I.B. 33-820-C10

RECEIVING • INSTALLATION • MAINTENANCE

INSTRUCTIONS

BV-5 33-1-820-5

WATCH-CASE

De-ion® Grid

OIL CIRCUIT BREAKER

Outdoor Type 2300-GW-15,000

230/196 Kv, 1600 Amperes
3-Cycles
15,000,000 Kva

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

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

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

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

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De-ion Grid Outdoor
OIL CIRCUIT BREAKER

PART 1 - RECEIVING, HANDLING & 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 continued 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 welded to an I-beam base arranged for mounting on a suitable foundation, and provision is made for securing the base rigidly to the foundation by bolts and holding down clamps. Tie rods are welded between the tops of the pole units to further insure accurate and permanent spacing and alignment. 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 47-A-6528 and 404-D-975 Fig. 2.

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 are shipped completely assembled except for condenser bushings and contacts, which must be removed for shipping clearance. The crates containing bushings, contacts, floor clamps, etc., may be identified by proper checking of the 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, and "De-ion Grid" 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.

Do not remove the oiled paper covering from the "De-ion Grid" stacks until ready for installation. Do not allow the "De-ion Grid" stacks to become exposed to moisture at any time. It is possible for the fibre in these stacks to absorb enough moisture, either from direct contact or from a humid atmosphere, to swell and warp out of shape. For this reason, if the stacks are to be stored for any length of time, or any spare units are involved, they should be kept in containers filled with WEMCO "C" oil.

The operating mechanism housing is weather-proof, 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 weight of the breaker without bushings or contacts is 31,000 lbs. The breaker should be lifted by lifting rods in I-beam base rather than anywhere near top, as shown on outline Dwg. 404-D-805. The weight of each condenser bushing is 1800 lbs. This information should serve as a guide to the strength of cranes or other lifting means required for handling the breakers.

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.

Before unpacking the condenser bushings read carefully Instruction Leaflet 33-155-1 which is sent with each bushing.

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 removed. Always look for a wire holding the mechanism triggers and latches from jarring loose during shipment.

MOUNTING

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

Mounting the 3-pole welded unit is quite simple, since individual poles are already aligned with one another. After the unit is leveled, tighten floor clamps securely - see drilling plan on outline dwg. 404-D-805 for placement of clamps.

BUSHING CURRENT TRANSFORMERS

Current transformers are shipped assembled in the breaker. Short leads are provided from each tap on each transformer to terminal blocks in a small weatherproof box on top of each pole unit. The lettering on these terminal blocks corresponds to the transformer ratio and connection diagram. The long leads connected to the terminal blocks for each transformer run through conduit into the mechanism housing, where additional terminal blocks are provided for terminating these leads and selecting the desired ratio.

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

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 1800 lbs. An auxiliary hoist will be required to attach to the top cap fitting to balance and up-end the bushing to the proper 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 below the upper porcelain fitting, and a second sling to the top cap. Great care must be exercised in lowering the bushings into position to avoid damaging either the porcelain on the lower end or the insulation on the inside of the transformer. Before lowering the bushing into position be sure the 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. Before tightening the holding bolts, the bushings should be accurately aligned with respect to the center-lines of the tank, and the lower ends spaced the proper distance apart as indicated on pole unit section drawing 404-D-975. 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.

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 the effect of a short circuiting turn and would throw the transformer off ratio.

CONTACT ASSEMBLY AND ADJUSTMENTS

With the bushings in place, the stationary contact assembly may next be assembled on the lower end of the bushing studs. The contact feet on the two bushings must be located at exactly the same height, being sure to get full length of engagement on the threads. The contact feet are not clamped until the final

contact adjustments have been made. The stationary contact assembly may be lifted into position and bolted to the contact foot. Do not assemble the contact shields until the final adjustments have been made.

The final alignment of the stacks cannot be made until the moving contact is in place. The wood-Micarta lift rod should first be hung in position on the main lever of the pole-unit lever mechanism. In order to maneuver the lift rod into position for attaching to the main lever, it is first necessary to remove the cover plates, item 48, and pin, item 19 dwg. 47-A-6528, so that the lower toggle lever, item 7, can be swung out of the way. 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 stacks. 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, 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 pipe beside the lift-rod stop. 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". Note the horizontal alignment dimension of the dashpots at either end of the moving contact cross-arm should be centered on the lower moving contact of the 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 7 dwg. 30-B-9424 - clamping nuts, item 5 must be loose.

