Westinghouse

Type SAF-4 Solenoid Operated Mechanism for Circuit-Breakers

INSTRUCTION BOOK

Westinghouse Electric & Manufacturing Company
East Pittsburgh, Pa.

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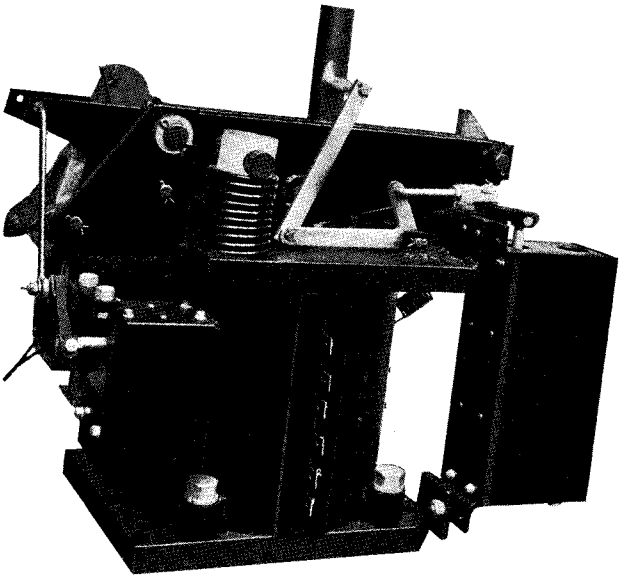


FIG. 1—MECHANISM—CLOSED POSITION

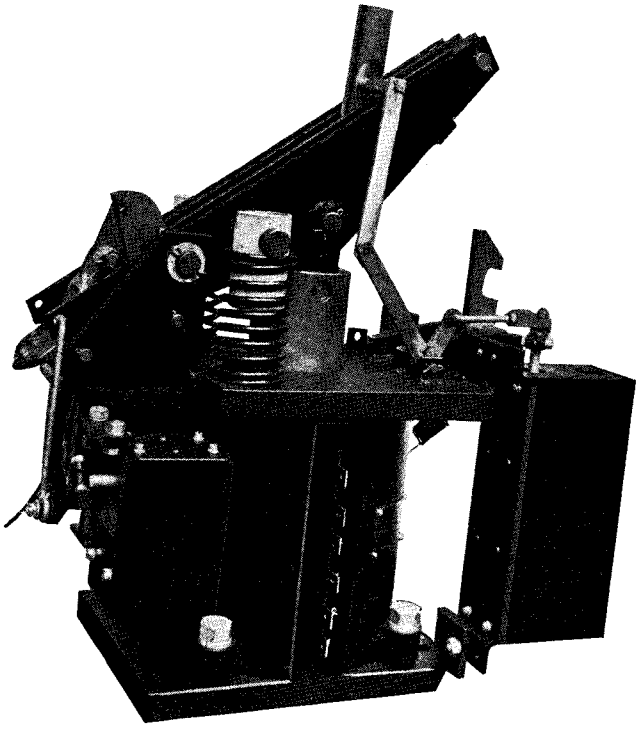


FIG. 2—MECHANISM—OPEN POSITION

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Type SAF-4 Solenoid Operated Mechanism for Circuit-Breakers

Introduction

This mechanism is of the direct current solenoid type, mechanically full automatic, trip free in all positions. It is applicable to indoor and outdoor service and is supplied complete with operation counter and auxiliary switch, attached to the main lever to indicate the position of the closing core, and a 10 pole auxiliary switch, attached to the automatic lever to indicate the position of the circuit breaker.

Shipment and Storage

Each mechanism is carefully inspected and tested at the factory, and should be in good condition when received. It should be carefully inspected, when received, for damage which may have occurred in shipment.

If the mechanism is to be stored for any length of time, it should be kept in a clean, dry place, protected from corrosion and moisture. It should never be allowed to stand where moisture can reach the insulated parts. It should be handled with reasonable care, to prevent breakage.

Unpacking should be done carefully so as not to damage the mechanism. All parts should be checked with the shipping list and care taken not to leave any part in the packing material. An Instruction Book is included with the shipping papers.

Operation

Figure 3 shows the mechanism in the closed position and names the various parts. Referring to this figure, the breaker pull rod is connected to the automatic (inner) lever, which is pivoted to the closing (outer) lever at fulcrum "A". The closing lever is pivoted to the mechanism frame at the fulcrum "B" and connected to the moving closing core by two links. When the control switch on the switchboard is moved to the position for closing, the contactor on the control panel is closed. This energizes the closing coil and causes the moving closing core to move downward. The closing and automatic levers rotate clockwise together about fulcrum "B", closing the breaker. When the closed position (figure 3) is reached, the moving closing core stops against the stationary closing core and the holding latch engages the fulcrum pin "A", holding the circuit breaker in the closed position. Just before the closed position is reached, the two pole auxiliary switch makes contact, causing the closing relay to open and de-energize the closing coil. This operation is not completed until the mechanism has completed the closing movement and the holding latch has engaged.

In order to trip the mechanism and open the breaker from the closed position (figure 3) the trip coil is energized,

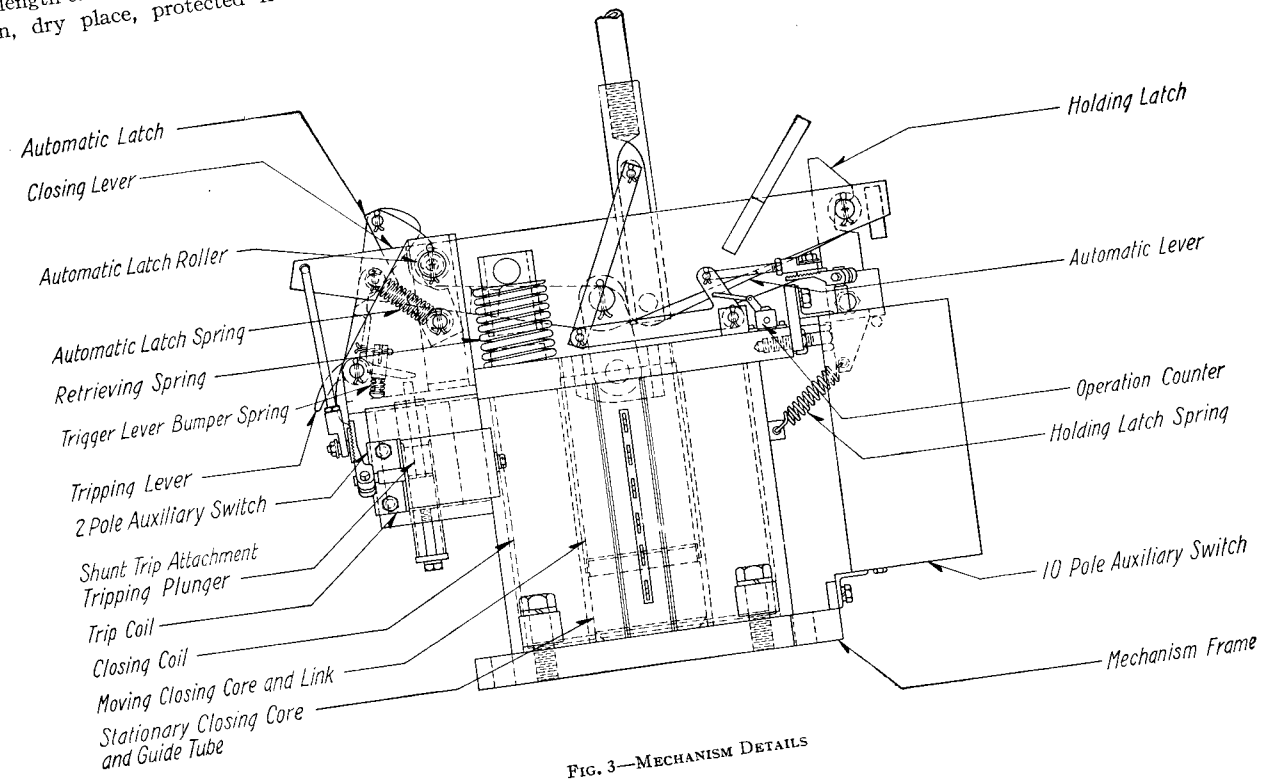


FIG. 3—MECHANISM DETAILS

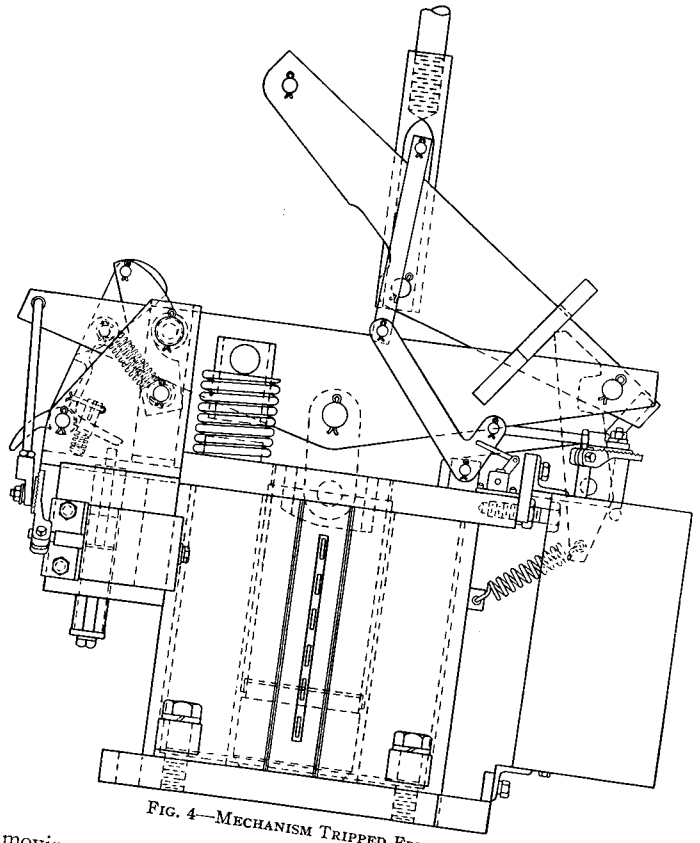


FIG. 4—MECHANISM TRIPPED FREE

raising the moving tripping core and the trip rod strikes the tripping lever. This causes the automatic latch to rotate counter-clockwise and release the roller. The automatic lever, to which the breaker rod is attached, rotates clockwise about fulcrum "A" allowing the breaker to open. This intermediate position is shown in figure #4. As this position is reached, a block on the automatic lever strikes the holding latch,—causing it to rotate counter-clockwise and disengaging it from the fulcrum pin "A". The closing lever rotates counter-clockwise about fulcrum "B", due to the pressure of the retrieving springs, to the open position (figure 5), where the automatic latch re-engages the roller. The mechanism is then ready for a subsequent closing operation. It is essential to have the mechanism connected to the control power supply by leads of sufficient capacity to maintain full control voltage on the mechanism. The actual potential available for closing the mechanism should be measured by voltmeter across the terminals of the coil, when the coil is energized.

There is no accelerating spring on this mechanism. Breakers, to which this mechanism is applied, are provided with separate acceleration as necessary to produce the proper operating speed.

The 10 pole auxiliary switch is connected to indicate the position of the circuit breaker. The first and third contacts of this auxiliary switch are wider than the rest and are connected in series, to control the trip coil circuit. The other three odd numbered contacts are arranged in line with contacts 1 and 3, and are used for indicating purposes. The even numbered contacts are all narrow and are used for indicating and interlocking purposes. Any contact can be changed from one line to the other, by removing the rotor of the auxiliary switch from the switch, and removing the segment from the rotor and replacing it 90° from the original position. The 2 pole, or cut-off switch, used to open the closing relay when the closed position on the circuit breaker is reached, is connected to operate with the closing core.

The hand closing device, used on this mechanism, is attached to the closing lever, leaving the mechanism free to open, if the trip coil is energized.

Adjustment

The mechanism is completely adjusted and tested at the factory and it is only necessary to check to see that these adjustments have not been changed. In case the mechanism is connected to a breaker already in the field, care must be taken to see that the circuit breaker and the mechanism operate properly in unison.

The connecting link between the mechanism and the breaker should be adjusted as to length, so that, with the mechanism in the closed and latched position, the circuit breaker is in the closed position, as indicated by the toggle stops on the circuit breaker. Note that in closing, the moving closing core is drawn down against the stationary closing core, leaving approximately $\frac{1}{16}$" clearance between the face of the holding latch and the fulcrum pin "A". This clearance is referred to as "back-lash". As the mechanism closing cores come together, the toggle stops in the pole unit will come together and then, as the closing coil is de-energized, the mechanism will drop back slightly against the holding latch, permitting the toggle stops to open slightly.

"Back-lash", at the holding latch, is adjusted by loosening the clamp bolts in the holding latch and rotating the eccentric brass bushing. The "back-lash" should be just sufficient to insure positive latching of the holding latch.

If the holding latch fails to engage in operation, it is necessary to check to see, —first, that there is sufficient back-lash to permit the latch to swing into place and second,—to see that the energy is remaining on the closing coil long enough to bring the mechanism into the full closed position. Note that the 2 pole switch makes contact before the circuit breaker reaches the fully closed position, and that this starts to open the control relays, which in turn, de-energizes the closing coil. Too early cut-off will be indicated by the breaker closing and latching, if the control relays are prevented from cutting off. The time of de-energizing the closing solenoid can be delayed by adjustment of the 2 pole switch.

The extension of the closing lever will strike on the tripping lever, with the mechanism in the open position, when detached from the breaker. Clearance, at this point, should be present when the mechanism is attached to the breaker. Lack of clearance at this point indicates the breaker travel is greater than

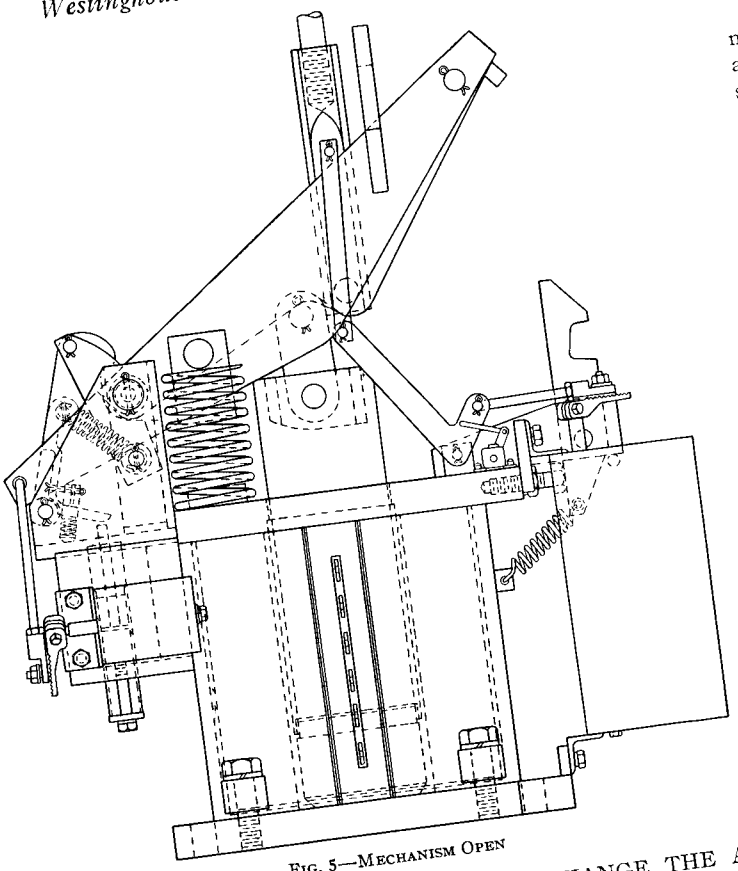


FIG. 5—MECHANISM OPEN

mechanism travel, and changes are necessary in the connecting linkage between the two.

The automatic latch is made of hardened tool steel and so designed as to present a flat surface normal to the direction of travel of the roller. The length of the latching surface is such that, with the latch hooked on the roller as far as it will go, the nose of the latch will extend approximately $\frac{1}{16}$" past the center of the roller. When the trip rod is raised slowly by hand, the automatic latch should be released while there is still a gap of not less than $\frac{1}{8}$" between the moving and stationary tripping cores. With the moving, tripping core raised completely, the nose of the automatic latch should not be back more than $\frac{1}{8}$" beyond the center of the roller. With the circuit breaker in the partially-open position, and with the roller opposite the nose of the automatic latch, it should not be possible to draw the automatic latch back to obtain more than $\frac{1}{8}$" clearance.

The engaging surface of the automatic latch is ground to exact limits. It may be polished with fine emery, if it becomes dirty or rusty. DO NOT ATTEMPT TO GRIND THE SURFACE OR CHANGE THE ANGLE OF THE FACE.

In order to open the mechanism slowly by hand, during adjustment, the hand closing device must be inserted and the closing lever pulled down until the load is released from the holding latch. The holding latch can then be pushed back out of engagement. The closing lever can then be allowed to open slowly, holding it with the hand closing device.

Inspection

The electric solenoid closing mechanism contains a number of moving joints and operating parts, all of which are subject to wear if not kept in the proper condition. It is desirable to inspect the mechanism at regular intervals and be assured of its good working condition, by making a number of operations. It is desirable to apply a light lubricating oil to the various pins,—but the quantity of oil should be kept to a minimum, to prevent gumming, and causing friction at the joints. It is necessary to keep the moving parts, particularly the automatic latch and the switches, clean and free from foreign matter.

In case there is any trouble in operation, the mechanism should be taken out of service at once, and put in proper condition. The circuit breaker is highly dependent on the proper functioning of the mechanism and, therefore, it should always be kept in good condition.

High Speed Switch

A high speed switch which opens its contacts with the initial movement of the breaker, may be mounted on the top plate of the mechanism. An adjusting bolt is provided so that the switch contacts will close during the final movement of the mechanism in closing. Care should be exercised in making this adjustment, that the over-travel of the mechanism does not over-stress the over-travel spring provided in the switch, and that with the mechanism closed and latch the switch makes good contact. When this adjustment is completed, the switch contacts should open almost simultaneously with the first movement of the automatic lever in opening. The contacts may be inspected by removing

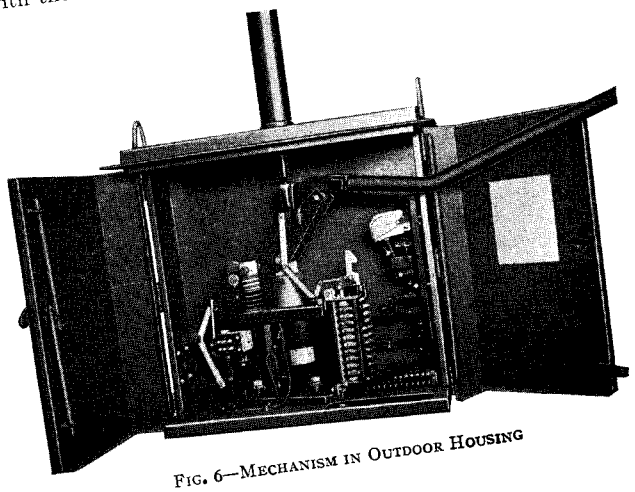


FIG. 6—MECHANISM IN OUTDOOR HOUSING

the two screws that hold the cover in place.

Latch Checking Switch

The latch checking switch is mounted on the mechanism. An adjustment is provided by a clamp bolt through the tripping lever that engages teeth cut in the shaft carrying the switch operating lever. To adjust the switch, loosen the nut on the bolt and rotate the switch operating lever by turning the bolt with a screw driver. With the automatic latch in its engaged position, the over-travel spring on the switch plunger should be compressed about 1/8 inch. After completing the adjustment, be sure to re-tighten the locking nut on the underside of the clamp bolt to assure that the adjustment is maintained. The contacts may be inspected by removing the two screws that hold the cover in place.

RENEWAL PARTS DATA

Recommended Stock of Renewal Parts for TYPE SAF-4 SOLENOID OPERATED MECHANISM for Oil Circuit Breakers

FOR ILLUSTRATION OF PARTS, SEE FIG. 3

The following is a list of the Renewal Parts and the quantities of each that we recommend should be stocked by the user of this apparatus to minimize interrupted operation caused by breakdowns. The parts recommended are those most subject to wear in normal operation or those subject to damage or breakage due to possible abnormal conditions. This list of Renewal Parts is given only as a guide. When continuous operation is a primary consideration, additional insurance against shut-downs is desirable. Under such conditions more renewal parts should be carried, the amount depending upon the severity of the service and the time required to secure replacements.

Mechanisms in use up to and including	No. Required	1 / 5 Recommended for Stock		Style No.
Description of Part				
Mechanism Without Coils	1	0	0	.....
Main Lever—Indoor	1	0	0	859602
Main Lever—Outdoor	1	0	0	859603
Full Automatic Lever	1	0	0	859604
Retrieving Spring	2	0	0	849892
Tripping Lever	1	0	1	859605
Holding Latch	1	0	0	859606
Holding Latch Spring	1	0	0	849891
Trigger	1	0	1	859607
Trigger Spring	1	0	0	859608
Trigger Bumper	1	0	1	859609
Trigger Roller	1	0	0	806085
Type W Auxiliary Switch—2 Pole (Indoor)	2	0	0	676957
Type W Auxiliary Switch—2 Pole (Outdoor)	4	0	1	591816
*Moving Contact	1	0	4	545626
*Contact Finger	1	0	0	519279
Type W Auxiliary Switch—10 Pole (Indoor)	2	0	0	676966
Type W Auxiliary Switch—10 Pole (Outdoor)	8	0	1	591825
*Moving Contact—Large	20	1	4	545837
*Moving Contact —Small	1	4	20	545626
*Contact Finger	1	0	0	519279
Operation Counter	1	0	0	504230
†Closing Coil	1	0	1	†
†Trip Coil				†

*Not listed on illustration.
†When ordering, specify identification number stamped on part.
Parts indented are included in the part under which they are indented.
Recommendations for stocking Renewal Parts for your complete equipment will be supplied upon request to the nearest Sales Office of the Company.

ORDERING INSTRUCTIONS

When ordering Renewal Parts, always specify the name of the part wanted as shown on the illustrations in this Instruction Book, giving Shop Order Number, and the type of Mechanism as shown on the nameplate. For Example: **One Holding Latch, S# 859606, for Type SAF-4 Operating Mechanism, S. O. 4F946 shown in Instruction Book 5664, Figure 3.**

To avoid delays and misunderstandings, note carefully the following points:

1. Send all correspondence and orders to the nearest Sales Office of the Company.

2. State whether shipment is to be made by freight, express or parcel post. In the absence of instruction, goods will be shipped at our discretion. Parcel post shipments will be insured only on request. All shipments are at purchaser's risk.

3. Small orders should be combined so as to amount to a value of at least $1.00 net. Where the total of the sale is less than this, the material will be invoiced at $1.00.

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•ST. LOUIS, MO., 411 North Seventh St.
†#ST. LOUIS, MO., 717 South Twelfth St.
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†#SALT LAKE CITY, UTAH, 346 A Pierpont Ave.
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Fully equipped sales offices and warehouses are maintained at all addresses.

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zNEW YORK, N. Y., 150 Varick St.
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PHILADELPHIA, PA., 1101 Race St.
PHOENIX, ARIZONA, 315 West Jackson St.
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RALEIGH, N. C., 319 W. Martin St.
READING, PA., 619 Spruce St.
RICHMOND, VA., 301 South Fifth St.
ROANOKE, VA., 726 First St., S. E.
ROCHESTER, N. Y., 1048 University Ave.
ST. LOUIS, MO., 1011 Spruce St.
ST. PAUL, MINN., 145 East Fifth St.
SACRAMENTO, CALIF., 20th and R Sts.
SALT LAKE CITY, UTAH, 235 West South Temple St.
SAN ANTONIO, TEXAS, 1211 E. Houston St.
SAN FRANCISCO, CALIF., 260 Fifth St.
SEATTLE, WASH., 558 First Ave., South
SIOUX CITY, IOWA, 1005 Dace St.
SPOKANE, WASH., 152 So. Monroe St.
SPRINGFIELD, MASS., 46 Hampden St.
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I. B. 5664-A

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5664-A

Westinghouse

Types
B-20-B and B-22-B Oil Circuit-Breakers
600- and 1200-Amperes, 15,000 Volts

INSTRUCTION BOOK

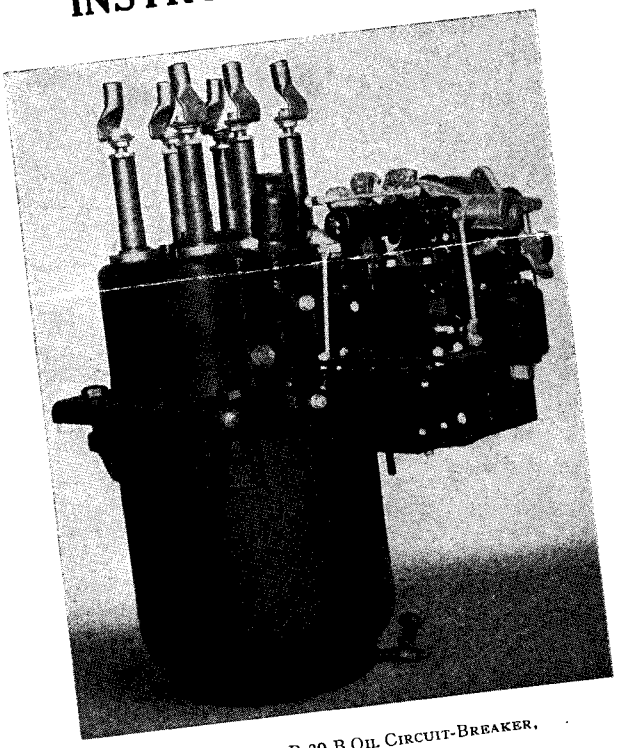


FIG. 1—TYPE B-20-B OIL CIRCUIT-BREAKER, 15,000 VOLTS, 600 AMPERES SOLENOID-OPERATED

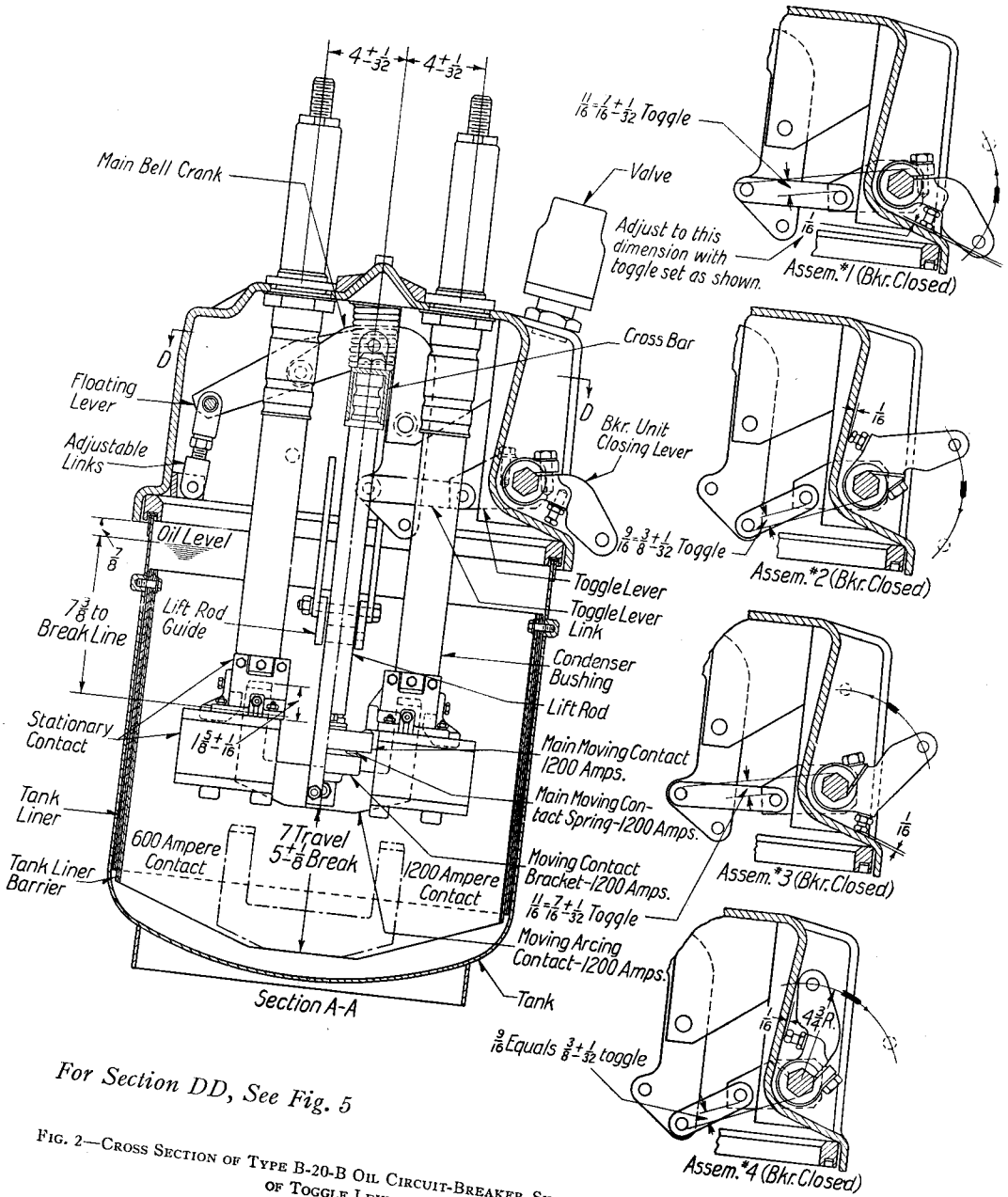
Westinghouse Electric Corporation

East Pittsburgh Works, **East Pittsburgh, Pa.**

I. B. 5660-C

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For Section DD, See Fig. 5

FIG. 2—CROSS SECTION OF TYPE B-20-B OIL CIRCUIT-BREAKER SHOWING VARIOUS ARRANGEMENTS OF TOGGLE LEVER AND LINK ASSEMBLY

Westinghouse

Types B-20-B and B-22-B Oil Circuit-Breakers

600- and 1200-Amperes, 15,000 Volts
Manually or Electrically Operated
(Lift-up Cell, Frame or Truck Mounted)

General Description

The Types B-20-B and B-22-B oil circuit-breakers are 3-pole single-throw breakers of non-oil-throwing design, with all poles contained in a single round tank. They are designed for a maximum of 15000-volt service in both the 600- and 1200-ampere sizes.

These breakers may be mounted in cells or trucks, on steel or pipe frames or as lift-up units.

Electrical operation may be by solenoid, when direct-current is available or by solenoid plus Rectox when alternating-current is available. The breaker may also be operated manually.

These breakers are equipped with "De-ion Grid" Contacts, Fig. 4. The arc interruption takes place in the "De-ion Grid" chambers supported from the terminals. This chamber consists of a series of insulating plates having interspersed plates of magnetic material, all so disposed and vented that the arc is moved laterally into oil pockets where it vaporizes the oil. The resultant gases are then forced transversely through the conducting gases of the arc stream in such a manner as to de-ionize them and extinguish the arc.

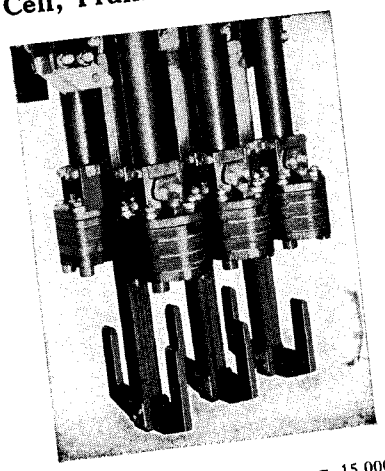


FIG. 3—TYPE B-22-B 600-AMPERE, 15,000-VOLT BREAKER CONTACT ASSEMBLY WITH "DE-ION GRIDS"

Shipment

The breaker is shipped in the following manner:

1. Breaker and operating mechanism are assembled as a complete switching unit with the breaker tied in the closed position.
2. For remote control the breaker and operating mechanism will be crated separately.

