushing Eccentric Location

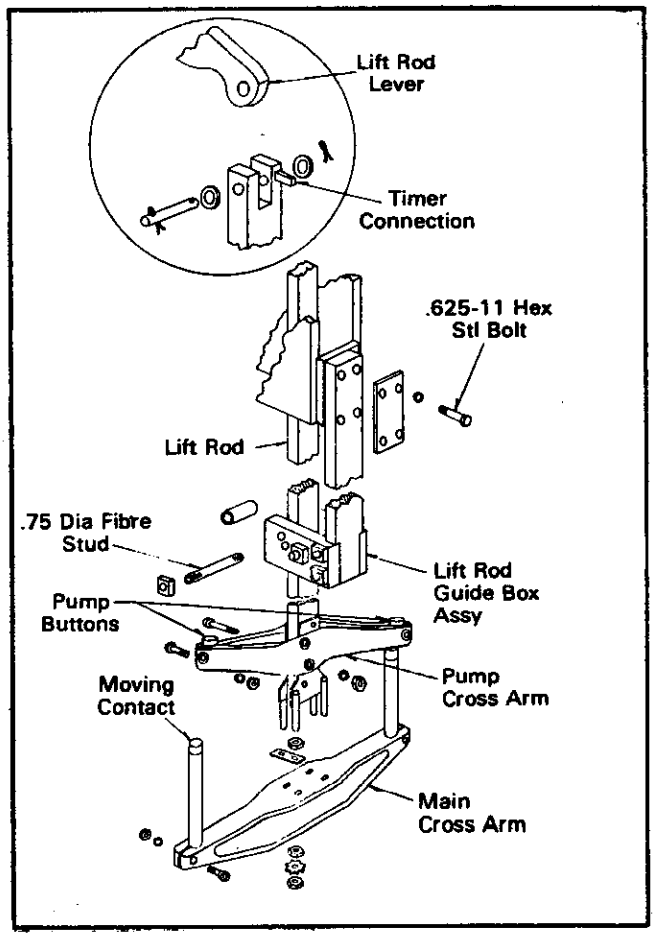

FIG. 8 - Moving Contact

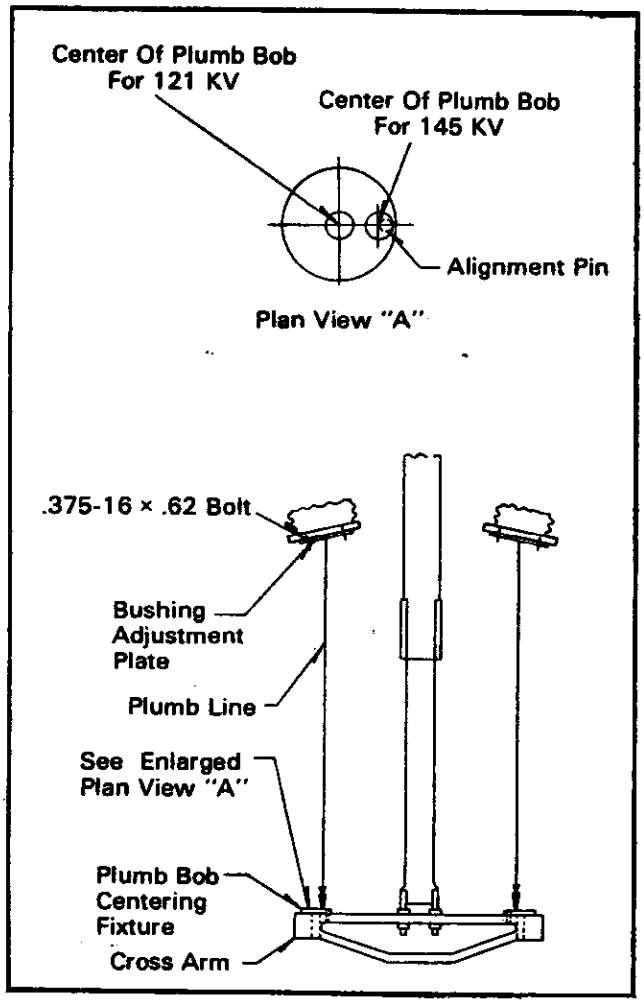

FIG. 9 - Condenser Bushing Alignment

b. The main crossarm should be approximately 6" from the full open position.

c. Remove moving contacts from crossarm.

d. Position plum-bob centering fixture into cross arm.

e. Drop the plumb bob to within .125" of the main crossarm.

f. With lift rod assembly hanging free, adjust the bushing flange with the eccentrics until the plumb is within .25" of the correct position as marked on the plumb bob centering fixture positioned in the moving contact hole in the crossarm.

5. 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. 7A.) It is advisable to check this ground by "lighting out", or using bell ringer, between the bushing flange and the tank.

6. Make sure that the condenser bushing's metal flange that extends inside the tank **does not touch the** transformer support at any point, since this would cause a short circuiting effect and throw the transformer off ratio. Tighten all flange bolts evenly and securely to 280 ft-lbs.

Interrupter Assembly and Adjustment

(Partially Assembled Breakers Only)

Interrupter Bushing Foot Adjustment (Each Pole) - Fig. 12

1. Screw the flange ring on each bushing to the end of threads, then back off 1/2 turn.

2. Assemble the bushing foot to each bushing, but do not tighten the bolts.

3. Assemble the top casting (without pump assembly) to each bushing foot centering the top casting with respect to the oversized holes in the bushing foot. Tighten the top casting to the bushing foot with (4) bolts.

4. Install the top casting leveling fixture to each top casting (without lock washers), tighten.

5. Using the inter-alignment bar as a guide, rotate each bushing foot until the alignment bar is flush with the pump mounting surface on both top castings.

6. Level each top casting in all directions with a machinist's level on the top face of the top casting leveling fixture, by swivelling the bushing foot relative to the bushing and tightening the bushing foot bolts in the desired sequence to maintain a level plane in all directions.

