PART 1 - RECEIVING, HANDLING AND STORING

INTRODUCTION

The oil circuit breaker is a very important unit in the modern transmission system, being depended upon for protection and for flexibility of control. 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 on the breaker must not exceed those specified at the time the breaker was purchased.

Proper installation and maintenance are necessary to insure satisfactory operation of the circuit breaker. Attention is called to Section 19 of the "Standards of the American Institute of Electrical Engineers" and to "NEMA Switchgear Standards", published by the National Electrical Manufacturer's Association. A number of the instructions for the general installation and care of circuit breakers have been copied without change from the NEMA standards.

GENERAL DESCRIPTION

The oil circuit breakers described in this instruction book consist of three individual pole units, mechanically connected together so as to operate as a 3-phase circuit breaker. The three poles are arranged for mounting on a suitable foundation and provision is made for securing them rigidly to the foundation by bolts and holding down clamps. The three pole units are connected by operating rods for simultaneous operation. The operating means for closing and opening the breaker is a mechanism of the pneumatic type located on the No. 1 pole unit.

Each pole unit consists of a tank of steel plate, two outlet bushings of the condenser type 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 between the two interrupting units; one lever mechanism for operating the moving contact member; bushing-type current transformers over the ground portion of each bushing (when ordered). See pole unit drawings 382D664 and 41A9981.

The several component parts briefly referred to here are described in detail under their respective designations on pages following.

SHIPMENT AND STORAGE

Breakers of this type, on account of the size and the weight of the component parts, are shipped dismantled. Tanks and boxes of material making up a complete 3-pole breaker can be delivered at convenient locations by proper checking of the identifying marking on each package against the shipping list.

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, a claim for damage should be filed at once with the carrier (transportation company), and the nearest Westinghouse Electric Corporation Sales Office notified promptly.

Certain parts of the breaker are of insulating material and must be so 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 entirely encased in porcelain and are self-protecting against moisture, but other insulating parts such as lift rods, guides, "De-ion Grid" and current transformer stacks should be stored in a dry place. When storing lift rods and guides - especially spare parts which may not be used for a long time - lay these pieces on a flat surface or hang them up in order to minimize the possibility of warping.

Components manufactured from vulcanized fibre are extremely sensitive to moisture and must be carefully protected. Excessive moisture will cause swelling and warping to such an extent that parts of this material may be rendered useless. High-humidity conditions and direct contact with moisture for even relatively short periods of time can be destructive.

The bonded-grid interrupter blocks, for example, are very susceptible to moisture. Humidity control is exercised in manufacturing these. For shipment they are packaged in sealed cartons and wrapped in oiled paper impervious to moisture. Do not open these cartons before they are required. If lengthly storage is contemplated, select a sheltered and dry location.

The stationary-contact assemblies when shipped separately will be packaged (less interrupter blocks) in a weather resistant manner, but not completely sealed. If these are to be stored for any length of time, a dry location should be selected and the packaging material should be removed since it may have picked up moisture. A very acceptable technique is to store such stationary-contact assemblies in containers filled with dry insulating oil.

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 inside the housing due to moisture conditions.

HANDLING

The tanks on this type breaker are not as stable as cylindrical tanks, and must be handled carefully to prevent tipping over.

The shipping weight of #1 tank (with pneumatic mechanism without bushings or contacts) is approximately 28,000 lb., while the weight of #2 and #3 tanks is approximately 24,000 lb. The weight of the condenser bushings crated is about 5,000 lb. each. This information should serve as a guide to the strength of cranes or other lifting means required for handling the breakers. The lifting lugs on the lever box on top of the tank are of adequate strength for lifting the entire pole unit.

When using cable slings for supporting the apparatus, do not allow the slings to strike the condenser bushings, as any strain may cause them to crack or break.

LOCATION

The breaker should be located so that it will be readily accessible for cleaning and inspection. Sufficient space must be provided for opening the mechanism housing doors. The breaker foundation should be sufficiently high so that water will not enter the operating mechanism housing during flood conditions.

UNPACKING

When unpacking the circuit breaker, the crating or boxing must be removed carefully. Porcelains and other parts are sometimes broken by carelessly driving a wrecking bar or other tool into crates or boxes.

When the breaker has been unpacked, the various parts should be placed in proper position for mounting on the permanent foundation. To avoid delay in assembly, the parts should be arranged so that they will be accessible and ready to put in place.

After the tanks are set upright on their foundation, the bushing flange covers may be removed.

Before unpacking the condenser bushings read carefully Instruction Leaflet 33-155-5A which is sent with each bushing and included in this book.

Check all parts with the shipping list. Avoid bending, breaking or injuring any part.

Do not leave screws, bolts, nuts, etc., in the packing material.

See that all instruction books and tags are kept with the circuit breaker.

PART 2 - INSTALLATION

Blocks and tie wires used to hold moving parts in the closed position during shipment must be moved. Always look for a wire holding the mechanism triggers and latches from jarring loose during shipment.

In order to facilitate the work on these large breakers, the following items have been provided for each station:

(1) Framework for scaffolds and rail posts around top of each tank per dwg. 45A9552.

(2) Ladder for reaching top of condenser bushings per dwg. 44A4266. Mounting brackets are provided for top of each tank, and ladder may be moved readily from tank to tank.

(3) Three platforms for working inside tanks. Platforms are clamped to manhole flange on one side per dwg. 382D654.

