Westinghouse

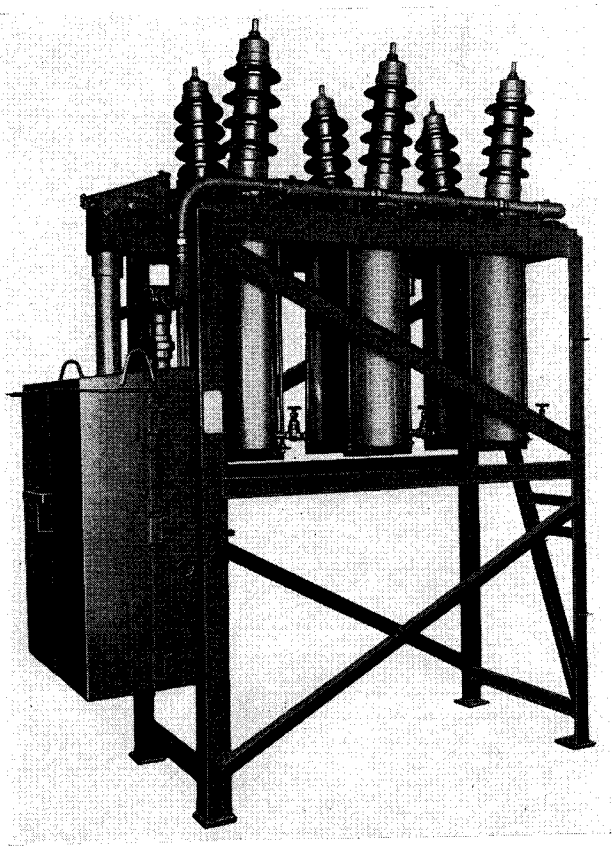
"De-ion" Grid

Outdoor Oil Circuit Breakers

Type GO-1A—34.5 Kv.—600 Amp.

Type GO-1A—46 Kv.—600 Amp.

INSTRUCTION BOOK



60-1A 34.5 Kv., 600 Amp. Oil Circuit Breaker

Westinghouse Electric & Manufacturing Company

East Pittsburgh, Pennsylvania

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I.B.—33-746

COMMUNICATIONS

When communicating regarding a Product covered by this Instruction Book, replies will be greatly facilitated by citing complete NAMEPLATE READINGS of the involved Products. Also, should particular information be desired, please be very careful to clearly and fully STATE THE PROBLEMS AND ATTENDANT CONDITIONS.

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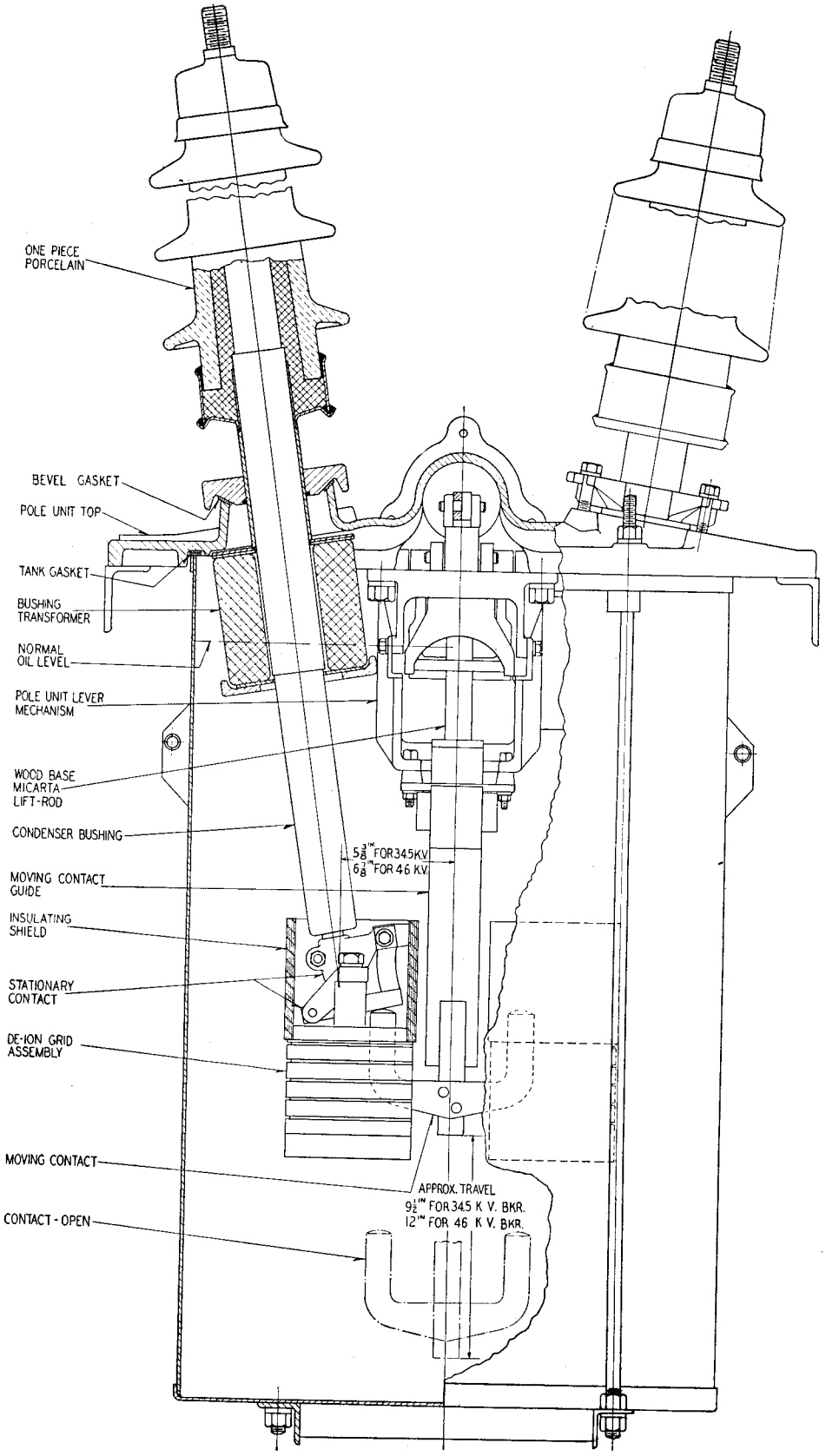