7. Check items 5&6 as appropriate to maintain the level and fixture direction concurrently.

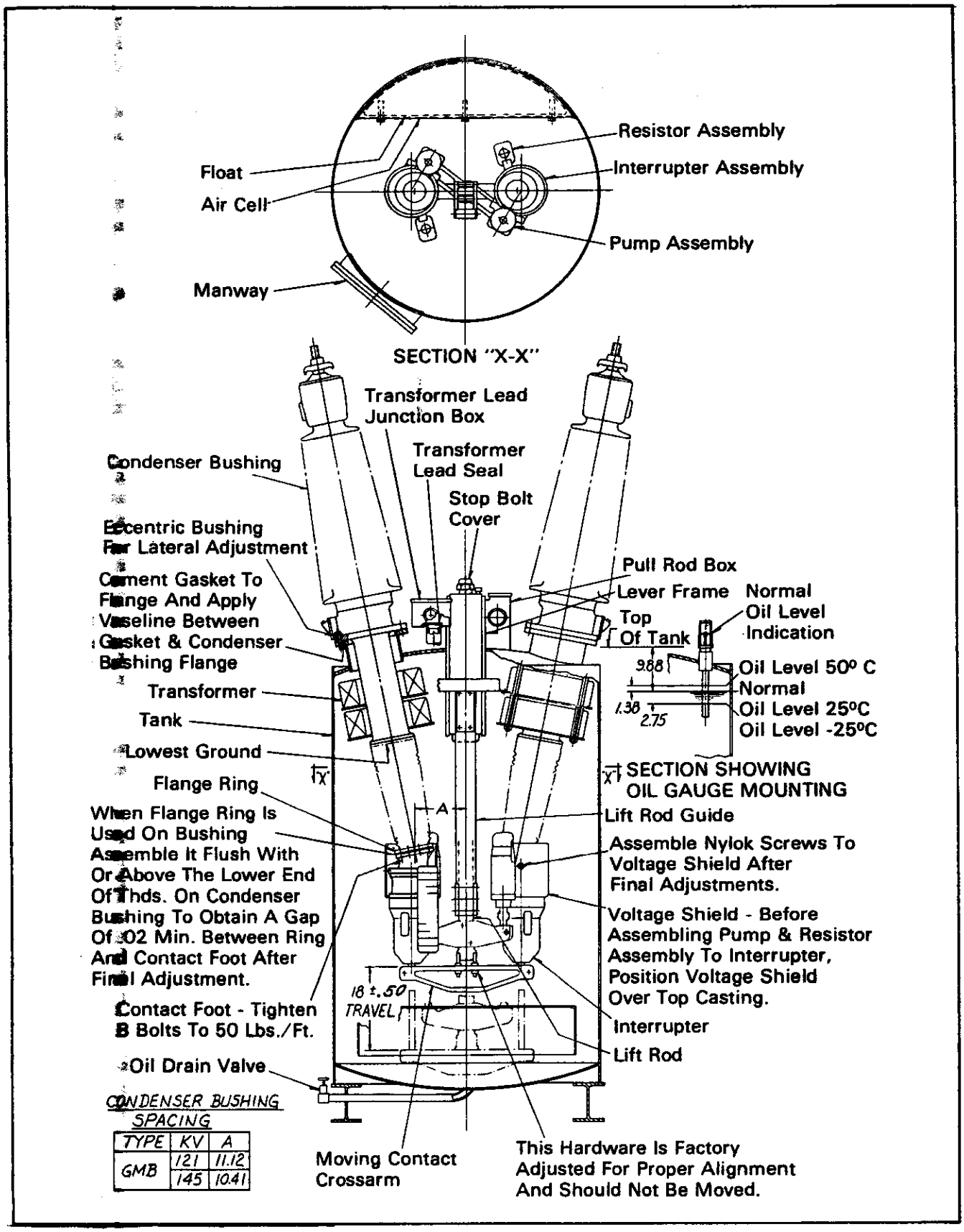

FIG. 10 - Pole Unit End View

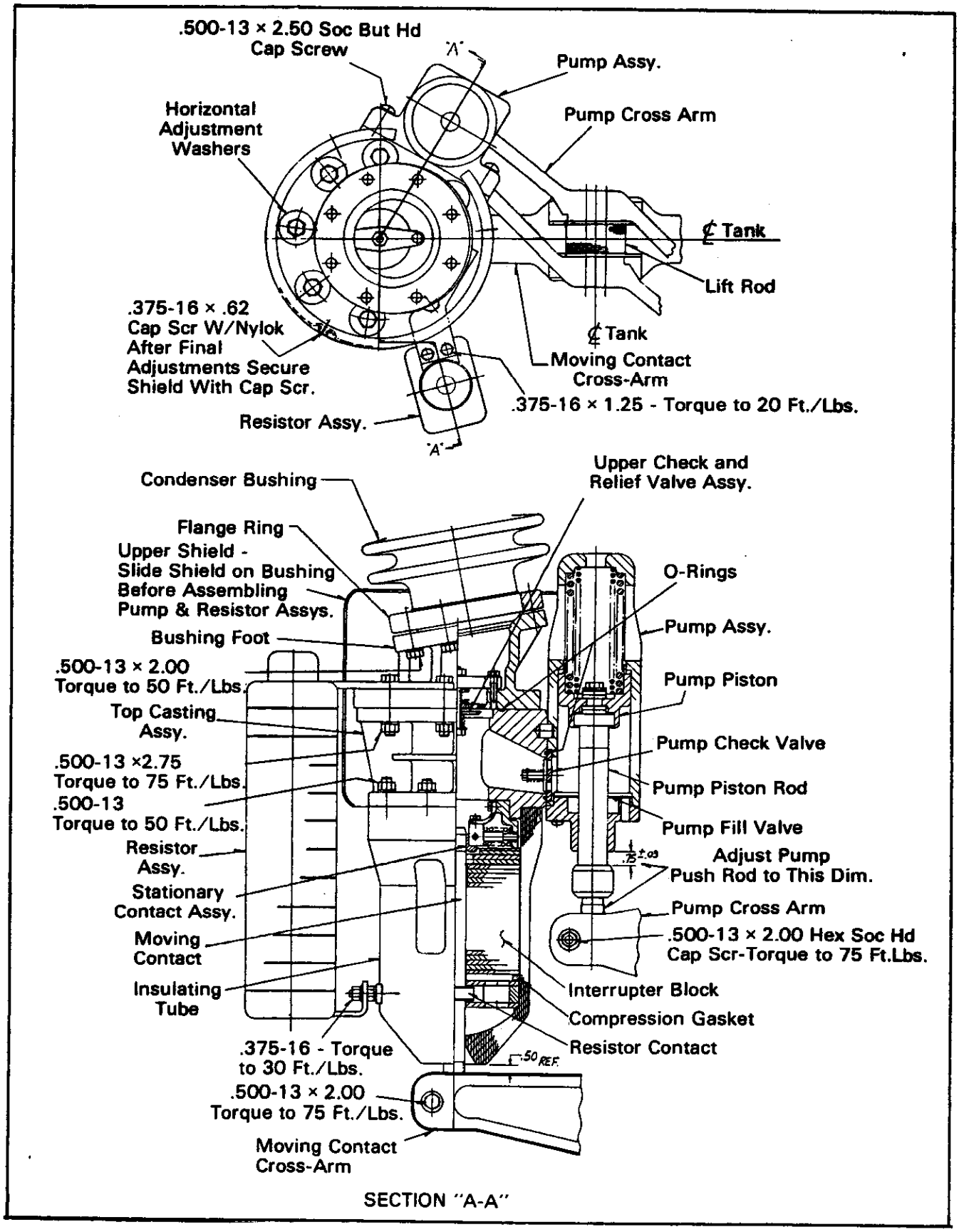

FIG. 11 - Interrupter Assembly

8. Tighten the bushing foot onto the ring flange, using successively increasing torques to a final reading of 50 ft-lb. while using an accepted tightening pattern.

Note: All bushing/bushing foot bolts must be uniformly torqued. Imbalance will cause rotation and damage to the interrupters.

9. Check level of fixture after tightening the bushing foot, and repeat items 5-8 as is necessary. The level should show a flat plane ± .001 in/ft.

Top Casting Horizontal/Rotational Adjustments - Fig. 12

1. Insert bayonet contacts into main crossarm. Do not screw the bayonets to end of threads, but rather screw the bayonets until they are flush with the bottom of the crossarm at the tapped hole.

2. Slip the moving contact centering fixture over the moving contact and tighten. Position stationary contact centering fixture into stationary contacts.

3. Manually jack the breaker closed until the dowel pin in the centering fixture is 1.0 to 1.5 inches from the stationary contact centering fixture.

4. Raise the dowel pins in each fixture to within .125" from pilot hole in the stationary contact centering fixture.

5. Loosen the (4) top casting/bushing foot bolts so that the top castings may be moved horizontally.

6. Attach the inter-alignment bar loosely so that the top castings are in the correct position, but the distance between the top castings may be adjusted within the tolerance allowed by the inter-fixture bar clearance holes.

7. With the lift rod assembly hanging free and clear of any objects, adjust one top casting until the dowel pin enters the pilot hole in fixture without moving the lift rod assembly.

8. With that dowel pin locked in the up position (in the fixture pilot hole), adjust the other top casting until the second dowel pin can enter its fixture pilot hole without interference.

9. Tighten the inter-alignment bar.

10. Tighten the top castings to their respective bushing feet.

11. Check for interference-free fit of fixture dowel pins and fixtures. Repeat 7-11 as is necessary.

Contact Penetration - Fig. 12

1. Lower the main crossarm approximately 8 inches and remove the centering fixtures.

2. Remove the inter-alignment bar and both top casting leveling fixtures.

3. Manually jack the breaker into the closed and latched position.

4. Measure the distance from the base of the stationary contact to the top of the moving contact tip. This nominally is 1.25".

5. Adjust the moving contact into the stationary cluster until the measurement made at 4 is 1.25 inches. This will correspond to a light-out penetration of .91 inches.

Pump Stroke Adjustment - Fig. 11

1. Lower lift rod assembly until pump may be attached to the top casting without touching the pump crossarm.

2. *Be sure check valve is installed in pump casting.*

3. Attach both pumps.

4. Jack the mechanism closed and latched.

5. Adjust the pump push rod until a 3/4" gap is measured between the bottom plate of the pump and the top of the pump rod cap.

Completely Assembled Breakers

When the GMB breakers are shipped fully assembled the interrupters are adjusted at the factory and only a few checks are necessary to determine proper operation.

1. Contact penetration should be .91" ± .125. This should be measured by slowly opening the breaker and checking continuity across the bushing terminals. The contact touch between all phases should be within .06".