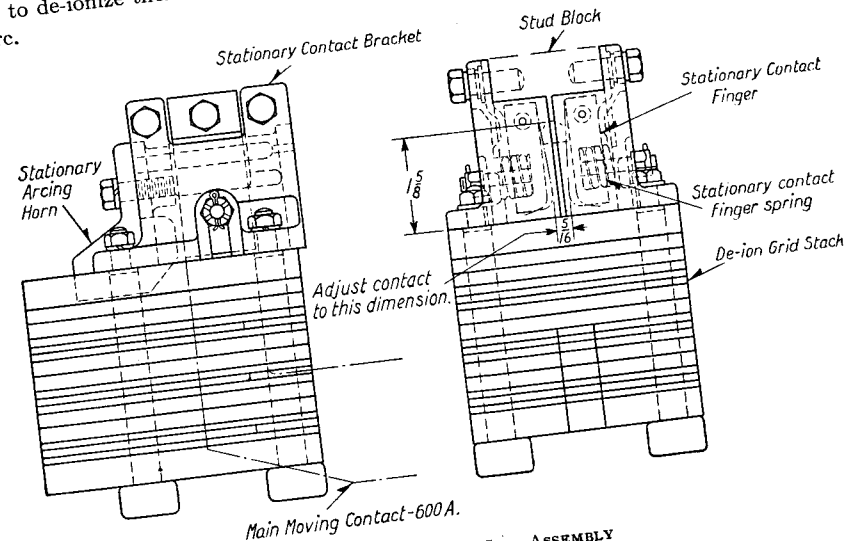
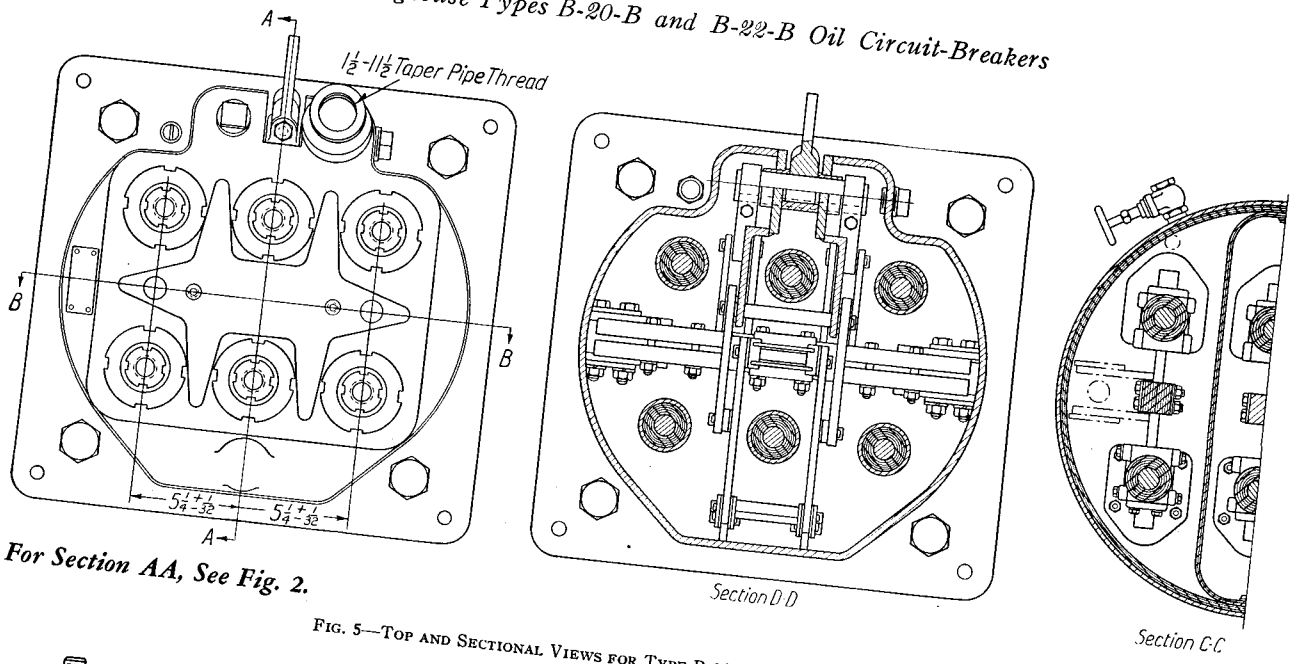


FIG. 4—DE-ION GRID ASSEMBLY

Installation

1. Attach the breaker to the supporting structure, first making sure that the structure is level.
2. Remove the tank and examine the inside for evidence of moisture and foreign matter. Flush with benzine.
3. Remove the wire which holds the breaker in the closed position and allow the breaker to open slowly.
4. When the mechanism is mounted separately from the breaker, connect the breaker and operating mechanism, making sure that full contact is secured and that the breaker rests on the bumpers when open.
5. Examine the contacts and note that they are clean and in alignment. For adjustment, see section covering Adjustment.
6. Operate the circuit-breaker by hand several times, watching each pole and the operating mechanism to be sure that all parts move freely.
7. Install connections to the breaker studs.
8. Insulate the connections with varnished cambric and non-elastic cotton tape in accordance with Westinghouse Standards for the various operating potentials. See Fig. 7.
9. Connect the vent pipe to the top of the venting valve. This pipe should be connected to the main venting header pipe, or outside the cell or truck in which the breaker is mounted. It should be so arranged that it will not be possible for rain or condensation to enter the piping. The piping should also be free of any pockets which would retard the drainage of any oil that might be discharged, back to the circuit-breaker.
10. With the tank removed, fill it with oil to within two inches of the top, or if more desirable, the oil can be added through the



For Section AA, See Fig. 2.

FIG. 5—TOP AND SECTIONAL VIEWS FOR TYPE B-20-B CIRCUIT-BREAKER

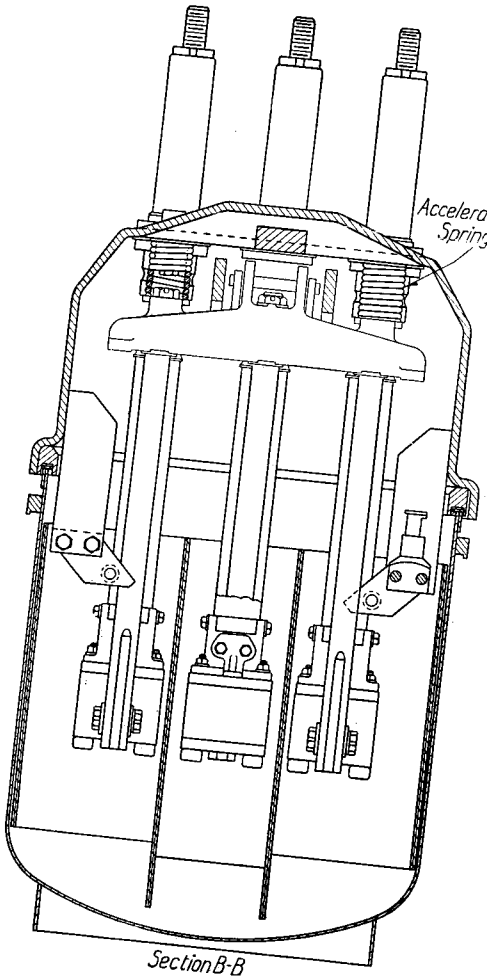


FIG. 6—CROSS SECTIONAL VIEW OF TYPE B-20-B CIRCUIT-BREAKER

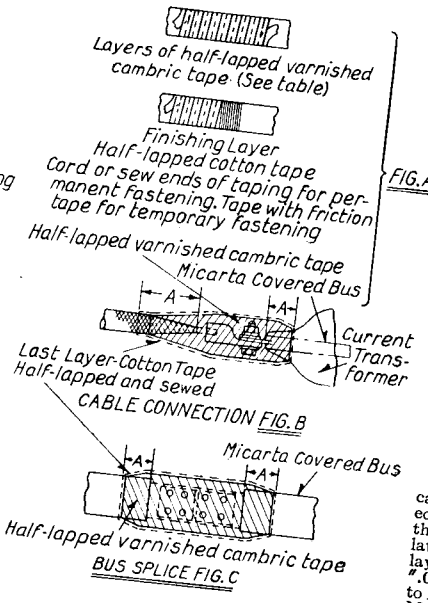


FIG. 7—INSTRUCTIONS FOR TAPING CONNECTIONS

The following instructions should be followed in taping all main connections on circuit-breaker trucks and switchhouses. All connections except joints are insulated at the factory, the joints being left open for purchaser's inspection. In order to obtain maximum safety of the equipment do not fail to complete taping before putting into service.

SERVICE VOLTAGE	LAYERS OF VARNISHED CAMBRIC TAPE	"A" CREEPAGE INCHES
750	3	1
2500	4	1
4000	5	1
4500	6	1
6600	7	1 1/2
7500	8	1 1/2
13200	12	1 1/2
15000	13	2
25000	18	2
37000	28	Engineers' Instructions

Wrap with half-lapped layers of ".010 varnished cambric tape (Westinghouse No. 1225 Tan Treated Cloth) applying as many layers as given in the above table. Apply a coat of No. 9 insulating varnish (Westinghouse No. 311) between layers. Tape over the cambric with one layer of ".007 cotton tape and wrap the ends with cord to keep them in place. Finish with two coats of M-1736 black insulating varnish (Westinghouse No. 414).

filling plug located in the breaker top after the tank has been bolted in place, Fig. 5. **Be sure to replace filling plug and see that tank is drawn up even and tight all around, otherwise oil may leak or be forced out.**

11. Remove the small plug in the top of the oil gauge and move the oil float indicator up and down to see that it is free to move. The red cap at the top of the float should show in the top of the glass for the proper oil level.
12. Connect the breaker frame through one of the mounting bolts to ground. The National Electric Code requires grounding cable to have one-fifth of the main circuit capacity, except that it must never be smaller than No. 8 and need not be larger than No. 0, B. & S. gauge.
13. Check the operation of the breaker by operating it electrically in accordance with the instructions covering the mechanism used.

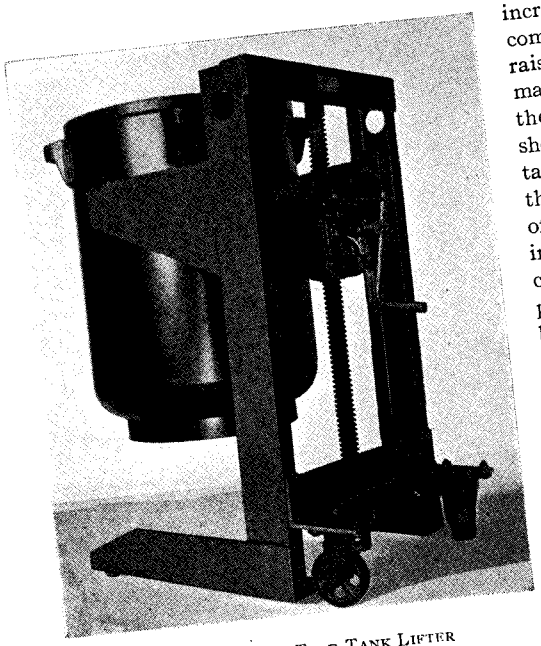


FIG. 8—TRUCK-TYPE TANK LIFTER

Adjustments

Breaker Mechanism—The toggle mechanism is designed for reversible operation, so that the direction of operation can be changed by a simple change in the location of the toggle pin which is located in the toggle lever. No adjustment is required on the toggle setting as this is set at the factory. This setting is such that with the breaker in the closed position there is a clearance of $\frac{1}{16}$ inch between the operating lever set screw and the breaker top. The toggle is set $\frac{3}{8}$ inch off center. See Fig. 2.

Changing the Direction of Operation—To change the direction of operation, use a shorter link and interchange toggle pin with the holes in the toggle lever.

CAUTION—Do not interchange links, levers or cross bars between breakers of different ampere-capacities, as certain parts are made of non-magnetic material. To interchange these parts may result in excessive heating.

The hydraulic bumper action is secured by reaction of the moving cross bar on two hydraulic stops—one on each end of the cross bar guides. This action is non-adjustable and requires no attention. Do not operate the breaker excessively without oil.

Contacts—The contact arrangement for the 600-ampere breaker is shown in Fig. 4. Adjustment is provided by means of adjustable links located in the breaker top at the rear. To increase the amount of contact, the complete moving contact must be raised up. This is accomplished by making the links shorter. To decrease the amount of contact, the links should be made longer. For full contact, the distance between top of the "De-ion Grid" top plate and the top of the moving contact should be $1\frac{5}{8}$ inches $\pm \frac{1}{16}$ inch, with the breaker closed. This dimension is only for new parts. Some allowance must of course be made when contacts burn.

CAUTION—After adjustment has been made, be sure that the adjusting screw is securely locked in place with the lock nut.

When fitting new stationary contact fingers the adjustment should be so made that the distance between the fingers is $\frac{5}{16}$ inch. See Fig. 4. These fingers should also be adjusted symmetrically with respect to the slot in the grids.

The main contacts of the 1200-ampere capacity breaker (Figure 2) are adjustable by turning the bracket up or down on the lift rod. With the breaker in the closed position the distance between the contact cross bar and cross bar bracket should be $\frac{1}{8}$ to $\frac{5}{32}$ inch. It is important that this dimension be maintained.

These contacts make silver-to-silver contact and it is unnecessary to use an abrasive to keep them bright. In fitting new contacts it is not necessary that perfect line contact be obtained. With the soft material (silver) good contact is obtained after a few operations. If it is necessary to renew the silver surfaces, return the parts to the factory as the blocks of silver are put on with special solder.

The moving contacts are tipped with a special arc-resisting tungsten alloy to insure long life. This can only be replaced at the factory.

"De-ion Grid" Stacks—It is important that the arrangement of the plates in the "De-ion Grids" be correct. Should it be necessary to renew parts of the stacks, it is recommended that they be returned to the factory for repair or complete new assembled stacks supplied.

Connections to Operating Mechanisms

When the breaker unit and its operating mechanism are shipped separately, it is important that the operating rod between the two units be properly adjusted. The adjustment should be made, so that there is a full $\frac{1}{16}$ inch clearance between the operating lever and the breaker top, when the breaker is fully closed and latched. See Fig. 2.

The adjustment should also be made so that the opening shock is absorbed

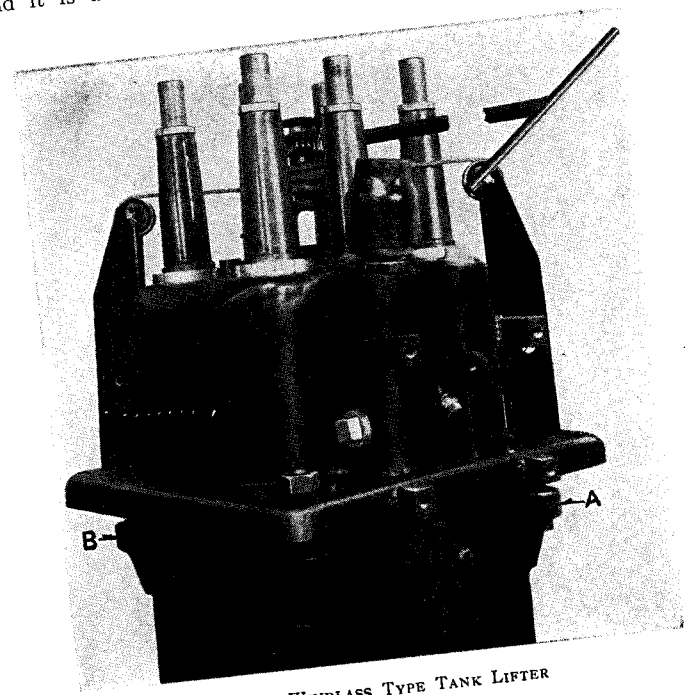


FIG. 9—WINDLASS TYPE TANK LIFTER

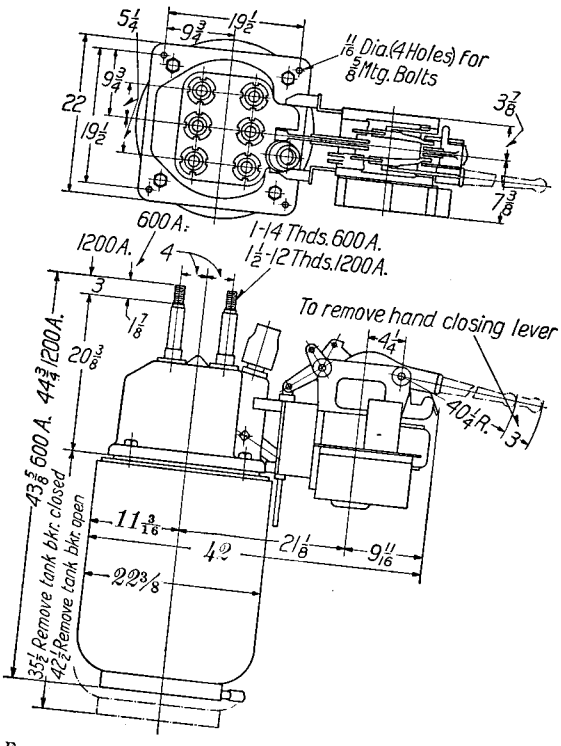


FIG. 10—TYPE B-22-B "DE-ION GRID" OIL CIRCUIT-BREAKER

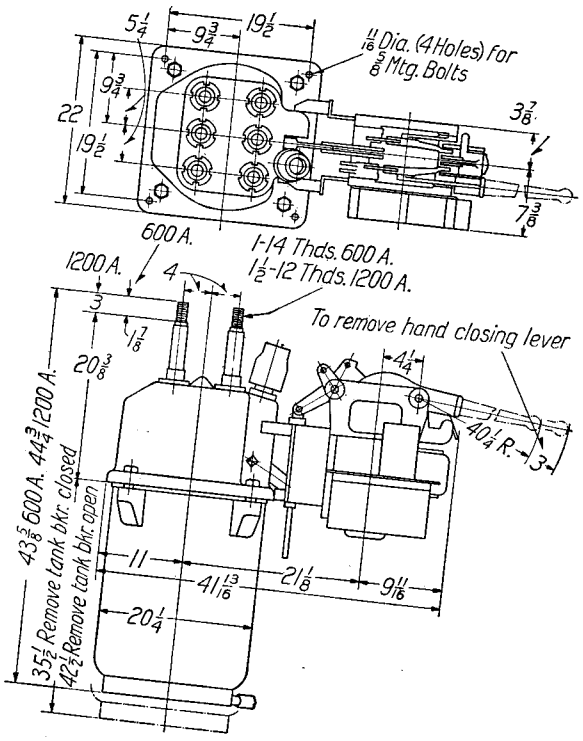


FIG. 11—TYPE B-20-B "DE-ION GRID" OIL CIRCUIT-BREAKER

on the bumpers and not on the operating mechanism.

Terminal Bushings—The surface of the bushing insulation should be smooth and well varnished. If the varnished surface is damaged or questionable, it should be smoothed off with fine sand paper and revarnished with three coats of good quality, clear, air-drying Spar varnish. Each coat should be allowed to dry for 24 hours.

Operation

Points to be Observed in Operating—

1. Before making any adjustment to any oil circuit-breaker, make sure that all lines leading to it are electrically dead.
2. Be sure that the breaker frame is grounded.
3. Do not operate the breaker excessively by the operating mechanism when the oil tanks are removed.
4. Examine all contacts frequently, especially after severe short-circuits. See that the contacts are aligned properly.
5. After making any adjustments, operate the apparatus carefully by hand to make sure that it operates smoothly and correctly.
6. When testing, coat the contacts with a thin film of vaseline.
7. Inspect the oil regularly and after severe short-circuits. If it shows signs of moisture, carbonization or dirt, filter and retest it before replacing it in service. See that the oil level in the tanks is maintained at the proper height. See Fig. 2.
8. Remove all oil and thoroughly clean the tanks, tank liner, lift rod, terminal bushings, etc., at least once a year.
9. Occasionally inspect and tighten clamping nuts around the bushing on top the breaker.
10. Arrange for regular inspection to see that the apparatus is in adjustment as explained.

Insulating Oil—Dielectric tests of the oil should be made every three months, to show if it is reasonably good for circuit-breaker work. Samples should not be taken until the oil has remained undisturbed for at least four hours. In testing for indication of water, take the sample from the bottom through the tank drain. If for indication of carbon, and after a heavy short-circuit, take the sample from the surface of the oil. For instructions as to the care and testing of insulating oil, see Instruction Book 5336.

Operating Mechanisms—For instructions covering the Type SA-3 Solenoid Mechanism, see Instruction Book 5567. For instructions covering the Type CFO Motor Mechanism, see Instruction Book 5334. For instructions covering Rectox Unit, see Instruction Leaflet 1782.

Windlass Type Tank Lifter—Fig. 9

To operate the windlass type tank lifter it must be first bolted in place as shown. Tank bolts A and B must be removed, and the cable inserted through the pulley supports, the supports should be then placed in the tank bolt holes, taking care to assemble support with clip in hole A. The swivel ends should be then screwed into the lugs on the tank and all slack in the cable taken up, using care to not unduly strain the cable. The two remaining tank bolts can be then removed and the tank lowered. The worm and worm wheel construction will permit the tank to hang in all positions without blocking. The lifter may be operated from the front or rear of the breaker.

RENEWAL PARTS DATA

Recommended Stock of Renewal Parts
TYPES B-10-B or B-22-B OIL CIRCUIT-BREAKERS
600 to 1200 Amperes; 15,000 Volts; 2 or 3 Poles; Single Throw
For Illustration of Parts, see Figs. 2 and 4

The following is a list of the Renewal Parts and the quantities of each that we recommend should be stocked by the user of this apparatus to minimize interrupted operation caused by breakdowns. The parts recommended are those most subject to wear in normal operation or those subject to damage or breakage due to possible abnormal conditions. This list of Renewal Parts is given only as a guide. When continuous operation is a primary consideration, additional insurance against shut-downs is desirable. Under such conditions more renewal parts should be carried, the amount depending upon the severity of the service and the time required to secure renewals.

Breakers in use up to and including	2-Pole			3-Pole			Style No.
Description	No. Req.	Recommended for Stock 1	Recommended for Stock 5	No. Req.	Recommended for Stock 1	Recommended for Stock 5	
Parts indented are included in the part under which they are indented.							
Breaker Complete	1	0	0	1	0	0	... ...
Breaker Unit Complete	1	0	0	1	0	0	... ...
*Accelerating Spring	2	0	1	2	0	1	841 625
*Bumper Spring	2	0	1	2	0	1	840 068
*Moving Contact Complete	2	0	0	3	0	0	... ...
Lift Rod—600 Amperes	2	0	1	3	0	1	1019 421
Lift Rod—1200 Amperes	2	0	0	3	0	1	1019 422
Main Contact—600 Amperes (B-20-B)	2	0	1	3	0	1	850 330
Main Contact—600 Amperes (B-22-B)	2	0	1	3	0	1	1087 060
Main Contact—1200 Amperes	2	0	1	3	0	1	850 333
Contact Bracket—1200 Amperes	2	0	1	3	0	2	881 670
Main Contact Spring—1200 Amperes	2	0	2	6	0	0	841 729
Arcing Contact—1200 Amperes	4	0	0	3	0	4	850 334
*Stationary Contact Complete	2	0	4	12	1	1	... ...
Condenser Bushing—600 Amperes, Standard	8	1	1	3	0	0	1123 893
Condenser Bushing—600 Amperes, Lift-Up	2	0	0	6	0	2	1114 750
Condenser Bushing—1200 Amperes, Standard	4	0	2	6	0	2	1123 892
Condenser Bushing—1200 Amperes, Lift-Up	4	0	2	6	0	2	1114 751
Stationary Contact—600 Amperes	4	0	2	6	0	2	... ...
Stationary Contact—1200 Amperes	4	0	2	6	0	0	... ...
De-ion Grid Stack	4	0	0	6	0	0	841 775
Main Contact—1200 Amps., R.H.	4	0	2	6	0	2	809 989
Main Contact—1200 Amps., L.H.	4	0	2	6	0	2	809 988
Contact Finger (B-20-B)	4	0	2	6	0	2	834 159
Contact Finger (B-22-B)	4	0	2	6	0	2	834 159
Contact Finger—600 Amperes (B-22-B)	4	0	2	6	0	2	834 159
Contact Finger—1200 Amperes (B-22-B)	4	0	2	6	0	2	834 159
Contact Finger Spring	4	0	2	6	0	2	834 159
Arcing Horn (B-20 B)	4	0	2	6	0	2	834 159
Arcing Horn (B-22-B)	4	0	2	6	0	2	834 159
Tank Complete—(B-20-B)	4	0	2	6	0	2	834 159
Tank Liner	4	0	2	6	0	2	834 159
Tank Liner Barrier	4	0	2	6	0	2	834 159
Tank Complete—(B-22-B)	4	0	2	6	0	2	834 159
Tank Liner	4	0	2	6	0	2	834 159
Tank Liner Barrier	4	0	2	6	0	2	834 159

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0995

Westinghouse

Oil Circuit-Breakers

Type GO-B—15,000 Volts—600 Amperes—50,000 KVA.
Type GO-1-B—15,000 Volts—600 Amperes—100,000 KVA.
Type GO-2-B—15,000 Volts—600 Amperes—250,000 KVA.
Type GO-2-B—15,000 Volts—1200 Amperes—250,000 KVA.
Type GO-1-B—23,000 Volts—600 Amperes—250,000 KVA.

INSTRUCTION BOOK

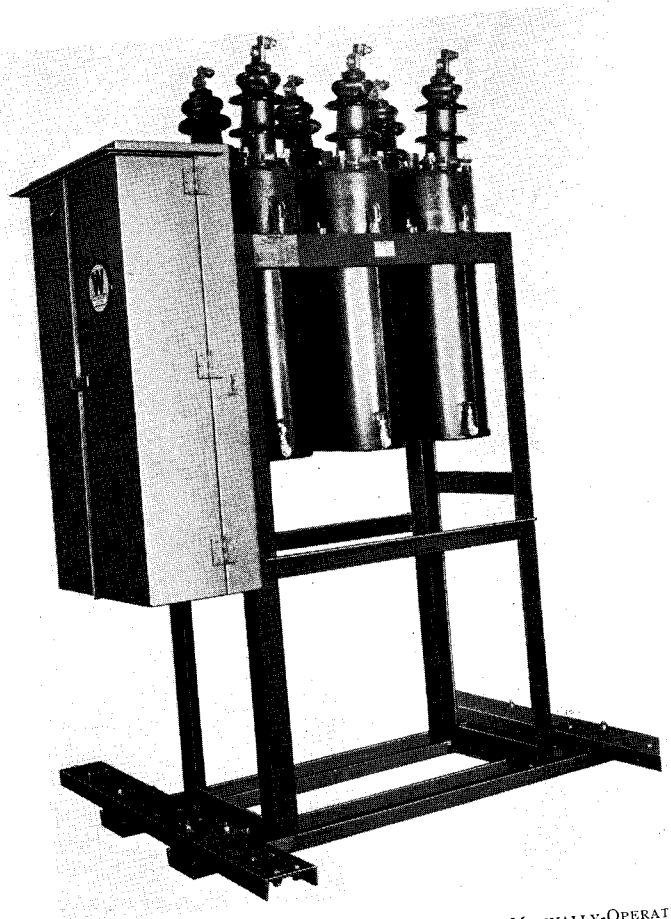


FIG. 1—TYPE GO-1-B, 15000 VOLT, 600-AMPERE, SOLENOID- AND MANUALLY-OPERATED BREAKER.

Westinghouse Electric & Manufacturing Company
East Pittsburgh, Pa.

East Pittsburgh Works

I. B. 5816
(Filing No. 33-000)

Printed in U.S.A. (7-38)

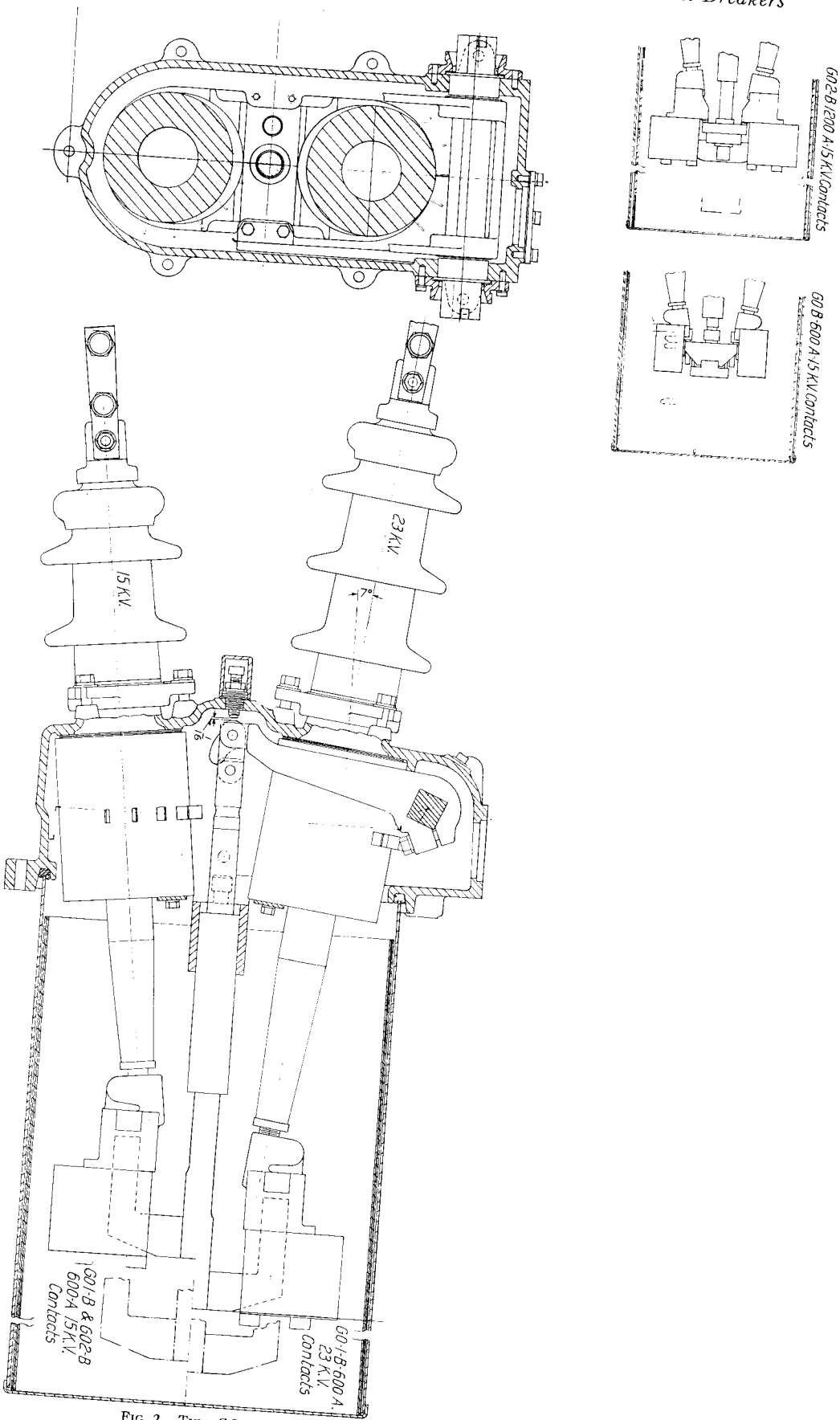


FIG. 2 —TYPE GO-1-A POLE UNIT, 600 AMPERES (CROSS SECTION).