FIG. 1—POLE UNIT CROSS SECTION

Westinghouse

"De-ion" Grid Outdoor Oil Circuit Breakers

Part I
INSTALLATION

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 the N.E.M.A. Switchgear Standards, published by the National Electrical Manufacturers' Association. A number of the instructions for the general installation and care of circuit-breakers have been copied without change from the N.E.M.A. Standards.

A review of the technical discussions on the action of the "De-ion" Grid oil circuit-breaker will be helpful to all who are responsible for the satisfactory operation and maintenance of these breakers. The following publications will be of interest:

1. Extinction of a Long A-c. Arc, by Dr. J. Slepian—A.I.E.E. Trans., Vol. 49, 1930.
2. The Use of Oil in Arc Rupture, by B. P. Baker and H. M. Wilcox—A.I.E.E. Trans., Vol. 49, 1930.
3. Field Tests on "De-ion" Grid Breakers, by L. W. Dyer—Electrical World, April 19, 1930.
4. 220 Kv. Tests on "De-ion" Grid Breakers, by L. W. Dyer—Electrical World, April 26, 1930.

The oil circuit breakers described in this instruction book are of 250,000 kv-a. interrupting rating. Each breaker has three elliptical steel tanks bolted to three cast steel tops. Each tank top supports its own pole unit levers and two condenser bushings. The stationary contacts are secured to the lower end of the bushings and the moving contact cross bar is carried on the lower end of the wood base Micarta lift rod which in turn is suspended from the main lever of the pole unit mechanism.

Bushing type current transformers are supported beneath the pole unit top, one around each bushing (when ordered).

The 3 pole units are mounted upon a common structural supporting frame and are connected by suitable pull rods for operating the three poles. Weatherproof fittings protect the operating rods. Interpole conduit and fittings carry the transformer secondary wiring to suitable terminal blocks in the operating mechanism housing mounted on the end of the supporting frame.

Within the operating mechanism housing are located the operating mechanism with its control panel and other auxiliaries and accessories. The several component parts briefly referred to here are described in detail under their respective designations on pages following.

SHIPMENT

All oil circuit breakers are assembled and given complete commercial tests at the factory. The breakers covered by this instruction book are normally shipped completely assembled. Each breaker is carefully inspected and prepared for shipment by workmen experienced in the proper handling and packing of electrical equipment.

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 Sales Office notified promptly.

STORAGE

When an oil circuit-breaker can be set up immediately in its permanent location, it is advisable to do so even though it will not be placed in service for some time. The protective covering should not be taken from the insulators until after the breaker has reached its permanent location, all overhead work completed, and all tanks filled with oil.

If the breaker cannot be installed in the final location immediately, and it is necessary to store the equipment, it should be protected from possible mechanical injury, and internal insulating parts protected against moisture. Special care should be taken to protect machined parts of the operating mechanism, etc., against rusting by coating with grease or a good rust inhibiting material. If the breaker is stored for any length of time, it should be inspected periodically to see that rusting has not started.

There are several dehydrating materials which may be used to advantage as an assistance in protecting the breaker during temporary storage. Among these are Silica-Gel and Activated Alumina. Three or more small bags of one of these materials may be hung within the operating mechanism housing and some within each pole unit, in case the breaker cannot be filled with oil during storage. It must be understood that these materials are not 100% moisture absorbent, nor are they continuously effective over long periods. They are suggested only as offering some added protection in conjunction with other reasonable precautions.

If it is not feasible to fill the tanks with oil for storage over a long period of time, the insulating parts, including condenser bushings, lift rods and guides, "De-ion" grid stacks, should be removed and stored in a dry place. **DO NOT ALLOW THE "DE-ION" GRID STACKS TO BEOME EXPOSED TO MOISTURE AT ANY TIME.** It is possible for the fibre in these stacks to absorb enough moisture, either from direct contact or from a humid atmosphere, to swell and warp out of shape. Under extreme conditions the swelling may even break the stack tie rods. We strongly recommend that the "De-ion" Grid stacks be stored under WEMCO "C" oil.

HANDLING

The total weight of the breaker without oil is given on the nameplate located on the supporting frame. Breakers may be lifted by hooking onto the supporting frame.

When using cable slings for moving the apparatus, do not allow the slings to strike the condenser bushings, as any strain on these may cause them to crack or break. Do not lash the breaker down to a truck or car by the condenser bushings when transporting it. The skids on which the breaker is mounted for shipment should be left with the circuit-breaker, as they will be found convenient for use in moving the breaker to its foundation. Special care must be exercised to see that the apparatus is not injured through shock or jars, due to rough handling.

The center of gravity of these breakers is rather high; when moving, care should be taken to prevent their tipping over.