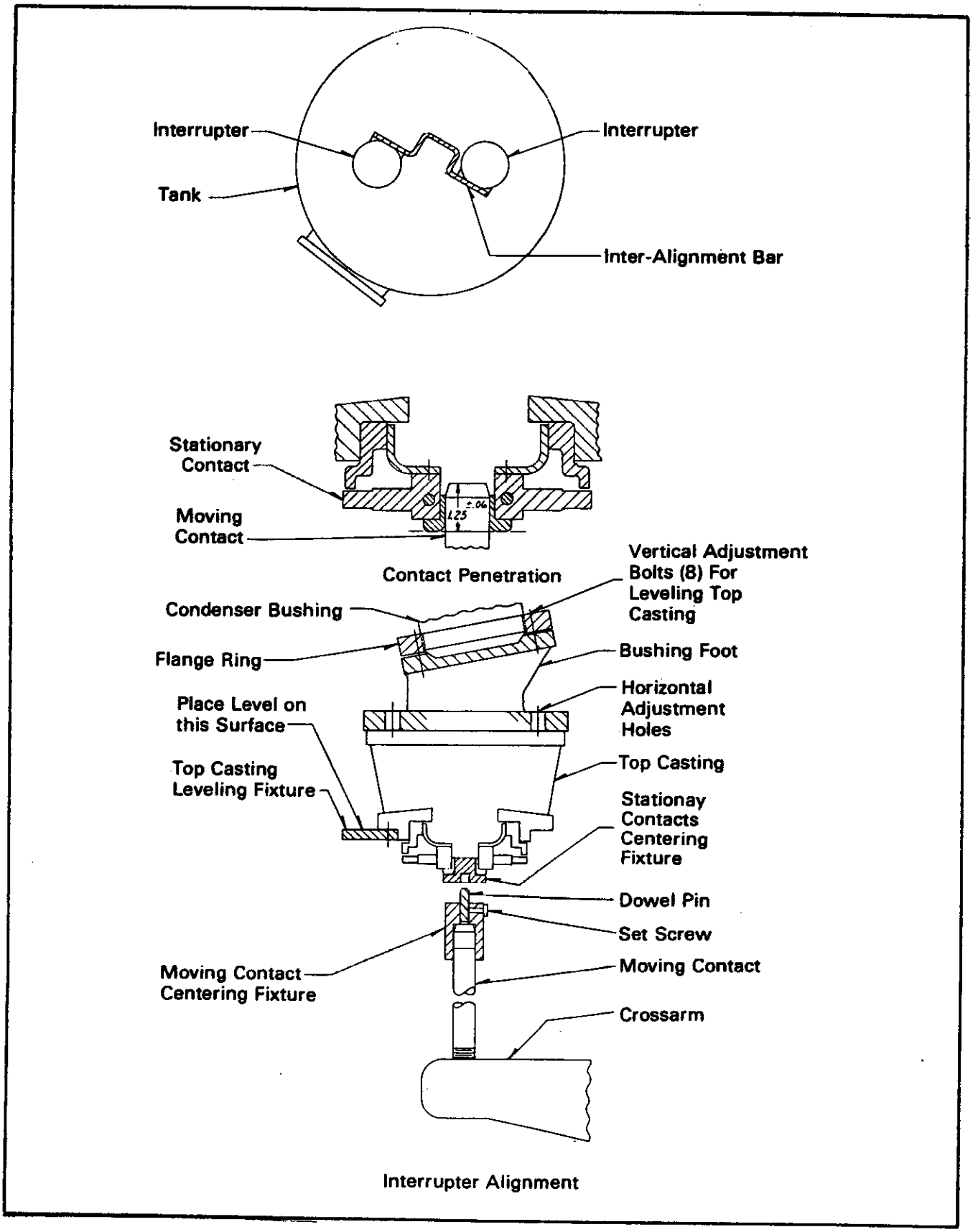

FIG. 12 - Interrupter Alignment

All moving contact adjustments necessary can be made by screwing the moving contact up or down into the main cross arm. Pump cross arm should contact pump within .032″ in all poles while closing slowly by hand. Total pump travel should be 4″ ± .062″. Closed position pump gap .75″ ± .062″.

2. Check moving contact alignment by closing the breaker until the moving contact is 3″ inside the interrupter insulating tube. The moving contact should be free to move within the clearance the hole in the tube provides. If the moving contact is tight and cannot move, the alignment must be checked according to the procedure outlined in Part II "Interrupter Assembly and Adjustment".

3. After contact adjustments have been made in all 3 poles, close breaker and check for .062″ ± .015″ clearance at all lift rod and toggle stops.

4. Check pull rod lever toggle in each pole by slipping lever gauge over trunnion link pin and lift rod pin. See Fig. 4.

5. Open the breaker slowly by hand and check to see that the oil dashpots in each pole unit touch within .090″. The oil dashpots may be adjusted if necessary by adding or removing washers under the bolt head on the bumper rod as shown on Fig. 4. Adjust for the total travel of 18″ within a ±.500″ tolerance as shown on Fig. 4. Note that the dashpots are interacting between poles, thus it may be necessary to adjust for plus tolerance in another pole.

6. Check resistance of each interrupter resistor. The measurement should be 700 ohms ± 10%.

Checking the Operating Mechanisms

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

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. Conductors and connectors 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.

Connection of an aluminum conductor to a copper alloy terminal could result in galvanic action and serious corrosion unless the mating surfaces are properly protected. Several different means of protecting the surfaces are available. A heavy coating of corrosion resisting conductive compound such as Westinghouse 53535BU or equivalent on both surfaces used in conjunction with tin plating of the copper alloy is recommended. The unplated aluminum surface must be cleaned prior to the application of the compound.

Ground Connections

Two ground pads are provided on the H-beam base. Each of these pads has two (.5″-13) tapped holes located 1.75″ apart.

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 the top of each pole unit tank.

Transformers are usually of the multi-ratio type, having five leads to provide a range of ratios. Short leads from taps are carried through a Micarta seal plug to a weather-proof box on top of each unit. Long leads for all taps are spliced to the short leads and carried through conduit to terminal blocks inside the operating mechanism housing where the desired ratio may be selected.

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 operating 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 will be found in the pocket on the inside of the operating mechanism housing door which 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. A minimum wire size of #14 is recommended.

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

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 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 accumulated.

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

3. See that all bearings of the operating mechanisms 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). Grease S#1802395 (M55213 AG) is recommended. Check the oil level in the compressor crankcase.

4. Close the breaker slowly by hand, checking to see that the lift rod and contacts are properly adjusted for correct alignment and that proper stationary contact engagement is obtained when the pole unit is closed. Recheck lift rod and toggle stops.

Open the breaker slowly by hand. The movement of the pole unit on opening and closing should be free and without binding; 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, (280 ft. - lbs) 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 due to vibration or shock received during handling, lifting, and transportation. They should be checked after the breaker is installed and tightened where necessary.

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

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

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

11. Make sure that lock washers and lock nuts are secure and that locking clips are bent on moving contact where they attach to the 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, lift rods, pole unit levers, etc.

14. Apply petrolatum (vaseline) to side of manhole cover gasket which presses against flange on the tank, so that the door will open easily without damaging gasket at next inspection. Close door and draw down all .625-11 × 1.75" bolts and .625 lockwashers evenly.

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").

16. "Operating and timing tests". (See detailed instructions.)

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.

Fill the tanks to the proper level with Wemco "C" oil. The proper level is dependent on ambient temperature see Part III under "Oil Gauge". 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 45-063-100B for proper methods of testing and handling.)

It is recommended that the oil be allowed to settle at least 3 hours in the tanks before closing the breaker on a live line. This is desirable in order to allow air bubbles to dissipate. It is expected that operation and timing tests will require at least 3 hours, so that the waiting period does not involve any additional delay.

Operation and Timing Tests

CAUTION

Fill tanks with oil before tripping or power closing.

Interrupters are equipped with oil dashpots and may be damaged by high speed operation dry. Before power closing, the hand-closing jack and the safety pin must be removed from the mechanism.

It is recommended that the settings be checked on the governor switch, low pressure alarm, and cut-off switch before operating breaker. Refer to mechanism nameplate in mechanism housing for settings.

Starting with normal air pressure (marked on the mechanism nameplate) on the pneumatic mechanism, check the breaker for number of 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 close circuit, and at least one operation below this. A jumper may be used to short out the low pressure cut-off switch (see control diagram) in order to count the operations below cut-off. If the number of operations is less than this, it may be due to any of the following reasons:

(1) Too much accelerating spring compression (located at top of pole #3).

(2) Improper contact alignment.

(3) Excessive air loss in pneumatic mechanism.

(4) Incorrect setting of pole-unit lever system or bell crank assembly.

(5) Improper setting of the mechanism auxiliary switch contact ("aa") which de-energizes the closing circuit.

(6) Inaccurate pressure gauge on air reservoir, or improper setting of the low-pressure cut-off switch.