MOUNTING

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

When lining up the tanks, follow carefully the drilling plan sent in advance from the factory - see also outline dwg. 445D900.

The following steps should now be taken:

Step 1. Place tanks at proper pole spacing, and see that centerlines between tank bushing flanges are at right angles to 3-pole centerline. Prick punch marks will be found on the tank legs and tank sides which will aid in alignment. As an additional alignment check, the diagonal distance between bushing flange seat No. 1 and No. 4 should be equal within 1/2" to the diagonal between flange seat No. 2 and No. 3, and similarly between No. 2 and No. 3 poles. (Starting at No. 1 pole, bushings are numbered 1-3-5 on L.H. side, and 2-4-6 on R.H. side.)

Individual tanks should be properly plumbed and leveled, using the leveling screws provided in the feet of the tank legs. Each tank may be accurately plumbed by hanging a plumb line inside from the 10-32 screw provided with a hole through it (item 68 dwg. 41A9981). When the tank is level the plumb line should fall within a 3/4" diameter circle of prick punch marks in the bottom of the tank which is identified by a circle of paint.

Step 2. Assemble the horizontal pull rod pipe housings between poles per Items 23, 28, 20 or 36 drawing 44A4262. Place retainer and gasket, Items 9 and 10 on both ends of pipes before sliding pipes into place. Pipes enter back side of #1 pole and #2 pole first (Section "AA"). As shown on drawing 44A4262 under "Interpole Tie Pipe Assembly" torque bolts Item 33 to 80 lb. ft. on pipe end shown in Section "BB". On other end, as shown in Section "AA", assemble pipe retainer Item 12 run nuts Item 13 hand tight, then torque bolts Item 33 to 80 lb. ft. Now torque Item 13 to 50 lb. ft. Torque values are given for breaker in open position.

CAUTION: During tightening sequence, tanks must remain plumb. Weatherseal tie pipes by tightening bolts Item 15 at gasket retainer.

Assemble interpole conduit pipe (5) as per detail drawing 702C977. Since there are no compression stops for the conduit pipe, equalize the amount of pipe projecting inside boxes.

Step 3. Reference dwg. 44A4262. Screw the rod ends 6 and 7 onto the pull rods (8) far enough to allow for adjustment either way. It will be noted that rod end (6) has R.H. threads while rod end (7) has L.H. threads, so that adjustment of interpole lengths may be made by merely loosening clamping bolts (20) on rod ends and turning rod (8). A hex-section for a wrench is available near the end of the rod with R.H. threads.

Pull rods may be inserted into the pipe housings through the bell crank housing on No. 1 pole by following sequence of operations given on dwg. 44A4262. Assemble rod ends to crank levers (2) with pins, washers, and cotters (17-18-19). If difficulty is encountered when installing pins, this is an indication that tank alignment should be rechecked.

Step 4. Shim under tank feet as necessary and grout around feet, and after grouting has set sufficiently, tighten floor clamps on tank feet securely per dwg. 445D900.

BUSHING CURRENT TRANSFORMERS

Refer to drawings 382D654 and 382D655.

Transformers are epoxy encased on a heavy aluminum bottom plate. They are shipped unassembled and should be assembled in the breaker tank tops before the condenser bushings are assembled in the tanks. Though a windlass lifter, which may be used for lifting current transformer assemblies and stationary contacts into position is included in each set of tools furnished, the lifting and positioning of current transformer assemblies is simplified by use of a crane or hoist above the tanks with lifting sling down through the tank bushing flange.

Before proceeding with the work inside the tanks install the tank work platforms drawing 20B5477 and secure with bolt in the manhole flange.

Before lifting transformer assemblies, assemble proper male - male stud Item 6 or 7 or 8 drawing 382D655 in tank tops.

Regardless of which lifting source is to be used on the current transformer assemblies, the assemblies must be supported for lifting by the tray Item 2 drawing 382D654. Therefore, the tray may be inserted in the tank and left inside until all transformer assemblies have been lifted and secured in position. Position the tray Item 2 drawing 382D654 as shown in view "A" and "D" and secure assembly to tray with bolts Item 11. When lifting the assembly by means of a sling down through the bushing flange, use a strong wood block such as a 4x4 across beneath the tray. Block and sling can be positioned so that assembly can be lifted an approximately proper angle and without tipping. To lift the transformer assemblies using the windlass lifter, assemble cables per view "D" with cables attached to tray and guide Item 17 bolted to Item 5 as shown in guide assembly, drawing 382D654. The guide assembly prevents the transformer assembly from tipping and has its real advantage when raising or lowering a transformer assembly over a condenser bushing.

Refer to transformer assembly drawing 382D655. When single assemblies are required, they are secured by using elastic stop nut, Item 9. When double assemblies are required, secure top assembly with proper length female - male adapter Item 10 or 11 or 12 and lower assembly with elastic stop nut, Item 9. The lead conduit channel, Item 2 drawing 382D655 which is shown as Item 11 on pole unit end, view drawing 382D664 may be assembled. Leads are to be assembled as per notes on 382D655 and brought the lead seal assembly, Item 10 drawing 382D664 as shown on lead seal detail drawing 701C372 per Gr. 5. The transformer short leads are either terminated on terminal blocks in condulet, Item 9 drawing 382D664 or ample length left for splicing to long leads. The long leads run from the condulet on top of each pole unit through conduit to terminal blocks in the mechanism housing. See transformer connection diagram. Desired ratio may be selected at these blocks.

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 appear across the open secondary terminals.