LOCATION

The breaker should be located so that it will be readily accessible for cleaning and inspection. Sufficient space must be provided for operation of the hand closing lever and tank lifter, and opening mechanism housing doors. The breaker foundation should be sufficiently high so that water will not enter the operating mechanism house during flood conditions.

UNPACKING

Most of the instructions under this heading will not apply for breakers normally shipped completely assembled.

When unpacking the circuit-breaker, the crating or boxing must be removed carefully. The 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 the instructions on page 8.

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 the Instruction Books and tags are kept with the circuit-breaker.

It is well to remember that details which have been removed from the breaker after factory tests are identified by number markings which correspond to the serial number of the breaker and the terminal or pole location. The left hand terminal of the pole unit next to the mechanism, when facing the mechanism end of the breaker, is 1 and the right hand terminal is

2. The left hand terminal of the second pole unit is 3 and the right hand terminal is 4. Likewise, the third pole unit has terminals 5 and 6.

Blocks and wire used to hold the 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 level in order that the moving parts within the breaker shall operate freely. Otherwise friction will develop, and undue strains will be imposed upon the lift rods and other moving contact details which may cause breakage or defective operation. Also, the mechanism housing may be twisted so that the doors will bind.

In preparing the foundation for the breaker, the drilling plan sent from the factory should be carefully followed. The nuts on the foundation bolts should be left loose until the breaker frame is properly plumbed and leveled, by inserting shims where necessary, so that the breaker rests solidly on the foundation. The foundation bolts should then be securely tightened.

The breakers covered by this instruction book are normally shipped completely assembled with condenser bushings, contacts, operating mechanisms, etc. It should only be necessary to carefully remove the breaker from its skids onto the permanent foundation before making the installation inspection given on page 4.

BUSHING CURRENT TRANSFORMERS

Current transformers (when ordered) are shipped assembled in the breaker. Refer to Fig. 5 and 6. Short leads are provided from each tap on each transformer to the respective condulet opposite each condenser bushing. Each lead is identified by a metal tag. Two leads are supplied from each condulet to terminal blocks in the operating mechanism housing. If the desired ratio has been specified in ordering the breaker, the two leads will be connected to the leads from the proper taps and the terminal block suitably marked. If the ratio was not specified, it will be necessary to connect the two long leads to the desired tap leads and to suitably mark the terminal block when installing the breaker.

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

CONDENSER BUSHINGS

These circuit breakers are normally shipped with the condenser bushings assembled in place. The outer end of each bushing is covered with suitable packing to protect the porcelain insulator which should be checked for possible damage. See instructions IL-3930 and IC-3828 for the handling of bushings.

CONTACTS

Breakers are tested for proper contact adjustment before shipment and should require only an inspection to be sure that no parts have become loose or damaged in transit. Fig. 4 will indicate the proper contact compression.

TANKS

These breakers have removable tanks which fit against a gasket in the breaker top. It is very important that the tank bolts be drawn up tight. This is to prevent throwing of oil when interrupting a short circuit, as well as to prevent entrance of moisture.

OIL GAUGE

All breakers are provided with gauges for indication of the level of oil within the tanks. The oil level should show at all times. Change in temperature will cause considerable change in the depth of oil within the tank. Normal level is shown for oil at approximately 25°C.

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 carrying capacity to avoid heat being transmitted into the breaker bushing. All joints must be clean, bright, and free from burrs.

CONTROL WIRING

All control wires to the circuit breaker should be run in conduit when practicable. A diagram pasted 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 cause slower closing time on solenoid operated breakers.

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

GROUNDING CONNECTIONS

Each tank top is provided with two ½"—13 tapped holes located 1¾" apart for grounding purposes in accordance with A.E.I.C. specifications (Association of Edison Illuminating Companies). However, some operators find it more convenient to ground the breaker supporting frame. A permanent low resistance ground is essential for adequate protection. A poor ground may be worse than no ground at all, since it gives a feeling of safety to those working around the equipment.

FINAL INSTALLATION INSPECTION

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

1. **All insulation and parts within the 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 packing materials and have been lubricated. Excessive lubrication will pick up dirt and is not necessary.**
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. See Part II for correct adjustments. 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 tight so that moisture cannot enter the circuit breaker through any of these gasketed joints.**
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. **Check the electrical operation of the breaker several times.**

PLACING OIL IN SERVICE

The most careful precautions must be taken to insure the absolute dryness and cleanliness of the apparatus before filling it with oil, and to prevent the entrance of water and dirt during the transfer of the oil to the apparatus. When putting a new circuit-breaker into service, see that the tank is free from moisture and foreign material. 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. As far as possible, lowering the tanks should be avoided at times when there is an appreciable difference between the temperature of the oil and the surrounding air.

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 instruction book on insulating oil No. 65-000 for proper methods of testing and handling.

Do not allow the tank-holding bolts to go without one or two inspections after the breaker is installed. Draw the nuts as tight as possible when first installing the breaker, then after a period of from three (3) days to one (1) week take up whatever slack may be found. To insure a positive tight joint a third inspection should be made after about twenty (20) days.