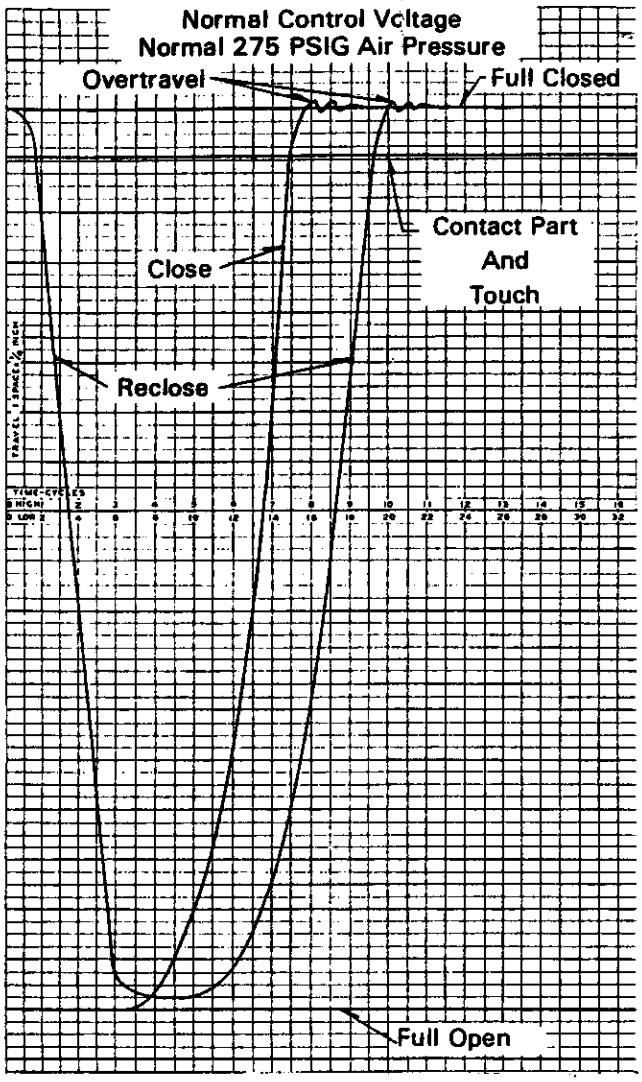

FIG. 13a - Typical Operations Timing Chart

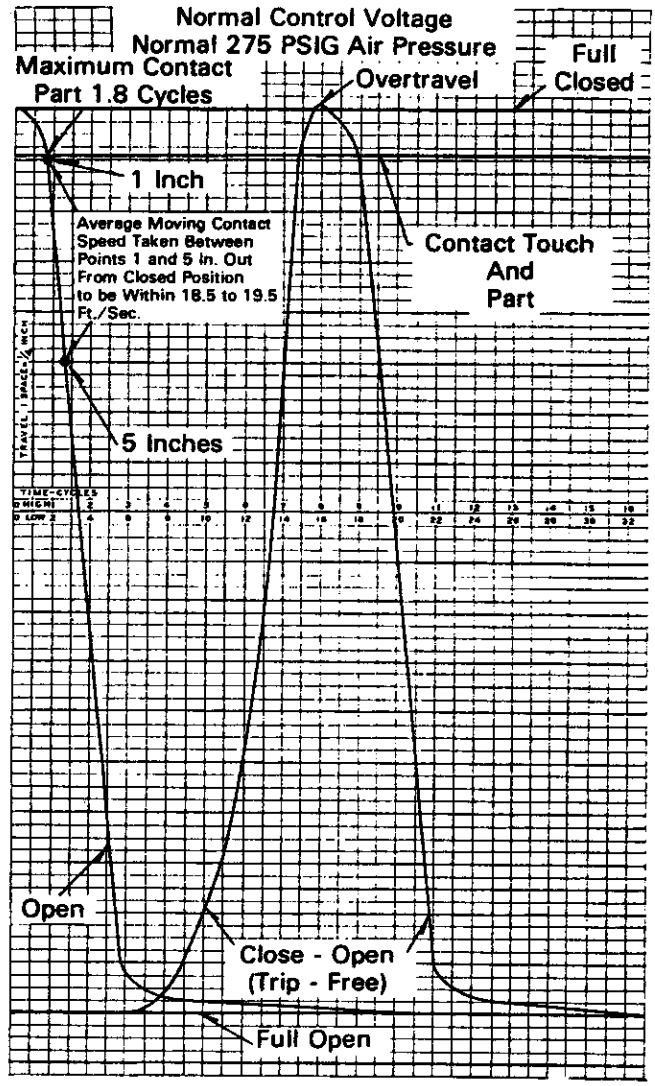

FIG. 13b - Typical Operations Timing Chart

Caution: Be sure to remove jumper wire if used to short out low pressure cut-off switch after performing this test.

Check the opening speed and reclosing time (if required) of the breaker with a graphic recorder. In order to be sure of getting 3 cycle interruption the contacts should part within 1.80 cycles and the moving contact lift rod speed should be 18.0 to 19.5 feet/second as measured by the slope of a line through points on the graphic recorder curve 1 inch and 5 inches from full closed position, as shown on typical timing curve Fig. 13a and 13b. If the breaker is slower than this, it may be due to any of the following reasons:

(a) Incorrect calibration of the timing device (zero setting affects contact parting time).

(b) Improper contact alignment.

(c) Insufficient accelerating (tail) spring compression.

(d) Incorrect setting of pole-unit lever system or bell crank.

(e) Incorrect trip-armature setting on pneumatic mechanism.

(f) Low trip-coil voltage or excessive voltage drop in control cable.

Provision has been made for connecting a graphic time-travel recorder on any of the 3 poles, but checking the speed on No. 2 pole is considered sufficient. Removing a 3/8" pipe cap in the top of the lever box adjacent to the lift rod stop permits a .188" dia. timer rod with .190-32 threads to be passed through the tank top and screwed into a tapped hole in the upper end of each moving contact lift rod. This is most readily accomplished with the breaker in the closed position. A bracket for mounting the timer is available on request which consists of a plate welded to a pipe coupling that may be screwed onto the lift rod stop boss.

Note that the permissible rebound on the opening stroke of the breaker (as controlled by the oil dashpots) is 5% of the total moving contact travel. In this case 5% of the 18" travel would amount to .9".

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 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 on a live line.

Tools Required for Installation

Special tools are supplied for breaker adjustment and are included with each breaker or order.

These tools are:

1. Stationary contact centering fixture
2. Moving contact centering fixture
3. Toggle lever checking gauge
4. Timer mounting bracket
5. Mechanism hand closing jack

Additional tools supplied with knock down breakers:

1. Bushing adjustment plate
2. Inter-alignment bar

See Fig. 17 for tools required for interrupter alignment.

PART III - OPERATION, ADJUSTMENT AND MAINTENANCE

CAUTION

When the breaker is found to be out of adjustment or when parts are found to be worn, equal or greater than the allowable amount described within this book, immediate action must be taken to replace the worn parts with new ones and readjust the breaker. Failing to do so could result in damage to the circuit breaker and possibly endangering personnel.

CAUTION

Before entering a breaker for inspection or maintenance, allow the tanks to be aired out after draining the oil. The residue gases left in the tanks could be explosive. Thoroughly air the tanks by removing the inspection cover on the tank top and circulate air through the man way.

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

Before inspecting a breaker, read carefully the General Maintenance Procedure, Part IV.

Pole Unit Lever System

The pole-unit lever mechanism, located in the upper part of each pole-unit, operates the lift rod which carries the crossarms. Lever assembly Fig. 4 shows this mechanism, which is simply a lever system designed to give a straight-line motion with the proper mechanical advantage throughout its stroke. The toggle spring included with the lever system, supplemented by an accelerating spring on top of the number 3 pole unit, and the interrupter pump springs provides acceleration for opening the breaker. A schematic of the complete breaker operating linkage is shown in Fig. 14a and 14b.

When the breaker is properly adjusted and closed with the hand-closing jack, there should be .063 ± .015 inch clearance at the toggle stop and lift rod stop within each pole unit as indicated. This clearance is necessary to permit the operating mechanism to overtravel and latch, and also to make sure that the closing movement is completed by the operating mechanism without putting undue strains on any of the pole-unit parts. The clearance at these stops may be checked as indicated in Part II.

It should be assumed initially that the stops have been properly set at the factory. Accordingly, pull rod adjustments should be made (see "Pull Rod Adjustment" Part 2) to give the .063 ± .015 inch clearance and not by changing the position of the stop bolts.

If the toggle lever travels beyond the normal closed position and its stop is set too high, the link may strike the shaft and the opening acceleration of the breaker may be low. On the other hand, if the travel of the toggle lever is stopped short of the normal closed position, the initial opening acceleration will be good but the load at the mechanism as the closed position is approached may be excessive. If evidence such as this indicates that the stop settings have been disturbed and that the lever system is improperly set, conditions may be verified by employing the lever checking gauge as shown on Fig. 4. This gauge is normally supplied with the breaker maintenance tools and is the basic tool employed in the shop for establishing the proper setting of the lever system and stops. A word of caution, however, — correct results in using this gauge depend upon all three poles being loaded at their normal closed-position load, as obtained by closing the breaker carefully with the hand-closing jack to avoid overtravel, and the breaker load transferred to the latches by backing off the jack as soon as latching is accomplished. If the checking gauge proves that the system is mis-adjusted, refer to "Pull Rod Adjustment" Part II and adjust pull rods until the checking gauge drops into place on all 3 poles, and then re-adjust the toggle and lift rod stops to get .063 ± .015 clearance. Once this has been done correctly, the stop bolts should not be disturbed for subsequent adjustments.