CONDENSER BUSHINGS

Reference I.L. 33-155-5A

Each bushing is packed in a separate crate in a horizontal position. For handling the bushing, it is recommended that a main hoist be provided capable of lifting the complete bushing which weighs 3750 lbs. An auxiliary hoist will be required to attach to the top cap fitting to balance and up-end the bushing to the proper 14° angle to go through the breaker top. Raise the bushing from the crate by means of a rope or cable sling placed around the bushing flange (using wood block provided) below the upper porcelain fitting, and a second sling to the top cap. See Fig. 1 and 2 of I.L. 33-155-5A. Great care must be exercised in lowering the bushings into position to avoid damaging either the porcelain on the lower end of the insulation on the inside of the transformer. An aluminum "sock" is provided to cover lower porcelain while lowering. Before lowering the bushing into position be sure the moulded bevel gasket on which it rests is in place - no cement is required on this gasket, but it is advisable to apply grease so that the gasket will not be damaged when the bushing is shifted.

CAUTION: Condenser bushings are to be assembled in pole unit tanks with the oil gauges and voltage tap receptacles facing to the rear of breaker for more direct connection from voltage tap receptacle to potential devices with standard length potential device cables. Condenser bushings should be properly turned before lifting so that the gauges and voltage tap receptacles will be toward the rear of the breaker.

Assemble studs, Item 20 drawing 382D664 per drawing. These studs are to be used to guide condenser bushings into place when lowering, so that they will not tend to slide "down-hill" on their seats, and are to remain as two of the permanent bushing seat fasteners. Before tightening the holding bolts, the bushings should be accurately aligned with respect to the centerlines of the tank, and the lower ends spaced the proper distance apart as indicated on pole unit section drawing 382D664. Prick punch marks will be found on each inside wall of tanks 2 INCHES OFF [redacted] centerline at near level of bottom of condenser bushing studs. Alignment of bushings will be facilitated by stretching a string across inside of tank tied to two small magnets located by prick punch marks. The bevel seat permits alignment of the bushing; as the holding bolts are tightened down, it is possible to shift the bushing into alignment by loosening the bolts on one side and tightening on the other side, according to which direction the bushing is to be swung. Holding bolts on flange of condenser bushing should be tightened to 450 ft. lbs.

There should be ample clearance between the condenser bushing and the transformer case, but it would be well to make sure that the metal flange on the bushing does not touch the case - this would have effect of a short circuiting turn and would throw the transformer off ratio.

CONTACT ASSEMBLY AND ADJUSTMENTS

Before assembling the moving contacts and lift rods, close the breaker by hand and check the clearance at all lift rod stops. The lift rod stops are indicated as Item 42 on pole unit lever drawing 42A9981 - the clearance should be 1/16" and may be checked by removing a pipe plug in the side of the lever box. The stop settings have been made at the factory, so that the stop clearances should check closely.

Toggle stops, indicated by Item 49 of drawing 41A9981, are readily accessible in the pull rod box. However, it is not necessary to check for 1/16" clearance at these stops until the contact load is added.

If for some reason the stop settings have been disturbed, or there is any suspicion that they are not correct, check the position of the toggle lever as indicated under POLE UNIT LEVER SYSTEM in PART 4.

Once it has been determined that the stop settings are correct, they should not be changed in order to get the 1/16" clearance. The correct procedure to get the proper clearance is to adjust the operating rod lengths between poles. Starting with #1 pole, adjust the length of the pull rod (Item 8 drawing 44A4265) between the bell crank and #1 pole. This may be done by removing the bell crank cover and pull rod box cover at #1 pole, loosening clamping bolts in rod ends and turning rod at hex section inside #1 pull rod box. Since this rod also has R.H. and L.H. threads, turning it will change its length. At this time it would be wise to check the position of the bell crank lever. Referring to the adjustment note on dwg. 44A4265, the machined surface on lever (6) should be levelled (breaker closed) if necessary by adjusting length of vertical pull rod to pneumatic mechanism which also has R.H. and L.H. threads. The position of the bell crank lever is important in order to get the required mechanical advantage.

Adjusting the pull rod to #1 pole will, of course, also affect #2 and #3 poles; however, the interpole pull rods may be adjusted very easily. The interpole rods have R.H. threads on one end and L.H. threads on the other, so that by loosening the clamping bolts in the rod ends, it is possible to change the length of the rods by merely turning them - it is not necessary to remove the pins in the crank levers. The rod between #1 and #2 pole may be turned readily at the pull rod box on #2 pole, at which point there is a hex-section on the rod for a wrench. No. 3 pole may likewise be adjusted by loosening the clamping bolts in the rod ends at both ends of the rod between #2 and #3 poles, and turning the rod at #3 pole.

With the bushings in place, the interruptor assembly may next be assembled on the lower end of the bushing studs. To facilitate handling interruptors assemble windlass lifter in tanks as per views "A" and "C" drawing 382D654. Using grid lifting bracket, Item 4 lift interruptors through manway after padding manway per Notes on 382D654.

CAUTION: The contact foot must not be removed. The four red-headed bolts are used to hold the contact foot, which is continuously under spring load, to the top casting assembly.

Referring to pole unit end view 382D664 free upper static shield which is Item 11 drawing 501F665 by removing mounting details Items 12 and 18 drawing 501F665. Slide shield down as far as possible over the stationary contact assembly (5) as described in note on drawing 382D664.