Part II

ADJUSTMENT AND MAINTENANCE

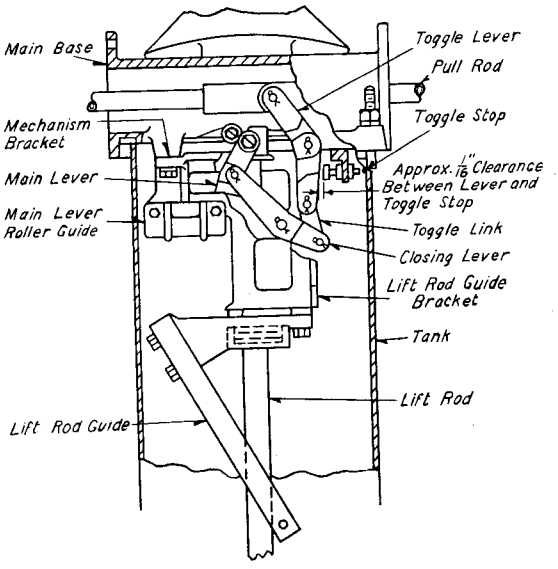
GENERAL

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.

TOGGLE LEVER MECHANISM

This mechanism, located in the upper part of each pole unit, operates the lift rod which carries the moving contact. Reference to Figure 2 will show that the lever mechanism consists of four members identified as: toggle lever, toggle link, closing lever and main lever. The toggle action is between the toggle lever, toggle link and one end of the closing lever. With the breaker closed the middle toggle pin (connecting the toggle lever to the toggle link) is kept at least one half its diameter back of the line of dead center through the 3 pins of the toggle. With closer setting than this, the pin friction may result in failure to open when the operating mechanism is released. With the toggle pin too far from dead center the breaker will be hard to close.

An adjustable toggle stop is provided to stop the toggle levers in the proper position. When the toggle members are in the correct position as indicated in above paragraph, there should be a $\frac{1}{16}$" clearance at the stop in the normal closed position if the toggle stop is adjusted correctly. This allows the closing mechanism a little over-travel so that it will have an op-



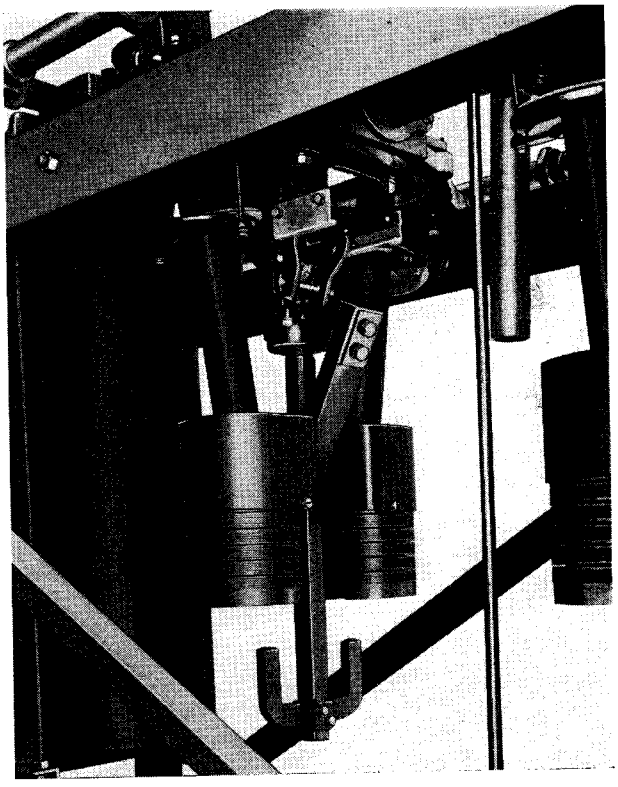


FIG. 2—POLE UNIT LEVER ASSEMBLY

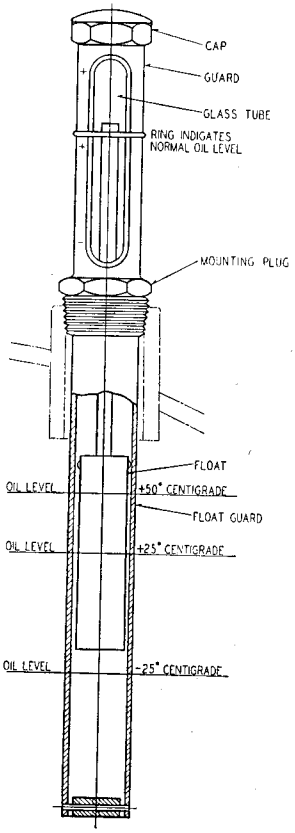


FIG. 3—FLOAT TYPE OIL GAUGE

portunity to latch without placing undue strains on any of the parts.

The stops have been set and locked at the factory at the most desirable setting and under usual conditions should not be changed. **Do not change the stop adjustments without first making sure that the toggle members are in the proper position.**

BUMPERS

A bumper in each pole is provided to stop the moving contact in the open position. The bumper consists of leather washers between steel washers and is located in a pocket in the moving contact guide support.

In the open position, weight of all moving contacts should rest equally on all 3 bumpers, so that the opening shock is divided equally among the 3 pole units.

OIL GAUGE

An oil gauge is provided on each pole unit for indicating the proper level of oil in the tank. This gauge is of the float type and is located on the breaker top instead of being mounted on the tank. In order to indicate the level to which the tank is to be filled when standing on the ground, a line is marked on the inside of the tank.

The construction of the gauge is shown in Fig. 3. 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 glass, and tighten cap so that glass is held in proper position. Then fill bottom end of guard with Westinghouse cement, P.D. Spec. No. 690-2. In case any threaded parts are dismantled, use Westinghouse cement, P.D. Spec. No. 672 when reassembling.