Fundamentally, the checking gauge was designed as a simple means to verify that the pin at the top end of the lift rod has traveled to the correct elevation with respect to the hexagonal shaft of the lever system. Referring to Fig. 4, it is evident that the center of this pin should be positioned 1.06 ± .06 inches above the center line of the hexagonal shaft when the system is properly closed. Should the checking gauge not be available, measurements may be made to establish this relationship. Use of the gauge, however, greatly facilitiates this verification.

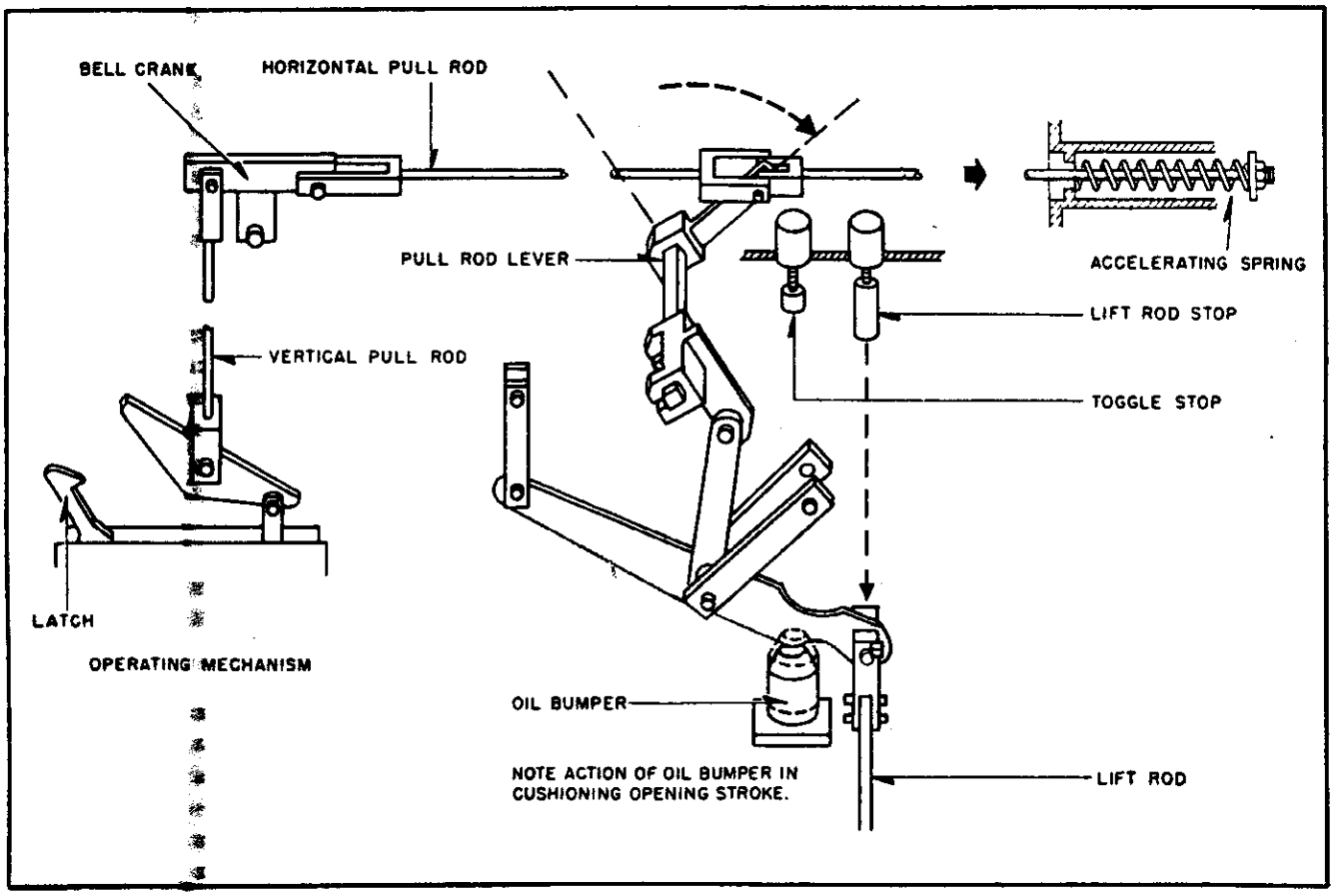

FIG. 14a - Closing Stroke of Pole Unit Lever Mechanism

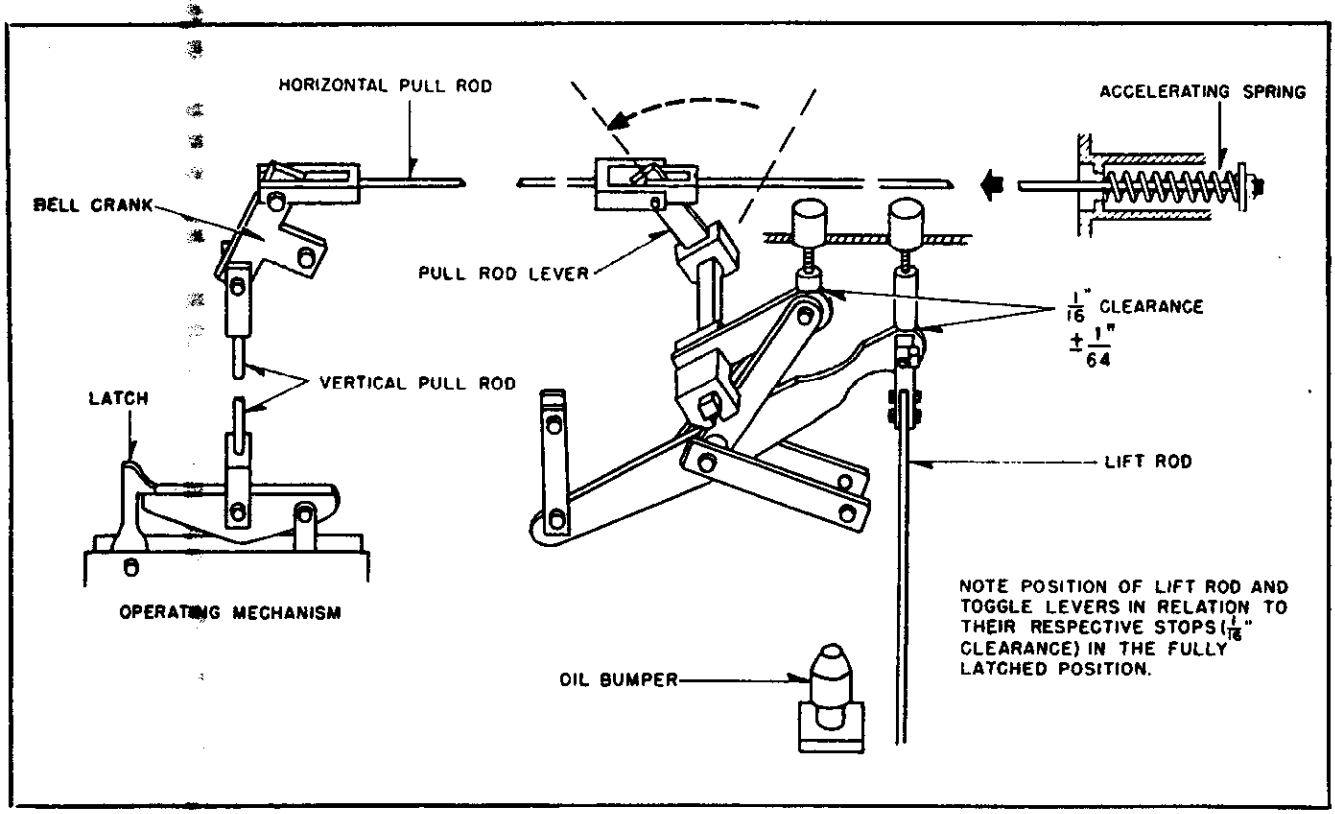

FIG. 14b - Opening Stroke of Pole Unit Lever Mechanism

Provision has been made for connecting the time-travel recorder through the top of the breaker. Removing a .375" pipe cap on top of the lever box adjacent to the lift-rod stop permits the travel-recorder rod to be screwed into a bracket on the upper end of the lift rod which is provided with a .190-32 tapped hole. This is most readily accomplished with the breaker in the closed position. This arrangement may also be used to measure contact engagement as explained under "Contact Adjustment and Maintenance".

In order to cushion the breaker-opening stroke, oil dashpots (bumpers) in each pole unit operate over the last 1.25 inches of travel. Adjusted with washers under the bolt head shown, the bumper height determines the breaker stroke. This is not a critical setting, but it should be possible to set the 18" stroke ± .50 inches as indicated. With correct adjustments, the dashpots in all three poles will share the load equally. Note that the dashpots are inter-acting between poles. Thus, it may be necessary to adjust for plus tolerance on travel in one pole (usually No. 1) in order to obtain minimum tolerance in another pole (usually No. 3). The permissible rebound on opening stroke of the circuit breaker moving contact (lift rod) as controlled by the oil dashpots is 5% of total travel of the total moving contact (lift rod) travel. The reservoirs of the dashpots fill automatically when the breaker tanks are filled with oil.