3. By tipping cross-arm on its lift rod to engage both lower stationary contacts simultaneously. This adjustment should be made sparingly - larger adjustments may be obtained by changing height of one contact foot on bushing stud.

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.

Refer to contact assembly drawing 2-X-232 for contact adjustments.

With breaker closed and 1/16" clearance obtained at all lift rod and toggle stops, adjust moving cross-arm (3) on its lift rod to get 3/32" ± 1/32 clearance between projection on cross-arm and bottom cover (11) on interruptor.

This may be checked with feeler gauge without removing lower static shield item 5. 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 III. Be SURE to release fingers to their normal position before attempting power closing.

After contact adjustments have been made in all 3 poles, check for 1/16" clearance at all lift rod and toggle stops, indicated as items (70) & (71) of lever dwg. 47-A-6528. This clearance may be checked by removing pipe plugs inside of lever box opposite each stop. Since breakers have been set up and adjusted at factory, the stop clearances should check very closely. For basic stop settings and operating rod adjustments which may be checked on subsequent maintenance of breaker, see PART 3.

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 on bumper rod, item 42, dwg. 47-A-6528. Adjust to 16 travel ± 3/8" per Gr. #2.

POWER CLOSING

The breaker is now ready for power closing. Before starting up the air compressor or operating the pneumatic mechanism be sure to study carefully Instruction Book 33-125-C3.

The breaker may be tripped without oil in the tanks if the reservoirs around the oil bumpers are filled by hand - This may be done by removing 1/2" pipe cap at side of bumper casting. However, the breaker should not be tripped any more than necessary to check operation and timing, since the oil dash pots on the lower end of the moving contact in the interruptors are not effective without oil in the tanks. It is suggested that preliminary timing tests of the breaker opening speed be taken at this time - see subsequent section titled "OPERATION AND TIMING TESTS".

Use minimum air pressure on the mechanism, and check closing operation. The breaker will slam too hard at higher pressures without the cushioning effect of the oil. Do not make trip free operations without oil in the breaker tanks. It is desirable to operate the breaker several times in order to take up any slack in adjustments. The pressure drop in the air reservoir should be about 8 lbs. for each operation. If much higher than this, the breaker will not operate enough times on one tank of air and is an indication of - (1) too much contact compression, (2) improper contact alignment, or (3) excessive air loss in pneumatic mechanism.

After the operations, recheck all contact adjustments and stop clearances and make any necessary adjustments.

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

Check to be sure that all nuts and bolts are securely tightened, and that cotter pins are in place.

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

There are two copper-alloy pads located diametrically opposite either end of I beam base. 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 inside of the mechanism-housing door pocket 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-C3 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 except energizing of the power line, 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 and have been lubricated. Excessive lubrication will pick up dirt and is not necessary. 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.

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 compression is obtained when the breaker is closed. Open the breaker slowly by hand. The movement of the breaker on opening and closing should be free and without friction.

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

11. 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.

12. 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-filled 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. When carbonized oil is removed from a circuit breaker in service, thoroughly clean all carbon from the interior of the circuit breaker, so that the new oil will not be contaminated. This may be done by flushing with clean insulating oil and wiping with clean, dry cotton cloths. Cotton waste is undesirable on account of the lint which may be introduced into the oil. The preparation and filling of outdoor apparatus should be preferably 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 will occur and moisture will 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.

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

Fill the oil tanks to the proper level with WEMCO "C" oil. Oil which has a dielectric strength of less than 22,000 volts when tested by the usual method 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 Westinghouse Instruction Book 44-820-1 for proper methods of testing and handling.

OPERATION AND TIMING TESTS

Starting at normal air pressure (marked on mechanism nameplate) on the pneumatic mechanism, check the breaker for number of closing operations per tank of air with the compressor shut off. If all adjustments are correct, there should be at least five operations before the low pressure cut-off switch on the pneumatic mechanism opens the control circuit, and one or two more reserve operations beyond this. Be sure to use a jumper across the low pressure cut-off switch (see control diagram) when counting operations. If the number of operations is less than this, it is an indication of:

(1) Too much contact compression

(2) Improper contact alignment

(3) Excessive air loss in pneumatic mechanism.