CONDENSER BUSHINGS

Instruction Leaflet I.L.-3930 and Instruction Card I.C.-3828 for the handling of bushings have already been referred to on page 3. These should be carefully read, particularly when handling separately shipped bushings. Certain general precautions should be observed:

Do not store bushings under a leaky roof, where water will drip on them, or in any extremely damp place. It is desirable to store spare bushings with the lower end under WEMCO "C" oil.

When assembling a condenser bushing in a breaker, care should be taken to prevent it from striking against the sides of the opening in the breaker top, and thus damaging the Micarta of the bushing. Likewise care should be exercised to prevent the end of the bushing stud from striking and damaging the insulation on the bushing current transformer.

Remember to put the weather-proofing bevel gasket in place between the bushing flange and bushing seat in the breaker top—it is not necessary to use cement on this gasket. The beveled faces on flange and seat permit accurate alignment of the bushing. The flange bolts should be tightened uniformly around the flange with the gasket carefully placed to insure a moisture-tight joint between flange and breaker top.

When in service, do not permit the brass sleeve 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.

Caution—Before working on a breaker which has just been disconnected from the line, be sure that the charging current of the condenser bushing has been removed. The larger bushings have a rather high capacity and a serious shock might be received unless the bushing has been discharged by grounding the terminal end.

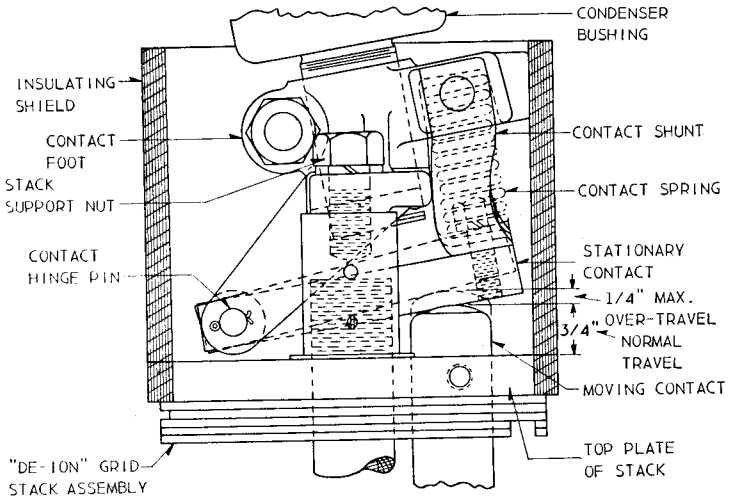


FIG. 4—BUTT TYPE CONTACT ASSEMBLY

INSTRUCTIONS FOR ADJUSTING BUTT TYPE CONTACTS AND "DE-ION" GRIDS

1. The breaker toggles should be checked for proper clearance at the toggle stops with the breaker in the closed position.

2. The breakers are shipped from the factory completely assembled and with proper adjustments. However, it is always advisable to check these adjustments before placing the breaker in service. Adjustment of the contact pressure may be made by raising or lowering the stationary contact assembly on the condenser bushing.

Make sure that the contact spring maintains good pressure at all times and that the contact shunt is replaced if the strands of wire in it begin to show breakage.

Keep the contact travel as near as possible to the original setting—see Fig. 1.

Be sure that the bolts on the moving contacts are kept tight.

3. Whenever assembly of the stationary contacts is found necessary, the contact supports should be screwed on the condenser bushing in such a position that approximately the full thread length of the support is engaged on the bushing stud. The insulating shield should then be slipped on over the contact support, and the "De-ion Grid" stack secured to the contact support. It must be remembered that the insulating shield will not pass over the "De-ion Grid" stack, and therefore, it is necessary that this shield be slipped over the condenser bushing and tied up out of the way until all contact adjustments have been made.

4. The setting of the condenser bushings controls the clearance on the moving contact member when it is passing through the slot in the grids. It is important that care be used when the final setting of the bushings is made, as it is necessary to have the contact member centered with the grid slots.

5. The proper contact pressure will be obtained when the stationary contact is in the closed position as shown.

6. After the contacts have been properly adjusted and the clamping bolts on the contact supports have been tightened, the insulating shields may then be lowered and fastened in place.

7. When making these final adjustments of the contacts, if it is found necessary to remove the lift rod from the lift rod guide, Bakelite Cement should be used to re-seal the fibre pins which hold the micarta tubes in the lift rod guides.

Caution: The grid stacks have been assembled under pressure and the large nuts on the two studs should not be removed. The whole stack should be handled as a unit. If it is necessary to remove the stack from the contact bracket this may be done by removing the two steel bolts which are tapped into the large nuts.

ACCELERATING SPRING

A compression spring on the end pole (farthest from operating mechanism) is provided to open the breaker quickly. This spring is adjusted at the factory to give proper contact speed on opening and should not be disturbed.

OIL

The Westinghouse Electric and Manufacturing Company assumes the responsibility of circuit-breaker operation only when the insulating oil employed is in accordance with its recommendations. WEMCO "C" oil is recommended for all oil circuit breakers.

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 an 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 of the operation of the circuit breakers, together with the record of dielectric tests of the oil should determine the frequency of inspection and test. 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 1″ diameter electrode discs 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 change of temperature, rupturing of heavy currents, or possible leakage of oil. Low oil levels may cause flashover of bushings or failure to properly handle heavy short circuits. Attention is called to Westinghouse Instruction Book No. 65-000, which is a manual covering the care and maintenance of oil. The operator should become familiar with this book before any attempt is made to test or purify the oil.