Westinghouse

Types GO-B, GO-1-B and GO-2-B Oil Circuit-Breakers

15,000 and 23,000 Volts—600 and 1200 Amperes

Manually or Electrically Operated

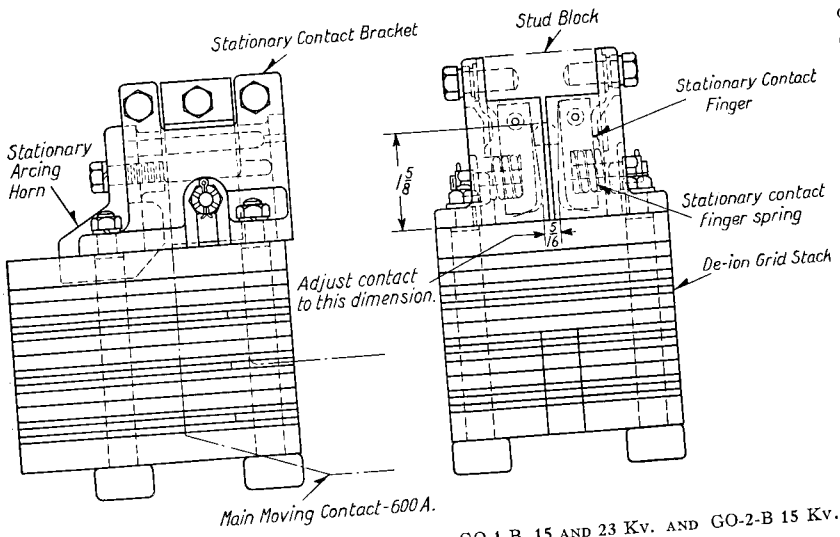


FIG. 3—DE-ION GRID ASSEMBLY, FOR 600 AMPERE GO-1-B, 15 AND 23 KV. AND GO-2-B 15 KV. CIRCUIT-BREAKER

General

The types GO-B, GO-1B and GO-2B breakers are designed for outdoor service and comply with all standard requirements. When properly installed and maintained they will give satisfactory service. The interrupting capacities of these breakers have been verified by testing laboratories and field installations.

The GO-1B and GO-2B breakers are equipped with "De-ion" Grid contacts (See Figs. 3 and 4.) The arc interruption takes place in the "De-ion" Grid chambers supported from the terminals. The device consists of a series of insulated plates having interspersed plates of magnetic material, all so disposed and vented that the arc is moved laterally into pockets where it vaporizes the oil. The resultant gases are then forced transversely through the conducting gases of the arc stream in such a manner as to de-ionize them and extinguish the arc.

The GO-B breakers uses the "De-ion" interrupter contacts (see Fig. 5). The arc interruption takes place in the "De-ion" Interrupters. They are the results of innumerable laboratory tests, and indicate remarkable interrupting ability with the advantages of small space requirements. These interrupters consist essentially of two fibre insulated iron plates, one on each side of the arcing contact, and connected at the top by a small iron bar.

As the contacts part, the magnetically controlled arc is moved outward away from the arcing contacts. This driving force on the arc lengthens it considerably more than is represented by the contact separation. This driving action forces the arc continually against a wall of cool oil, thereby increasing the restriking voltage necessary for reignition along the arc path.

Shipment

The breakers are shipped completely assembled with all attachments and auxiliaries mounted in place. Do not remove the crating until the breaker reaches its permanent location.

Installation

1. Remove the crating and frame skids.
2. Mount the breaker on its foundation. The four foundation bolts should be left loose until the frame is properly leveled by inserting shims under the feet. The breaker must be perfectly level.
3. Remove the tie wire from the mech-

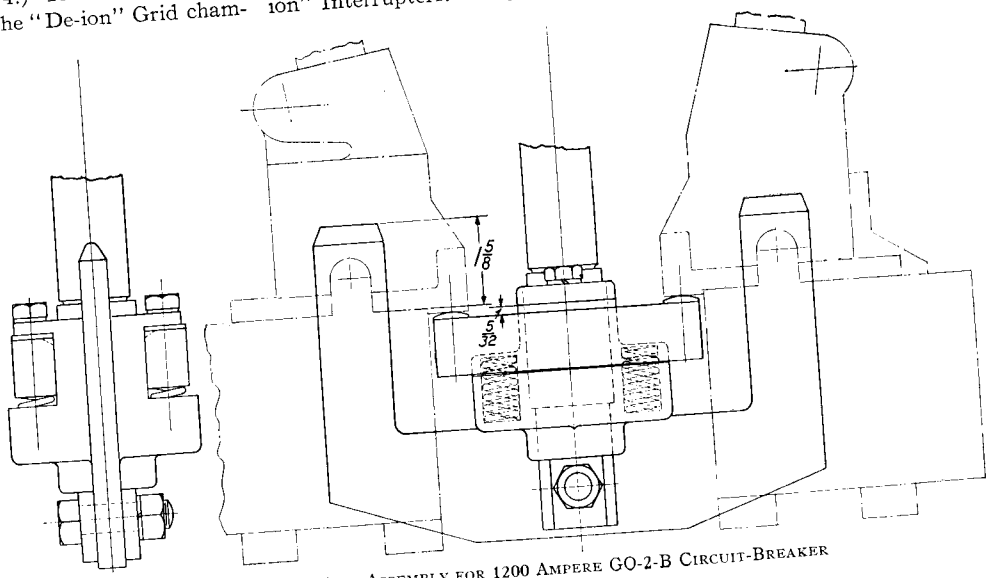


FIG. 4—DE-ION GRID ASSEMBLY FOR 1200 AMPERE GO-2-B CIRCUIT-BREAKER

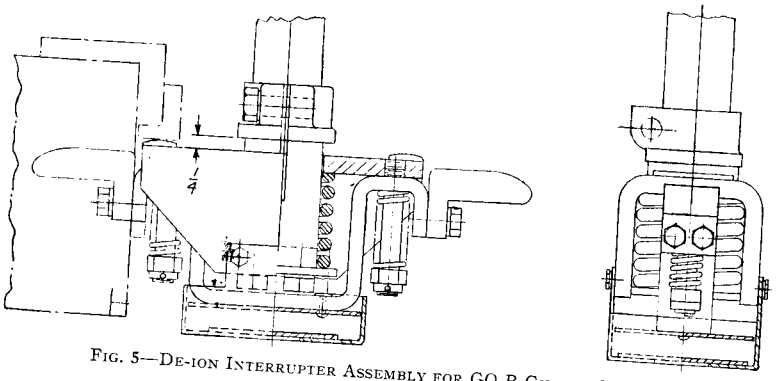


FIG. 5—DE-ION INTERRUPTER ASSEMBLY FOR GO-B CIRCUIT BREAKER

anism trigger and allow the breaker to open slowly.

4. Remove the tanks and examine the inside for evidence of moisture or foreign matter. Flush with benzine. Tanks should not be lowered in wet weather without provision for keeping moisture out of them. The internal parts of the breaker should be protected as well.
5. Examine the contacts to see that they are clean and in alignment. For adjustments, see section covering "Adjustments".
6. Operate the breaker by hand several times, watching each pole and the operating mechanism to be sure that all parts move freely.
7. Install connections to the breaker studs. All contact surfaces should be cleaned and should be free of burrs. The terminal studs are not designed to carry undue cable or bus bar loads. An excessive strain, which at first may have no apparent effect, will eventually loosen the porcelain weather casing and permit moisture to enter the breaker.
8. With the tanks removed, fill them with oil in accordance with name plate instructions or if more desirable, the oil can be added through a filling plug located in the breaker top after the tank has been bolted in place. Be sure to replace the filling plug and to see that tank is drawn up even and tight all around. See that the oil level is at the proper height on the oil gauge.
9. Connect the breaker frame to ground through the grounding pad provided on the breaker frame. The National Electric Code requires grounding cable to have one-fifth the main circuit capacity, except that it must never be smaller than No. 8 and need not be larger than No. 0, B & S gauge.
10. Remove the undrilled conduit entrance plate from the bottom of the mechanism housing and drill for the conduit entrance as desired.
11. Connect the control and transs former circuits to the proper point on the terminal blocks, as shown on the diagram supplied (Ref. Fig. 6).

When the breaker is located a considerable distance from the battery or transformer, allowance should be made for the voltage drop between the battery, or transformer, and the terminals of the operating coil to secure proper operation at minimum control voltage. The bushing type current transformer name plate should be used as an indication of the proper taps to use, although the proper taps will be determined by the loading. It is always necessary to determine the proper taps by test. The following tables indicate the primary current necessary to trip the breaker for several standard attachments. Always be sure the transformer secondary connections are completed before impressing primary current on the breaker.

12. Check the operation of the breaker by operating it electrically, if for electrical operation.

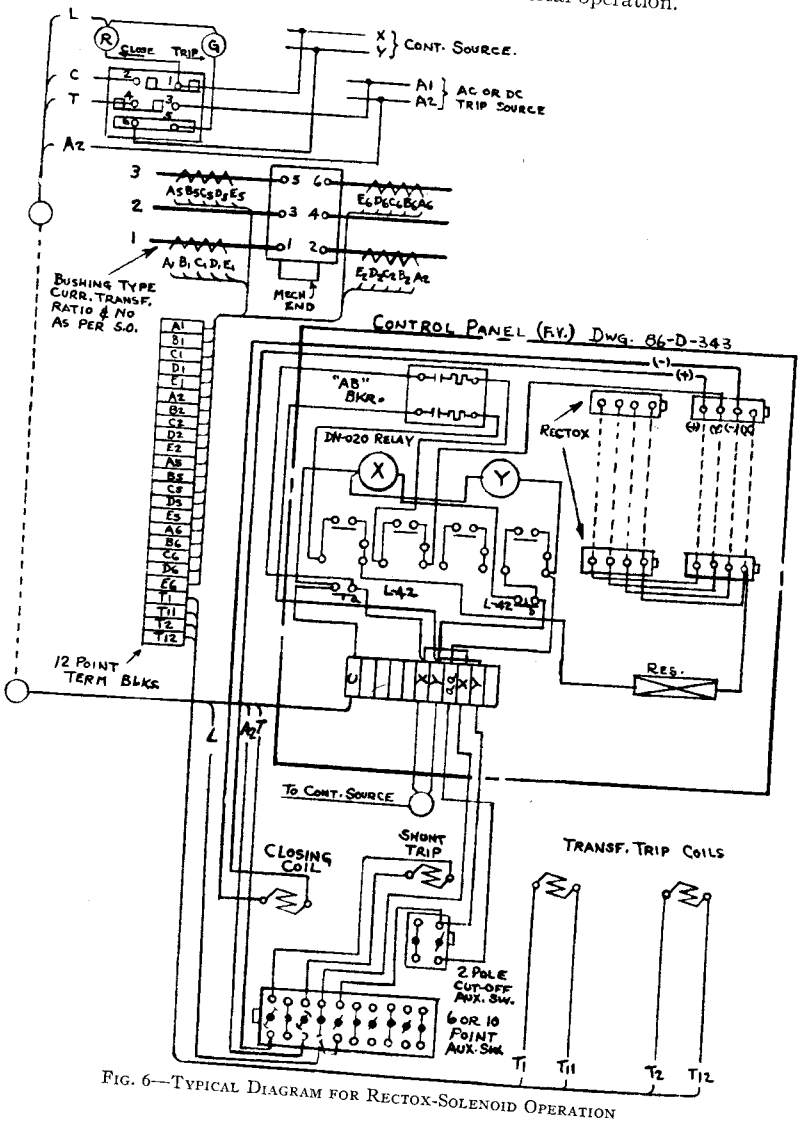


FIG. 6—TYPICAL DIAGRAM FOR RECTOX-SOLENOID OPERATION

Adjustments

These breakers used the wedge and finger type "De-ion" grid or interrupter contact shown in Figs. 3, 4 and 5. They are designed with sufficient pressure to carry rated current without the temperature rise exceeding A.I.E.E. limts.

GO-1-B to GO-2-B, 600 Amperes—The contacts are non-adjustable and are set properly at the factory. The distance between the top of the "De-ion" grid top plate and the top of the moving contact should be $1\frac{5}{8}$ inches with the breaker closed. This dimension is only for new parts. Some allowance must of course be made when the contacts burn. The moving contacts are tipped with a special arc-resisting tungsten alloy to insure long life. This can only be replaced at the factory.

When fitting new stationary contact fingers the adjustment should be so made that the distance between the fingers is $\frac{5}{16}$ inch. See Fig. 3. The fingers should also be adjusted symmetrically with respect to the slot in the grids.

GO-2-B, 1200 Amperes—The auxiliary contacts (Fig. 4) are adjustable by turning the bracket up or down on the lift rod. With the breaker in the closed position the distance between the contact cross bar and cross bar bracket should be $\frac{5}{32}$ inch. It is important that this dimension be maintained.

These contacts make silver to silver contact and it is unnecessary to use an abrasive to keep them bright. In fitting new contacts it is unnecessary that perfect line contact be obtained. With the soft material (silver) good contact is obtained after a few operations. If it is necessary to renew the silver surfaces, use solder of at least 300°C. melting point. Use only "pure silver." Coin silver is unsatisfactory.

The moving contacts are tipped with a special arc-resisting tungsten alloy to ensure long life. This can only be replaced at the factory.

The adjustment of the stationary contact arcing fingers is the same as the 600 ampere breakers.

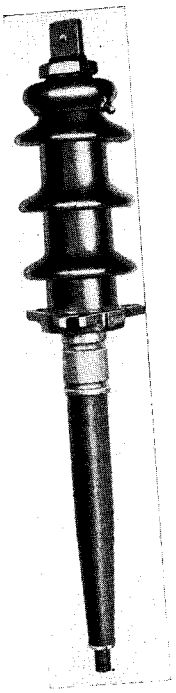


FIG. 7—GO-1-B CONDENSER BUSHING, 23,000 VOLTS

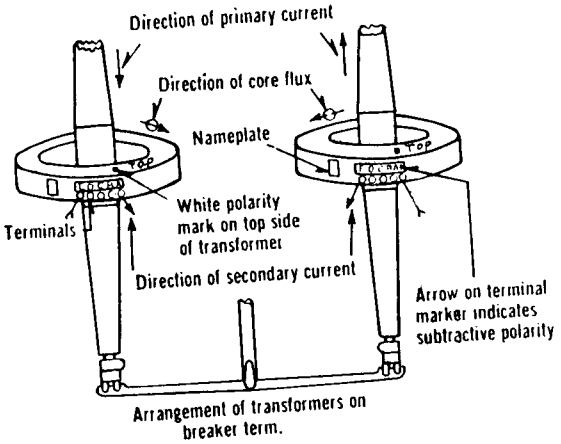


FIG. A

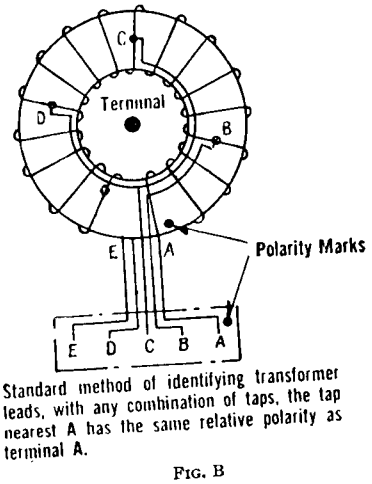


FIG. B

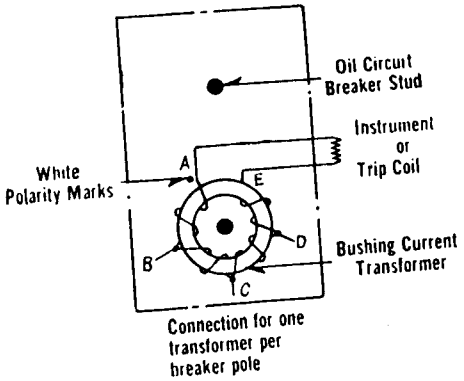


FIG. C

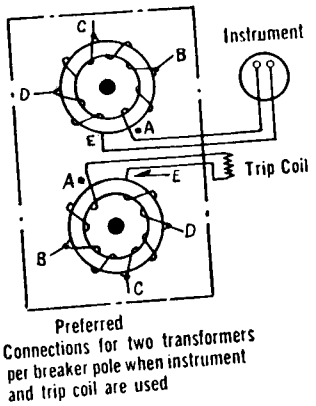


FIG. D

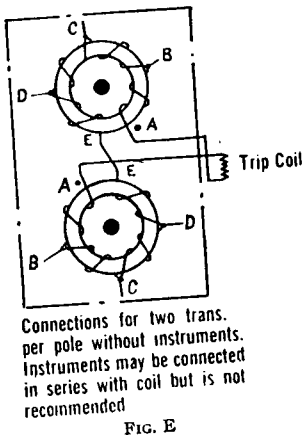


FIG. E

FIG. 8—TYPICAL BUSHING TYPE CURRENT TRANSFORMER CONNECTIONS

GO-B—The contact arrangement is shown in Fig. 5. The main and arcing contacts are both of the butt type, the ¼-inch lead of the arcing contacts being maintained by the thickness of the copper on the arcing tips. The contact pressure on the main contacts is obtained by a compression spring. With the breaker closed the top of the main moving contact should be ¼-inch below the shoulder on the lift rod end. If necessary to adjust, loosen the lift rod end and screw the assembly up or down as necessary.

It is important that the ¼-inch dimension be maintained as this determines the main contact pressure.

The main contacts make silver to silver contact and it is therefore unnecessary to use an abrasive to keep them clean. The oxide of silver does not increase the contact drop. In fitting new contacts it is unnecessary to secure perfect line contact; with the comparatively soft material (silver) good contact is secured after a few operations, as the silver flows slightly under pressure.

If the silver contacts on the moving contacts are replaced, use solder of at least 300°C. melting point. **Use only "pure silver", coin silver is unsatisfactory.**

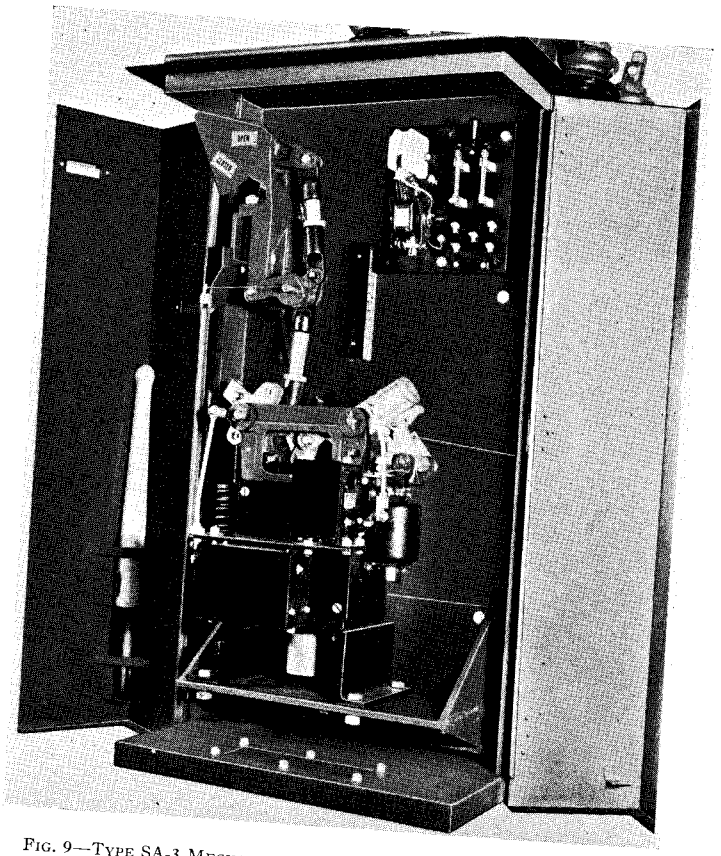


FIG. 9—TYPE SA-3 MECHANICALLY TRIP-FREE SOLENOID AND HOUSING

General:

Vertical and rotational adjustment of the contacts is secured by loosening the clamping bolt of the stationary contact foot and rotating the foot into alignment. If necessary to rotate the contact foot a complete turn, it will be necessary to remove the stationary contact bracket (with "De-ion" grid attached). Before rotating the foot a wedge should be driven into the saw cut to spread the foot. Never attempt to force the contact foot as the copper may "gall".

A limited amount of horizontal adjustment can be secured by adjusting the three clamp flange bolts on the top of the pole unit. This is done by loosening one or two bolts and tightening the remaining bolts. The bolts loosened should be checked for tightness after adjustment.

Before completing any adjustments, make sure that the contact support is turned so as to secure the minimum amount of friction or rubbing, between the moving contact and the stack or interrupter.

When removing the copper oxide from the contacts use sandpaper or a fine file. Do not use emery cloth; the particles of emery are electrical conductors and any particles remaining ower the insulating value of the oil.

Caution—Remember do not use an abrasive on silver contacts.

"De-ion" Grid Stacks—It is important that the arrangement of the plates in the "De-ion" grids be correct. Should it be necessary to renew parts of the stacks, it is recommended that they be returned to the factory for repair or completely new assembled stacks supplied.

"De-ion Interrupters"—The "De-ion Interrupters" control the arc and quickly extinguish it by de-ionization. These devices need little attention other than an occasional inspection. They must be kept securely tightened and properly aligned so that the moving contacts move freely and do not rub causing excessive friction. The fibre insulation is affected very little by the arc action but should be inspected occasionally and replaced if excessive deterioration is found.

Terminal Bushing—The surface of the bushing insulation should be smooth and well varnished. If the varnished surface is damaged or questionable, it should be smoothed off with fine sand paper and revarnished with three coats of good quality, clear, air-drying Spar varnish. Each coat should be allowed to dry for 24 hours.

Mechanical—Do not try to adjust the contacts by changing the toggle adjustment. The toggle of the breaker is set at the factory and should not be disturbed. The correct setting is ⅞-inch off center for the standard breaker. Refer to Fig. 10. Excessive overtravel of the contacts is prevented by the set screw stop in the top of the main casting. This stop should be set to secure $\frac{1}{16}$-inch clearance between the top of the pole unit main lever and the bottom of the set screw. This clearance can be approximated by screwing the set screw down until it touches the main lever, and then backing off one turn.

Maintenance

Points to be Observed in Maintenance—

1. Before making any adjustments, make sure that all lines are electrically dead.
2. Be sure the breaker frame is grounded.
3. Do not operate the breaker excessively with the operating mechanism when the tanks are removed.

4. Examine all contacts frequently especially after short-circuit. See that the contacts are properly aligned.

5. After making any adjustments, operate the apparatus carefully by hand to make sure that it operates smoothly and correctly.

6. Inspect the oil after severe faults. If it shows signs of moisture, carbonization or dirt, filter and retest it.

7. Remove all oil and thoroughly clean the tanks, tank liners, lift rods, terminal bushings, etc., at least once a year.

8. Occasionally inspect and tighten clamping nuts around bushings on top of breaker.

9. Any pitting of the contacts should be smoothed, or, if badly burned, the contacts should be replaced.

10. Keep the bearing surfaces of the mechanism and breaker units adequately oiled.

11. **Operating Mechanism**—For instructions covering the Type SA-3 solenoid mechanism, see Instruction Book 5567.

Insulating Oil

Dielectric tests of the oil should be made every three months, to show if it is reasonably good for circuit-breaker work. Samples should not be taken until the oil has remained undisturbed for at least four hours. In testing for indication of water, take the sample from the bottom of the tank. If for indication of carbon, and after a heavy short-circuit, take the sample from the surface of the oil.

The care of the insulating oil in circuit-breakers is of the utmost importance in their successful operation. Contamination by dirt, moisture, metallic particles, lint, etc., all reduce the dielectric strength, upon which the operation and current-interrupting ability largely depend. Consequently, the most careful attention should be given to keeping the oil clean, not only in filling the tanks originally but in later maintenance or other work on the breakers which might involve opening the tanks.

Only the highest grade, such as Wemco "C" or other approved oil, should be used in the breakers. The oil should be new or at least thoroughly reconditioned by means of a filter press or centrifuge. In any case, before using, it should be given a dielectric test which should show a minimum of 22,000 volts (preferably 25,000 to 30,000) measured between 1-inch diameter discs spaced .1 inch apart.

Before filling, the tanks should be thoroughly cleaned, and flushed out with insulating oil. The same treatment should be given the inside of the top of the breaker and the operating linkage and contact system. In doing this, rags which will leave lint should not be used as lint absorbs and holds moisture.

The same care should be used during inspection or maintenance work on the breaker, which should preferably be done only under favorable weather conditions. If the oil is to be reconditioned following operation of the breaker under short-circuit, the tank and entire inside of the breaker should be cleaned before the oil is returned to the tank. If the work merely involves lowering or removal of the tank, care should be taken to keep the tank covered until it is replaced so that dirt, dust, metallic particles, etc., cannot fall into the oil.

The above precautions may appear academic to those familiar with the maintenance and operation of oil circuit-breakers, but a little more than ordinary care in oil-handling will be well repaid in reliable and dependable operation for which the breaker is designed and built.

For instructions as to the care and testing of insulating oil, see Instruction Book 5336.

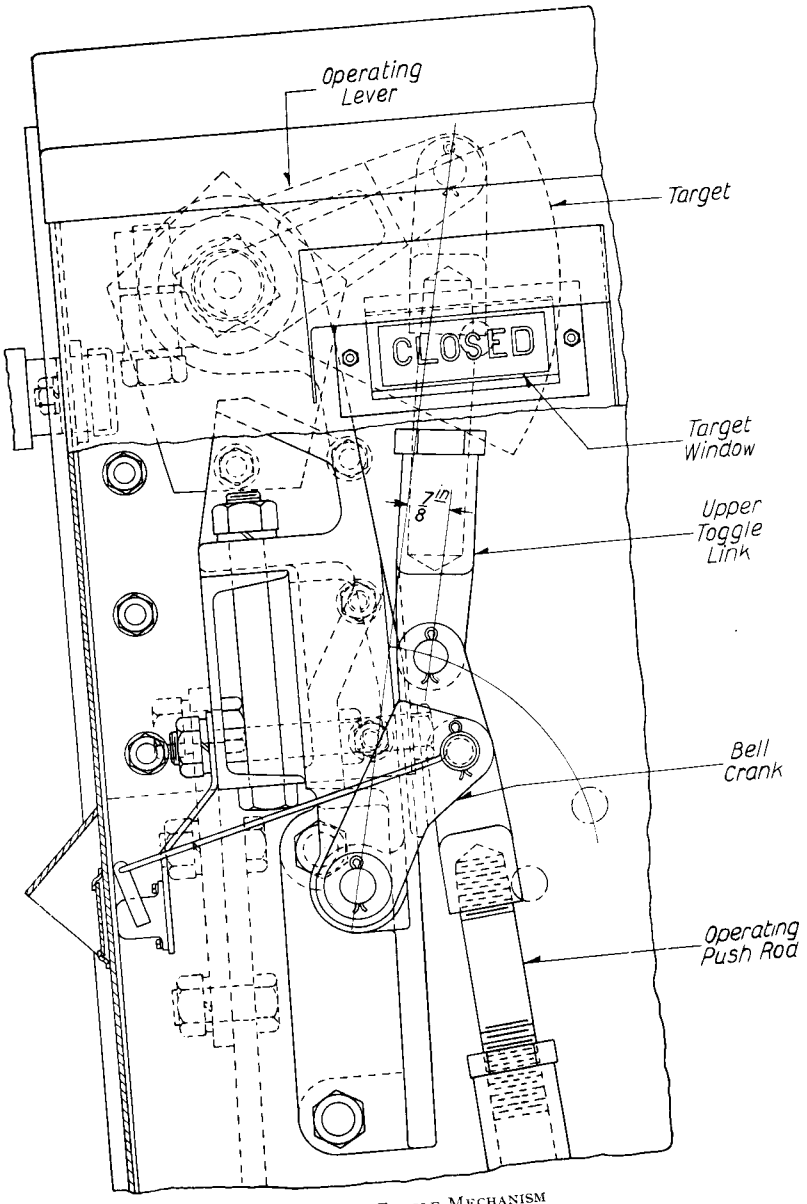


FIG. 10—TOGGLE MECHANISM

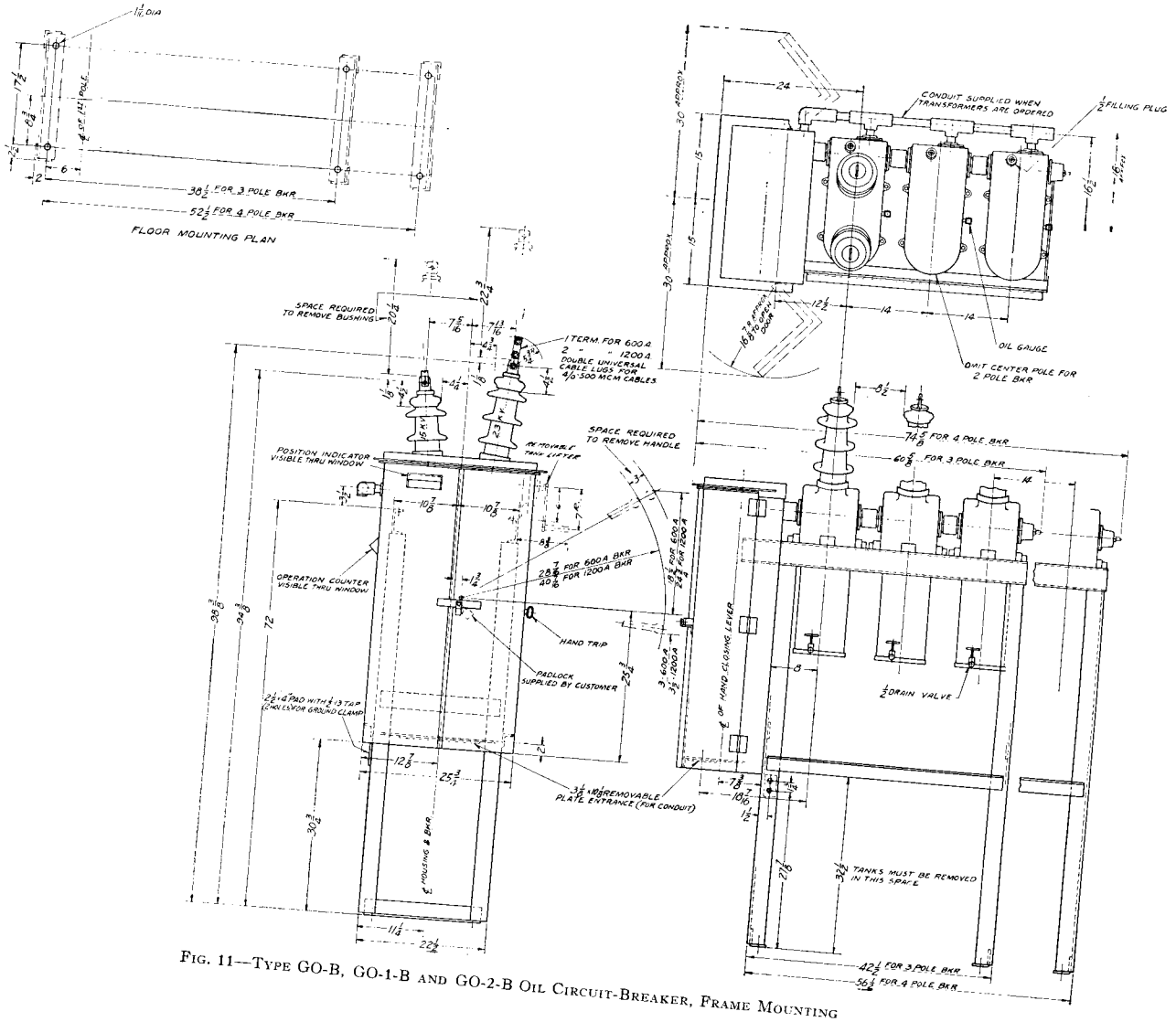


FIG. 11—TYPE GO-B, GO-1-B AND GO-2-B OIL CIRCUIT-BREAKER, FRAME MOUNTING

Type GO-B, GO-1-B and GO-2-B Breakers

DATA APPLYING TO 600–5 AND 1200–5 TRANSFORMERS

ACTUAL PRIMARY CURRENTS NECESSARY TO PRODUCE 5 AMPERES IN SECONDARY FOR ATTACHMENTS INDICATED

60 CYCLES

GO-B	15000 Volts	600 Amperes	50000 Kv-a.
GO-1-B	15000 Volts	600 Amperes	100000 Kv-a.
GO-2-B	15000 Volts	600 and 1200 Amps.	250000 Kv-a.
GO-1-B	23000 Volts	600 Amperes	250000 Kv-a.