It will be noted that roller bearings are used on the main, hexagonal shaft and at the pin on the pull-rod lever. The ALEMITE grease fittings for these bearings should be lubricated with a pressure gun, using Westinghouse grease #55213AG, as part of the regular breaker maintenance program.

Bell Crank Assembly

The bell crank used on this breaker is a simple, single lever, as shown on Fig. 4 and the lever is positioned so that an additional toggle effect comes into play as the breaker nears the closed position to give the needed mechanical advantage to overcome the heavy contact and accelerating spring loads. The position of the bell crank lever is important in order to get the proper mechanical advantage. The correct position may be obtained by adjusting length of vertical and horizontal pull rods as previously explained in Part II.

It will be noted that roller bearings are used on the shaft and at the horizontal pull rod connection. The three ALEMITE fittings should be lubricated with a pressure gun, using Westinghouse grease #55213AG, as part of the regular breaker maintenance program.

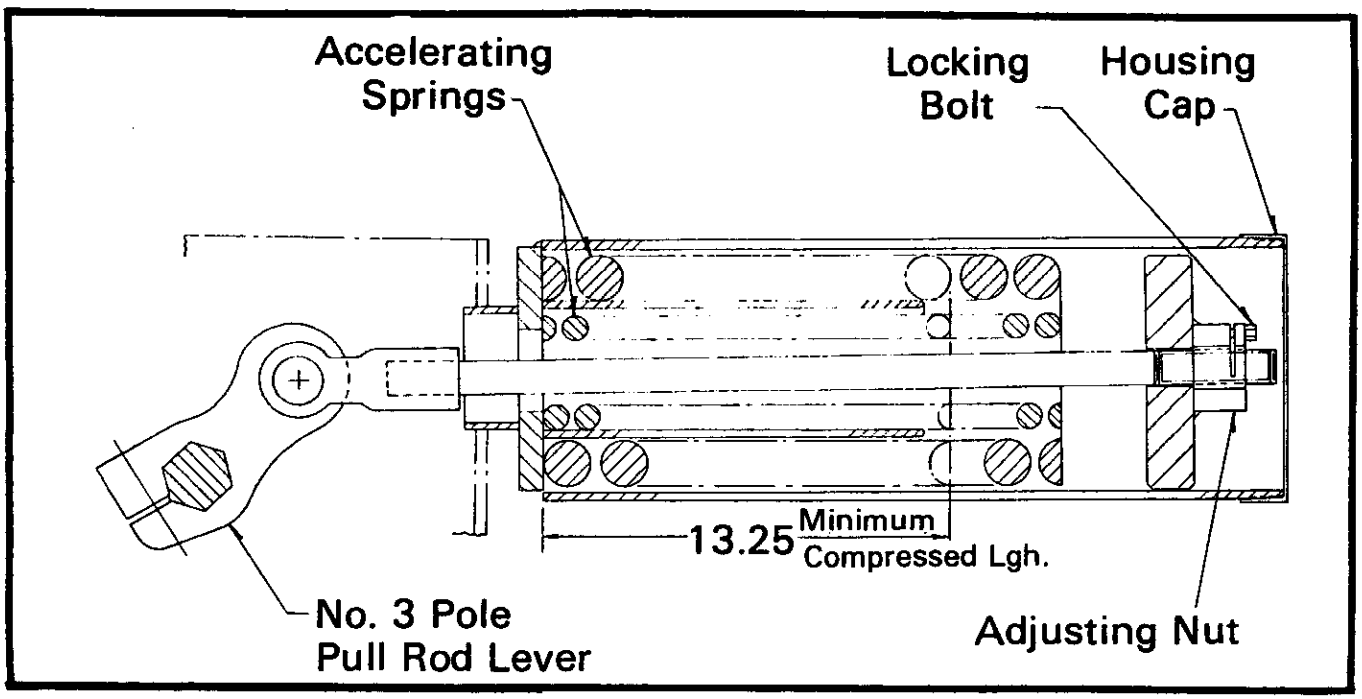

FIG. 15 - Accelerating Spring Assembly

Accelerating Spring

In addition to the acceleration provided by the pole-unit lever system springs and by the pump springs, an additional spring assembly shown on Fig. 15 commonly known as the "tail" spring is mounted on #3 pole. This assembly consists of two springs operating on the horizontal pull rod to provide acceleration at the beginning of the opening stroke.

The springs are arranged so that it is not effective over the initial portion of the closing stroke. Free travel is provided to aid in fast reversal of movement for high-speed reclosing operations. The spring compression may be changed if necessary as indicated in Part II by adjusting the special locknut. Adjustment should be made with the breaker open in order to unload the spring.

Oil Gauge and Tank Air Cells*

A float-type oil gauge is provided as shown on Fig. 10. The gauge ring marker is calibrated to show the proper combined volume of the oil and air in the air cells at 25°C (77°F). The oil level will fluctuate considerably with temperature: for example, the correct level for 50°C (122°F) is 1-27/32″ above the ring, while the correct level for 0°C (32°F) is .1-27/32″ below the ring. The tanks should be filled to a level corresponding to the oil temperature at the time of filling.

The inverted air cell near the bottom of tank is open on the bottom (except for float) for the purpose of absorbing the pressure shock transmitted through the oil during heavy interruptions. The breaker would not fail to interrupt if the cells were flooded, but the reduction in shock due to the air cushion in the cells is very desirable in order to minimize changes in breaker adjustment, oil leaks in condenser bushings, etc.

In order to reduce the absorption of air into the oil over a long period of time, floats are used inside the air cells - thus keeping the air from coming in direct contact with the oil. Barring air leaks in the cells, it is estimated that there will still be enough air inside the cells after five years to do an adequate job of cushioning. The air cells are automatically recharged, of course, every time the tanks are drained.

*Air cells are not required for GMB breakers with interrupting rating below 50KA.

If abnormally low oil level is observed during routine breaker inspections (taking ambient temperature into account) look first for evidence of external oil leakage. If there are no signs of oil leakage, drain the tank at the earliest opportunity, remove the floats, and examine the inside of the air cells. If the cells are wet all the way to the top, an air leak is present which should be located and repaired. The chances of such a leak are small, since the cells are leak-tested at the factory.

Type SB2A Interrupter Operation Fig. 11

Within the pole unit a type SB2A interrupter is attached to each condenser bushing, and interconnected with a bridging "crossarm" member to complete the circuit when the breaker is closed. Each interrupter assembly consists of two arc-rupturing units in series mounted inside an insulating tube or a total of 2 breaks per pole.

The orifice and venting arrangement on each grid block is such that on high-current interruptions pressure for driving fresh, un-ionized oil into the arc stream is self-generated. On an interrupting operation, the contacts are rapidly opened as the crossarm is driven downward by the spring acting on the lever system and by the two springs inside the piston of the pump casting assembly. The arc is drawn between arc-resistant tungsten-silver tips on the moving contact members and the stationary contact fingers in each stationary contact assembly.

In order to assure 3-cycle interruption on low currents, an auxiliary oil driving piston is included in the pump casting assembly. When the contacts open, the oil below the piston is forced down inside the tube, where the only escape is through the orifices of the grid block.

The auxiliary oil-driving piston also performs a flushing action immediately following each high-current fault interruption, clearing out arc products to prepare for another operation within a fraction of a second if required. In this case the pressure generated by the interrupting units stalls the piston until the interruption is completed, after which the piston is free to perform the flushing function.

To permit refilling the interrupter with oil, check valves are provided at the bottom of the piston assembly. Oil pressure due to an interruption or operation of the piston causes the check valves to close automatically.

In order to distribute the voltage equally between the stationary contact assemblies in each pole, a resistor is shunted across each interrupter. The resistor has a nominal value of 700 ohms ± 10%.

Adjustment and Maintenance of Interrupter Assembly

Contact Inspection

On routine inspections a reliable indication of the contact condition may be obtained by measuring the contact engagement using the following technique which does not require draining the oil from the tanks. A .190" dia. rod with .190-32 threads such as used with a time-travel recorder may be passed through the top of the lever box by removing a .375" pipe cap adjacent to the lift rod stop. Screw this rod into a projection on the lift rod upper fitting with the breaker closed as shown in Fig. 4. Once the rod is installed a reference measurement should be made to indicate closed position.

Contact engagement is determined by a second measurement made with the breaker actuated by the hand-closing jack. With the jack installed and a "lighting out" circuit established between bushing terminals, open the breaker far enough to part contacts, then slowly close the breaker, measuring travel on the extension rod where contacts once again make. This should be approximately .91" ± .125" below the full closed position. If any pole unit shows less than .625" on routine inspection, excessive contact burning or other troubles are indicated, and oil should be drained to permit a complete internal inspection.