The contact assembly (5) and shield (11) drawing 501F665 can then be lifted into position and bolted to the bushings with 8 bolts and washers (22, 23) drawing 382D664. Tighten the 8 mounting bolts uniformly to insure that the weight of the stationary contact assembly is always evenly distributed among them. Do not assemble the contact shields until the final adjustments have been made. The final alignment of the stationary contacts.

Preparatory to installing the moving contact assembly the following precautions should be taken in regard to the operating mechanism. To block accidental tripping, insert the safety pin above the trigger as recommended in the mechanism instruction book No. 33-125-C4. Also, close the manually-operated valve located in the air line between the mechanism and air reservoir to preclude accidental closing. Use the hand-closing jack to permit manipulation and adjustment of the breaker.

The wood-Micarta lift rod should first be hung in position on the main lever of the pole-unit lever mechanism. The wood-Micarta guides must next be assembled; these are bolted to the faces provided on the lever mechanism box. Clearance has been left around the bolts holding the guide members so that they may be shifted to bring the lift rod exactly vertical and central between the stationary contacts. After the final adjustments have been made, the fibre nuts on the guide assembly should be screwed in place using shellac on the threads to prevent loosening.

Assemble the moving contacts and lift rods per dwg. 382D664, being 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 hole through the lift rod stop boss. Make the necessary adjustments to align the moving contact cross-arm with the grids and to pick up the stationary contacts at the same time within 1/32". The dashpots on either end of moving contact cross-arm should be centered on lower moving contact of interruptor within 1/4". Several methods are available for securing alignment and simultaneous touching of contacts:

1. By slight rotation of entire stationary contact assembly at contact foot on condenser bushing stud.

2. By slight rotation of moving contact cross-arm on lift rod, using adjusting screws Item 24, dwg. 382D664, Section "AA" - clamping nuts, Item 25 must be loose.

3. By tipping cross-arm on its lift rod to engage both lower stationary contacts simultaneously.

4. By slight shifting of the guide members to move the cross-arm horizontally. If the alignment is still not correct, it may be necessary to shift the condenser bushing slightly.

After proper alignment has been obtained per above instruments, raise shields (11, Drawing 501F665) and tighten hardware.

Refer to contact assembly drawing 501F665 for contact adjustment. The only adjustment required to get proper contact engagement is the adjustment of the cross-arm (2) on the wood-Micarta lift rod. With the breaker closed and 1/16" clearance obtained at all lift rod and toggle stops, adjust moving contact to get 3/32", ± 1/32" clearance between projection on cross-arm and bottom cover (23) on interruptor. This may be checked with feeler gauge without removing lower static shield (10). Since the static friction on the multiple finger contacts encountered on slow hand closing is very great, it may be difficult to get the 3/32" setting equalized between interruptors. Adjustment will be facilitated by retracting the fingers slightly as described under "Contact Removal" in Part 3. Be sure to release fingers to their normal position before attempting power closing.

It is best to make the adjustments on each pole independently; this may be done by dropping the 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 toggle stop and 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. Re-adjust pull rod lengths as previously described to bring all stop settings back to 1/16".

If pull rod adjustments have been found necessary, it may be necessary to re-adjust the moving contacts. If it is found after these re-adjustments that a slight additional adjustment is desirable on the pull rod to #1 pole, this may be conveniently made on the vertical pull rod inside the pneumatic mechanism housing. Slight adjustments at this point will not affect the toggle position of the bell crank lever too much.

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 in bumper rod Item 21, dwg. 41A9981. Adjust for 20" travel ± 3/8" as shown on pole unit lever dwg. 41A9981.

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

Do not connect an aluminum conductor to a copper-alloy connector unless the latter has plating, or preferably an insert suitable for such a connection. The galvanic action resulting from a joint of aluminum to copper will in time cause considerable corrosion.

GROUNDING CONNECTIONS

Each tank is provided with a copper-alloy pad near the base for a ground connector. Each of these pads has two 1/2" - 13 tapped holes located 1-3/4 inches apart according to A.E.I.C. specifications (Association of Edison Illuminating Companies).

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

CONTROL WIRING

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

The control wiring should be so installed that trouble on 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 control wiring to see that all connections are tight. Small nuts and clips may have become loose during transit and handling.

OPERATING MECHANISM

Read carefully Instruction Book 33-125-C4 on the pneumatic operating mechanism which accompanies this instruction book.

FINAL INSTALLATION INSPECTION

After the breaker has been installed with all mechanical and electrical connections completed, before filling the breaker with oil, the following inspections and tests should be made:

1. All insulation and parts within the breaker tank, including the inside of the tank should be wiped carefully to remove any dirt and 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. The latch faces should be coated with a thin film of rust inhibitor. This inhibitor should be carefully selected to be free-flowing at all anticipated temperatures, non-hardening, and self-healing (does not completely wipe off in one operation). A light graphite lubricant is suggested, or other material with similar properties. Grease S# 1802395, (M9921-4) can be used for this purpose.

4. Close the breaker slowly by hand, noting that the operating rod and contacts are properly adjusted for correct alignment and that proper stationary contact adjustment is obtained when the breaker is closed. Open the breaker slowly by hand. The movement of the breaker on opening and closing should feel free, with some friction noticeable when the moving contact is carrying the load of the stationary contact assemblies.

5. 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 properly tightened so that moisture cannot enter the circuit breaker through any of these gasketed joints. Also be sure to check the large nuts which fasten the pneumatic mechanism to the No. 1 tank.