Minimum Primary Tripping Currents for Bushing Type Current Transformers.

Ratio	TAPS				
	Without Relays Inst and I.T.L. Trip 5 Amps.	With Circuit Closing Relays and Shunt Trip 4 Amps. Tap	With Circuit Opening Relay and Inst. Trip 4 Amps. Tap	With Circuit Closing Relay and Direct Trip 5 Amps. Tap	With Circuit Closing Relay and Tripping Trans. 5 Amps. Tap
			600/5 M. R.		
			82	70*	85*
		49	98	110*	115*
	90	84	135	175	185
50/5 BC	120	122	175	215	220
100/5 AB	165	165	215	265	270
150/5 AC	210	202	245	310	315
200/5 DE	260	245	330	410	415
250/5 CD	305	324	370	457	460
300/5 BD	407	362	420	508	510
400/5 AD	455	405	490	605	610
450/5 CE	505	483			
500/5 BE	605				
600/5 AE					
			1200/5 M. R.		
			110	115*	120*
		85	175	220	225
	125	185	250	315	320
100/5 BC	220	248	335	415	420
200/5 AB	315	326	420	510	515
300/5 AC	415	406	495	610	615
400/5 DE	510	486	650	808	808
500/5 CD	610	645	730	905	905
600/5 BD	805	723	810	1005	1005
700/5 AD	905	803	965	1205	1205
900/5 CE	1005	963			
1000/5 BE	1205				
1200/5 AE					

Note—Minimum trip values based on one transformer per phase unless otherwise indicated.

* Two transformers in series.

ORDERING INSTRUCTIONS

When ordering Renewal Parts, always specify the name of the part wanted as shown on the illustrations in this Instruction Book, giving Shop Order Number and the type of Oil Circuit-Breaker, as shown on the name plate. For example:

One Moving or Stationary Contact Complete, 600 Amperes, for Type GO-B Oil Circuit-Breaker, S. O. 30-F-171, shown in Instruction Book 5816, Figure 2.

To avoid delays and misunderstandings, note carefully the following points:

1. Send all correspondence and orders to the nearest Sales Office of the Company.

2. State whether shipment is to be made by freight, express or parcel post. In the absence of instructions, goods will be shipped at our discretion. Parcel post shipments will be insured only on request. All shipments are at purchaser's risk.

3. Small orders should be combined so as to amount to a value of at least $1.00 net. Where the total of the sale is less than this, the material will be invoiced at $1.00.

RENEWAL PARTS DATA

Recommended Stock of Renewal Parts for TYPES GO-B, GO-1-B AND GO-2-B OIL CIRCUIT-BREAKERS

Outdoor Service

Manually or Solenoid Operated—Frame Mounting

600 or 1200 Amperes—15 or 23 KV.—3 Pole-Single Throw

FOR ILLUSTRATION OF PARTS SEE FIGURES 2, 3, 4, 5, 6 AND 9

The following is a list of the Renewal Parts and the quantities of each that we recommend should be stocked by the user of this apparatus to minimize interrupted operation caused by breakdowns. The parts recommended are those most subject to wear in normal operation or those subject to damage or breakage due to possible abnormal conditions. This list of Renewal Parts is given only as a guide. When continuous operation is a primary consideration, additional insurance against shut-downs is desirable. Under such conditions more renewal parts should be carried, the amount depending upon the severity of the service and the time required to secure replacement.

TYPE GO-B OIL CIRCUIT BREAKER

Breakers in use up to and including

Name of Part	No. Per 3-Pole Breaker	1 Recommended For Stock	5 Recommended For Stock
Breaker Complete	1	0	0
Breaker Pole Unit Complete	3	0	0
Bumper Spring	3	0	1
Moving Contact Complete	3	0	0
Lift Rod	3	0	1
Main Moving Contact	3	0	1
*Main Moving Contact Spring	3	0	1
Moving Arcing Contact Breaker	6	0	0
Moving Arcing Contact	6	6	12
Moving Arcing Contact Spring	6	2	6
Moving Arcing Contact Complete	6	0	0
Stationary Contact Complete	6	0	2
Condenser Bushing	6	0	2
Main Stationary Contact	6	6	12
Stationary Arcing Contact	3	0	2
Stationary Arc Shield	3	0	0
Oil Tank Complete	3	0	1
Oil Tank	3	0	1
*Oil Gauge Glass	1	0	0
Tank Liner	1	0	1
*Type SA-3 Solenoid Operated Mechanism	1	0	1
*†Closing Coil	1	0	0
*†Trip Coil	1	0	1
*†Rectox Rectifier	1	0	0

* Not illustrated.
† When ordering, specify identification number stamped on part.
Parts indented are included in the part under which they are indented.

TYPE GO-1-B AND GO-2-B OIL CIRCUIT BREARERS

Breakers in use up to and including

Name of Part	No. Per Breaker	1 Recommended For Stock	5 Recommended For Stock
Breaker Complete	1	0	0
Breaker Pole Unit Complete	3	0	0
Bumper Spring	3	0	1
Moving Contact Complete	3	0	0
Lift Rod	3	0	1
Moving Contact	6	0	1
Stationary Contact Complete	6	0	0
Condenser Bushing	6	0	2
Stationary Contact	6	0	0
De-ion Grid Stack	12	0	0
Stationary Contact Finger	12	12	24
Stationary Contact Finger Spring	6	4	12
Stationary Arcing Horn	3	6	12
Oil Tank Complete	3	0	0
Oil Tank	3	0	0
*Oil Gauge Glass	3	0	1
Tank Liner	1	0	1
*Type SA-3 Solenoid Operated Mechanism	1	0	1
*†Closing Coil	1	0	0
*†Trip Coil	1	0	1
*†Rectox Rectifier	1	0	0
Current Transformer 600/5	.	.	.
Current Transformer 1200/5	.	.	.

* Not listed on illustration.
† When ordering, specify identification number stamped on part.
Parts indented are included in the part under which they are indented.

Ordering Instructions on Page 9

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§BALTIMORE, MD., 40 S. Calvert St.
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#DENVER, COLORADO, 1700 Sixteenth St.
†DENVER, COLORADO, 988 Cherokee St.
§DENVER, COLORADO, Gas & Elec. Bldg.
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Westinghouse Electric Supply Company

Fully equipped sales offices and warehouses are maintained at all addresses

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①Changed or added since previous issue.

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ERIE, PA., Star Electrical Co.
HUNTINGTON, W. VA., Banks-Miller Supply Co.
KANSAS CITY, MO., Columbian Elec'l Co.
KANSAS CITY, MO., Continental Elec. Co.
LOUISVILLE, KY., Tafel Electric Co.
MONROE, LA., Monroe Hardware Co.
NASHVILLE, TENN., Tafel Electric Co.
NEW ORLEANS, LA., Electrical Supply Co.
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*CHICAGO, ILL., 20 North Wacker Drive
#CHICAGO, ILL., 2211 W. Pershing Road
*CINCINNATI, OHIO, Third & Elm Sts.
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*HUNTINGTON, W. VA., 1029 Seventh Ave.
*INDIANAPOLIS, IND., 137 So. Penna. Ave.
*JACKSON, MICH., Consumers Power Bldg.
*KANSAS CITY, MO., 101 W. Eleventh St.
#*LOS ANGELES, CALIF., 420 S. San Pedro St.
*LOUISVILLE, KY., 332 West Broadway
*MEMPHIS, TENN., 130 Madison St.
*MILWAUKEE, WISC., 546 North Broadway
*MINNEAPOLIS, MINN., 2303 Kennedy St., N. E.
*NEW ORLEANS, LA., 333 St. Charles St.
yNEW YORK, N. Y., 150 Broadway
*OKLAHOMA CITY, OKLA., 10 E. California St.
*OMAHA, NEB., 409 So. Seventeenth St.
*PHILADELPHIA, PA., 3001 Walnut St.
*PITTSBURGH, PA., 306 4th Ave., Box 1017
#PITTSBURGH, PA., Try St. Terminal Bldg.
*ROCHESTER, N. Y., 1048 University Ave.
*SALT LAKE CITY, UTAH, 10 West First South St.
*SAN FRANCISCO, CALIF., 1 Montgomery St.
#SAN FRANCISCO, CALIF., 60 Federal St.
*SEATTLE, WASH., 603 Stewart St.
#SEATTLE, WASH., 3451 East Marginal Way
*ST. LOUIS, MO., 411 No. Seventh St.
#ST. LOUIS, MO., 1219-21 Gratoit St.
*SYRACUSE, N. Y., 109 So. Warren Street
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xTRENTON, N. J., 400 Pennington Ave.
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*CLEVELAND, OHIO, 7016 Euclid Ave.
*DALLAS, TEXAS, 207 Browder St.
#*DETROIT, MICH., 5757 Trumbull Ave.
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#†MONTREAL, 1844 William St., Montreal, Quebec, Can.
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Westinghouse

Types GO-1-A and GO-2-A Oil Circuit-Breakers

GO-1-A—15,000 Volts—600 Amperes
GO-2-A—15,000 Volts—600 or 1200 Amperes
2, 3 or 4 Poles

INSTRUCTION BOOK

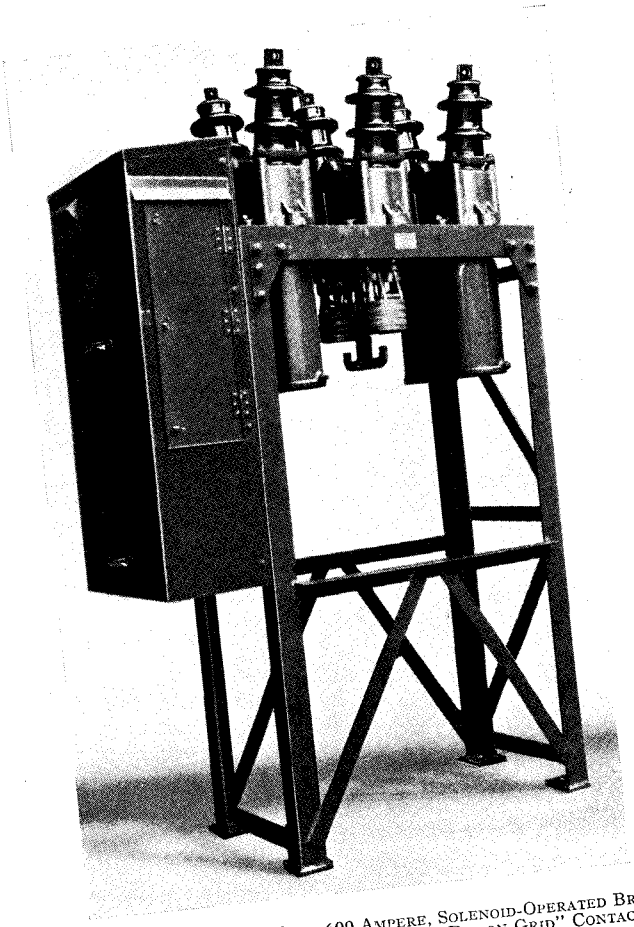


FIG. 1—TYPE GO-1-A 15000 VOLT, 600-AMPERE, SOLENOID-OPERATED BREAKER WITH CENTER TANK REMOVED SHOWING THE "DE-ION GRID" CONTACTS.

Westinghouse Electric & Manufacturing Company

East Pittsburgh Works **East Pittsburgh, Pa.**

I. B. 5771

(Filing No. 33-000)

Printed in U.S.A. (5-37)

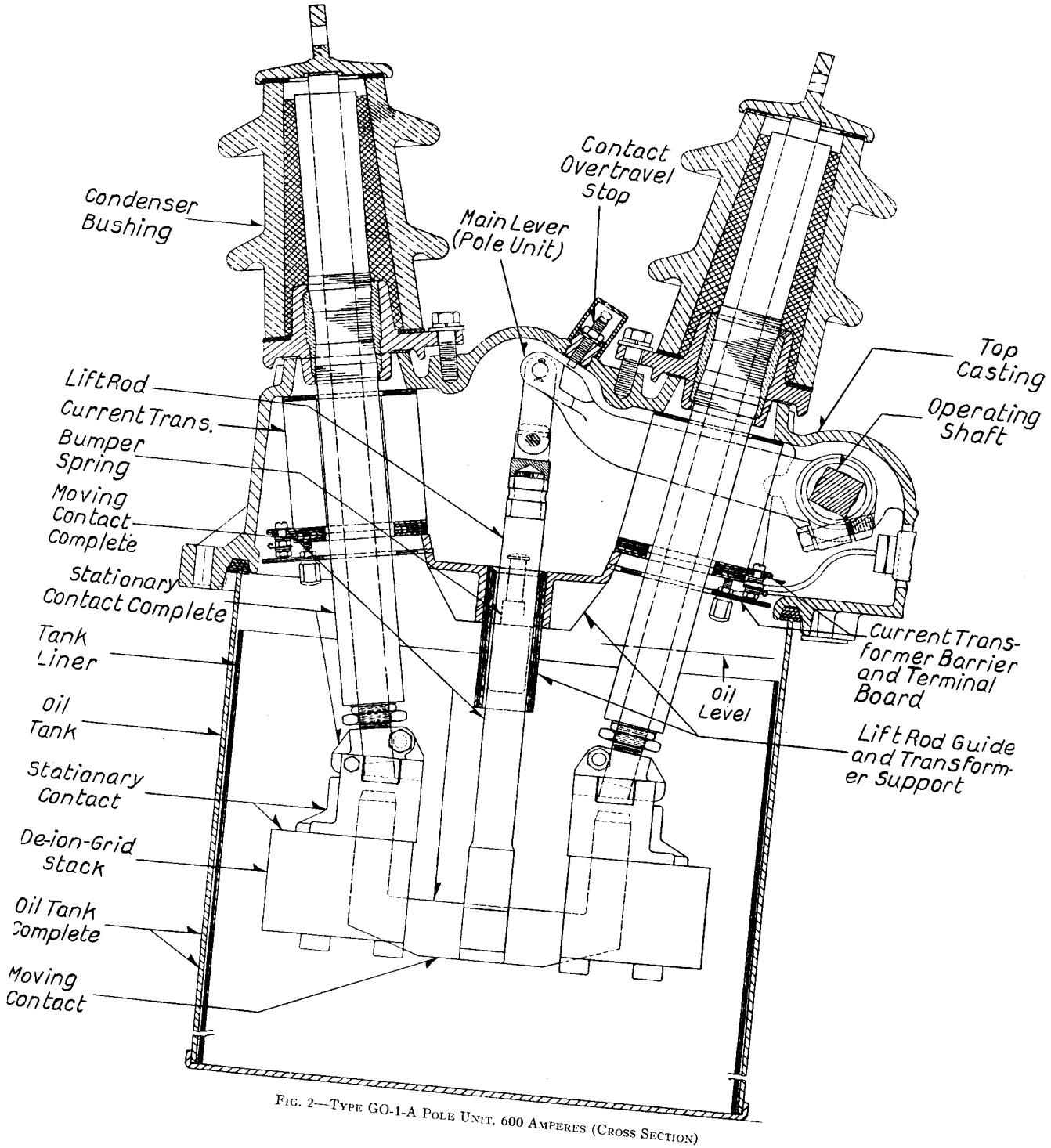


FIG. 2—TYPE GO-1-A POLE UNIT, 600 AMPERES (CROSS SECTION)

Westinghouse

Types GO-1-A and GO-2-A Oil Circuit-Breakers

15,000 Volts—600 and 1200 Amperes

2, 3 or 4-Poles

Manually or Electrically Operated

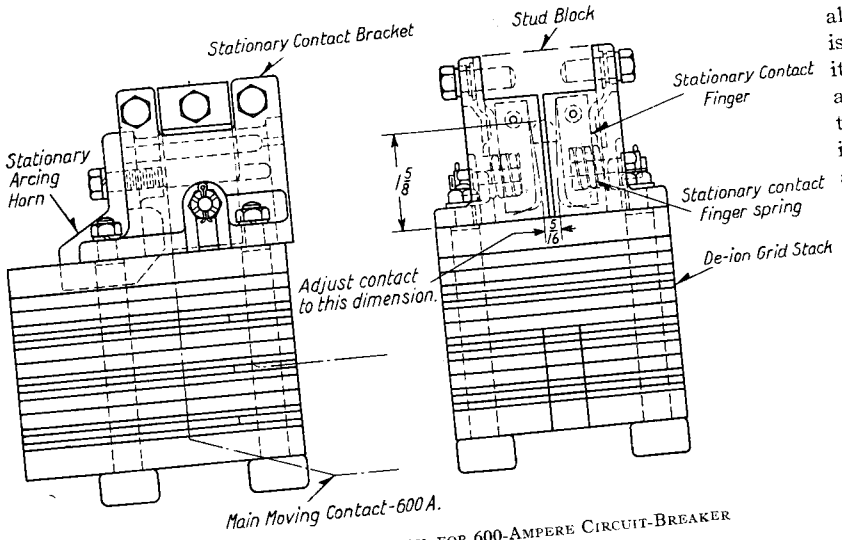


FIG. 3—DE-ION GRID ASSEMBLY, FOR 600-AMPERE CIRCUIT-BREAKER

General

The types GO-1A and GO-2A breakers are designed for outdoor service and comply with all standard requirements. When properly installed and maintained they will give satisfactory service. The interrupting capacities of these breakers have been verified by short-circuit tests in testing laboratories and by field installations.

Both breakers are equipped with "De-ion" Grid contacts. (See Fig. 3.) The arc interruption takes place in the "De-ion" Grid chambers supported from the terminals. The device consists of a series of insulated plates having interspersed plates of magnetic material, all so disposed and vented that the arc is moved laterally into pockets where it vaporizes the oil. The resultant gases are then forced transversely through the conducting gases of the arc stream in such a manner as to de-ionize them and extinguish the arc.

Shipment

The breakers are shipped completely assembled with all attachments and auxiliaries mounted in place. Do not remove the crating until the breaker reaches its permanent location.

Installation

1. Remove the crating and frame skids.
2. Mount the breaker on its foundation. The four foundation bolts should be left loose until the frame is properly leveled by inserting shims under the feet. The breaker must be perfectly level.
3. Remove the tie wire from the mechanism trigger and allow the breaker to open slowly.

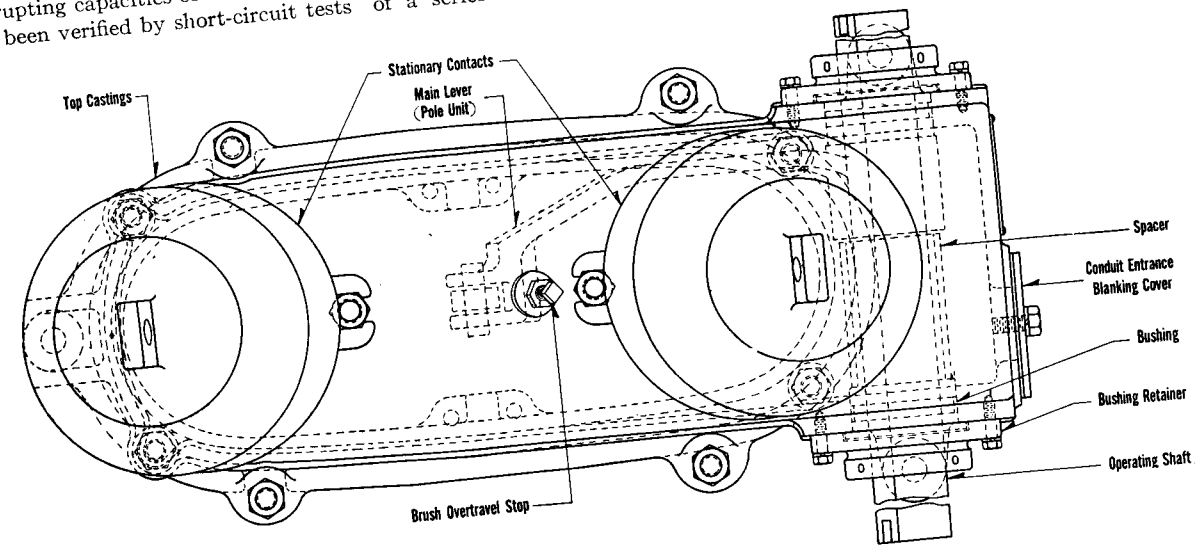


FIG. 4—TYPE GO-1-A POLE UNIT (TOP VIEW)

4. Remove the tanks and examine the inside for evidence of moisture or foreign matter. Flush with benzine. Tanks should not be lowered in wet weather without provision for keeping moisture out of them. The internal parts of the breaker should be protected as well.
5. Examine the contacts to see that they are clean and in alignment. For adjustments, see section covering "Adjustments".
6. Operate the breaker by hand several times, watching each pole and the operating mechanism to be sure that all parts move freely.
7. Install connections to the breaker studs. All contact surfaces should be cleaned and should be free of burrs. The terminal studs are not designed to carry undue cable or bus bar loads. An excessive strain, which at first may have no apparent effect, will eventually loosen the porcelain weather casing and permit moisture to enter the breaker.
8. With the tank removed, fill with oil in accordance with name plate instructions. When bolting in place, be sure the tank is drawn up evenly and tightly all around. See that the oil level is at the proper height on the oil gauge.
9. Connect the breaker frame to ground through one of the mounting bolts. The National Electric Code requires grounding cable to have one-fifth the main circuit capacity, except that it must never be smaller than No. 8 and need not be larger than No. 0, B & S gauge.
10. Remove the undrilled conduit entrance plate from the bottom of the mechanism housing (when supplied) and drill for the conduit entrance as desired. Unit mechanisms have definitely located conduit entrances as shown on the outline drawing.
11. Connect the control and transformer circuits to the proper points on the terminal blocks, as shown on the diagram supplied. When the breaker is located a considerable distance from the battery or transformer, allowance should be made for the voltage drop between the battery, or transformer, and the terminals of the operating coil to secure proper operation at minimum control voltage. The bushing type current transformer name plate should be used as an indication of the proper taps to use, although the proper taps will be determined by the loading. It is always necessary to determine the proper taps by test. The following tables indicate the primary current necessary to trip the breaker for several standard attachments. Always be sure the transformer secondary connections are completed before impressing primary current on the breaker.
12. Check the operation of the breaker by operating it electrically, if for electrical operation.

Adjustments

These breakers used the wedge and finger type "De-ion" grid contact shown in Fig. 3. They are designed with sufficient pressure to carry rated current without the temperature rise exceeding A.I.E.E. limits. The moving contacts are non-adjustable and are set properly at the factory. The distance between the top of the "De-ion" grid top plate and the top of the moving contact should be $1\frac{5}{8}$ inches with the breaker closed. This dimension is only for new parts. Some allowance must of course be made when the contacts burn. The moving contacts are tipped with a special arc-resisting tungsten alloy to insure long life. This can only be replaced at the factory.

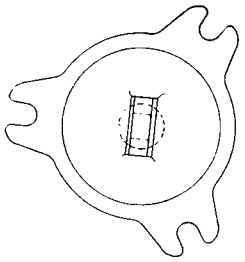
When fitting new stationary contact fingers the adjustment should be so made that the distance between the fingers is $\frac{5}{16}$ inch. See Fig. 3. The fingers should also be adjusted symmetrically with respect to the slot in the grids.

Vertical and rotational adjustment of the "De-ion" grids is secured by loosening the clamping bolt of the stationary contact foot and rotating the foot into alignment. If necessary to rotate the contact foot a complete turn, it will be necessary to remove the stationary contact bracket (with "De-ion" grid attached). Before rotating the foot a wedge should be driven into the saw cut to spread the foot. Never attempt to force the contact foot as the copper may "gall".

A limited amount of horizontal adjustment can be secured by adjusting the three clamp flange bolts on the top of the pole unit. This is done by loosening one or two bolts and tightening the remaining bolts. The bolts loosened should be checked for tightness after adjustment.

Before completing any adjustments, make sure that the contact support is turned so as to secure the minimum amount of friction or rubbing, between the moving contact and the stack.

When removing the copper oxide from the contacts use sandpaper or a fine file. Do not use emery cloth; the particles of emery are electrical conductors and any particles remaining lower the insulating value of the oil.



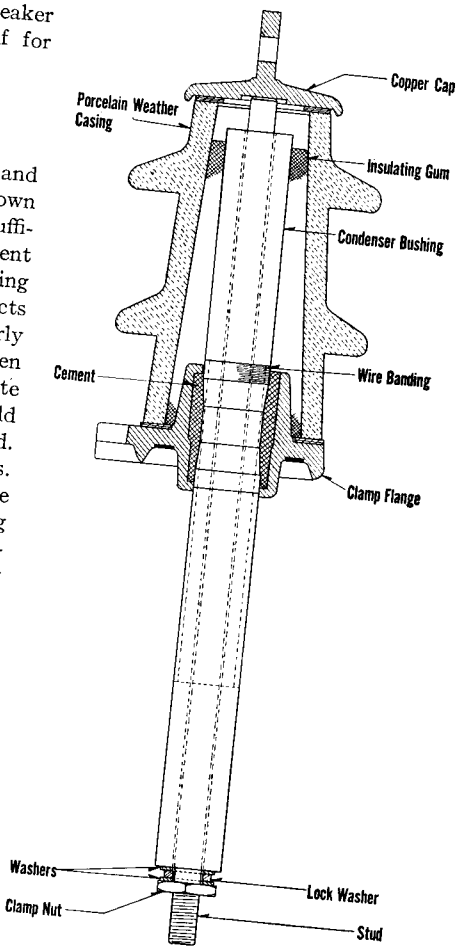


FIG. 5—GO-1-A STATIONARY CONTACT, 15,000 VOLTS

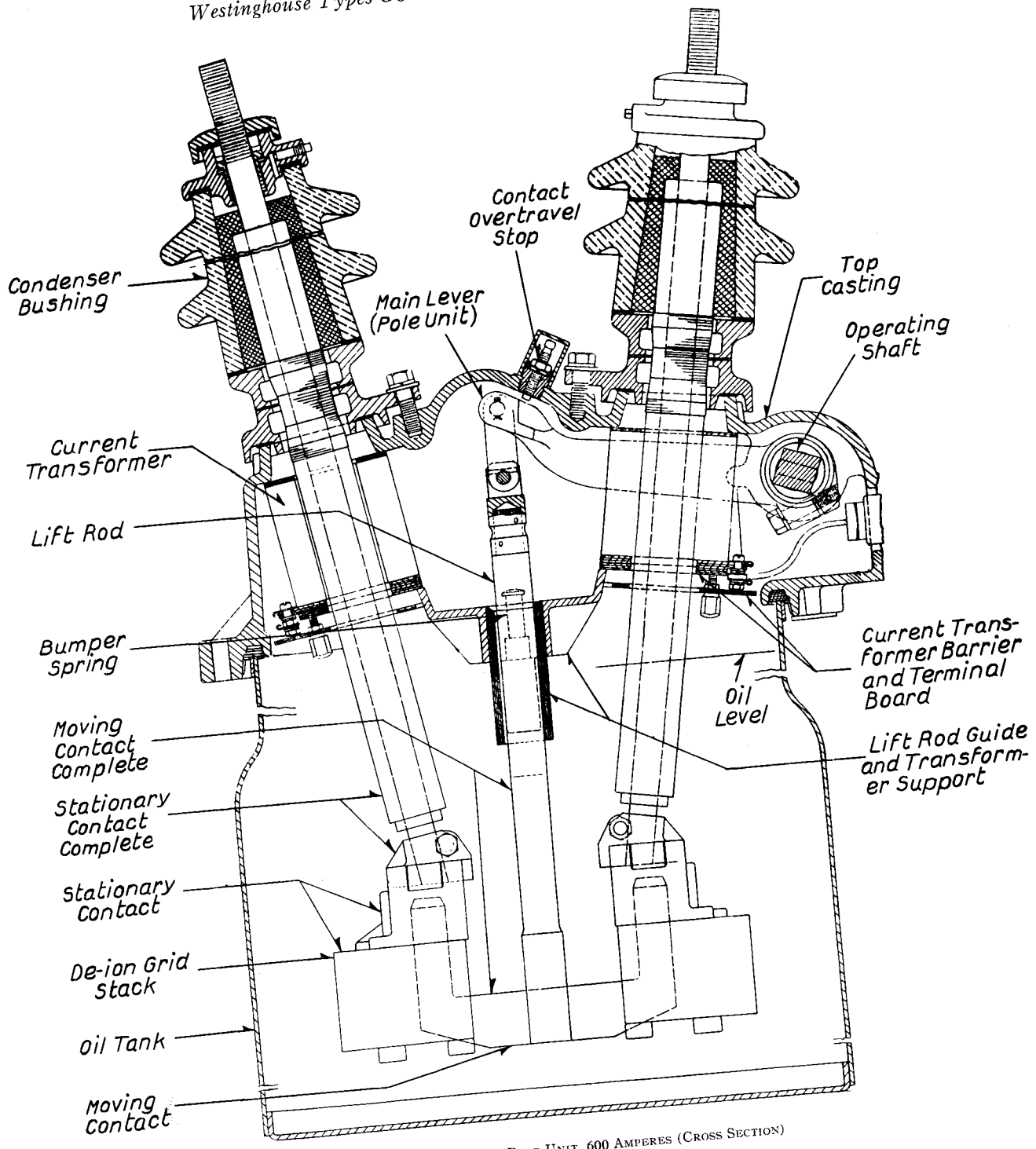


FIG. 6—TYPE GO-2-A POLE UNIT, 600 AMPERES (CROSS SECTION)

"De-ion" Grid Stacks—It is important that the arrangement of the plates in the "De-ion" grids be correct. Should it be necessary to renew parts of the stacks, it is recommended that they be returned to the factory for repair or completely new assembled stacks supplied.

Terminal Bushing—The surface of the bushing insulation should be smooth and well varnished. If the varnished surface is damaged or questionable, it should be smoothed off with fine sand paper and revarnished with three coats of good quality, clear, air-drying Spar varnish. Each coat should be allowed to dry for 24 hours.