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

Check the opening time and reclosing time (if required) of the breaker with a graphic recorder, or preferably an oscillograph for best accuracy. In order to be sure of getting 3 cycle arc interruption, the time from energizing the trip coil until the contacts part should not exceed 2 cycles (60 cycle basis). Contact parting time on all three poles should be checked. The average lift rod speed as measured by the slope of a straight line between one point on the opening curve one inch from the closed position and another point on the curve 5 inches from the closed position should fall within the range of 14 to 16 feet per second. If the breaker is slower than this, it may be due to any of the following reasons:

(a) Improper contact alignment.

(b) Insufficient accelerating (tail) spring compression.

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

(d) Incorrect trip armature setting on pneumatic mechanism.

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 projection on the upper end of the lift rod is provided with a 10-32 tap, so that a 3/16" diameter rod with 10-32 threads on one end may be passed through the tank top and screwed into this tapped hole.

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 this purpose.

PART 3 - ADJUSTMENT AND MAINTENANCE

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 47-A-6528 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 (8) 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-inch clearance at both the toggle stops (71) and lift rod stops (70) 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 II. It should be remembered that the stops have been properly set at the factory; all adjustments should be made to give the 1/16-inch clearance without changing the position of the stop bolts. If the toggle lever (3) were permitted to go too far forward, the link (4) would strike the shaft (9) 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 "A" dimension on each pole. This dimension may be easily checked by removing cover, item 75, and reaching through hand hole with toggle position gauges furnished with each order. This gauge is a go-no-go gauge, so that tolerance on the "A" 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 according to the tabulation shown for each pole. Thus 3 gauges are furnished for checking these dimensions. Gauges are marked according to pole No. - #2 & #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 compression as explained under "Contact Adjustment and Maintenance".

In order to cushion the breaker-opening stroke, oil bumpers (10) in each pole unit operate over the last 2-1/2 inches of travel. Using washers under the bolt head on the bumper rod as required, the bumper height determines the breaker stroke. This is not a critical setting, but it should be possible to get 16 inches $\pm$ 3/8 inch stroke as indicated. With correct adjustments, the bumpers in all three poles will share the load equally. The oil bumpers are surrounded by a small reservoir, so that the breaker may be operated a number of times without oil in the tanks. The reservoirs fill automatically when the breaker tanks are filled, or can be filled by hand when the breaker is first installed.

It will be noted that roller bearings are used on the main shaft and at the pin on the pull rod lever (2). The three alemite grease fittings (61) & (62) for these bearings should be lubricated with a pressure gun, using

Westinghouse grease #9921-4, as part of the regular breaker maintenance program.

OPERATING ROD ADJUSTMENTS

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 5 Drawing 33-A-9850) between the bell crank and #1 pole. This may be done by removing the pull rod box cover at #1 pole, removing pin through crank arm, loosening clamping bolt (item 33 Drawing 33-A-9850) in rod end (23), and turning rod end in half-turn steps. When removing the pin, it may be found convenient to block the breaker part way closed by placing a block on one of the oil bumper rods (item 42 Drawing 47-A-6528). At this time it would be wise to check the position of the bell crank lever-referring to drawing 39-A-9850. The vertical pull rod should be adjusted if necessary to get the dimension of 1-21/32 shown between the center of the bell crank shaft and the center of the pin connected to the horizontal pull rod when the breaker is closed and latched. 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.

BELL CRANK ASSEMBLY

The bell crank used on this breaker is a simple, single lever, as shown on drawing 39-A-9850, Gr. #1 line 2. The lever arms for the vertical and horizontal pull rod are at 30^{o} to each other, 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.

It will be noted that roller bearings are used on the shaft and at both ends of link (5). The four alemite fittings 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 drawing 55-B-3434 Gr. #2 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 spring compression may be changed if necessary as indicated in Part 2 by adjusting the self-locking nut (15)

OIL GAUGE

A float-type oil gauge is provided, which screws into each tank top. The gauge is marked for normal oil level at $25^{o}C$; 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 gaskets at top and bottom of glass, and tighten cap so that glass is held in proper position. Then fill bottom end of guard with Westinghouse cement No. 690-2. In case any threaded parts are dismantled, use Westinghouse cement No. 672 when re-assembling, so that water cannot enter the tank at this point.