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

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

8. Test the wiring for possible grounds or short-circuits.

9. See that all current-carrying parts outside the oil tanks are correctly insulated in accordance with standard practice. See that all joints in the control circuits are made correctly.

10. Be sure that each current transformer is properly connected and a burden or short circuit is placed across the terminals at the blocks in the mechanism housing.

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

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

13. Fill the tanks with clean, dry, WEMCO "C" oil and check dielectric breakdown of a sample taken from the bottom of the tank. See following paragraphs for more detailed instructions on oil.

PLACING OIL IN SERVICE

The most careful precautions must be taken to insure the absolute dryness and cleanliness of any oil-insulated 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 returning a circuit breaker to service, thoroughly clean all carbon from the interior so that the new oil will not be contaminated. This may be done by flushing and swabbing with clean insulating oil and wiping with clean, dry lintless material. Cotton waste is undesirable on account of the residual lint which may be introduced into the oil. The preparation and filling of outdoor apparatus should preferably be done on a clear, dry day. If this is not practicable, protection against moisture must be provided.

Precaution should be taken against the handling of oil at a temperature different from the container into which the oil is being poured, as condensation may occur and moisture may be introduced into the oil. Extra care must be taken in case 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 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 method should not be put into the circuit breaker. New oil should test considerably higher than this. However, unless tested under proper conditions, the oil may appear to be worse than it really is due to contamination of the sample when testing. See Westinghouse Instruction Book 45-063-100 for proper method of testing and handling.

OPERATION AND TIMING TESTS

CAUTION: Fill tanks with oil before tripping or power closing.

Interruptors are equipped with oil dashpots and may be damaged by high-speed operation dry. Before power closing, the hand closing jack must be retracted to its proper open position as described in mechanism instruction book 33-125-C4 and the safety pin must be removed from the mechanism.

Starting with normal air pressure (marked on the mechanism nameplate) on the pneumatic mechanism, operate breaker several times after which contact engagement should be checked by "lighting out". This will give good indication that there has been no mechanical failure due to malalignment or mechanical defects. Engagement should be approximately 1/2" as pointed out under FINAL INSTALLATION INSPECTION. 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 cutoff switch on the pneumatic mechanism opens the close circuit. If the number of operations is less than five, 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 which de-energizes the closing valve.

6. Inaccurate pressure gauge on air reservoir, or improper setting of the low pressure cutoff switch.

Check the opening and reclosing time (if required) of the breaker with a graphic recorder, or preferably an oscillograph for better accuracy. In order to be sure of getting 3-cycle interruption the moving contact lift rod should have moved 4-5/8" as measured on the #1 pole unit, 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:

(a) Incorrect calibration of the timing device.

(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) Incorrect trip-coil voltage.

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 cap over the lift-rod stop. A bracket 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 threaded into this tapped hole.

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 on a live line.

PART 3 - OPERATION AND ADJUSTMENT

GENERAL

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 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.

POLE-UNIT LEVER SYSTEM

The pole-unit mechanism, located on the upper part of each pole unit, operates the lift rod which carries the moving contact. Cross section drawing 41A9981 shows this mechanism, which is simply a lever system designed to give a straight-line motion with the proper mechanical advantage at the end of the closing stroke. The spring (12) included with the lever system provides acceleration for opening the breaker in addition to the tail spring on #3 pole.

With the breaker properly adjusted, there should be 1/16" clearance at both the toggle stops (49) and lift rod stops (42) as indicated, after the breaker has been closed by hand. This clearance is necessary to permit the operating mechanism to over-travel and latch, and also to make sure that the closing movement is stopped by the operating mechanism without putting undue strains on any of the pole-unit parts. The clearances at these stops may be checked as indicated in Part 2. It should be remembered that the stops have been properly set at the factory; all adjustments should be made to give the 1/16" clearance without changing the position of the stop bolts. If the toggle lever (9) were permitted to go too far forward, the link (8) would strike the shaft (14) and the opening speed would be slow. With the toggle lever too far back, the breaker would be hard to close.

If there is any suspicion that the stop settings have been disturbed, check the 11-27/32" dimension between pins (29) and (66). This dimension may be easily checked by removing cover, Item 20, and reaching through hand hole with toggle position gauges furnished with each order. This gauge is a go-no-go gauge, so that the ± 1/16" tolerance on the 11-27/32" dimension is automatically assured if the gauge drops into place over the pins. It has been found that the travel is equalized better between all 3 poles by setting this dimension at 11-27/32" for #1 pole, 11-3/4" for #2 pole, and 11-5/8" for #3 pole. Thus 3 gauges are furnished for checking these dimensions. Gauges are marked according to pole No. - #2 and #3 poles are combined into one piece.

Provision has been made for connecting a time-travel recorder from outside the breaker. Removing the cap over the lift-rod stop will permit a travel-recorder rod to be screwed into a projection on the upper end of the lift rod which has a No. 10-32 tap. This arrangement may also be used to measure contact engagement as explained under "Contact Adjustment and Inspection."

In order to cushion the breaker-opening stroke, oil bumpers (13) in each pole unit operate over the last 2-1/2 inches of travel. Using washers under the bolt head in bumper rod Item 21 drawing 41A9981 as required, the bumper height determines the breaker stroke. This is not a critical setting, but it should be possible to get 20 inches ± 3/8 inch stroke as indicated. The bumpers should be fully depressed in each pole, so that the bumpers in all three poles will share the load equally. The reservoirs fill automatically when the breaker tanks are filled.