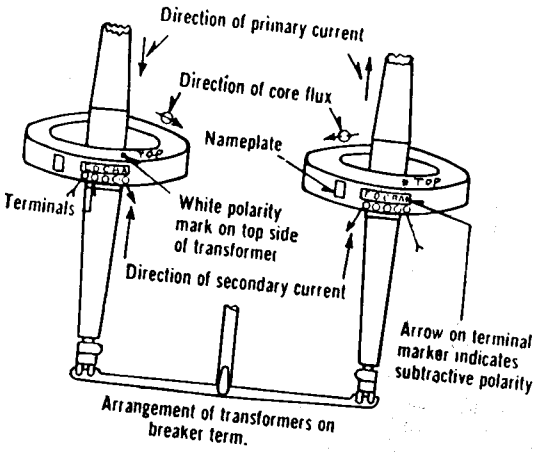


FIG. A

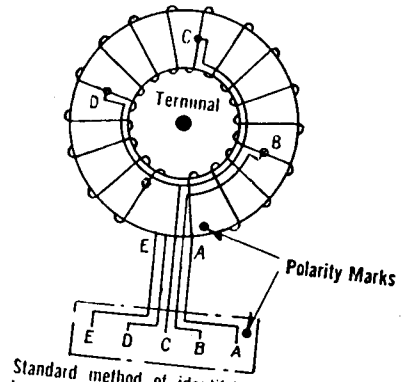


FIG. B

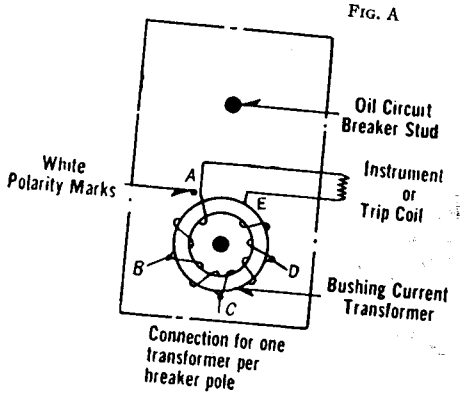


FIG. C

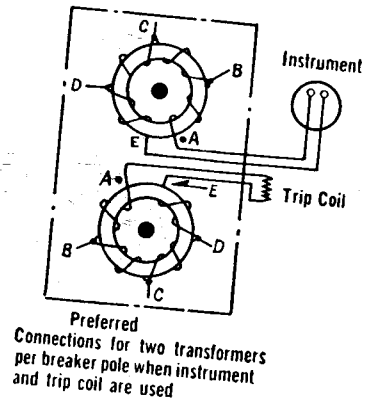


FIG. D

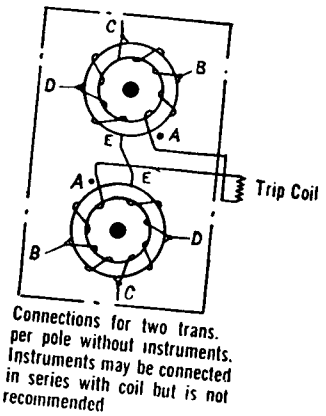


FIG. E

FIG. 7—TYPICAL BUSHING TYPE CURRENT TRANSFORMER CONNECTIONS

Mechanical—Do not try to adjust the contacts by changing the toggle adjustment. The toggle of the breaker is set at the factory and should not be disturbed. The correct setting is $\frac{7}{8}$-inch off center for the standard breaker. Refer to Fig. 9. Excessive overtravel of the contacts is prevented by the set screw stop in the top of the main casting. This stop should be set to secure $\frac{1}{16}$-inch clearance between the top of the pole unit main lever and the bottom of the set screw. This clearance can be approximated by screwing the set screw down until it touches the main lever, and then backing off one turn.

Maintenance

Points to be Observed in Maintenance—

1. Before making any adjustments, make sure that all lines are electrically dead.
2. Be sure the breaker frame is grounded.
3. Do not operate the breaker excessively with the operating mechanism when the tanks are removed.
4. Examine all contacts frequently especially after short-circuit. See that the contacts are properly aligned.
5. After making any adjustments, operate the apparatus carefully by hand to make sure that it operates smoothly and correctly.
6. Inspect the oil after severe faults. If it shows signs of moisture, carbonization or dirt, filter and retest it.
7. Remove all oil and thoroughly clean the tanks, tank liners, lift rods, terminal bushings, etc., at least once a year.
8. Occasionally inspect and tighten clamping nuts around bushings on top of breaker.
9. Any pitting of the contacts should be smoothed, or, if badly burned, the contacts should be replaced.
10. Keep the bearing surfaces of the mechanism and breaker units adequately oiled.
11. **Operating Mechanism**—For instructions covering the Type SA-3 solenoid mechanism, see Instruction Book 5567.

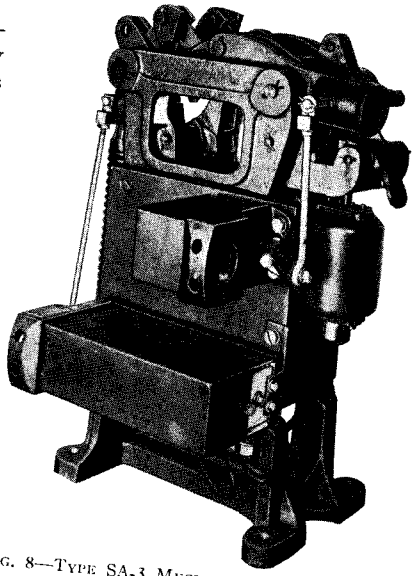


FIG. 8—TYPE SA-3 MECHANICALLY TRIP FREE SOLENOID

Type GO-1-A 600-Ampere 15,000-Volt Breaker

DATA APPLYING TO 400/5 AND 600/5 TRANSFORMERS

ACTUAL PRIMARY CURRENTS NECESSARY TO PRODUCE 5 AMPERES IN SECONDARY FOR ATTACHMENTS INDICATED

60 CYCLES

400/5 Transformers

Nominal Ratio	Turn Ratio	Tap	INSTANTANEOUS OR INVERSE TIME LIMIT TRIP				DIRECT TRIP				CO RELAY			
			Hand Operated		Solenoid Operated		Hand Operated		Solenoid Operated		†Standard		†Low Energy	
			L*	R*	L*	R*	L*	R*	L*	R*	L*	R*	L*	R*
30	6	AB	O.L.	O.L.	O.L.	O L.	O.L.	O.L.	O.L.	O.L.	O.L.	O.L.	50	40
50	10	BC	O.L.	O.L.	O.L.	O.L.	O.L.	O.L.	O.L.	O.L.	O.L.	60	55	50
80	16	AC	O.L.	O.L.	O.L.	130	O.L.	O.L.	O.L.	O.L.	80	75	70	65
125	25	CD	O.L.	180	O.L.	140	O.L.	O.L.	O.L.	190	110	105	105	100
175	35	BD	240	230	200	190	O.L.	O.L.	210	195	155	150	145	140
205	41	AD	255	245	230	220	O.L.	O.L.	230	220	170	165	170	165
300	60	CE	335	325	325	315	O.L.	335	320	310	250	245	245	240
350	70	BE	375	365	370	360	O.L.	370	365	360	285	280	280	275
380	76	AE	400	395	395	390	410	395	395	390	310	305	305	300

600/5 Transformers

50	10	BC	O.L.	O.L.	O.L.	O.L.	O.L.	O.L.	O.L.	O.L.	O.L.	80	75	50
100	20	AB	O.L.	O.L.	O.L.	O.L.	O.L.	O.L.	O.L.	O.L.	140	90	90	85
150	30	AC	O.L.	O.L.	O.L.	165	O.L.	O.L.	O.L.	205	135	130	125	120
200	40	DE	O.L.	250	O.L.	215	O.L.	O.L.	O.L.	215	170	170	165	165
250	50	CD	295	280	285	260	O.L.	O.L.	280	255	210	210	205	200
300	60	BD	340	330	330	315	O.L.	O.L.	315	295	250	250	245	240
400	80	AD	435	425	425	415	O.L.	O.L.	390	375	330	330	325	325
450	90	CE	480	475	475	470	O.L.	460	425	415	365	365	360	360
500	100	BE	525	520	525	520	510	485	480	470	410	410	405	405
600	120	AE	620	620	615	610	530	525	580	570	485	485	480	480
							625	625						

Type GO-2-A 600-Ampere 15,000-Volt Breaker

400/5 Transformers

30	6	AB	O.L.	O.L.	O.L.	O.L.	O.L.	O.L.	O.L.	O.L.	O.L.	O.L.	O.L.	40
50	10	BC	O.L.	O.L.	O.L.	O.L.	O.L.	O.L.	O.L.	O.L.	O.L.	65	O.L.	55
80	16	AC	O.L.	O.L.	O.L.	O.L.	O.L.	O.L.	O.L.	O.L.	O.L.	80	75	70
125	25	CD	O.L.	200	O.L.	155	O.L.	O.L.	O.L.	O.L.	115	110	110	105
175	35	BD	O.L.	240	210	195	O.L.	O.L.	230	200	160	155	150	145
205	41	AD	O.L.	250	245	235	O.L.	O.L.	250	240	180	175	175	170
300	60	CE	360	330	335	325	O.L.	O.L.	340	330	250	245	245	240
350	70	BE	390	370	380	365	O.L.	335	385	270	290	285	285	280
380	76	AE	410	400	400	395	420	375	405	400	315	310	310	305
								405						

600/5 Transformers

50	10	BC	O.L.	O.L.	O.L.	O.L.	O.L.	O.L.	O.L.	O.L.	O.L.	70	85	55
100	20	AB	O.L.	O.L.	O.L.	O.L.	O.L.	O.L.	O.L.	O.L.	115	90	100	85
150	30	AC	O.L.	O.L.	O.L.	195	O.L.	O.L.	O.L.	O.L.	140	130	130	125
200	40	DE	O.L.	265	O.L.	235	O.L.	O.L.	O.L.	255	175	170	170	165
250	50	CD	305	295	295	275	O.L.	O.L.	O.L.	295	215	210	210	205
300	60	BD	345	335	335	320	O.L.	O.L.	O.L.	340	255	250	250	245
400	80	AD	435	425	425	415	O.L.	O.L.	460	435	330	330	325	325
450	90	CE	480	475	475	470	O.L.	475	490	475	370	370	365	365
500	100	BE	525	520	520	515	520	495	525	520	410	410	405	405
600	120	AE	625	620	620	615	530	525	625	620	485	485	480	480
							630	625						

* R or L = Right or Left Hand Transformer.
* R = Right Hand Transformer.

† Relay set on 4-ampere tap.
O.L. = Transformer Overloaded—Do not use.

Insulating Oil

Dielectric tests of the oil should be made every three months, to show if it is reasonably good for circuit-breaker work. Samples should not be taken until the oil has remained undisturbed for at least four hours. In testing for indication of water, take the sample from the bottom of the tank. If for indication of carbon, and after a heavy short-circuit, take the sample from the surface of the oil.

The care of the insulating oil in circuit-breakers is of the utmost importance in their successful operation. Contamination by dirt, moisture, metallic particles, lint, etc., all reduce the dielectric strength, upon which the operation and current-interrupting ability largely depend. Consequently, the most careful attention should be given to keeping the oil clean, not only in filling the tanks originally but in later maintenance or other work on the breakers which might involve opening the tanks.

Only the highest grade, such as Wemco "C" or other approved oil, should be used in the breakers. The oil should be new or at least thoroughly reconditioned by means of a filter press or centrifuge. In any case, before using, it should be given a dielectric test which should show a minimum of 22,000 volts (preferably 25,000 to 30,000) measured between 1-inch diameter discs spaced .1 inch apart.

Before filling, the tanks should be thoroughly cleaned, and flushed out with insulating oil. The same treatment should be given the inside of the top of the breaker and the operating linkage and contact system. In doing this, rags which will leave lint should not be used as lint absorbs and holds moisture.

The same care should be used during inspection or maintenance work on the breaker, which should preferably be done only under favorable weather conditions. If the oil is to be reconditioned following operation of the breaker under short-circuit, the tank and entire inside

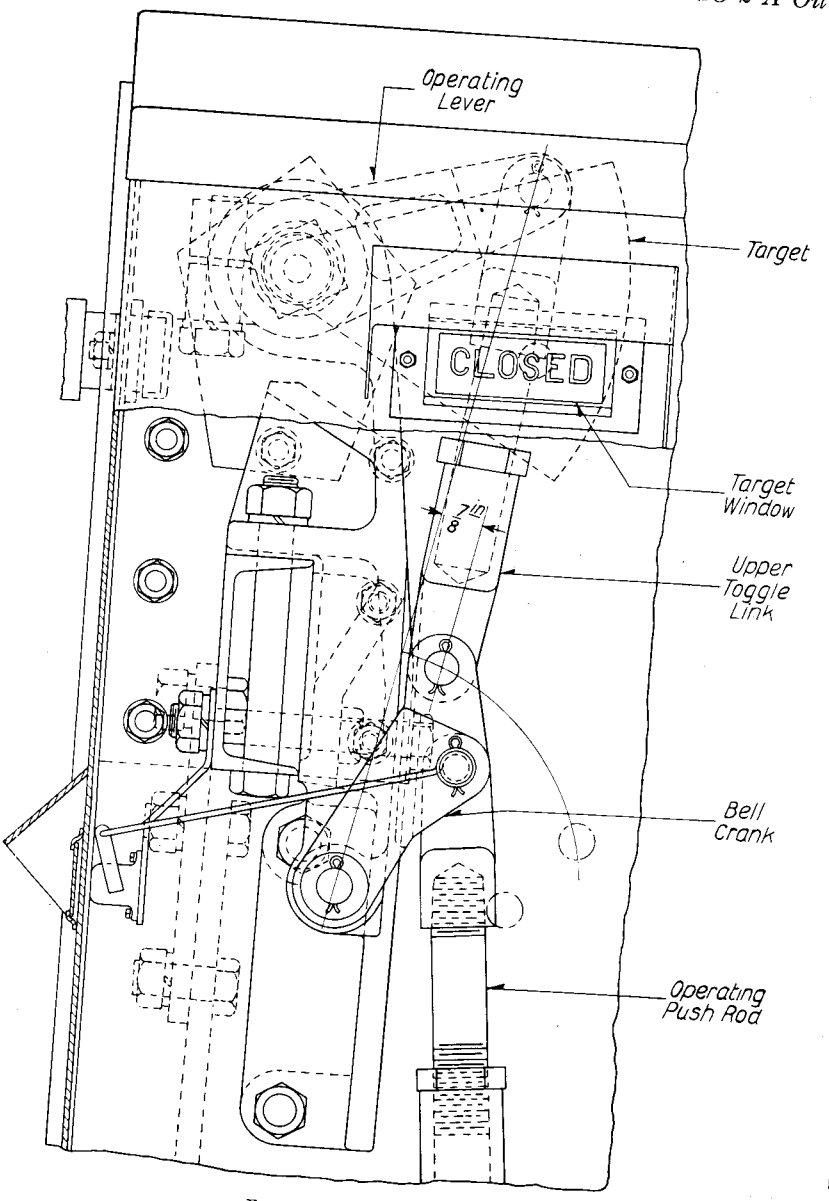


FIG. 9—TOGGLE MECHANISM

of the breaker should be cleaned before the oil is returned to the tank. If the work merely involves lowering or removal of the tank, care should be taken to keep the tank covered until it is replaced so that dirt, dust, metallic particles, etc., cannot fall into the oil.

The above precautions may appear academic to those familiar with the maintenance and operation of oil circuit-breakers, but a little more than ordinary care in oil-handling will be well repaid in reliable and dependable operation for which the breaker is designed and built.

For instructions as to the care and testing of insulating oil, see Instruction Book 5336.

OUTLINE DIMENSIONS IN INCHES—3-POLE

Type	Amp.	Volts	Gallons Oil	Shipping Wt., Lb. Without Oil	A	B	C
GO-1A	600	15000	20	1550	96	30	36
GO-2A	600	15000	32	1600	105 11/16	33 1/2	39 1/2
GO-2A	1200	15000	35	1650	98 1/2	32 1/4	38

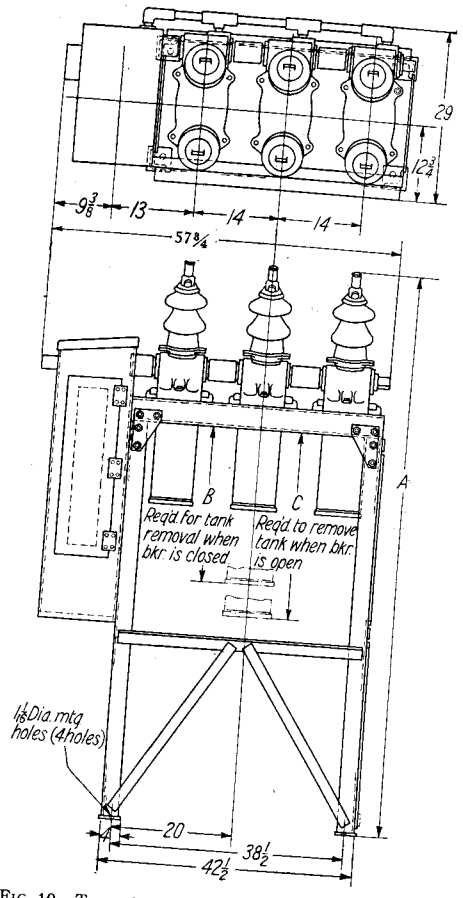


FIG. 10—TYPE GO-1-A OIL CIRCUIT-BREAKER, FRAME MOUNTING, 15,000 VOLTS

RENEWAL PARTS DATA

Recommended Stock of Renewal Parts for TYPES GO-1-A AND GO-2-A OIL CIRCUIT-BREAKERS

Outdoor Service

Manually or Solenoid Operated—Frame Mounting

15,000 Volts, 600 and 1200 Amperes; 3-Pole; Single-Throw

FOR ILLUSTRATION OF PARTS SEE FIGURES 2, 3, 4, 5, 6 AND 9

The following is a list of the Renewal Parts and the quantities of each that we recommend should be stocked by the user of this apparatus to minimize interrupted operation caused by breakdowns. The parts recommended are those most subject to wear in normal operation or those subject to damage or breakage due to possible abnormal conditions. This list of Renewal Parts is given only as a guide. When continuous operation is a primary consideration, additional insurance against shut-downs is desirable. Under such conditions more renewal parts should be carried, the amount depending upon the severity of the service and the time required to secure replacement.

Breakers in use up to and including		1	5	Type GO-1-A	Type GO-2-A
Name of Part	No. Per Breaker	Recommended For Stock		Style Number of Part	
Breaker Complete	1	0	0	... ...	... ...
Breaker Pole Unit Complete	3	0	0	... ...	... ...
Bumper Spring	3	0	1	1 014 241	1 014 241
Moving Contact Complete	3	0	0	... ...	... ...
Lift Rod	3	0	1	949 460	1 014 242
Moving Contact	3	0	1	850 330	850 330
Stationary Contact Complete	6	0	1	... ...	... ...
Condenser Bushing	6	0	0	666 241	948 989
Stationary Contact	6	0	2	825 710	825 710
De-ion Grid Stack	6	0	0	841 775	841 775
Stationary Contact Finger	12	0	0	834 159	834 159
Stationary Contact Finger Spring	12	12	24	841 665	841 665
Stationary Arcing Horn	6	4	12	850 328	850 328
Oil Tank Complete	3	6	12	... ...	... ...
Oil Tank	3	0	0	... ...	... ...
*Oil Gauge Glass	3	0	0	255 850	255 850
Tank Liner	1	0	1	1 014 246	... ...
*Type SA-3 Solenoid Operated Mechanism	1	0	1	See I. B. 5567	
*†Closing Coil	1	0	0	†	†
*†Trip Coil	1	0	1	†	†
*†Rectox Rectifier	1	0	0	See I. L. 1782	

*Not listed on illustration.
†When ordering, specify identification number stamped on part.
Parts indented are included in the part under which they are indented.

ORDERING INSTRUCTIONS

When ordering Renewal Parts, always specify the name of the part wanted as shown on the illustrations in this Instruction Book, giving Shop Order Number and the type of Oil Circuit-Breaker, as shown on the nameplate. For example:

One Moving or Stationary Contact Complete, 600 Amperes, for Types GO-1-A or GO-2-A Oil Circuit-Breaker, S. O. 31-F-434, shown in Instruction Book 5771, Fig. 3.

To avoid delays and misunderstandings, note carefully the following points:

1. Send all correspondence and orders to the nearest Sales Office of the Company.

2. State whether shipment is to be made by freight, express or parcel post. In the absence of instructions, goods will be shipped at our discretion. Parcel post shipments will be insured only on request. All shipments are at purchaser's risk.

3. Small orders should be combined so as to amount to a value of at least $1.00 net. Where the total of the sale is less than this, the material will be invoiced at $1.00.

MEMORANDUM

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*MILANO, ITALY, Piazza Crispi 3
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*WESTINGHOUSE ELEC. CO. OF INDIA, LTD. Feltham House, Graham Road, Ballard Estate, Bombay, India
*CIA. WESTINGHOUSE ELEC. INTERNACIONAL Edificio la Nacional Apartado 78-Bis. Mexico, D. F. Mexico
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*CHICAGO, ILL., 512 S. Peoria St.
*CLEVELAND, OHIO, 7016 Euclid Ave.
*DALLAS, TEXAS, 207 Browder St.
⋇*DETROIT, MICH., 5757 Trumbull Ave.
zxLONG ISLAND CITY, N. Y., 21-16 43rd Ave.
*LOS ANGELES, CALIF., 420 S. San Pedro St.
*MILWAUKEE, WISC., 534 North Broadway
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xBRIDGEPORT, CONN., Plastics Division Plant, 1105 Railroad Ave.
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*NEW YORK, N. Y., 100 East Forty-Second St.
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RETURN
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Westinghouse

Type B-28-B Oil Circuit-Breakers

600, 1200 and 2000 Amperes, 15,000 Volts

INSTRUCTION BOOK

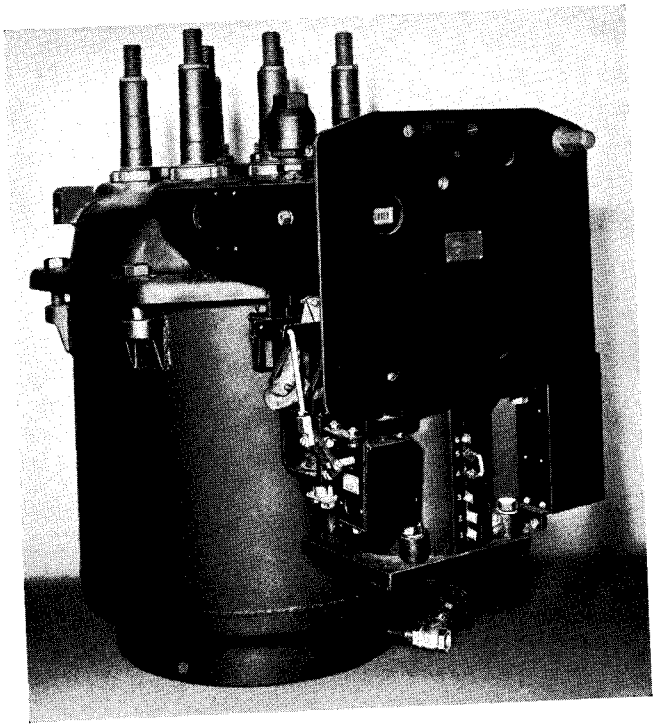


FIG. 1—TYPE B-28-B OIL CIRCUIT-BREAKER, SOLENOID-OPERATED

Westinghouse Electric & Manufacturing Company

East Pittsburgh Works, East Pittsburgh, Pa.

I. B. 5706-A

Filing No. 33-000

Westinghouse Press
Printed in U.S.A. (Rev. 8-40)

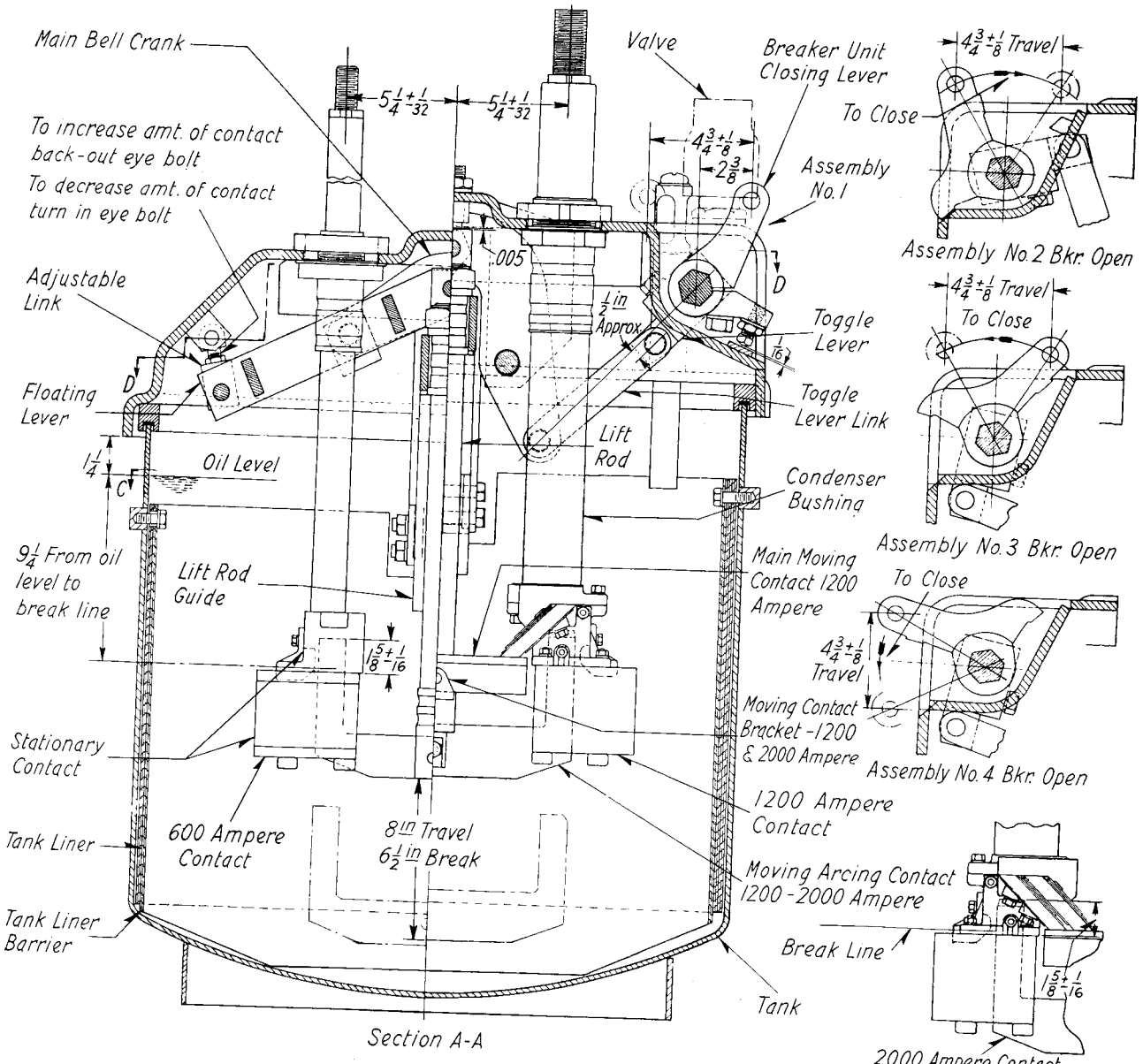


FIG. 2—600 AMPERES

CROSS SECTION OF TYPE B-28-B OIL CIRCUIT-BREAKER SHOWING VARIOUS ARRANGEMENTS OF TOGGLE LEVER AND LINK ASSEMBLY

FIG. 3—1200–2000 AMPERES

Westinghouse

Type B-28-B Oil Circuit-Breakers

600, 1200 and 2000 Amperes, 15,000 Volts

Electrically Operated

(Lift-up Cell, Frame or Truck Mounted)

INSTRUCTIONS

General Description

The Type B-28-B oil circuit-breakers are 3-pole single-throw breakers of non-oil-throwing design, with all poles contained in a single round tank. They are designed for a maximum of 15000-volt service in both the 600-, 1200- and 2000-ampere sizes.

These breakers may be mounted in cells or trucks, on steel frames or as lift-up units.

Electrical operation may be by solenoid, when direct-current is available or by solenoid plus Rectox or motor mechanism when alternating-current is available. The breaker may also be operated manually.

These breakers are equipped with Type F "De-ion Grid" Contacts, Fig. 5. The arc interruption takes place in the "De-ion Grid" chambers supported from the terminals. This chamber consists of a series of insulating plates having interspersed plates of magnetic material, all so disposed and vented that the arc is moved laterally into oil pockets where it vaporizes the oil. The resultant gases are then forced transversely through the conducting gases of the arc stream in such a manner as to de-ionize them and extinguish the arc.

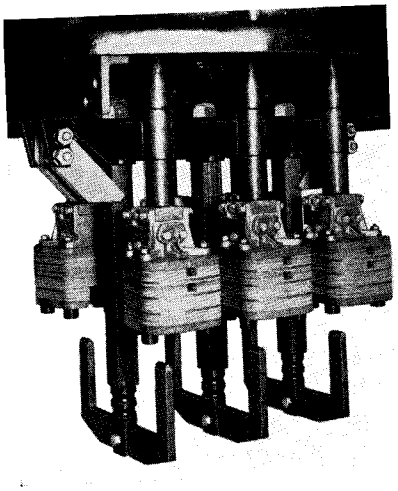


FIG. 4—TYPE B-28-B, 600-AMPERE, 15,000-VOLT BREAKER CONTACT ASSEMBLY WITH "DE-ION GRIDS"

The contact fingers and arcing horn are tipped with a special arc resisting tungsten alloy to insure long life.

Shipment

The breaker is shipped in the following manner:

1. Breaker and operating mechanism are assembled as a complete switching unit with the breaker tied in the closed position.
2. For remote control, the breaker and operating mechanism will be crated separately.

Installation

1. Attach the breaker to the supporting structure, first making sure that the structure is level.
2. Remove the tank and examine the inside for evidence of moisture and foreign matter. Flush with benzine.
3. Remove the wire which holds the breaker in the closed position and allow the breaker to open slowly.
4. When the mechanism is mounted separately from the breaker, connect the breaker and operating mechanism, making sure that full contact is secured and that the breaker rests on the bumpers when open.
5. Examine the contacts and note that they are clean and in alignment. For adjustment, see section covering Adjustment.
6. Operate the circuit-breaker by hand several times, watching each pole and the operating mechanism to be sure that all parts move freely.
7. Install connections to the breaker studs.
8. Insulate the connections with varnished cambric and non-elastic webbing in accordance with Westinghouse Standards for the various operating potentials. See Fig. 8.
9. Connect the vent pipe to the top of the venting valve. This pipe should be connected to the main venting header pipe, or outside the cell or truck in which the breaker is mounted. It should be so arranged that it will not be possible for rain or condensation to enter the piping. The piping should also be free of any pockets which would retard the drainage

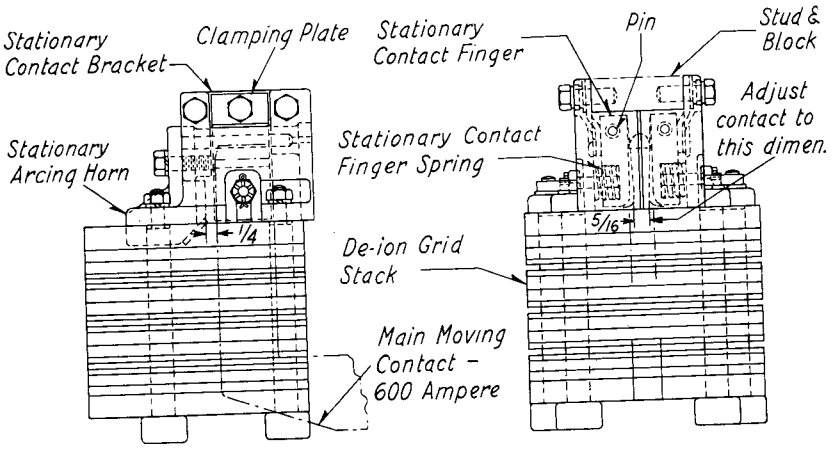


FIG. 5—DE-ION GRID AND CONTACT ASSEMBLY 600 AMPERE

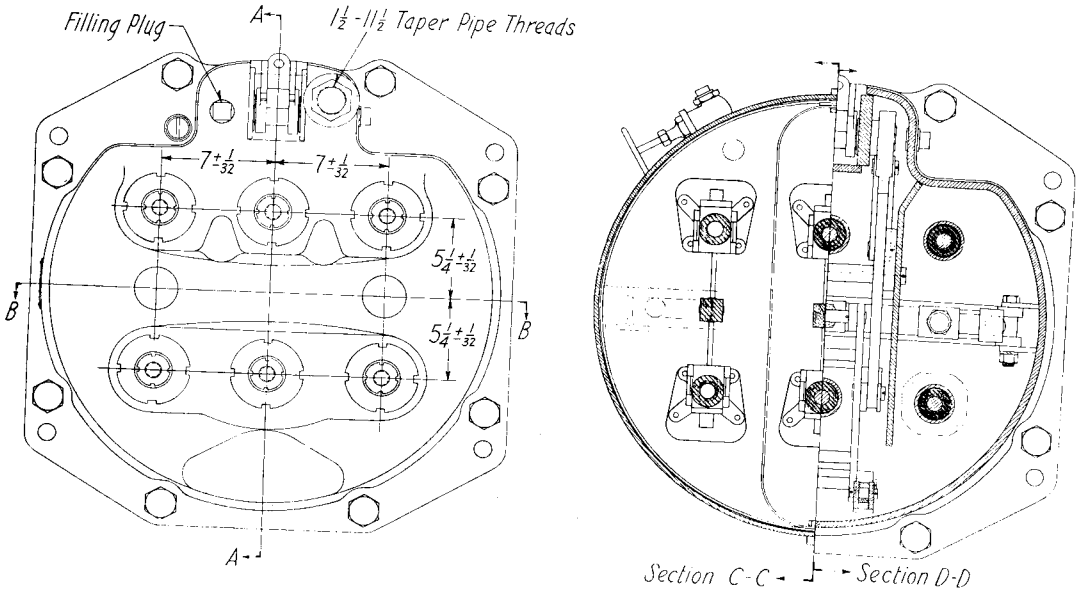


FIG. 6—TOP AND SECTIONAL VIEWS FOR TYPE B-28-B CIRCUIT-BREAKER

of any oil that might be discharged, back to the circuit-breaker.