CONDENSER BUSHINGS

Instruction Leaflet 33-155-1 is sent with each condenser bushing. This leaflet should be studied for information on handling and maintenance of bushings.

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 effects the ratio.

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

INTERRUPTOR OPERATION

One interruptor as shown on dwg. 2X232 is mounted on each condenser bushing, with a bridging cross-arm member to complete the circuit. The interruptor assembly consists of two independent arc rupturing units in series mounted inside a Micarta tube (6) making a total of 4 breaks per pole.

The orifice and venting arrangement on each grid unit (7) 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 spring which act on the cross arm (3), by the spring acting on the multiple moving contact (12), and by the three springs inside the piston (16). Two arcs in series are drawn between the moving contact members (12) 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 33-B-5614 Gr. #2 and 45-A-6180 Gr. #8.

In order to assure 3 cycle interruption on low currents, an auxiliary oil flow piston (16) 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 (16). 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 restrikes on charging current interruptions. The oil below the piston is forced down inside the Micarta tube (6), where the only escape is through the orifice of the grid units (7).

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 (16) causes the check valves to close automatically.

In order to distribute the voltage equally between the interruptors in each pole, a combination of resistors and capacitors (30) are

shunted across each interruptor. The two outside tubes contain resistors. The five inside tubes contain capacitors with 178.5 micro-micro-farads per interruptor.

In order to cushion the mechanical shock of a tripping operation, an annular groove in the lower casting of the moving contact (12) forms a dash-pot with the bottom cover (11). The closing operation shock is cushioned by an oil dash pot in either end of the cross-arm (3) as shown on 30-B-9424.

CONTACT ADJUSTMENT AND MAINTENANCE

Adjustment of the contacts has been fully explained under Part 2. It is only necessary to adjust the cross-arm (3) on the Micarta lift rod to get 3/32" ± 1/32 clearance between projection on cross-arm and bottom cover (11).

On routine inspections, a fairly good idea of the condition of the contacts may be obtained by measuring the contact lap without draining the oil from the tanks. Referring to pole unit lever Drawing 47-A-6528, connection may be made to the lift rod through the tank top by removing the cover 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 be also 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 3/4" for normal contact setting. If any pole shows considerably less than this on routine inspection, it is an indication of severe contact 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 (30) 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 terminal. This will give the reading of two parallel sets of resistors in series which is the same as the reading for one resistor. The nominal value for this reading is 1.0 megohm, but a ± 15% variation is permissible-greater variations should be cause for draining oil and making a 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 1.0 megohm (due to aging) 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.

Referring to dwg. 2X232 the condition of the contacts may be observed by removing the grid blocks (7). Grid blocks slide out of the tube (6) readily after loosening bolts (28) far enough to permit rotating locking plates (27) on one side. Note that the grid blocks are reversible, so that they may be turned up-side 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.

CONTACT REMOVAL

If there is enough burning to warrant removal of the contact, this may be done rather easily in the following order with the breaker open:-

(1) Remove bolts (28 & 37) and locking plates (27).

(2) Remove fibre grid blocks (7)

(3) Insert clamping pieces (23, 41, 42) provided through top grid block hole as shown in sec BB. Tighten the clamps so as to relieve the spring pressure of finger contacts against the inside of the tube.

(4) Remove lower static shield (5)

(5) Loosen lower end of lift rod guide and swing the lift rod and cross-arm out of the way.

(6) Remove bottom cover casting (11) cautiously-complete moving and stationary contact assembly which weighs about 50 lbs is now resting on bottom cover, and is ready to drop out when the cover is removed. Driving spring for moving contact (12) is retained by contact extension (15), so that the only force on the cover is the weight of the contacts.

(7) Lower the moving and stationary contact assembly out of the tube. Refer to subassembly dwgs. 45-A-6180 and 30B5614 to see how contact elements are fastened onto the "ladders".

If for any reason it is desired to remove the moving contact ladder (12) separately, this may be done as shown by Sec C-C dwg. 2-X-232. Remove bolts (28 only) and locking plates (27) so that socket head cap screws (32) provided may be inserted to retract the fingers individually. With the finger pressure released and the bottom shield (5) and cover (11) removed, the moving contact ladder is free to drop out.

It is not likely to be necessary to dissemble top casting (8) with piston and spring assembly. However, if this does become necessary, it may be done in the following manner:-

(1) Remove upper static shield (4)

(2) Detach interruptor assembly from contact foot (2) by removing bolts (22) and then lower the whole assembly to the work platform.