It will be noted that roller bearings are used at several points in the lever system to reduce friction and speed up the opening time. The bearings inside the tank are constantly exposed to an atmosphere of oil vapor and splashing during operation and hence need no lubrication attention. The bearings on the main shaft (32) and pull rod lever (33) are provided with alemite grease fittings (18) which should be lubricated with a pressure gun, using Westinghouse grease #9921-4, as part of the regular breaker maintenance program.

BELL CRANK ASSEMBLY

Additional mechanical advantage is provided at the bell crank as shown on dwg. 44A4265 to air the pneumatic mechanism 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. This is obtained by adjusting the length of the vertical pull rod (3) to make the machined surface on lever (6) level when the breaker is closed.

It will be noted that roller bearings are used on the shaft and at both ends of lever (5). The four alemite fittings (31) for these bearings should be lubricated with a pressure gun, using Westinghouse grease #9921-4, as part of the regular breaker maintenance program.

ACCELERATING SPRING

In addition to the acceleration provided by the contact springs and pole unit lever springs, an additional spring shown on drawing 41A5998 is mounted on #3 pole, commonly known as the "tail" spring. This assembly consists of a spring operating on the horizontal pull rod to provide acceleration over the opening stroke. The spring is arranged so that it is not effective over the initial portion of the closing stroke - this free travel is provided to aid in fast reversal of movement for high speed reclosing operations. The solid lines show the spring for the closed position of the breaker. The spring compression may be changedif necessary as indicated in Part 2 by adjusting the self-locking nut (7). It is only necessary to remove small auxiliary cover (9) in order to make this adjustment.

INTERRUPTOR OPERATION

One interruptor as shown on dwg. 501F665 is mounted on each condenser bushing, with a bridging cross-arm member to complete the circuit. The interruptor assembly consists of four independent arc rupturing units in series mounted inside insulating tube (3), making a total of eight breaks per pole.

The orifice and venting arrangement on each grid unit (9) is such that pressure for driving fresh, un-ionized oil into the arc stream is self-generated. On an interrupting operation the contacts are rapidly opened by the breaker accelerating springs which act on the cross-arm (2), by the spring acting on the multiple moving contact (7), and by the three springs inside the piston (3) on dwg. 701C424. Four arcs in series are drawn between the moving contact members (7) and the stationary contact members (14) in each interruptor assembly. The arc is drawn from the arc resistant tips at the lower ends of the fingers, while the upper ends of the fingers remain engaged with the next adjacent moving contact member at all times. A clearer picture of the moving and stationary contact sub-assemblies may be gained by looking at drawings 701C420 and 702C767.

In order to assure 3 cycle interruption on low currents, an auxiliary oil flow piston (3) dwg. 701C424 is included. When the contacts open, the spring seat is released, and the three springs behind it force it downward 1/2" before picking up the piston (3). There is no spring acting directly on the piston - this delayed action permits the contacts to have sufficient break distance before the oil flow is effective in order to reduce the probability of re-strikes on charging current interruptions. The oil below the piston is forced down inside the tube (3), where the only escape is through the orifices of the grid units (9). (Dwg. 501F665)

The auxiliary oil flow piston also performs a flushing action immediately following each fault interruption, clearing out all gas and other 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 holds the piston up until the interruption is completed, after which the piston is free to perform the flushing by action of its own driving springs.

To permit refilling the interruptor with oil, check valves are provided at the top and bottom. These valves also permit circulation of oil to keep the temperature rise down on normal current flow. Oil pressure due to an interruption or operation of the piston (3) dwg. 701C424, causes the check valves to close automatically.

In order to distribute the voltage equally between the interruptors in each pole, a combination of resistors (31) and capacitors (14) are shunted across each interruptor. The small tube (31) contain resistors of 2.2 megohms each - 4.4 megohms per pole. The purpose of the resistors is to divide the normal 60 cycle voltage. The large tube (14) contains capacitors having a reactance of 83 micro-micro-farads per interruptor - 41.5 micro-micro-farads per pole. The purpose of the capacitors is to divide high frequency impulse voltages. The resistor and capacitor current is but a fraction of an ampere which is broken within one cycle after the main interruption takes place. This is the only current broken by the cross-arm (2).

In order to cushion the mechanical shock of a tripping operation, the moving contact (7) strikes dash-pots in the bottom cover (23). The closing operation shock is cushioned by an oil dash-pot in either end of the cross-arm (2) as shown on dwg. 701C963.

CONTACT ADJUSTMENT AND INSPECTION

The adjustment of the interruptor assemblies, previously covered in Part 2, is extremely simple. It is only necessary to adjust the cross-arm (2) on the Micarta lift rod to get 3/32" ± 1/32" clearance between projection on cross-arm and bottom cover (23).

On routine inspections, a fairly good idea of the condition of the contacts may be obtained by measuring the contact engagement without draining the oil from the tanks. Referring to pole unit lever drawing 41A9981, connection may be made to the lift rod through the tank top by removing 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 engagement by screwing a 3/16 inch diameter rod with No. 10-32 threads on one end into the top of the lift rod. Close the breaker slowly by hand until the contacts just touch as checked by "Lighting out" between bushing terminals. Check the position of the 3/16 inch diameter rod and measure the travel between this point and the latched position of the breaker - this will be about 1/2" for normal contact setting. If any pole shows considerably less than this on routine inspection, it is an indication of severe burning or loose contacts, and the oil should be drained from the tanks for a complete inspection.