10. With the tank removed, fill it with oil to within two inches of the top, or if more desirable, the oil can be added through the filling plug located in the breaker top after the tank has been bolted in place, Fig. 2. **Be sure and replace filling plug and see that tank is drawn up even and tight all around, otherwise oil may leak or be forced out.**

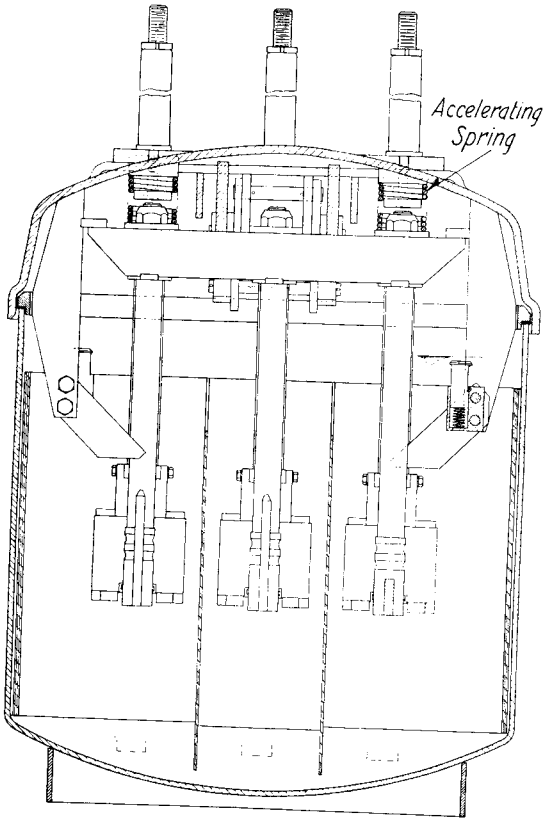


FIG. 7—CROSS SECTIONAL VIEW OF TYPE B-28-B CIRCUIT-BREAKERS

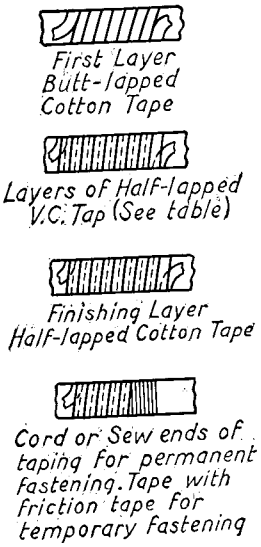
11. Remove the small plug in the top of the oil gauge and move the oil float indicator up and down to see that it is free to move. The red cap at the top of the float should show in the center of the glass for the proper oil level.

12. Connect the breaker frame through one of the mounting bolts to ground. The National Electric Code requires grounding cable to have one-fifth of the main circuit capacity, except that it must never be smaller than No. 8 and need not be larger than No. 0, B. & S. gauge.

13. Check the operation of the breaker by operating it electrically in accordance with the instructions covering the mechanism used.

Adjustments

Breaker Mechanism Fig. #2—The main operating lever is provided with an adjusting screw for setting the toggle, which is set at the factory and should not be disturbed. The setting is such that with the breaker in the closed position the toggle will be ½" $\pm\frac{1}{16}$" with $\frac{1}{16}$" clearance between the head of the adjusting screw and the breaker frame.



Service Volts	Layers of Varnished Cambric Tape
2500	4
4000	5
4500	6
6600	7
7500	8
15000	13

Wrap the conductor with butt-lapped layer of ".007 white cotton tape and cover with one coat of No. 9 insulating varnish (Westinghouse Catalog No. 311). Then wrap with half-lapped layers of ".010 varnished cambric tape (Westinghouse No. 1225 Tan Treated Cloth) applying as many layers as given in the above table. Apply a coat of No. 9 insulating varnish (Westinghouse No. 311) between layers. Tape over the cambric with one layer of ".007 cotton tape and wrap the ends with cord to keep them in place. Finish with two coats of M-1736 black insulating varnish (Westinghouse Catalog No. 414).

FIG. 8—INSTRUCTIONS FOR TAPING CONNECTIONS

CAUTION—Do not interchange links, levers or cross bars between breakers of different ampere-capacities, as certain parts are made of non-magnetic material. To interchange these parts may result in excessive heating.

The hydraulic bumper action is secured by reaction of the moving cross bar on two hydraulic stops—one on each end of the cross bar guides. This action is non-adjustable and requires no attention. Do not operate the breaker excessively without oil.

Contacts—The contact arrangement for the 600-ampere breaker is shown in Fig. 2. Adjustment is provided by means of adjustable links located in the breaker top at the rear. To increase the amount of contact, the complete moving contact must be raised up. This is accomplished by making the links longer. To decrease the amount of contact, the links should be made shorter. For full contact, the distance between top of the "De-ion Grid" top plate and the top of the moving contact should be $1\frac{5}{8}$ inch $\pm \frac{1}{16}$ inch, with the breaker closed. This dimension is only for new parts. Some allowance must of course be made when contacts burn.

CAUTION—After adjustment has been made, be sure that the adjusting screw is securely locked in place with the lock nut.

When fitting new stationary contact fingers the adjustment should be so made that the distance between the fingers is $\frac{5}{16}$ inch. See Fig. 5. These fingers should also be adjusted symmetrically with respect to the slot in the grids.

The main contacts of the 1200 and 2000-ampere capacity breaker shown in Figs. 9-10 may be adjusted by turning the moving contact supporting bracket up or down on the lift rod, using a half turn or full turn as required. When properly set it should be possible to insert a ".0015 feeler under the heel of the brush after closing the breaker by hand. When closed electrically it will be found in practically all cases that the heel will be tight.

CAUTION—Before closing the breaker electrically make sure that a clearance of ".005 minimum, ".007 maximum is maintained between the stops in the breaker top which control the overtravel of the moving contacts.

These contacts make silver to silver contact and it is unnecessary to use an abrasive to keep them bright. The main moving contacts have silver inserts and should it be necessary to renew the silver surfaces, the parts should be returned to the factory, as the silver is put on with special solder.

The auxiliary moving contacts which engages with the contact fingers are tipped with a special arc resisting tungsten alloy to insure long life.

"De-ion Grid" Stacks—It is important that the arrangement of the plates in the "Deion Grids" be correct. Should it be necessary to renew parts of the stacks, is is recommended that they be returned to the factory for repair or complete new assembled stacks supplied.

In assembling new stacks on the breaker, care should be taken to see that the contact is free and does not rub on the sides of the stack when opening or closing the breaker.

Connections to Operating Mechanisms

When the breaker unit and its operating mechanism are shipped separately, it is important that the operating rod

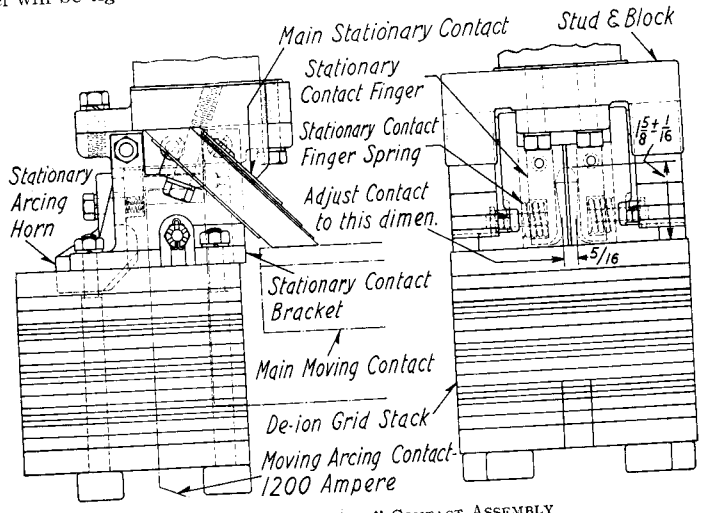


FIG. 9—"DE-ION GRID" CONTACT ASSEMBLY 1200 AMPERE

RETURN
TO
ENGINEERING DIVISION
BUFFALO OFFICE
WESTINGHOUSE ELEC. & MFG. CO.

RENEWAL PARTS DATA

Recommended Stock of Renewal Parts
TYPE B-28-B OIL CIRCUIT-BREAKER
600, 1200 and 2000 Amperes; 15000 Volts; 2 and 3 Pole; Single Throw
For Illustration of Parts, See Figures 2, 3, 5, 7, 9 and 10

The following is a list of the Renewal Parts and the quantities of each that we recommend should be stocked by the user of this apparatus to minimize interrupted operation caused by breakdowns. The parts recommended are those most subject to wear in normal operation or those subject to damage or breakage due to possible abnormal conditions. This list of Renewal Parts is given only as a guide. When continuous operation is a primary consideration, additional insurance against shut-downs is desirable. Under such conditions more renewal parts should be carried, the amount depending upon the severity of the service and the time required to secure renewals.

Breakers in use up to and including	2-Pole			3-Pole			
		1	5		1	5	
Description of Part	No. Req.	Recommended for Stock		No. Req.	Recommended for Stock		Style No.
Breaker Complete	1	0	0	1	0	0	.....
Breaker Unit Complete	1	0	0	1	0	0	.....
Accelerating Spring	2	0	1	2	0	1	881549
*Bumper Spring	2	0	1	2	0	1	918202
*Moving Contact Complete	2	0	0	3	0	0	.....
Lift Rod—600 Amperes	2	0	1	3	0	1	918203
Lift Rod—1200/2000 Amperes	2	0	1	3	0	1	918204
Moving Main Contact— 600 Amperes	2	0	1	3	0	1	918205
Moving Main Contact—1200 Amperes	4	0	2	6	0	2	1017908
Moving Main Contact—2000 Amperes	4	0	2	6	0	2	1017909
Moving Contact Bracket—1200/2000 Amperes	2	0	0	3	0	0	949029
Moving Arcing Contact—1200/2000 Amperes	2	0	1	3	0	1	918209
*Stationary Contact Complete	4	0	0	6	0	0	.....
Condenser Bushing— 600 Amperes, Standard	4	0	2	6	0	2	825615
Condenser Bushing— 600 Amperes, Lift-Up	4	0	2	6	0	2	841796
Condenser Bushing—1200 Amperes, Standard	4	0	2	6	0	2	881724
Condenser Bushing—1200 Amperes, Lift-Up	4	0	2	6	0	2	896761
Condenser Bushing—2000 Amperes, Standard	4	0	2	6	0	2	881725
Condenser Bushing—2000 Amperes, Lift-Up	4	0	2	6	0	2	.....
Stationary Contact— 600 Amperes	4	0	0	6	0	0	859230
Stationary Contact—1200 Amperes	4	0	0	6	0	0	841798
Stationary Contact—2000 Amperes	4	0	2	6	0	2	841790
De-ion Grid Stack	8	4	8	12	4	8	918210
Stationary Main Contact—1200 Amperes	8	4	8	12	4	8	918211
Stationary Main Contact—2000 Amperes	8	8	16	12	12	24	834160
Stationary Contact Finger	8	1	4	12	1	4	841665
Stationary Contact Finger Spring	4	4	8	6	6	12	859231
Stationary Arcing Horn	1	0	0	1	0	0	918212
Tank	1	0	0	1	0	0	918213
Tank Liner	—	—	—	1	0	1	918214
Tank Liner Barrier							See I.B. 5664 † †
*Type SAF-4 Operating Mechanism	1	0	0	1	0	0	
*†Closing Coil	1	0	0	1	0	0	
*†Trip Coil	1	0	0	1	0	0	
*Type CF-1 Operating Mechanism	1	0	0	1	0	0	See I.B. 5455 †
*†Rectox Unit	1	0	0	1	0	0	

*Not listed on illustrations.
†When ordering, specify identification number stamped on Part.
Parts indented are included in the part under which they are indented.

ORDERING INSTRUCTIONS

When ordering Renewal Parts, always specify the name of the part wanted as shown on the illustrations in this Instruction Book, giving Shop Order Number, and the type of Circuit Breaker, as shown on the nameplate. For example:

One Moving or Stationary Contact Complete, 1200 Amperes, for Type B-28-B Oil Circuit Breaker, S.O. 19-F-470, shown in Instruction Book 5706, Figure 2.

To avoid delays and misunderstandings, note carefully the following points:

1. Send all correspondence and orders to the nearest Sales Office of the Company.
2. State whether shipment is to be made by freight, express or parcel post. In the absence of instructions, goods will be shipped at our discretion. Parcel post shipments will be insured only on request. All shipments are at purchaser's risk.
3. Small orders should be combined so as to amount to a value of at least $1.00 net. Where the total of the sale is less than this, the material will be invoiced at $1.00.

Westinghouse

Type SAF-2 Operating Mechanism

for

Type F-122, 400, 600 & 800 Amp. 2 & 3 P. S. T.
and
Type F-124 600 & 1200 Amp. 2 & 3 P. S. T.
Oil Circuit Breakers

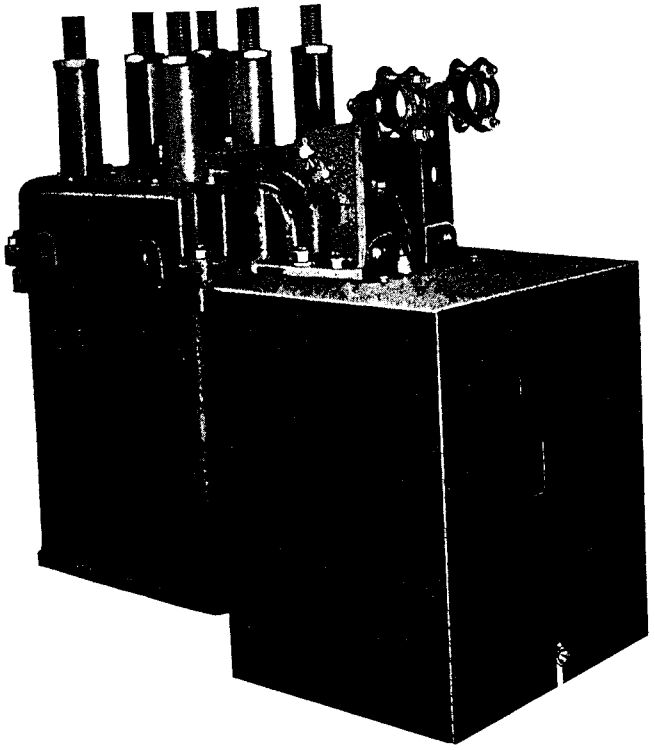


FIG. 1—TYPE F-122, SOLENOID-OPERATED BREAKER

Westinghouse Electric Corporation
East Pittsburgh, Pa.

I. B. 33-216★
(Filing No. 33-000)

Printed in U.S.A. (Reprinted 8-53)
★Supersedes I. B. 5790-A

Westinghouse Type SAF-2 Operating Mechanism

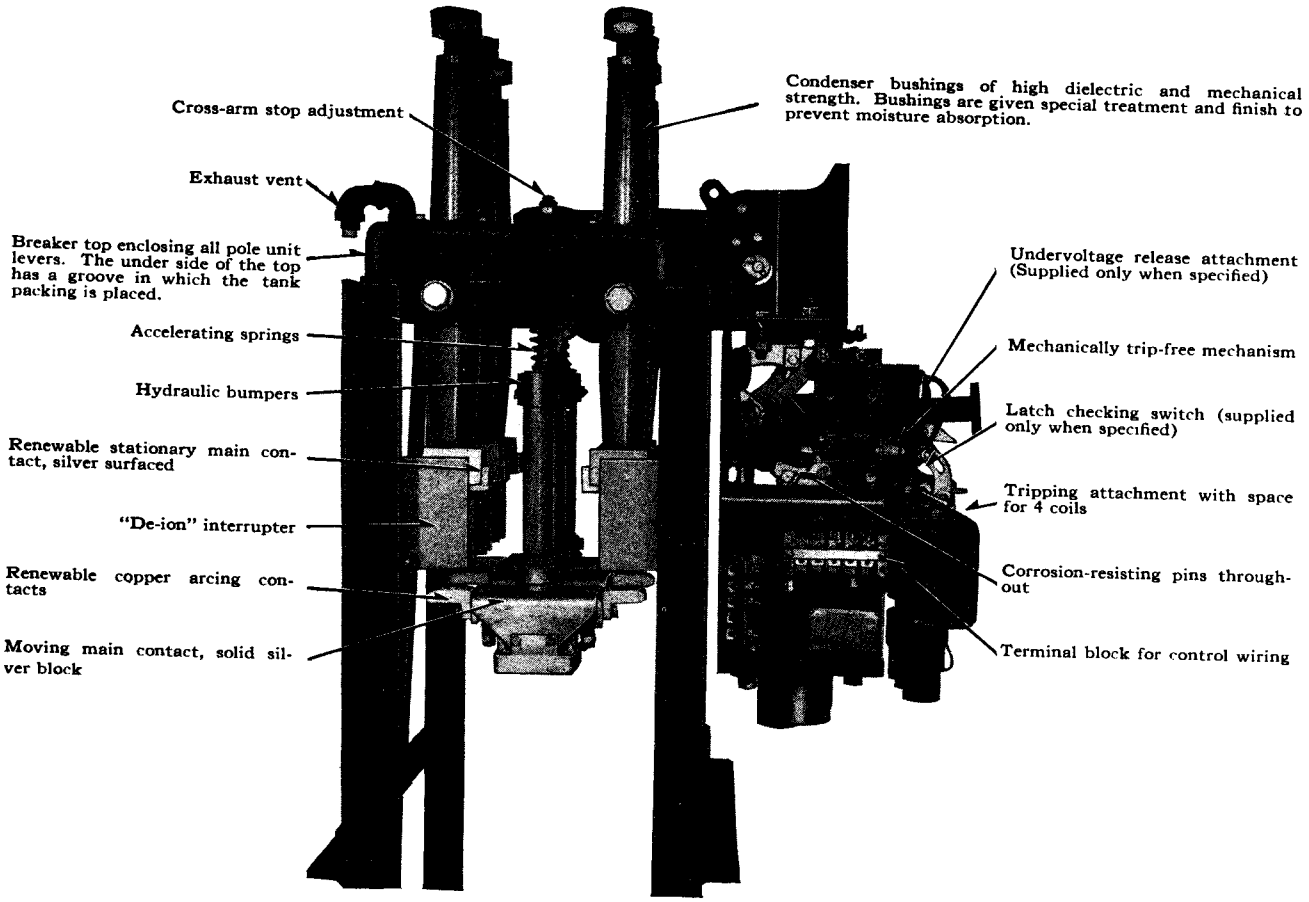


FIG. 2—TYPE F-124-A, 600 OR 1200-AMPERE, SOLENOID-OPERATED BREAKER WITH TANK REMOVED FROM THE BREAKER AND COVER REMOVED FROM THE TYPE SAF-2 SOLENOID

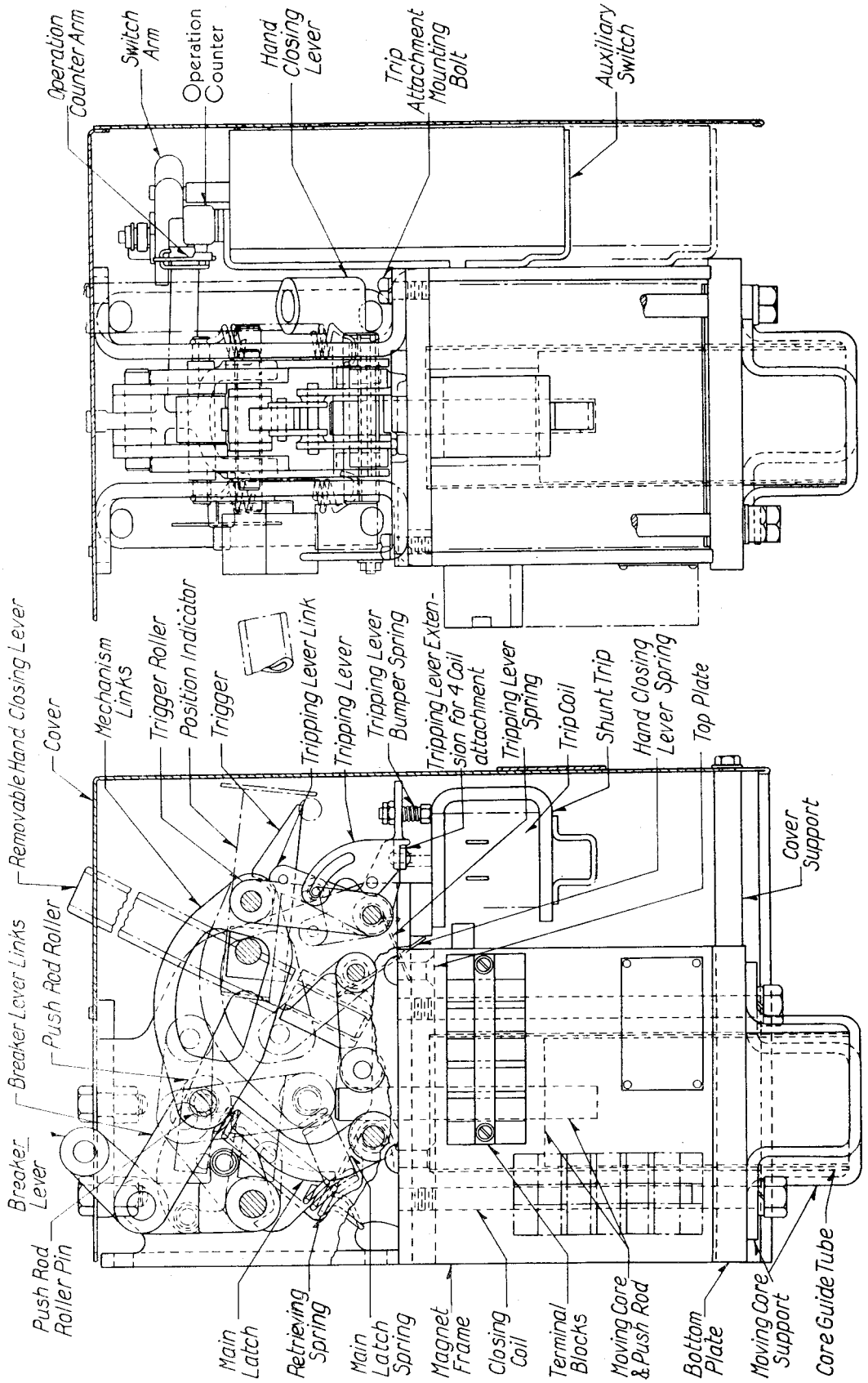


FIG. 3—CIRCUIT BREAKER—OIL-TYPE "SAF-2" MECHANISM ASSEMBLY

Westinghouse

Type SAF-2 Operating Mechanism

INTRODUCTION

This mechanism is the direct-current solenoid type. It operates on standard direct-current control voltages or when equipped with a rectox unit, on alternating-current. It is a mechanically full automatic mechanism, trip free in all positions.

This mechanism is used principally to electrically operate the 400, 600 and 800 ampere type F122 and the 600 and 1200 ampere type F124 oil circuit breakers. This instruction book applies to the mechanism only. Instructions on adjustments and maintenance of the type F122 and F124 breakers can be found in Instruction Books 5746 and 5767 respectively.

The standard mechanism is supplied with a single shunt trip coil, a 6 pole auxiliary switch, cover, position indicator and control relay. The mechanism can be equipped with additional attachments, such as, operation counter, latch checking switch, four coil tripping attachments (in place of single shunt trip coil), a 10 pole auxiliary switch instead of a 6 pole, an undervoltage tripping attachment and a single pole cut off switch.

SHIPMENT

Ordinarily the mechanism will be mounted on the breaker unit, with all adjustments complete, ready for installation as described in I.B. 5746 or 5767. Occasionally, however, the mechanism will be shipped separately, fastened in the closed position.

HANDLING

Do not attempt to lift the mechanism by its attachments or levers; or to move the attachments by the coil leads. Always grasp the frame, which is designed to withstand handling.

INSTALLATION

1. When the mechanism is mounted on the breaker before shipment, it is only necessary to follow the installation procedure outlined in the breaker Instruction Books and operations 8 to 12 of this book.

2, When the mechanism is shipped separately, however, it is necessary to first mount the breaker unit as described in the above Instruction Books and then mount the mechanism to the breaker as shown in Fig. 4, or the outline supplied with the breaker.

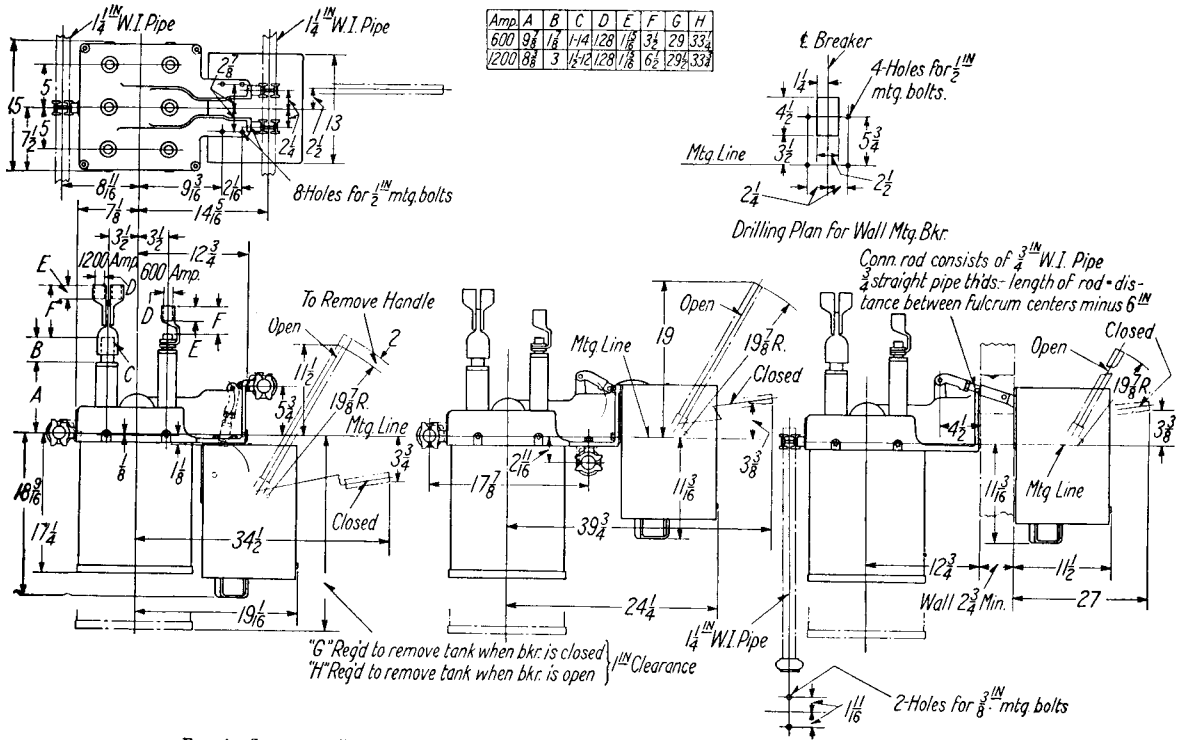
3. Bolt the mechanism to the breaker frame, floor or wall with four bolts. If the mechanism is for wall or floor mounting, structural steel members should be inserted between the mechanism and wall or floor to prevent disintegration of the wall by the closing shock.

4. Remove the rod end from breaker lever of the mechanism; remove the fulcrum pin from the toggle lever of the breaker, and the pin from the operation rod end of the breaker.

5. Screw the operating rod into the operation rod end, with the lock nut and lock washer in place as shown.

6. Replace the rod end assembly and pins, and check the operation of the mechanism.

7. Operations #4, 5 and 6 should be repeated until the length of the operating rod assembly is such, that, with the mechanism in the closed position, the breaker toggle lever links will be $\frac{1}{32}$" away from the breaker stop pin.