ELECTRIC OPERATING MECHANISM

Power for closing the breaker is provided by the electric operating mechanism attached to the end of the breaker frame. The auxiliary switches should require no adjustment after being set at the factory. The two pole switch operates to cause the trip free control relay to cut off the closing coil current as the breaker comes closed. The cut-off must be as near the end of the closing stroke as will allow the mechanism to close completely and latch positively. The length of the switch lever and the length of the operating rod are adjustable. Spare contacts are available on the 10-pole auxiliary switch for interlocking and control.

It is important to keep the tripping latch clean so that the breaker will try unfailingly at all times. The latching surface may be cleaned and polished by fine emery cloth if it has become dirty or rusty. **Do not attempt to grind or change the angle of the latch.** The space heaters provided should be used at all times (summer included) to prevent condensation within the mechanism housing. It has been found that a good grade of rust inhibiting material is desirable for the latching surfaces and other polished metal surfaces in extremely corrosive atmospheres; however, this should be only a thin film so as not to pick up dirt. The tripping latch should be examined at every routine inspection to make certain that it is not gummed up.

See the operating mechanism instruction book for further detailed description.

CONTROL

The control panels for the operating mechanism often differ because of varying operating conditions and requirements of installation. A control diagram is pasted inside the mechanism housing on each breaker which should be followed when connecting and checking the control circuits.

When checking closing time on solenoid-operated breakers in the field, it is sometimes found that closing is slower than the factory timing. Factory timing tests are made with normal voltage **at the coil** with **full closing coil current flowing.** Field installations often have normal voltage on open circuit, but line drop with closing current flowing results in subnormal voltage at the closing coil and hence slower closing time. However, unless closing time is important to the customer, this should not be any cause for concern as long as the breaker will close positively on the minimum control voltage likely to be encountered. Factory tests insure that every breaker will close at 72% of normal voltage (under load) at the coil terminals.

RECTOX OPERATION

When Rectox rectifiers are furnished for operation with circuit-breakers, Instruction Card No. 1782 is shipped with each Rectox, and must be carefully followed both for installation and operation. There are several possible control schemes, dependent upon the a-c. supply voltage, the method of tripping and other conditions. The wiring diagram previously mentioned under "control" should be followed carefully. Special care is required because this apparatus is for intermittent duty only. In case more than one breaker is operated from the same Rectox, care should be taken that only one breaker is connected to the Rectox at any given time.

The Rectox for circuit breaker operation is rated for intermittent duty. If the breaker fails to close after the control switch has been held on "close" for approximately one second, the operator should release the control switch in order to prevent injury to the Rectox. Protection against burn-out is provided by a thermal breaker in the control circuit which opens after several seconds, but the one second precaution by the operator will prevent premature aging of the Rectox.

A resistor is connected in series with the a-c. side of the Rectox and is adjusted at the factory to give the necessary d-c. voltage to operate the breaker. However, the internal resistance of the Rectox increases with age due to an inherent characteristic, thereby decreasing the d-c. voltage. This may be compensated for varying the adjustable resistor, but will not be necessary very often.

Additional data pertaining to the Rectox rectifier may be obtained from the nearest district office.

CURRENT TRANSFORMERS

Bushing type current transformers, supplied when ordered, are mounted on transformer supports in the top of the pole units. Transformers are usually of the multi-ratio type having five leads which provide a wide range of ratios as illustrated by the accompanying tables. Each has an identification tag for external connections. The transformer leads are run through conduit to terminal blocks in the mechanism housing at the end of the breaker. Connections to relays may be made at the terminals on these blocks.

Do not confuse the polarity of the bushing transformers. Figures 5 to 9 show how to distinguish the polarity and how to connect the transformers to their circuit.

If it should be necessary for any reason to replace a current transformer, first remove the stationary contact and "De-ion" Grid so that the transformer may be slipped down over the condenser bushing. The transformer may be disconnected at the condulet on the outside of the breaker near the condenser bushing. However, before the transformer can be removed, it is first necessary to melt the gum at the Micarta seal plug adjacent to the condulet. This plug will probably be damaged beyond use, so that it will be necessary to use a new plug with the new transformer. The transformer leads should be threaded through the seal plug before bolting the transformer support in place. Care should be taken to see that the packing on top and bottom of the transformer is in place. **Be sure to place the end of the transformer carrying the white polarity mark upward. Also, see that the transformer is not thrown off ratio by allowing the support to touch the brass sleeve on the condenser bushing.** Replace the gum (Westinghouse compound #1003) at the seal plug in order to prevent leakage of gas into the mechanism housing which might explode due to arcing of the closing contactor.

MULTI-RATIO TRANSFORMERS

Multi-ratio transformers are shown schematically by Fig. 10. Ratio tables for standard transformers are:

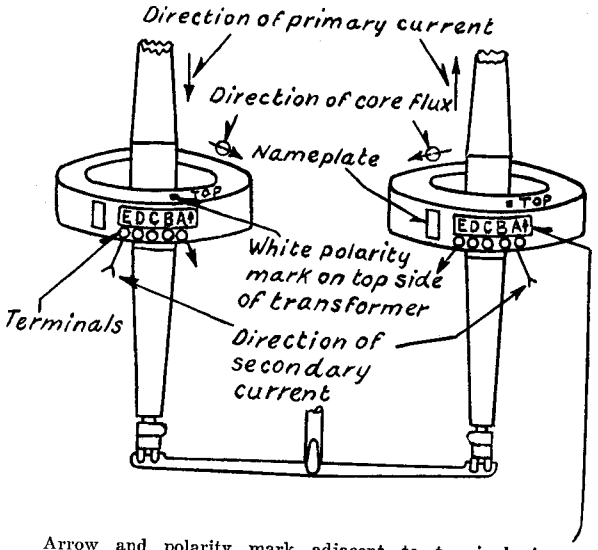
600/5 MULTI-RATIO TABLE

Approximate *Ratio	Turn Ratio	Secondary Taps
50 to 5	10 to 1	B—C
100 to 5	20 to 1	A—B
150 to 5	30 to 1	A—C
200 to 5	40 to 1	D—E
250 to 5	50 to 1	C—D
300 to 5	60 to 1	B—D
400 to 5	80 to 1	A—D
450 to 5	90 to 1	C—E
500 to 5	100 to 1	B—E
600 to 5	120 to 1	A—E