(3) Detach top casting (8) from interruptor complete with piston and springs by removing bolts (39).

(4) Using special jack screw bridge tool provided per item 5 dwg. 29-B-8932, compress moving contact driving spring so that contact extension (15) may be detached by removing 1/2" socket head bolts.

(5) Using jack screws provided per item 2 dwg. 29-B-8932, remove top plate, which relieves the load of the three springs inside piston (16).

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

1. Check all nuts and bolts for tightness.

2. Examine the check valves for freedom of movement.

3. Check dash pots on ends of moving contact cross-arm (dwg. 30-B-9424) for freedom of movement and shunts on underside for tightness.

CURRENT TRANSFORMERS

Bushing-type current transformers, supplied only when ordered, are mounted in transformer cases in the top of the pole units (Reference dwg. 404-D-975). Transformers are usually of the multi-ratio type having four leads which provide a wide range of ratios. Each has an identification tag for external connections. Short leads from all taps are carried in conduit through a seal plug (13) to terminal blocks in a small box on top of each pole unit. The long leads for each transformer should be

connected to the corresponding points on these blocks, and then carried through conduit to the terminal blocks in the mechanism housing located on No. 1 pole. Connections to relays may be made at these blocks, selecting the desired ratio.

Do not confuse the polarity of the bushing current transformers. Refer to the polarity, ratio, and connection diagrams sent out with each order which show how to connect the transformer to its circuit.

CAUTION: Be sure that the 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.

If it should be necessary for any reason to replace a current transformer, first remove the stationary contact and interruptor stack so that the transformer may be slipped down over the condenser bushing. The transformer may be disconnected at the terminal box on top of the pole unit. However, before the transformer can be removed, it is first necessary to loosen the compression seal inside the terminal box. This seal consists of a sandwich of two Moldarta pieces with a slice of Neoprene rubber in between, through which the transformer leads are threaded.

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

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

OPERATING MECHANISM

Complete instructions for operation and maintenance of the operating mechanism are covered by a separate instruction book. This instruction book is sent out with each breaker together with the breaker instruction book.

CARE OF OIL

WEMCO "C" is recommended for all oil circuit breakers. The Westinghouse Electric Corporation cannot assume the 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 in order to maintain it in good condition. The more handling which insulating oil receives, the greater the opportunity for contamination, unless adequate precautions are taken.

It is recommended that operators prepare a schedule for inspection based on operating conditions. Reference to the station log on the operation of the circuit breakers, together with the record of dielectric tests of the oil should determine the frequency of inspection and test. The period between successive inspections should never be longer than six months. When the dielectric strength of the oil drops to 20,000 volts, the oil should be looked upon with suspicion and in no case should it be allowed to drop below 16,500 volts when tested by one of the usual methods with electrodes 1-inch in diameter and spaced 0.1 inch apart. It is essential that the proper oil level be maintained in the circuit breakers. Considerable change may be caused by changing temperature or possible leakage of oil. Low oil levels may cause flashover of bushings or failure to properly handle heavy interruptions. Oil

bumpers may be uncovered and fail to provide proper cushioning effect. Attention is again called to Westinghouse Instruction Book 44-820-1, a manual covering the care and maintenance of oil, and should be referred to before any attempt is made to test or purify the oil.

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 given a general inspection at least once every six months. Oil samples should be taken and tested, and the mechanical operation of the breaker and the contact compression checked, using the method described under "Contact Adjustment and Maintenance". At least once a year the oil should be drained and the breaker given a thorough inspection.

An operation counter is mounted on the operating mechanism to show the number of closing and tripping operations of each breaker. However, neither the number of operations nor the length of time between inspections is to be taken as the only basis for determining the maintenance required. Short-circuit or heavy-overload interruptions place mechanical strains upon the breaker, and also reduce the dielectric strength of the oil. After each interruption at or near the breaker rating the mechanical operation should be checked, the condition of the contacts observed, and the oil tested. The breaker may be allowed a number of less severe interruptions before being inspected; operating experience will dictate the frequency of maintenance.

If it is found necessary to make any breaker readjustments it is recommended that a recheck of the operating speed be made with a graphic recorder as indicated in Part 2 under "FINAL INSTALLATION INSPECTION".