Resistors

The condition of the voltage dividing resistors shunting the stationary contacts may also be checked conveniently without draining oil from the tanks. With an ohmmeter across the bushing top terminals open the breaker slowly with the hand closing jack. When a definite increase in resistance is observed the contacts have parted and the resistance of two resistor assemblies in series is being measured. The nomimal value of this resistance is 1400 ohms, but a +10% -10% variation of this value is permissible - greater variations should be cause for draining oil and making a thorough investigation.

Since part of the resistor circuit is through a sliding contact between the moving contact and the resistor contact of the interrupter, there is a possibility of an oil film causing an open circuit on a low voltage test circuit. Jacking the breaker in and out a small amount will usually re-establish the circuit.

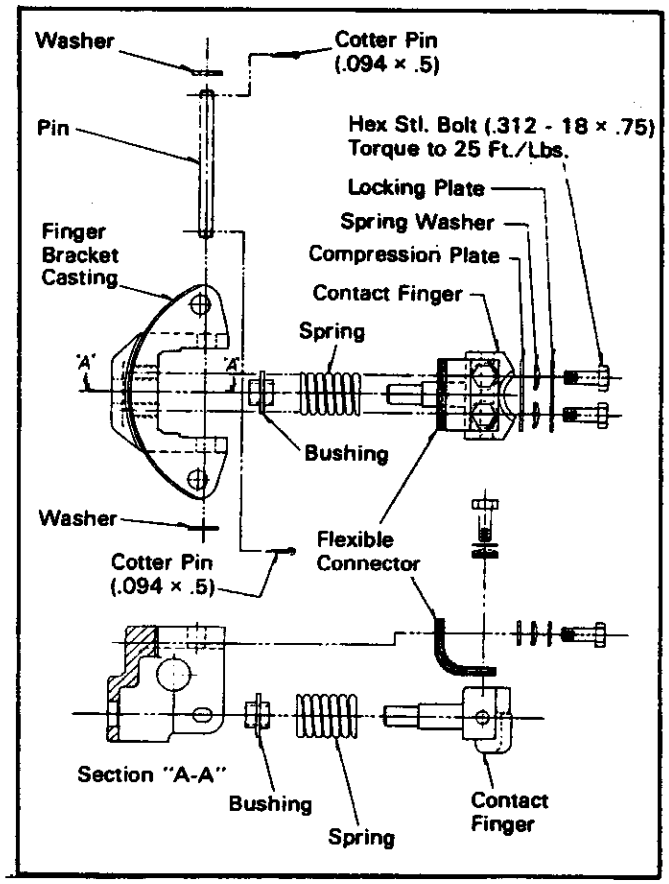

FIG. 16 - Stationary Contact Details

If it should be necessary to replace a damaged resistor, 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 interrupters. The resistance of the units may vary somewhat from the nominal 700 ohms (due to aging) but this is permissible as long as the two pairs in each pole are matched within 10%. 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.

Removal of Contacts and Interrupter Blocks From Interrupter Assembly Fig. 16

1. Have breaker in open position.

2. Remove bolts from upper shield and slide shield up on bushing porcelain.

3. Disconnect the lower and upper connection on the resistor assembly which attaches to the interrupter and remove resistor.

4. Remove (8) nuts which attach the interrupter tube to the top casting and drop interrupter tube.

5. Stationay contact assemblies are now in full view to be examined or removed by unscrewing the (2) socket head screws in each assembly.

6. The contacts can be removed by removing the shunt from the contact body and removing the pin. The contact is now free to slide out and can readily be replaced.

7. The moving contacts can be replaced by simply unscrewing the moving contacts out of the crossarm and replacing them with new contacts.

8. The resistor contact is located below the grid block and should be inspected for wear and arc terminals. Wear should not be more than .062 on the sliding surface. Arc terminals can be cleaned off with emery cloth.

Interrupter Blocks

Interrupter blocks can be inspected by removing the interrupter tube from the top casting. The interrupter block can then be slid out the top of the tube. The diameter of the hole in the top fibre plate of the interrupter block is 1.25 inches when manufactured, if erosion due to arcing has increased this diameter to 1.50 inches the interrupter block should be replaced. The interrupter block is keyed into position to insure the exhaust vents are aligned with the slots in the interrupter tube. All moving contact elements and contact fingers are tipped with silver-tungsten alloy which is especially resistant to arcing, so that deterioration will not be very rapid. Contacts may be reconditioned by simply smoothing off any surface protrusions. Severely burned contacts should be replaced.

Oil Pump Assembly

If it is necessary to disassemble the oil pump assembly to inspect the piston, care should be taken when removing the .50-13 × 1.75 cap screws. The (4) screws are spring loaded and the following procedure should be followed. Remove one bolt and insert in its place a .50-13 threaded stud 6 inches long. Add washer and nut, running nut up against washer and pump bottom. Replace a second bolt, diametrically opposite from the first one, with stud in same manner. Remove the two remaining bolts. Hold studs from turning and back off slowly on each nut equally thus allowing the bottom plate to rise slowly to release the spring load. When the spring load is released, remove bottom plate and piston assembly. Examine the piston, and piston rod ends and cylinder bore for any unusual wear. The re-assembly should be done by reversing the procedure outlined above.

Referring to Fig. 11 and 12, it should be noted that the bushing foot, top casting, and upper contact bracket are made from aluminum. If these parts are dis-assembled, special care should be taken to insure a good electrical joint when re-assembling. The best way to avoid the oxide skin that forms almost instantaneously on exposed aluminum is to coat the joint surfaces with petrolatum (vaseline) and wire brush these surfaces through the petrolatum. Re-assemble these pieces without removing the petrolatum and wipe off the excess that is squeezed out; the petrolatum will not interfere with the electrical conductivity.

PART IV - GENERAL MAINTENANCE PROCEDURE

It is recognized that the inspection and maintenance program will vary from one user to another. The important consideration is that a system of regular inspection be established, and the frequency determined by operating experience. The programming of maintenance can be scheduled with assurance by compiling operating data on individual breakers.

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 period, a thorough inspection should be made as outlined under "General Inspection Procedure."

Subsequent inspection and maintenance procedures are normally divided into two categories. These procedures should be supplemented by frequent visual inspections by operators touring the switchyard.

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 bushings can retain an electrical charge which may cause serious shock to a workman.