1200/5 MULTI-RATIO TABLE

Approximate *Ratio	Turn Ratio	Secondary Taps
100 to 5	20 to 1	B—C
200 to 5	40 to 1	A—B
300 to 5	60 to 1	A—C
400 to 5	80 to 1	D—E
500 to 5	100 to 1	C—D
600 to 5	120 to 1	B—D
800 to 5	160 to 1	A—D
900 to 5	180 to 1	C—E
1000 to 5	200 to 1	B—E
1200 to 5	240 to 1	A—E

**Not compensated for secondary loading. For performance, see excitation curves.*



Arrow and polarity mark adjacent to terminal A indicates "Like Polarity" for the marked primary (the end of the breaker terminal opposite the breaker contacts) and the marked secondary (Terminal A).

FIG. 5—ARRANGEMENT OF TRANSFORMERS ON OIL CIRCUIT BREAKERS

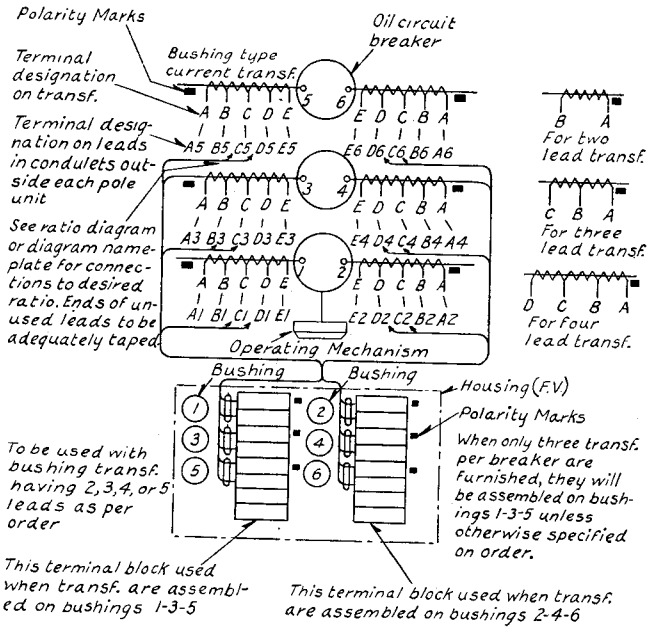


*FIG. 6—BUSHING TRANSFORMER CONNECTIONS ON OIL CIRCUIT BREAKERS

***Note for Fig. 6**

On frame mounted breakers having two lead (single ratio) transformer, the secondaries will be wired to the terminal blocks which will be marked with both the transformer lead and the bushing number the same as shown for terminal designation on the leads in the condulets, i.e., A2 and B2, A4 and B4, A6 and B6, A1 and B1, A3 and B3, A5 and B5.

Where transformers having three or more leads (two or more ratios) are furnished and the shop order specifies the ratio to be used, the connections for the specified ratio will be made and the terminal blocks marked accordingly. If the desired ratio is not specified, two leads for each transformer will be connected to the terminal blocks and tagged with the bushing number, i.e. bushing 1, 3 and 5 and/or bushing 2, 4 and 6. It will be necessary for customer to connect these two leads in each condulet to the proper transformer leads to obtain the desired ratio and mark the terminal blocks accordingly.

SINGLE AND DOUBLE RATIO TRANSFORMERS

Single and double ratio transformers are compensated for the loading specified when ordered. The diagram for these transformers and their markings correspond to that of the multi-ratio transformers. Lead "A" is always of the same polarity and the direction of flux and currents are the same as for the multi-ratio transformers. The low ratio is A—B, the next higher ratio A—C and the next higher ratio A—D, etc., for the higher ratios. For double ratio transformers only A—B and A—C are used.

HIPERNIK TRANSFORMERS

Hipernik transformers of special nickel steel are used for accurate metering and in some instances for very low ratios with low energy relays. When used for watthour metering, ratio and phase-angle curves are recommended for each design of transformer. Provision for such curves should be made when ordering transformers for this purpose.

While Hipernik is superior to standard transformer steel over the metering ranges of primary currents, there is little difference in performance over the overcurrent ranges for the same size and ratio transformer.

Typical performance data as outlined in circuit breaker descriptive data Sec. 33-765 will be supplied on request.