Maintenance and power-factor testing of condenser bushings should be given consideration during breaker inspection. Refer to condenser bushing manual Technical Data 33-156, for complete recommendations on bushing maintenance. A copy of this manual may be obtained from any Westinghouse Sales Office.

CAUTION: Before working on a breaker which has just been disconnected from the line, be sure that the condenser bushings have been discharged by grounding the terminal end. These bushings have a high capacity which might cause a serious shock to workmen.

GENERAL INSPECTION PROCEDURE

In making a general inspection of the breaker the oil is drained from the tanks and before disturbing any parts, the following adjustments should be checked to give an indication of the condition of the breaker as removed from service for the inspection.

CAUTION: Close the hand valve between the compressor and the mechanism and open the control circuit before entering the tanks so that an accidental operation of the magnet valve or contactor will not cause the breaker to close unexpectedly. Insert the safety pin above the trigger on the pneumatic mechanism.

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

2. Check clearnace at overtravel stop above main lift rod and at toggle stop on pole-unit lever system.

3. Remove the grid blocks from the grid assembly. Note the condition of the contact faces. A slight 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.

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

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

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

7. Check the pole-unit mechanism to make sure there are no loose bolts and nuts and that there are no cotter pins missing.

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

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

10. Check air system on pneumatic mechanism for leaks.

11. Check control wiring for loose connections.

12. Check dielectric breakdown strength of oil.

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

14. Check oil bumper cylinders to be sure they are working freely.

15. Refer to lever dwg. 47-A-6528 and bell crank dwg. 39-A-9850 and grease all the roller bearings. The alemite fittings for these bearings should be lubricated with a pressure gun, using Westinghouse grease No. 9921-4. This grease has been especially selected to be free flowing over a wide temperature range.

16. Replace oil and check closing and tripping operation, using all usual relays and circuits involved in the operation of the breaker.

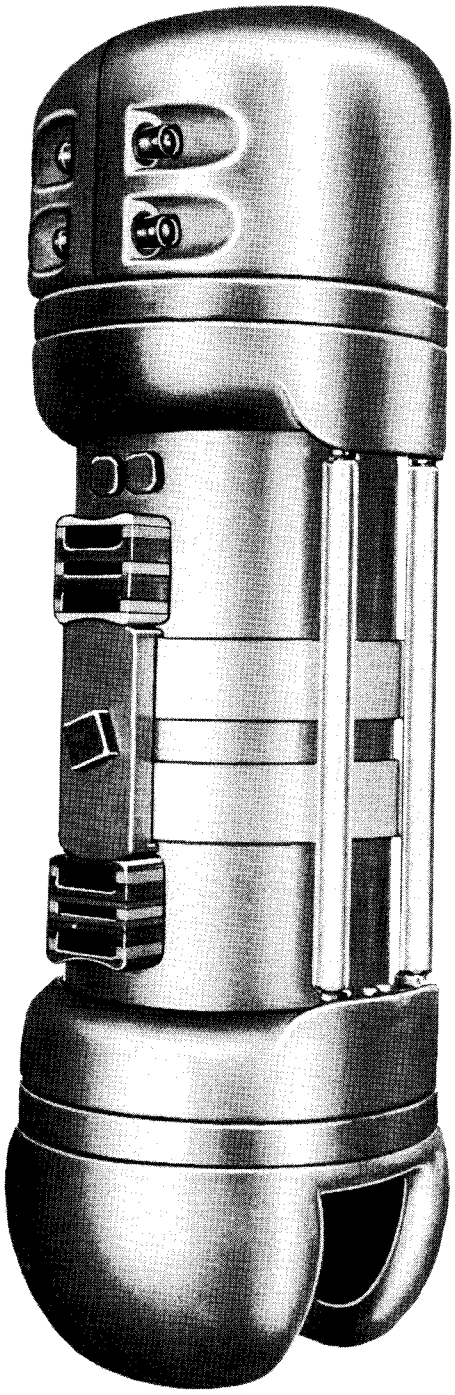
17. Check tripping at reduced voltage to insure safety margin.

Note:- If it is necessary to make any readjustments, it is recommended that a recheck of the operating speed be made, as indicated under "Operations and Timing Tests" Part II.