Amp	A	B	C	D	E	F	G	H
600	9⅞	1⅞	1-14	128	1⅛	3½	29	33¼
1200	8⅞	3	1½-12	128	1⅛	6½	29½	33¾

FIG. 4—STANDARD TYPE F-122, 400 AND 600-A—7500 VOLTS., 800 AMPERES, 5000 VOLTS—OUTLINE

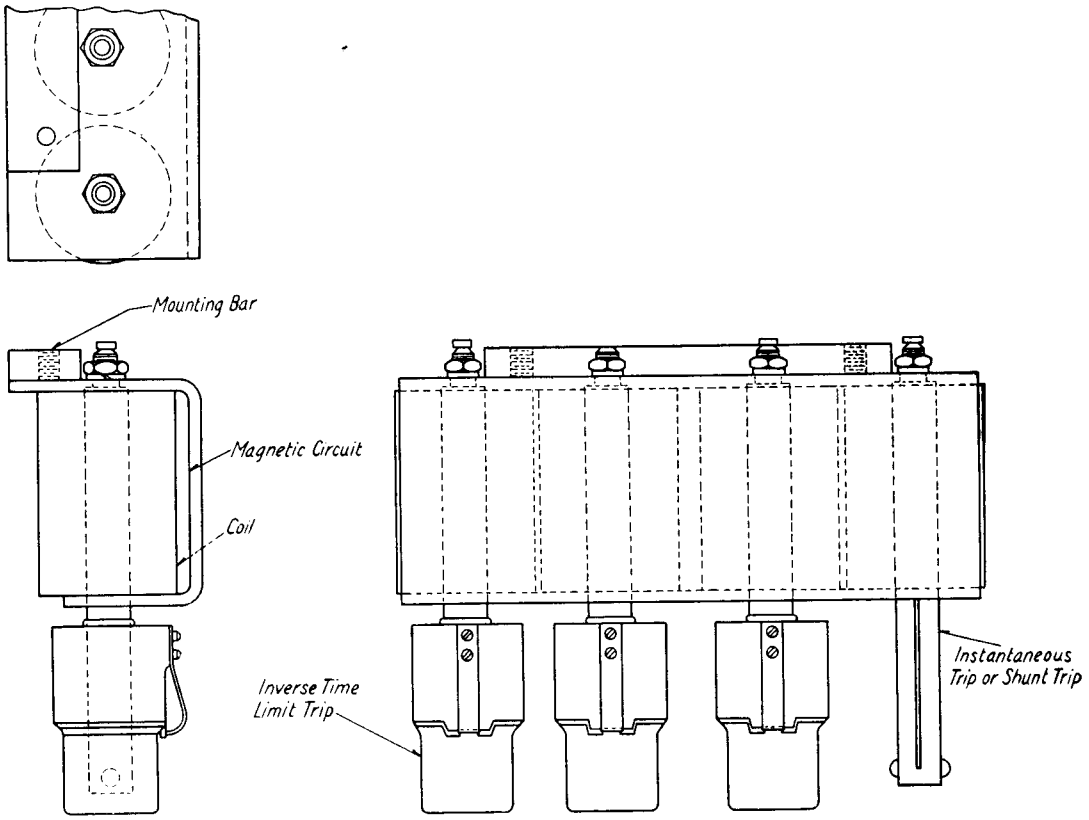


FIG. 5 INVERSE TIME LIMIT ASSEMBLY

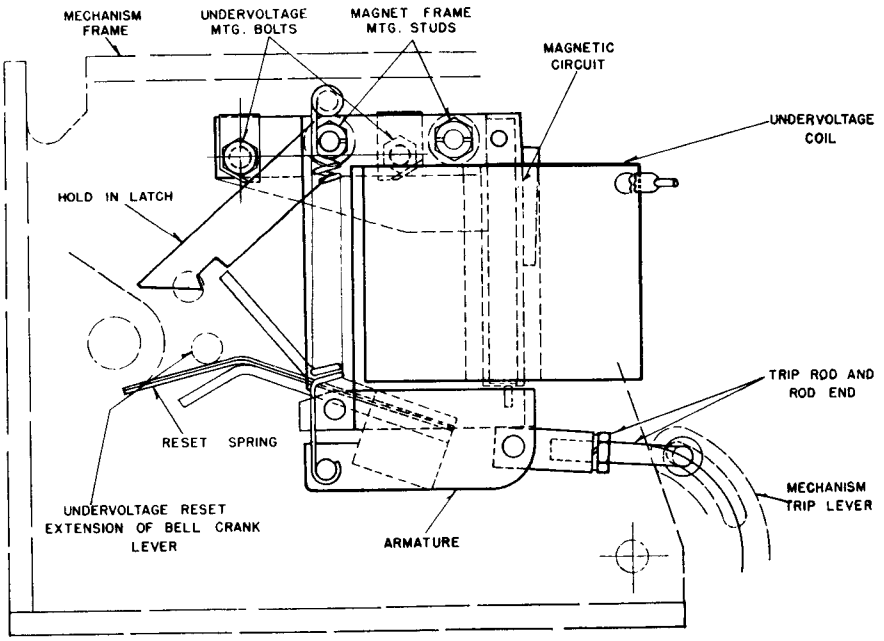


FIG. 6—UNDERVOLTAGE OPERATING ASSEMBLY

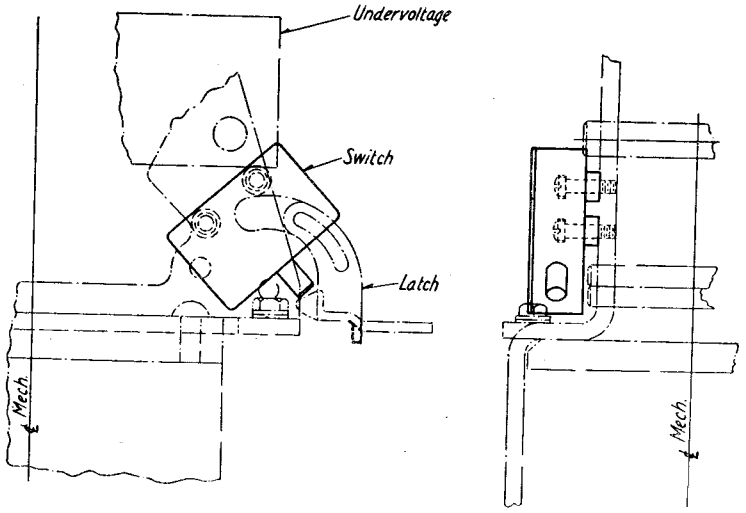


FIG. 7—LATCH CHECKING SWITCH ASSEMBLY

8. With operation #7 completed, the main moving contact of the breaker should be ¼" below the lift rod end as described in I.B. 5746 or 5767.

9. Mount the control panel in a convenient location.

10. Wire the control panel to the mechanism in accordance with one of the typical diagrams Figs. **8** and **9**, or in accordance with the diagram covering the complete installation. (The control panel is not wired at the factory; all wiring must be done at the time of installation.)

11, Operate the attachments to make sure they are functioning properly, as described under adjustments.

12. Apply voltage to the closing coil and check the electrical operation of the solenoid. The mechanism should operate satisfactorily with 72% of normal voltage applied, measured at the coil.

ADJUSTMENTS

Mechanism Operation:

Ref. Fig. **2.**

Energizing the closing coil forces the moving core and push rod upwards against the push rod roller (located at the junction of the breaker lever links and the mechanism links). This upward force straightens the toggle formed by the breaker lever links and the mechanism links which in turn rotates the breaker lever counter-clockwise, as the trigger roller (which is fastened to the mechanism links) is held stationary by the trigger. Just before the moving core strikes the top plate, the main latch is forced under the push rod roller by the main latch spring, thus locking the mechanism in the closed position. The toggle formed by the breaker lever links and the mechanism links is prevented from going over center by the push rod roller pin striking the top of the frame.

Energizing the trip coil rotates the tripping lever counter-clockwise to break the tripping toggle, and pull the trigger out of engagement with the trigger roller. This permits the entire linkage (mechanism links, breaker lever links and breaker lever) to slide horizontally off the main latch, thus permitting the mechanism to open. As the push

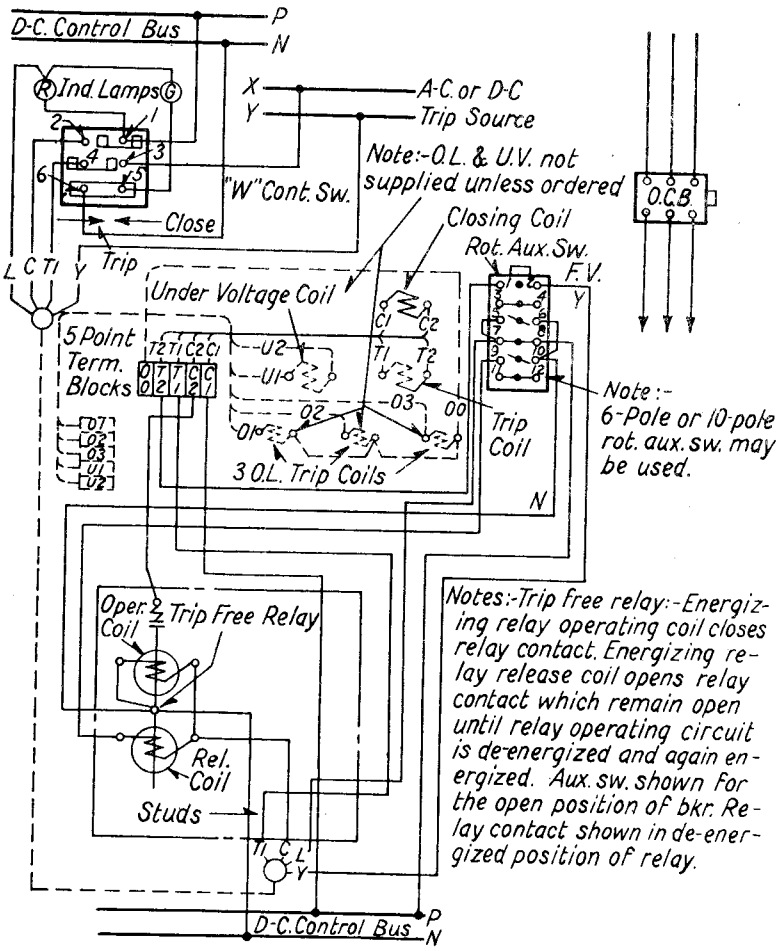


FIG. 8—DIAGRAM OF CONTROL PANEL CONNECTIONS

rod roller slides off the main latch, the retrieving springs pull the push rod roller downwards to reset the mechanism.

The mechanism tripping toggle should be set either on toggle or slightly over toggle to prevent trigger failure when closing on maximum voltage.

Four Coil Attachment

Ref. Fig. 5 and Fig. 2

The four coil attachment bolts to the mechanism frame, in place of the single coil shunt trip attachment. In bolting the attachment in place it is only necessary to observe that the coil plungers push the tripping lever upwards sufficiently to trip the mechanism. A tripping lever with suitable extensions must be used with the four coil attachment.

Overload Release

See I.C. 1488.

AUXILIARY SWITCH

Ref. Fig. 3.

The adjustable linkage between the mechanism breaker lever and the switch arm should be adjusted so that the switch arm travels equally on either side of a line thru the switch arm shaft.

The length of the switch arm should be adjusted so that the contact segments make good contact with the contact fingers in both the opened and closed position of the mechanism. Make certain the operating arm of the auxiliary switch is not in dead center, otherwise damaged parts will result.

UNDERVOLTAGE RELEASE

Ref. Fig. 6, 2 and 11.

The undervoltage mounts on the left hand side of the mechanism frame

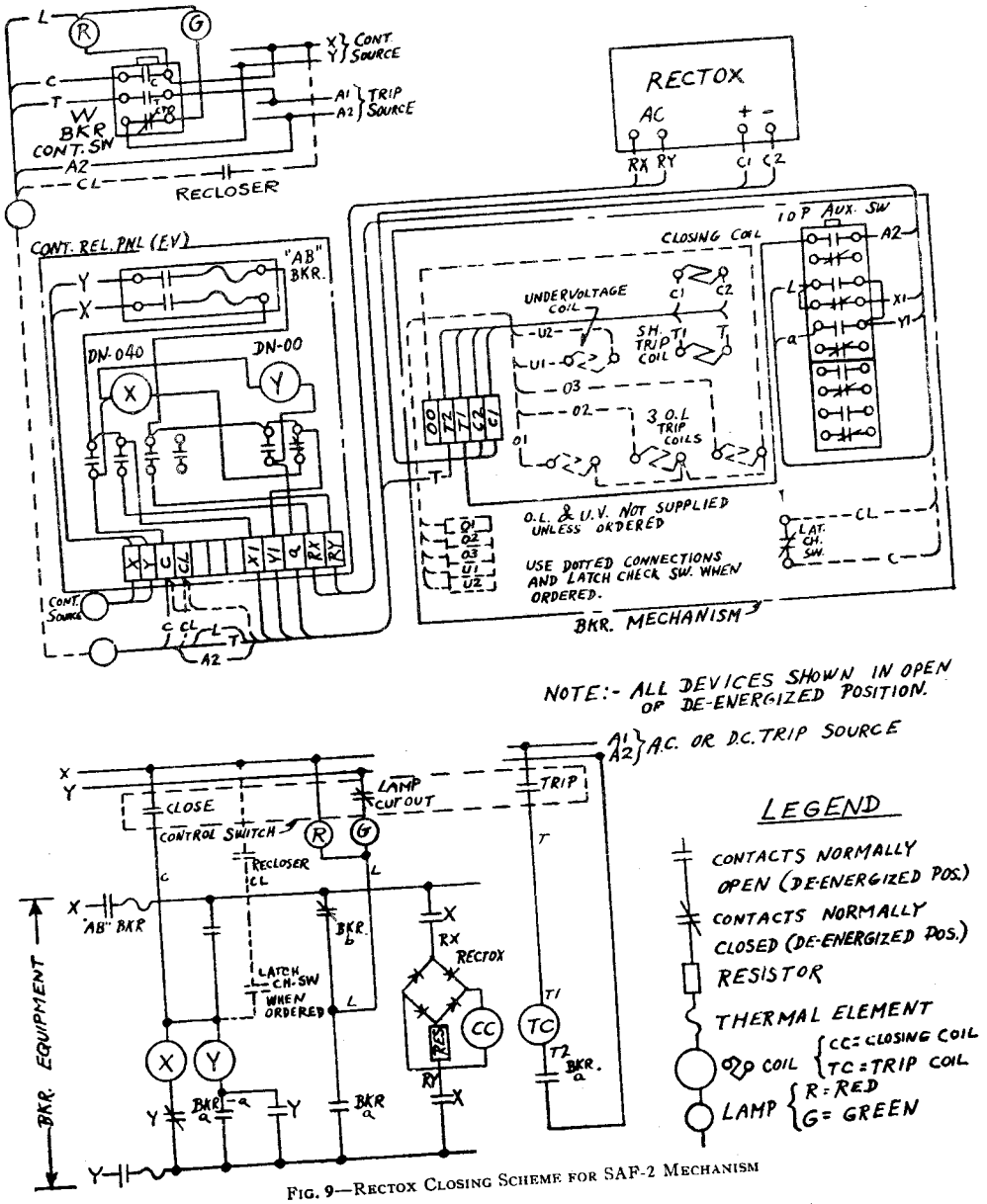


FIG. 9—RECTOX CLOSING SCHEME FOR SAF-2 MECHANISM

with the two mounting screws shown. The undervoltage reset extension of the breaker lever should operate between the undervoltage reset spring and the undervoltage hold in latch. As the mechanism closes, the reset extension of the breaker lever strikes the undervoltage hold in lever, which frees the undervoltage armature for operation on voltage failure. As the mechanism opens, the reset extension of the breaker lever strikes the undervoltage reset spring, retrieving the armature to its fully closed position; failure to reset the undervoltage armature properly will result in improper operation, as the coil is not capable of picking up the armature.

The adjustable trip rod should be set to secure $\frac{1}{8}$" clearance between the end of the slot in the mechanism tripping lever and the trip rod, with the armature in the closed position.

The drop out voltage is influenced by the small brass pin in the armature, which controls the air gap in the magnetic circuit.

LATCH CHECKING SWITCH

Ref. Fig. 7.

The latch checking switch block mounts on the two screws shown. The switch operates directly from the tripping lever and makes contact when the tripping lever is in the normal position, and breaks contact when the tripping lever is raised.

CUT OFF SWITCH

Ref. Fig. 10.

The single pole cut off switch mounts on the right side of the mechanism behind the rotary auxiliary switch. It is a normally closed contact switch but is held in the open position by means of a spring-biased operating lever. During the last portion of the closing stroke the mechanism roller pin strikes the switch operating lever which rotates the switch lever to release the switch push button and permit the switch to make contact.

OPERATION COUNTER

Ref. Fig. 3.

The operation counter mounts on the upper rotary auxiliary switch bracket. After mounting in place and connecting to the auxiliary switch extension of the breaker lever the operation counter arm should be loosened and set so that **only** one number is recorded for each operation of the mechanism. This setting should be checked for both manual and electrical operation.

MAINTENANCE

Arrange for regular inspection to see that the apparatus is in good adjustment and functions as required.

Thoroughly inspect all bolts and nuts—and tighten if necessary. Inspect all pins, links and bearings for excessive wear. Check all cotter pins.

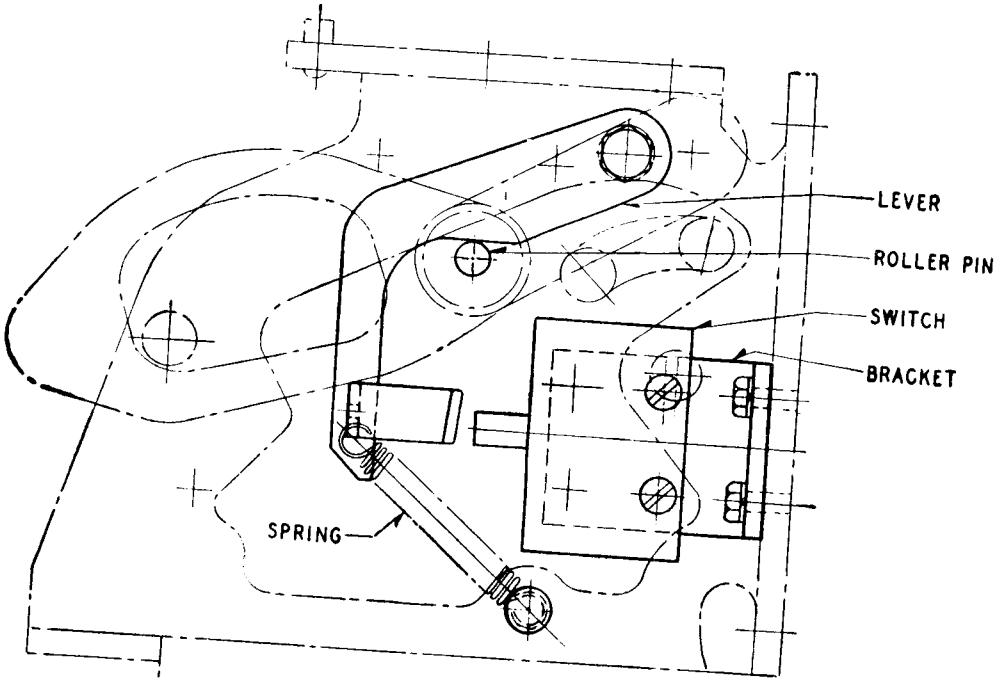


FIG. 10—CUT OFF SWITCH

Westinghouse Type SA F-2 Operating Mechanism

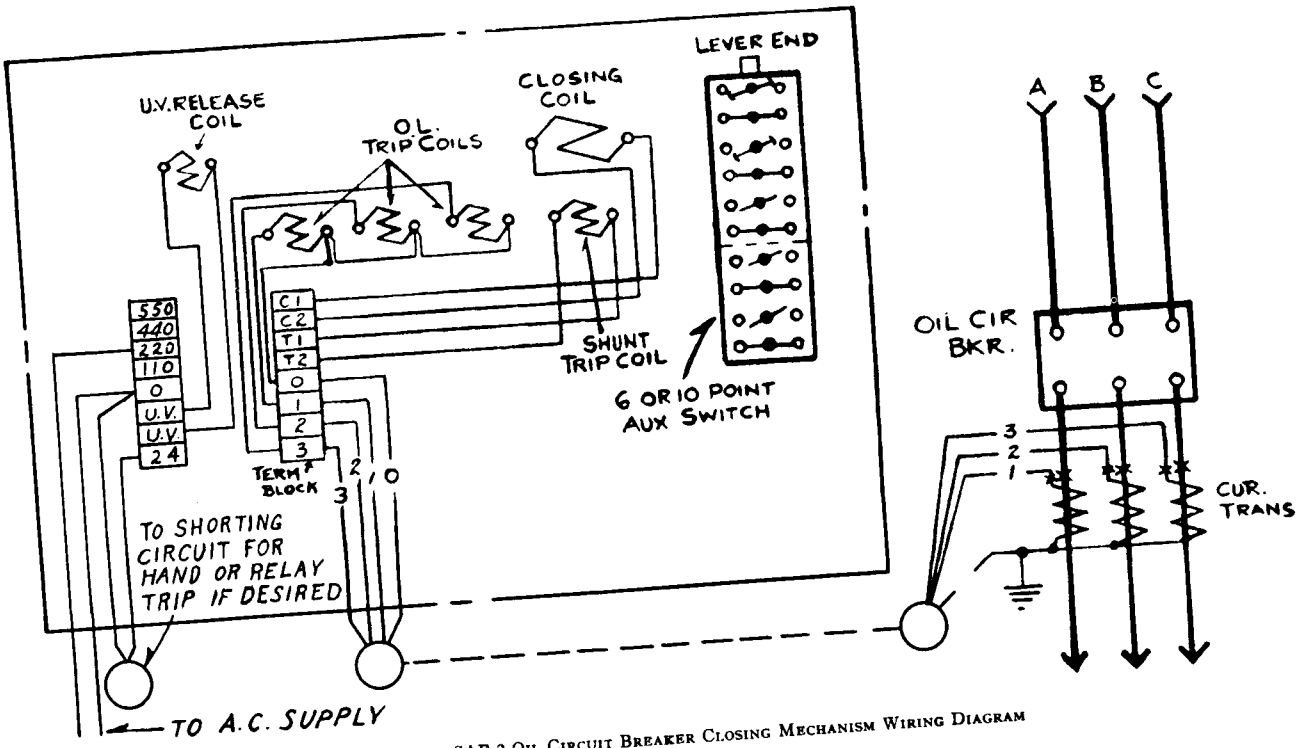
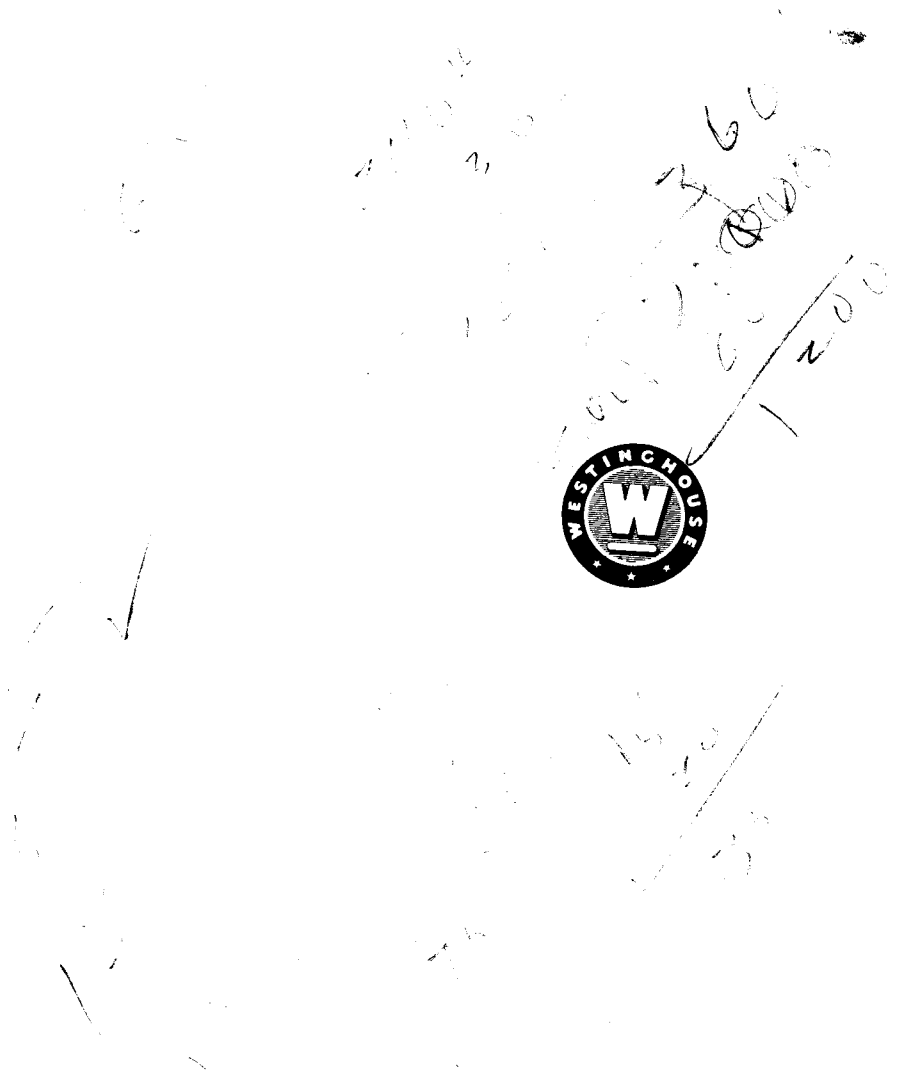


FIG. 11—TYPE SAF-2 OIL CIRCUIT BREAKER CLOSING MECHANISM WIRING DIAGRAM


WESTINGHOUSE

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BUFFALO OFFICE
WESTINGHOUSE ELEC. & MFG. CO.
33-000

Westinghouse

Type SAF-2 Operating Mechanism

for

Type F-122, 400, 600 & 800 Amp. 2 & 3 P. S. T.
and
Type F-124 600 & 1200 Amp. 2 & 3 P. S. T.
Oil Circuit Breakers

INSTRUCTION BOOK

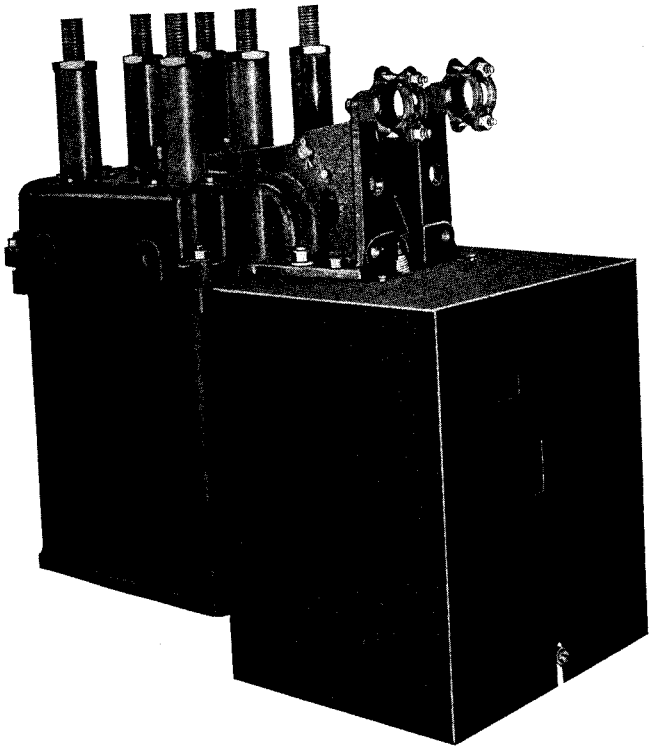


FIG. 1—TYPE F-122, SOLENOID-OPERATED BREAKER.

Westinghouse Electric & Manufacturing Company
East Pittsburgh Works East Pittsburgh, Pa.

I. B. 5790
(Filing No. 33-000)

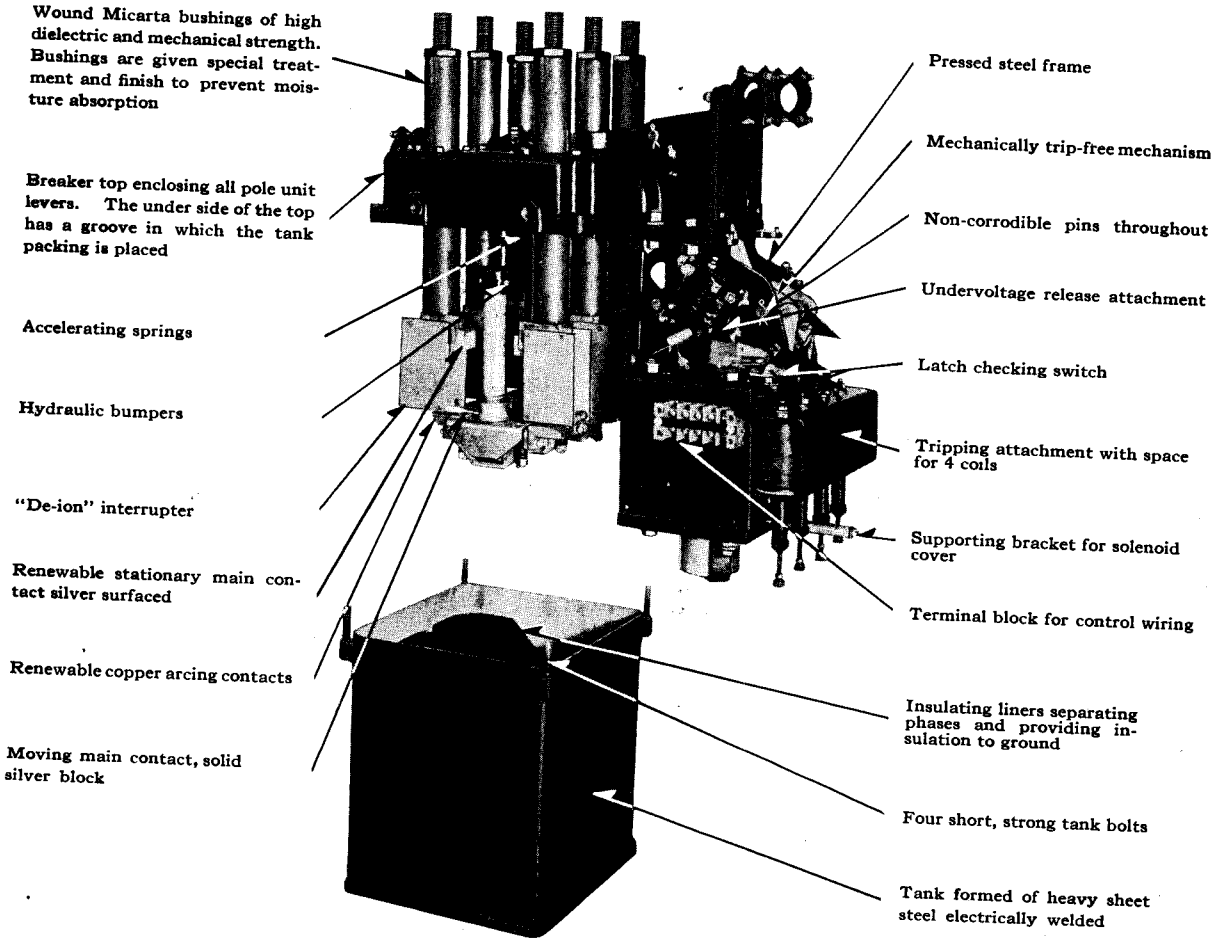


FIG. 2—TYPE F-122 BREAKER WITH TANK REMOVED AND SAF-2 SOLENOID WITH COVER REMOVED

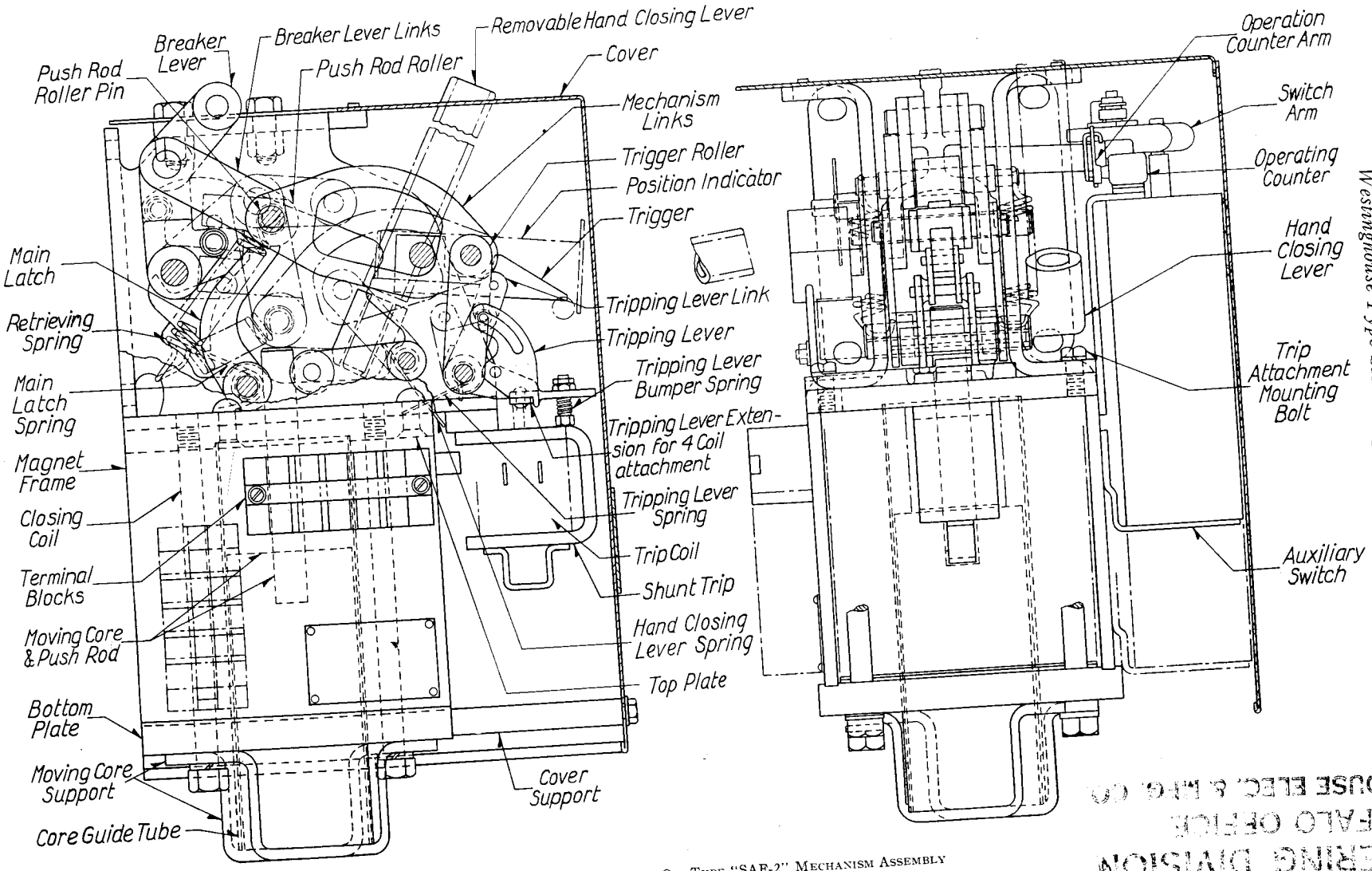


FIG. 3—CIRCUIT BREAKER—OIL-TYPE "SAF-2" MECHANISM ASSEMBLY

WESTINGHOUSE ELEC. & MFG. CO.
BUFFALO OFFICE
ENGINEERING DIVISION
RETURN

Westinghouse

Type SAF-2 Operating Mechanism

INTRODUCTION

This mechanism is the direct-current solenoid type. It operates on standard direct-current control voltages or when equipped with a rectox unit, on alternating-current. It is a mechanically full automatic mechanism, trip free in all positions.