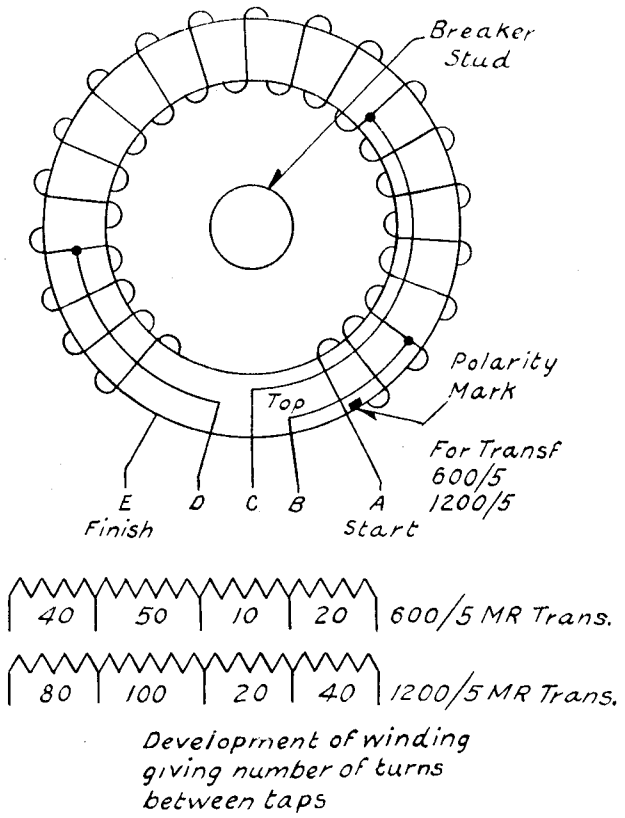


FIG. 10—TRANSFORMER CONNECTION CHART

CIRCUIT-BREAKER MAINTENANCE

It has become the practice of operating companies to establish a system of regular and frequent inspection of their apparatus. Oil circuit breakers especially, due to the nature of their function, should be inspected thoroughly at least once every six months. Oil samples should be taken and tested, and the mechanical operation of the circuit breaker checked.

Operation counters are mounted on the electric mechanisms 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.

A small amount of burning or pitting of contacts is not detrimental to proper breaker operation. When the contacts become pitted so that they no longer make good electrical contact, or the moving contact is in danger of fouling in the "De-ion" Grid slot, they should be hammered back into shape and filed smooth. After the stationary contacts have become burned to a depth of $\frac{1}{16}$" or greater, they should be removed and machined down to smooth metal. This may be done several times before replacement is necessary. The moving contact should be replaced after it has burned away to the point where it is no longer possible to maintain proper contact adjustment.

Routine maintenance should also cover inspection of gaskets, conduits, tank fittings, etc., to insure that no moisture can get into the breaker.

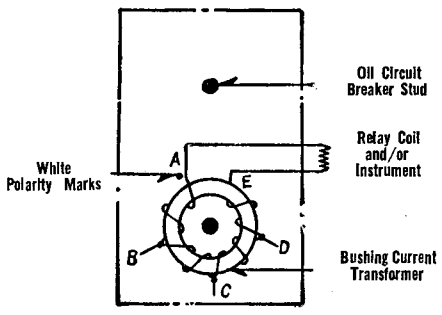


FIG. 7—CONNECTIONS FOR ONE TRANSFORMER PER BREAKER POLE

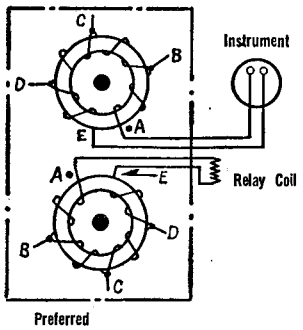


FIG. 8—CONNECTIONS FOR TWO TRANSFORMERS PER BREAKER POLE. INDEPENDENT LOADING RECOMMENDED FOR INSTRUMENTS

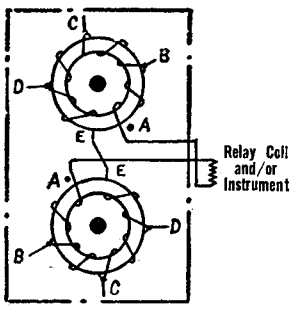


FIG. 9—CONNECTIONS FOR TWO TRANSFORMERS PER BREAKER POLE. SERIES ARRANGEMENT. COMMON LOADING

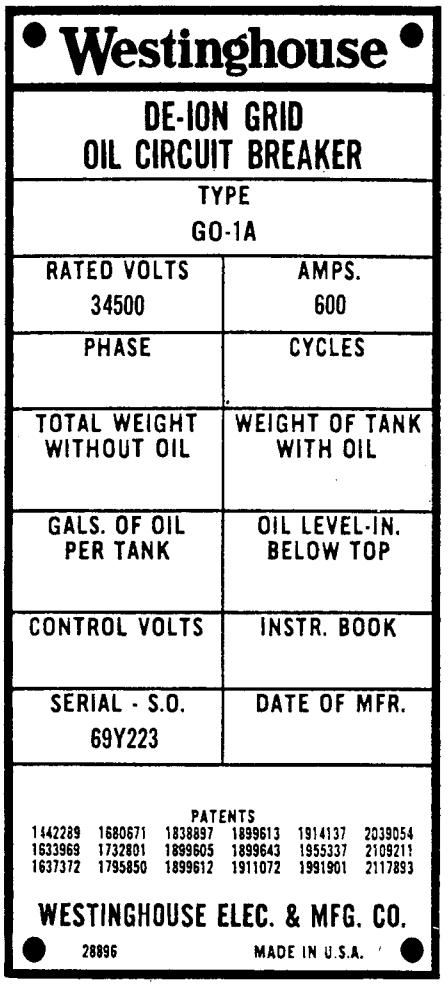


FIG. 11—BREAKER NAMEPLATE

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. Fig. 11 illustrates the breaker nameplate and shows what information should be given in addition to the name of the part required.

At any time a breaker fails to operate properly and you are not able to locate and remedy the trouble, you should notify the nearest Westinghouse Sales Office or Service and Repair Shop for assistance.