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 voltage dividing resistors (31) may also be checked conveniently without draining oil from the tanks. 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 sets of resistors in series. The nominal value for this reading is 4.4 megohms, but a ± 15 percent variation from these figures is permissible - greater variations should be cause for draining oil and making thorough investigation. Since part of the resistor circuit is through the sliding contact of the moving contact through the bottom cover, 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. 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 interruptors. The resistance of the units may vary somewhat from the nominal 2.2 megohms (due to aging) as long as the two 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. Periodic inspection of the capacitor units is not necessary.

Referring to drawing 501F665, the condition of the contacts may be observed by removing grid blocks (9). Grid blocks slide out of the tube (3) readily after removing "O" rings (6), pin (5) and locking plate (34) on one side. Note that the grid blocks are reversible, so that they may be turned upside-down to equalize any burning of fibre and thus double their life. All of the 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. It is expected that the contacts may be smoothed off many times before replacement is necessary.

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

(1) Check all nuts and bolts for tightness.

(2) Try check valves for freedom of movement.

(3) Check dash-pots on ends of moving contact cross-arm (dwg. 701C963 for freedom of movement and shunts on underside for tightness.

REMOVAL OF CONTACTS FROM STATIONARY ASSEMBLY

If there is enough burning to warrant removal of the contacts, this may be done with the interruptor mounted on the condenser bushing in the following manner:

1. With the breaker closed, install the work platform in bottom of the tank.

2. Open breaker by hand until the bottom of the moving contact cross-arm is approximately 2" from surface of the platform.

3. Remove "O" rings, locking pins and locking plates (Items 6, 5, and 34 of dwg. 501F665) and bonded grids (9). (See drawing for correct orientation when reassembling.)

4. Remove bottom shield (10).

5. Remove bottom casting assembly (23), holding casting in place when removing last nut (28) and then lower carefully to clear moving contact (7). Examine the two dashpots in the bottom casting for freedom of movement (they can easily be compressed by hand). If there is an accumulation of grit, remove mounting bolts and clean dashpots thoroughly. Examine that the check valve is operable and has 1/16" clearance between the washer and the plate.

6. Remove lower contact (Item 6, of dwg. 701C420) of the moving contact assembly (7) dwg. 501F665 by bending open locking clips (Item 9, dwg. 701C420), and remove the two mounting bolts (Item 10, dwg. 701C420).

7. Remove all caps, Item 16 dwg. 501F665 and all plugs (13).

8. To provide clearance when removing the internal contact assemblies of the interruptor, remove the fibre nut and pin from the lower end of the lift rod guide. This will allow the lift rod and moving contact cross-arm to be swung out from under the interruptor.

9. Replace the lower bonded grid (9) dwg. 501F665 into the tube (3) but do not lock in place. Remove screws (17) and replace with bolts and washers (24, 25). (See section "BB" of dwg. 501F665 and photograph.) Tighten bolts (24) to contract the fingers of the intermediate contact assembly (4) releasing the moving contact (7), which is prevented from dropping by the bonded grid (9) previously inserted for this purpose.

10. Reach inside the tube and lift up slightly on the moving contact to permit withdrawal of the bonded grid. Swing the cross-arm from under the interruptor and lower the moving contact assembly (7) out of the tube. (See view on dwg. 382D664.)

11. The two intermediate contact assemblies (4) dwg. 501F665 may now be removed by first removing 4 bolts (20) and the upper two retracting bolts (26). Each assembly is now held to the tube (4) by one retracting bolt (24). Support assembly inside the tube, remove retracting bolt and lower assembly from tube.

With the contact assemblies removed, it is possible to inspect the inside of the interruptor tube and the lower end of the top casting assembly. If this is the extent of the disassembly the components can be reassembled in the reverse order and the only breaker adjustment to be checked is the 3/32 ± 1/32 inch dimension between the bottom plate and cross-arm. Also jack the breaker closed and open to check movement of assembled interruptor.

If for any reason it is necessary to internally inspect the top casting assembly, it may be disassembled as follows:

1. Loosen top shield (Item 11, dwg. 501F665) by removing screws and bushings (Items 12 and 18, dwg. 501F665). Lower top shield exposing the 8 bolts (Item 22, dwg. 382D664) which hold the stationary contact to the bushing stud. Remove remaining bolts (Item 22, dwg. 382D664), lower the stationary contact assembly and remove from tank.

2. Referring to dwg. 501D665, free the top casting assembly (8) from the interruptor tube (3) by removing the 6 nuts (28).

3. Referring to dwg. 701C424 (Gr. 3) it is necessary to remove the contact foot (23) from the top casting (21) to permit inspection of the piston and spring seat. The four red nuts (28) are spring loaded, and extreme caution should be taken when attempting their removal. Use top casting assembly tool 702C989 Gr. 1. Assemble the details as shown and release the spring pressure by screwing out the two bolts Item 5 simultaneously after having removed the four nuts, Item 28 dwg. 701D424. When the spring load is released, remove the contact foot.

4. Remove the springs (24), (25), (26) the spring seat (5) and piston (3) from the top casting.

The top casting and contacts are reassembled by reversing the procedures outlined above. Since the stationary contact assembly was removed from the bushing it will be necessary to recheck dimensions as stated in "Stationary Contact, Assembly and Adjustment," under Part 2.