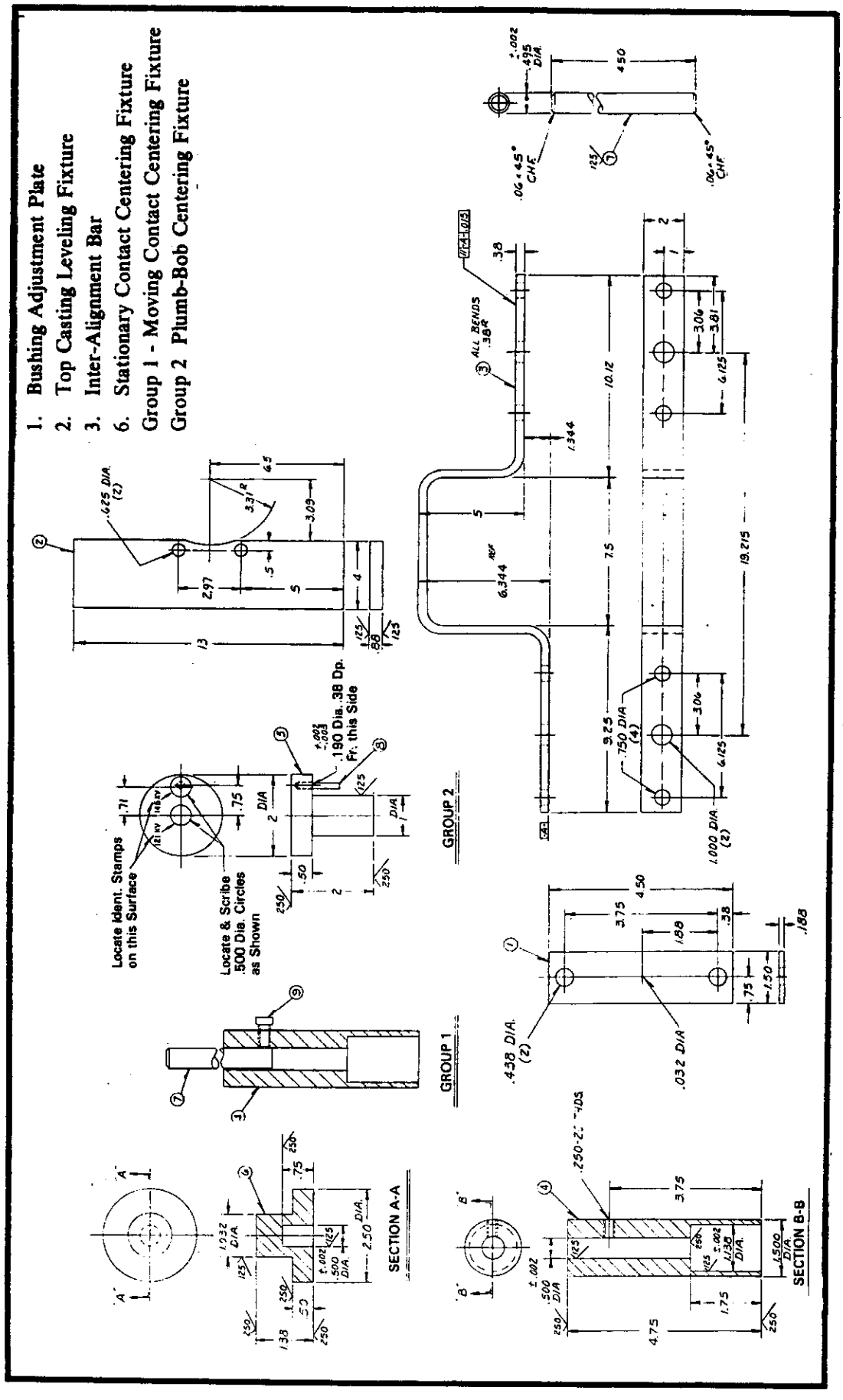

FIG. 17 - Alignment Tools

Routine Inspection Procedures

A routine inspection should be made yearly and used as an additional guideline in determining the necessity of a general inspection. A routine inspection includes checks which may be made externally without draining oil.

The suggested routine inspection procedure is as follows:

1. Check mechanical operation of breaker. This should include checking for 5 stored closing operations before closing cutoff and one after cutoff and checking pressure switch settings.

2. Check dielectric strength of oil. See "Care of Oil" Part IV.

3. Measure contact resistance across the bushings terminals. See "Installation Check List" for acceptable values.

4. Measure contact engagement by manually closing the breaker slowly and "lighting out" across the bushing stud as described under "Contact Inspection" Page 19. If this measures less than .625" it is an indication of considerable contact burning or need for adjustment. Note that normal engagement is .91" ± .125".

5. Measure resistance of voltage dividing resistors on interrupters - see "Resistor" Part III on how to check without draining oil.

6. Check the mechanical and electrical components of the operating mechanism as outlined in the Mechanism Instruction Book.

General Inspection Procedure

The following are some of the factors to be considered in determining the frequency of a general inspection procedure:

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.

8. Information received from routine inspections.

The following schedule is suggested as a basis for setting up a General Inspection program (whichever comes first):

1. Five years elapsed time.

2. Four times cumulative interrupting rating (4 rated faults, 8 half-rated faults, etc.)

3. 500 mechanical operations.

NOTE: *This schedule is recommended as a minimum maintenance program and does not preclude unusual environmental or switching applications. It is the user's responsibility to determine a suitable maintenance schedule with respect to the application to maintain the breaker in the operating condition recommended within this book.*

The suggested General Inspection procedure is as follows:

CAUTION

The following precautions should be taken before entering tanks:

1. Check for open disconnect switches to isolate breaker from the system.

2. Ground the bushing terminals solidly and maintain this condition while work is going on.

3. When tank doors are opened the tanks should be thoroughly cleared of gaseous products. These may be explosive! Keep sparks and open flame away.

4. Remove vent cap on tank top and establish adequate ventilation preferably using a fan or blower to force air into the tanks.

5. Ascertain that trouble lights and other electrical equipment to be used within the tank are adequately grounded.

6. To preclude accidental closing, close the hand-operated valve in the air line between the mechanism and air reservoir, and open control circuits with the switch provided on the control panel.

7. To preclude accidental tripping, insert the safety pin above the trip free trigger, and install the jack snugly against the mechanism spring housing.

Note: *The installation check list included in this booklet should be used as a reference when major maintenance is performed for two reasons:*

a. As a basis for comparison and

b. The same basic steps should be followed on major maintenance as on installation.

Before disturbing any parts, check adjustments 1 to 3 below to give an indication of the condition of the breaker when removed from service. (Breaker closed manually - no over-travel.)

1. Check clearance at over-travel stop above lift rod and at the toggle stop on the pole unit lever system. Check the pole unit lever system to make sure that there are no loose bolts and nuts and that there are no cotter pins missing. Pole unit lever system settings can be checked as described in the section on Pole Unit Lever System, Part III.

2. Check oil dashpots Fig. 4, in each pole unit lever system to determine that they are working freely.

3. Observe the condition of all parts that are now accessible. Check for loose bolts, nuts, springs, cotter pins, and damaged parts of any kind.

4. Open breaker with the hand jack and inspect the moving contact tip. Note the condition of the contact tip. A small amount of burning on the contacts is not detrimental so long as the electrical conductivity or contact adjustment has not been changed. If the burning is severe, the contacts should be removed and reconditioned or replaced. The interrupter tube should be removed to inspect the grid and the stationary contacts. (See section on Removal of Contacts from Stationary Contact Assembly). The engagement of the contact fingers and the contact adjustment can be determined by closing the breaker with the hand-closing jack.

5. Reassemble all components carefully after inspection. Be sure that the grid blocks are replaced in the tube so that the exhaust vents align up with the openings in the interrupter tube.

6. Check inside of tank cells for wetness, which is an indication of air leakage.

7. After the internal inspection is completed, clean the lower porcelains on the bushings with a clean, lint-free cloth dipped in clean breaker oil. Clean the surfaces of the lift rods and guides in the same manner. Clean all carbon from the stationary contact assemblies.

8. Check the operating mechanism for loose nuts and bolts. Torque 1"-8 mechanism mounting nuts (8) to 400 ft.lbs., and see that no cotter pins are missing. Lubricate bearings. Refer to mechanism instruction book.

9. Check the mechanism latches to see that the faces are in good condition and have proper adjustment. Apply a thin film of rust inhibitor, #55213AG to latch faces. (See mechanism instruction book.)

10. Check air system on pneumatic mechanism for excessive leakage. Leak rate should not exceed 5 psig/hour.

11. Check control wiring and current transformer junctions for loose connections.

12. Check gasket joints, conduit and tank fittings to make sure no water can enter breaker.

13. Refer to lever system, Fig. 4, and bell crank drawing, Fig. 4 and grease all roller brearings. The ALEMITE fittings for the bearings should be lubricated with a pressure gun, using Westinghouse grease No. 55213AG. This grease has been especially selected to be free-flowing over a wide temperature range.

14. Check dielectric breakdown strength of the oil. See "Care of Oil" below.

15. Refill tanks with oil, remove safety pin and remove hand jack from operating mechanism, open the hand valve between reservoir and mechanism, energize the control circuits, and check closing tripping operation using all relays and circuits usually involved in the operation of the breaker.

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

17. Make timing test with graphic recorder to check opening speed and reclosing time (if required). Ref. Part II, "Operation and Timing Tests."

18. Check number of stored closing operations starting from normal operating pressure. Ref. Part II, "Operation and Timing Tests."

19. Check setting of compressor governor, low pressure alarm, and cutoff switches. Pressure settings are tabulated on mechanism nameplate.

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 bushing or failure to handle heavy interruptions properly. Oil bumpers may be uncovered and fail to provide proper cushioning effect.

The oil should be allowed to settle for 2 hours before closing the breaker on a live line as recommended under "Placing Oil in Service", Part II.

Condenser Bushing

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

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

Bushing Current Transformer

If it should be necessary for any reason to replace a current transformer, first remove the stationary contact assembly from the bushing 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, by cutting the leads; however, before it can be removed, it is first necessary to loosen the compression seal inside the terminal box. The seal consists of a sandwich of two Moldarta pieces with a slice of Neoprene rubber in between, through which the transformer leads are threaded. See Fig. 10 for location of transformer lead seal.

When replacing the transformer, make sure that the end of the transformer carrying the white polarity mark is facing upward. Also, see that the transformer is not thrown off ratio by allowing the support plate 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.

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. 10. The gauge is marked for normal oil level at 25 degrees C. Fluctuations on either side of normal will be noted with temperature changes as described in Part III.

The gauge glass is gasketed to insure weather tightness. Should it be necessary to replace a gauge glass, re-assemble with new gaskets at top and bottom of the glass, and fasten guard so that the glass is held in proper position. If the gauge has been removed from the tank, use Dow Corning RTV 732 on the threads to prevent water from entering tank.

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 is 33-125-C3 and 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 illustrations in this book or the mechanism instruction book. Identify the breaker by including the type, amperes, volts and Shop Order (S.O.) number, as stamped on the nameplate.

Service Assistance

If a breaker fails to operate properly and the trouble cannot be found or corrected, notify the nearest Westinghouse Power Systems Sales Office or Service Dept. for assistance.