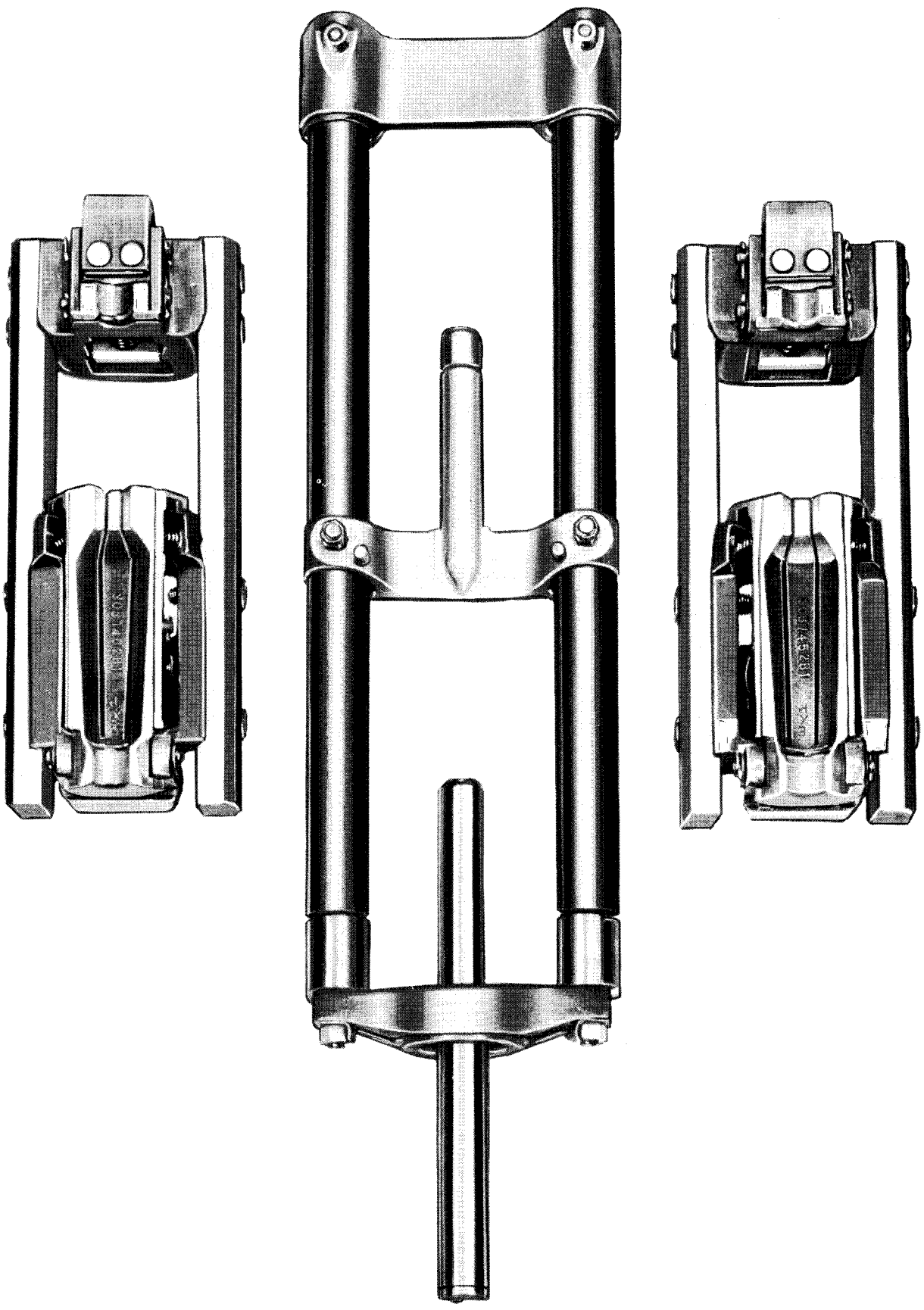
RENEWAL PARTS

When ordering renewal parts, specify the name of the part, giving the name shown in the illustration in this book or the mechanism instruction book. Identify the breaker by giving the breaker Type, Amperes, Volts, and Shop Order (S.O.) Number as found engraved in the nameplate.

At any time a breaker fails to operate properly and the trouble cannot be found or corrected, notify the nearest Westinghouse Sales Office or Service and Repair Shop for assistance.



Interrupter Assembly



Contactor Sub Assembly