When making routine inspections, the following points should also be checked on the contact assemblies:

1. Check all nuts and bolts for tightness.

2. Examine the check valves for freedom of movement.

3. Check dashpots on ends of moving contact cross-arm, dwg. 701C963, for freedom of movement and shunts on the underside for tightness. (The dashpots are considered to have freedom of movement if they can be rotated slightly.)

PART 4 - MAINTENANCE

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

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

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

Where an inspection schedule other than the yearly General Inspection is set up, we recommend that each breaker be given a Routine Inspection once yearly and that it be given a General Inspection at least once every three years. The significance of the two types of inspections 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. Maintain ground while work is going on. The larger bushings have a rather high capacity which may cause serious shock to workmen.

ROUTINE INSPECTION PROCEDURE (When Not Draining Oil)

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 engagement - see "Contact Adjustment and Inspection", Part 2 on how to check without draining oil.

4. Measure resistance of voltage dividing resistors on interruptors - see "Contact Adjustment and Inspection", Part 2 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 (When Draining Oil)

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.

In preparing to make an inspection of a breaker, the following steps should be taken:

(a) Open disconnecting switches to isolate the breaker from the system.

(b) Ground the bushing terminals solidly and maintain this condition while work is going on.

(c) Close the breaker electrically with the pneumatic mechanism.

(d) Drain oil from the tanks obtaining test samples if necessary.

Additional precautions should be taken before entering the tanks:

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

(b) Establish adequate ventilation preferably using a fan or blower to force air into the tanks.

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

(d) To preclude accidental closing by the mechanism, 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.

(e) To preclude accidental tripping of the mechanism, insert the safety pin above the trigger, and install the jack tightening it snugly against the mechanism spring housing.

Before disturbing any parts, check adjustments 1 to 3 below to give an indication of the condition of the breaker when removed from service.

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. If preferred, the lift rod and toggle stop clearance may also be checked with manual operation of the breaker at a later stage in the inspection procedure.

2. Check oil dashpots in each pole unit lever system to determine that they are working freely. (Item 15, drawing 424D110)

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 remove bonded grids from the stationary contact assemblies. 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, the contacts should be removed and reconditioned or replaced (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 while the bonded grids are removed from the tube. (For dimensions see section on Stationary Contact Assembly and Adjustment.)

5. Open the breaker and check dashpots on the ends of the moving contact cross-arm, drawing 701C963 for freedom of movement and shunts on the underside for tightness. (The dashpots are considered to have freedom of movement if they can be rotated slightly.)

6. Reassemble all components carefully after inspection. Be sure that the bonded grids are replaced in the tube so that the locking pins are vertical. (See drawing 501F644.)

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 wood-Micarta lift rods and guides in the same manner. Clean all carbon from the stationary contact assemblies.

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

9. Check dielectric breakdown strength of the oil.

10. Replace oil, remove safety pin and remove hand jack as instructed by nameplate attached to the mechanism cylinder, open the hand valve between reservoir and mechanism, energize the control circuits, and check closing and tripping operation using all relays and circuits usually involved in the operation of the breaker.

11. Operate breaker several times after which check contact engagement by "Lighting out" for reasons covered in "Operation and Timing Test".

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

<u>NOTE: If it is necessary to make any re-adjustments, it is recommended that a re-check of the operating speed be made as indicated in Part 2 under Operations and Timing Test.</u>

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 22,000 volts, the oil should be looked upon with suspicion, and in no case should it be allowed to drop below 20,000 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 and included in this instruction book. This leaflet should be studied for complete recommendations on maintenance of bushings.

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

BUSHING CURRENT TRANSFORMERS

If it should be necessary for any reason to replace a current transformer, this may be done without removing either the condenser bushing or stationary contact. It is necessary to remove only the moving contact cross-arm and lift rod guide. Refer to pole unit dwg. 382D664 for assembly, and dwg. 382D654 for method of handling transformers.

The transformer must first be disconnected at the terminal box on top of the pole unit, and also it is necessary to loosen the compression seal inside the terminal box (Item 10, dwg. 44A4260). 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.

In order to handle the heavy transformers used on the 345 kv breaker, a hand operated winch and a special tray are provided to facilitate lowering or raising. Drawing 382D654 has explanatory notes on how to use the winch. It will be noted that the winch may be pivoted to favor either terminal, and that an extension is used on the tray guides for the longer metering transformer. The purpose of the telescoping guides on the tray is to obtain a low center of gravity, but to permit raising the tray high enough to bolt the transformer into position.

Since the condenser bushings are mounted on a 14° angle, it will be necessary to tie a rope to the tray in order to pull toward the center of the tank while lowering. The weight of a relaying type transformer is 350 lb., while the metering type transformer weighs 700 lb.; however, the side pull required may be handled easily by one man.

Tighten the compression seal inside the terminal box until the wires are held snugly. No sealing compound is used with the compression seal.

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

OIL GAUGE

A float type oil gauge which screws into each tank top is provided. 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 re-assembling, so that water will not enter the tank at this point.

OPERATING MECHANISM

Complete instructions for operation and maintenance of the pneumatic operating mechanism are given in a separate instruction book which accompanies this book, identified by I.B. 33-125-C4.

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 the illustrations of this book. Identify the breaker by including the type, amperes, volts and Shop Order (S.O.) Number, as stamped on the nameplate.

345 KV [illegible]

Valley [illegible]

[illegible] MW [illegible]

[illegible]

-130 MV [illegible]

[illegible]

440 M.V. @ [illegible]

[illegible] MV [illegible]