This mechanism is used principally to electrically operate the 400, 600 and 800 ampere type F122 and the 600 and 1200 ampere type F124 oil circuit breakers. This instruction book applies to the mechanism only. Instructions on adjustments and maintenance of the type F122 and F124 breakers can be found in Instruction Books 5746 and 5767 respectively.

The standard mechanism is supplied with a single shunt trip coil, a 6 pole auxiliary switch, cover, position indicator and control relay. The mechanism can be equipped with additional attachments, such as, operation counter, latch checking switch, four coil tripping attachments (in place of single shunt trip coil), a 10 pole auxiliary switch instead of a 6 pole and an under-voltage tripping attachment.

SHIPMENT

Ordinarily the mechanism will be mounted on the breaker unit, with all adjustments complete, ready for installation as described in I.B. 5746 or 5767. Occasionally, however, the mechanism will be shipped separately, fastened in the closed position.

HANDLING

Do not attempt to lift the mechanism by its attachments or levers; or to move the attachments by the coil leads. Always grasp the frame, which is designed to withstand handling.

INSTALLATION

1. When the mechanism is mounted on the breaker before shipment, it is only necessary to follow the installation procedure outlined in the breaker Instruction Books and operations 8 to 12 of this book.

2. When the mechanism is shipped separately, however, it is necessary to first mount the breaker unit as described in the above Instruction Books and then mount the mechanism to the breaker as shown in Fig. 4.

3. Bolt the mechanism to the breaker frame with the four bolts shown. If the breaker and mechanism are for wall mounting, structural steel members should be inserted between the breaker, mechanism and wall to prevent disintegration of the wall by the closing shock.

4. Remove the eye bolt from breaker lever of the mechanism; remove the fuloram pin from the toggle lever of the breaker, and the pin from the operation rod end of the breaker.

5. Screw the eye bolt into the operation rod end, with the lock nut and lock washer in plate as shown.

6. Replace the eye bolt-rod end assembly and pins, and check the operation of the mechanism.

7. Operations #4, 5 and 6 should be repeated until the length of the eye bolt-rod end assembly is such, that, with the mechanism in the closed position, the breaker toggle lever links will be $\frac{1}{32}$" away from the breaker stop pin.

8. With operation #7 completed, the main moving contact of the breaker

Amp	A	B	C	D	E	F	G	H
600	9⅜	1⅛	1-1/4	1/28	1⅛	3½	29	33¼
1200	8⅜	3	1-1/2	1/28	1⅛	6½	29½	33⅜

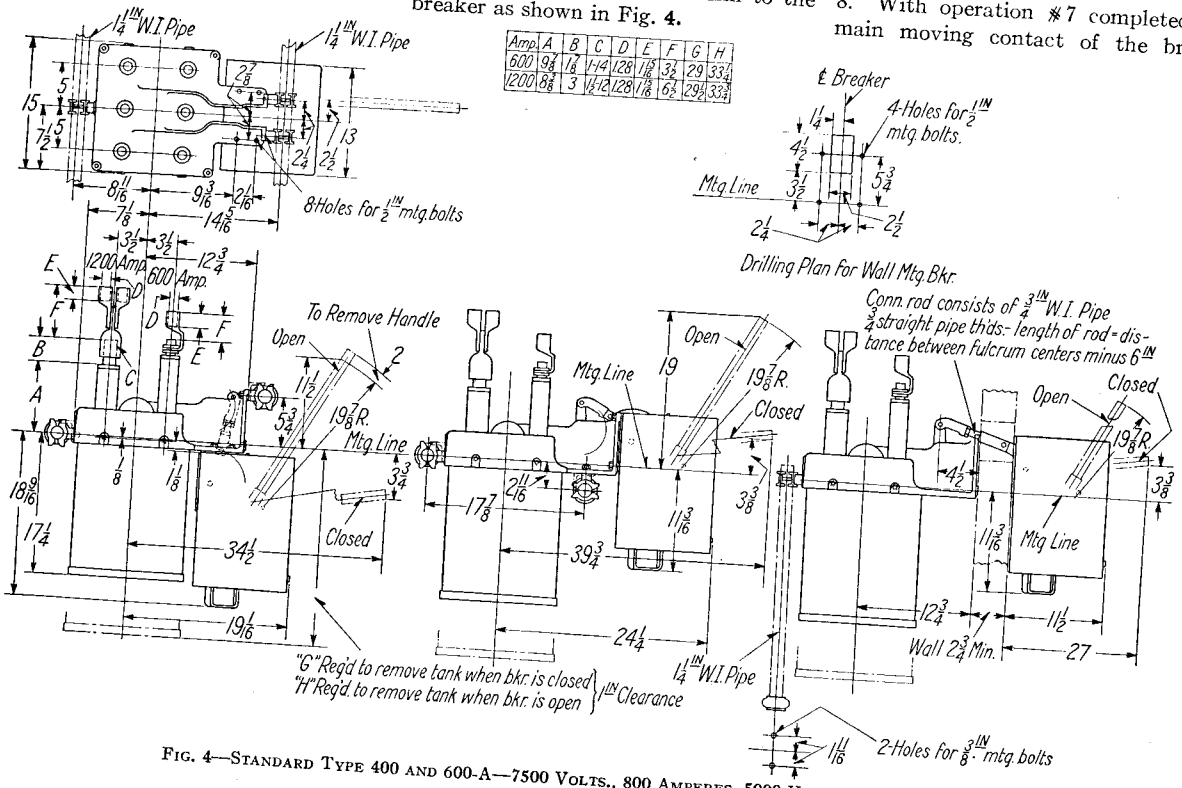


FIG. 4—STANDARD TYPE 400 AND 600-A—7500 VOLTS., 800 AMPERES, 5000 VOLTS—OUTLINE.

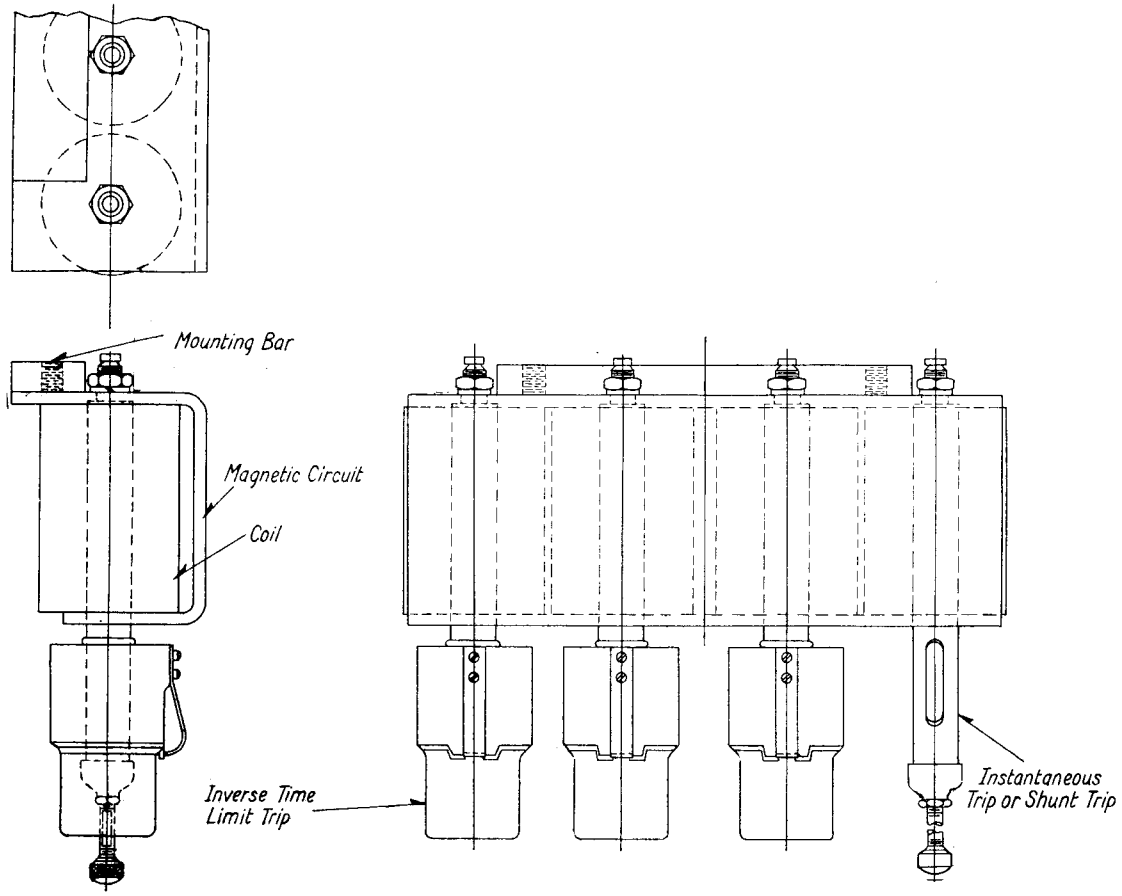


FIG. 5—INVERSE TIME LIMIT ASSEMBLY

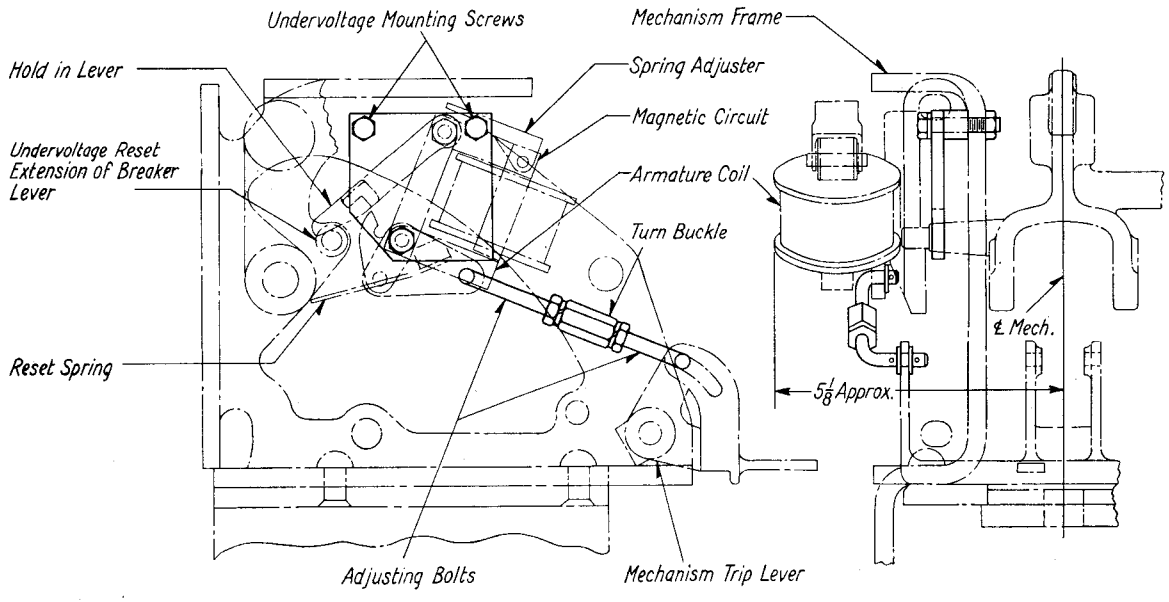


FIG. 6—UNDERVOLTAGE OPERATING ASSEMBLY

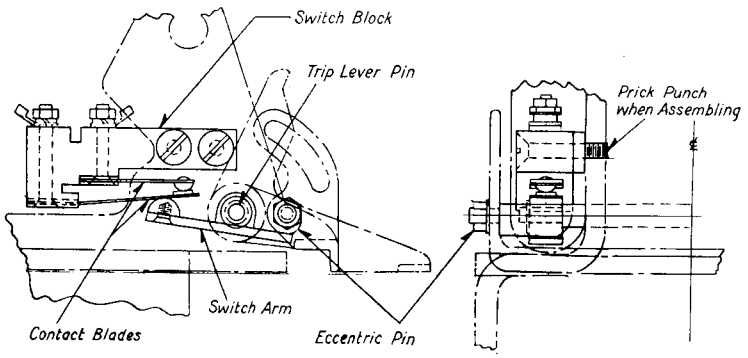


FIG. 7—LATCH CHECKING SWITCH ASSEMBLY

should be ¼" below the lift rod end as described in I.B. 5746 or 5767.

9. Mount the control panel in a convenient location.

10. Wire the control panel to the mechanism in accordance with one of the typical diagrams Figs. **8** and **9**, or in accordance with the diagram covering the complete installation. (The control panel is not wired at the factory; all wiring must be done at the time of installation.)

11. Operate the attachments to make sure they are functioning properly, as described under adjustments.

12. Apply voltage to the closing coil and check the electrical operation of the solenoid. The mechanism should operate satisfactorily with 72% of normal voltage applied, measured at the coil.

ADJUSTMENTS

Mechanism Operation:

Ref. Fig. 2.

Energizing the closing coil forces the moving core and push rod upwards against the push rod roller (located at the junction of the breaker lever links and the mechanism links). This upward force straightens the toggle formed by the breaker lever links and the mechanism links which in turn rotates the breaker lever counter-clockwise, as the trigger roller (which is fastened to the mechanism links) is held stationary by the trigger. Just before the moving core strikes the top plate, the main latch is forced under the push rod roller by the main latch spring, thus locking the mechanism in the closed position. The toggle formed by the breaker lever links and the mechanism links is prevented from going over center by the push rod roller pin striking the top of the frame.

Energizing the trip coil rotates the tripping lever counter-clockwise to break the tripping toggle, and pull the trigger out of engagement with the trigger roller. This permits the entire linkage (mechanism links, breaker lever links and breaker lever) to slide horizontally off the main latch, thus permitting the mechanism to open. As the push rod roller slides off the main latch, the retrieving springs pull the push rod roller downwards to reset the mechanism.

The mechanism tripping toggle should be set either on toggle or slightly over toggle to prevent trigger failure when closing on maximum voltage.

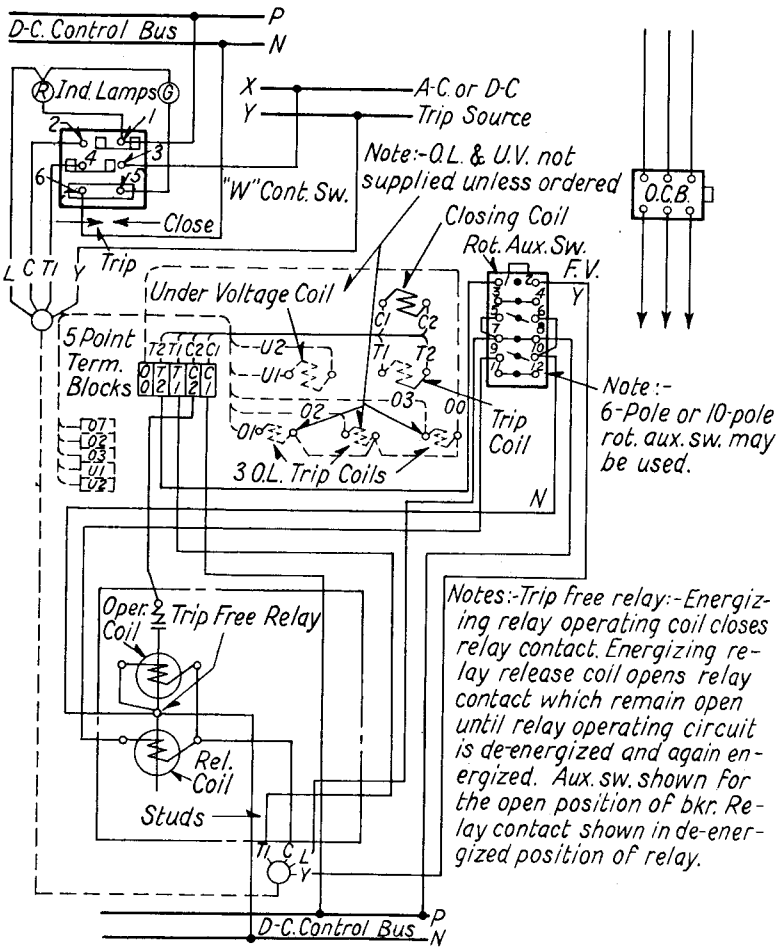


FIG. 8—DIAGRAM OF CONTROL PANEL CONNECTIONS

Four Coil Attachment:
Ref. Fig. **5** and Fig. **2**

The four coil attachment bolts to the mechanism frame, in place of the single coil shunt trip attachment. In bolting the attachment in place it is only necessary to observe that the coil plungers push the tripping lever upwards sufficiently to trip the mechanism. A tripping lever with suitable extensions must be used with the four coil attachment.

Overload Release (Fig. **10**)

The overload release consists of the parts shown in the picture. The moving core is magnetically drawn against the trip rod which is pushed up against the tripping lever. The calibration is varied by changing the air gap between the moving and stationary cores, by raising and lowering the calibration screw. The lock nuts must be drawn tight after changing calibration. The calibration setting is indicated by figures on the tube opposite the line on the moving core and corresponds to amperes in the secondary of the current transformer.

If the opening of the circuit-breaker is not desired unless the overload continues, an oil dashpot is attached to the end of the moving core. The calibration is then inscribed on the dashpot and is varied by screwing the pot into the cover. The time is varied by changing the number of the holes in the bottom of the piston uncovered by the diaphragm. Instantaneous tripping is possible because the check valve action of the washer at the time of tripping varies inversely with the amount of overload and directly with the variation in the viscosity of the oil. Fig. **11** shows approximate variations of the time with the variations of the overload and the effect of changed temperature on the standard dashpot oil as supplied with the dashpot.

The values given in Fig. **11** are approximate and will vary somewhat with changes in temperature, and changes in viscosity of the oil. Where a definite time delay is required the delay should be obtained by the use of suitable relays. The oil in the dashpots should be renewed periodically to obtain the best service.

Fill with oil to ¾-inch above the inside bottom surface of the pot, with the plunger removed.

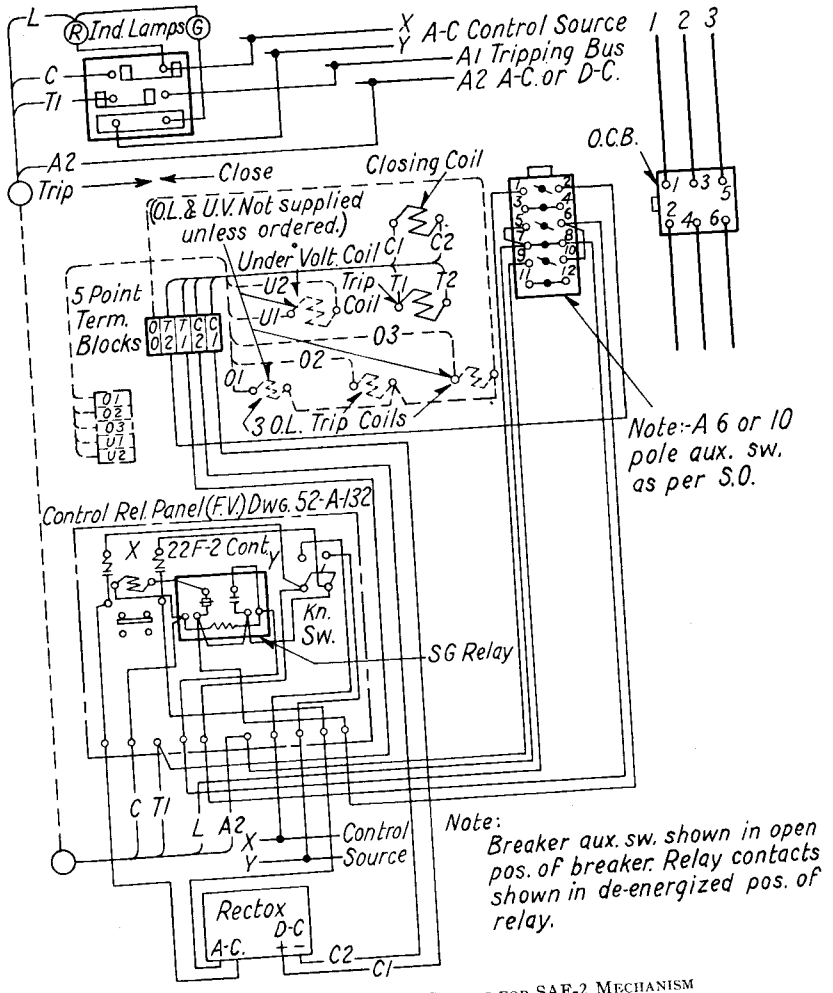


FIG. 9—RECTOX CLOSING SCHEME FOR SAF-2 MECHANISM

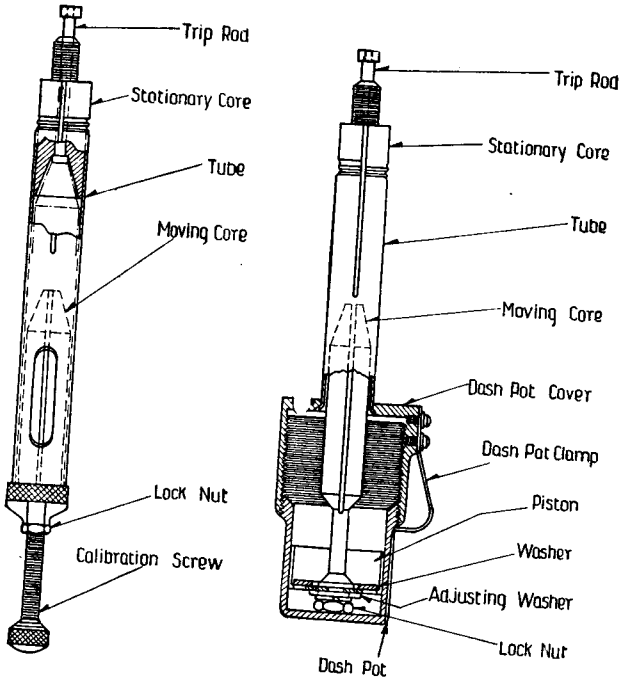


FIG. 10—OVERLOAD RELEASE CORES

AUXILIARY SWITCH

Ref. Fig. **3.**

The adjustable linkage between the mechanism breaker lever and the switch arm should be adjusted so that the switch arm travels equally on either side of a line thru the switch arm shaft.

The length of the switch arm should be adjusted so that the contact segments make good contact with the contact fingers in both the opened and closed position of the mechanism. Make certain the operating arm of the auxiliary switch is not in dead center, otherwise damaged parts will result.

UNDERVOLTAGE RELEASE:

Ref. Fig. **6, 2** and **12.**

The undervoltage mounts on the left hand side of the mechanism frame with the two mounting screws shown. The undervoltage reset extension of the breaker lever should operate between the undervoltage reset spring and the undervoltage hold in lever. As the mechanism closes, the reset extension of the breaker lever strikes the undervoltage hold in lever, which frees the undervoltage armature for operation on voltage failure. As the mechanism opens, the reset extension of the breaker lever strikes the undervoltage reset spring, retrieving the armature to within $\frac{1}{64}$" of its closed position; failure to reset the undervoltage armature properly will result in burning out the undervoltage coil, as the coil is not capable of picking up the armature if this distance is exceeded.

The turn buckle should clear the undervoltage armature during the tripping movement.

The turn buckle should be set to secure $\frac{1}{8}$" clearance between the end of the slot in the mechanism tripping lever and the outside adjusting bolt head, with the armature in the closed position.

The drop out voltage can be varied by regulating the extension of the two undervoltage tripping springs.

LAST CHECKING SWITCH:

Ref. Fig. **7.**

The latch checking switch block mounts on the two screws shown. The trip lever pin must be removed and replaced with a special pin on which the switch arm can be mounted. The eccentric pin mounts on the mechanism trip lever, and should be adjusted to secure $\frac{1}{32}$" deflection of the top contact blade with the trip lever in the normal position.

OPERATION COUNTER:

Ref. Fig. **3.**

The operation counter mounts on the upper switch bracket. After mounting in place and connecting to the auxiliary switch extension of the breaker lever the operation counter arm should be loosened and set so that **only** one number is recorded for each operation of the mechanism. This setting should be checked for both manual and electrical operation.

MAINTENANCE

Arrange for regular inspection to see that the apparatus is in good adjustment and functions as required.

Thoroughly inspect all bolts and nuts—and tighten if necessary. Inspect all pins, links and bearings for excessive wear. Check all cotter pins.

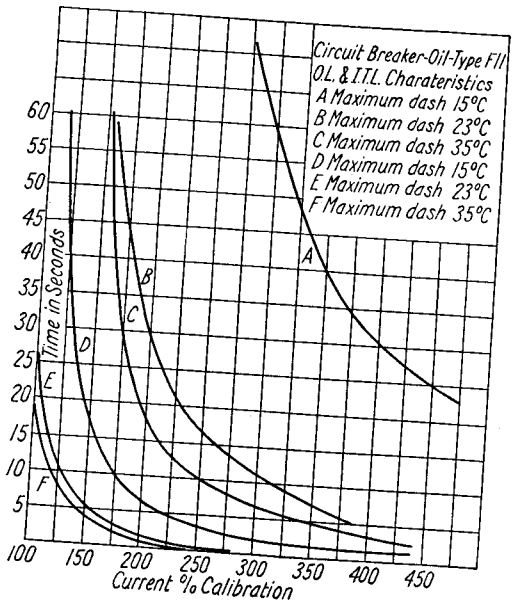


FIG. 11—CALIBRATION CURVE

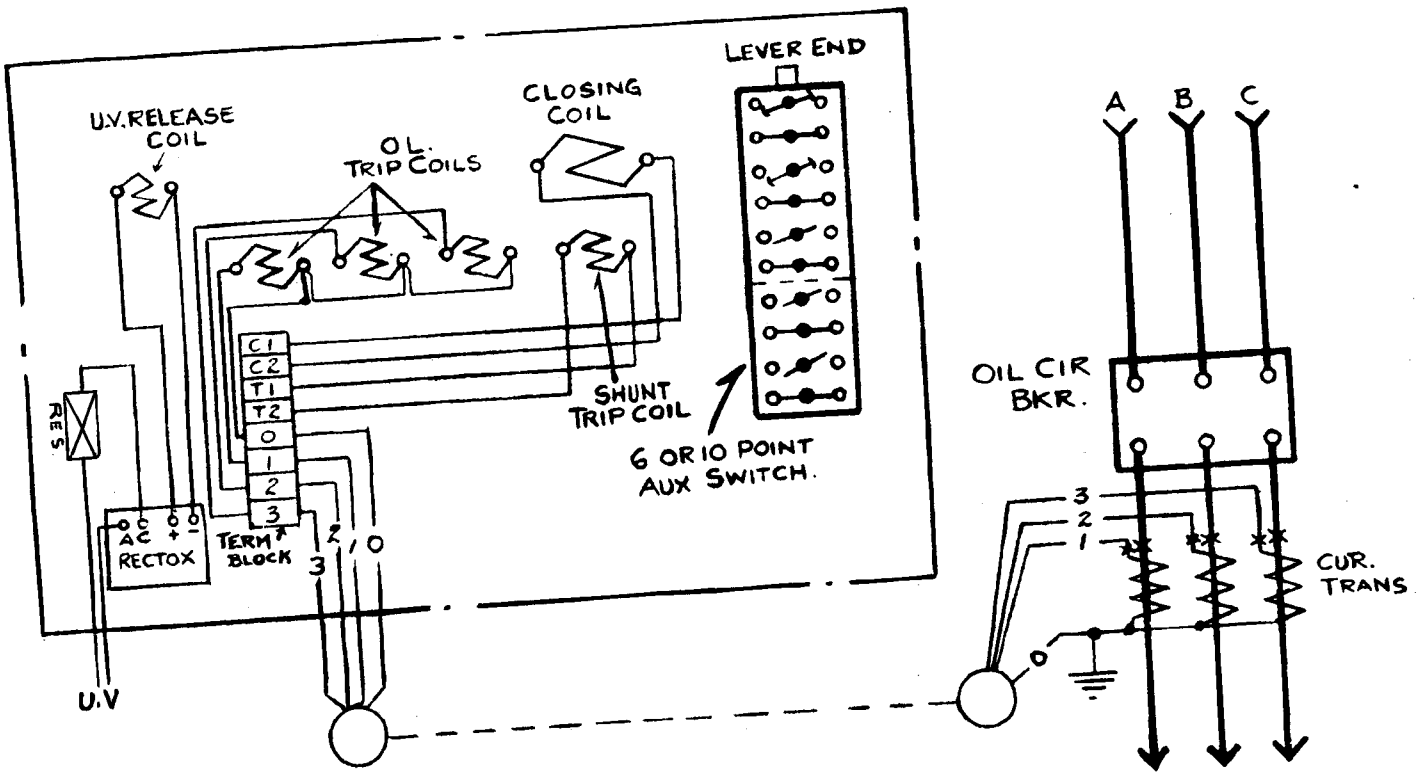


FIG. 12—TYPE SAF-2 OIL CIRCUIT BREAKER CLOSING MECHANISM WIRING DIAGRAM

RENEWAL PARTS DATA

Type SAF-2 Solenoid-operated Mechanism For Oil Circuit Breakers

Style No. 1020985, A, B—Vertical-Push—F-122
Style No. 1020986, A, B—Vertical-Push—F-124
Style No. 1021052, A—Horizontal-Push—F-124
Style No. 1021053, A—Horizontal-Push—F-124

(For Illustration of Parts—See Figure 3)

Mechanisms in use up to and including			1	5	
Ref. No.	Name of Part	Number Per Unit	Recommended for Stock		Style No. of Part
..	Mechanism Complete	1	0	0	. ...
1	Breaker Lever (Vertical-Push—F-122)	1	0	0	1 021 011
1	Breaker Lever (Horizontal-Push—F-122)	1	0	0	1 021 054
1	Breaker Lever (Vertical-Push—F-124)	1	0	0	1 021 012
2	Breaker Lever (Horizontal-Push—F-124)	1	0	0	1 021 055
3	Breaker Lever Link	2	0	0	1 020 990
4	Mechanism Lever	2	0	0	1 020 991
5	Mechanism Lever Retrieving Spring	2	0	1	1 021 000
6	Moving Core and Push Rod	1	0	0	1 020 988
7	Moving Core Push Rod Roller	1	0	0	970 132
8	Moving Core Push Rod Roller Pin	1	0	0	1 020 994
9	Moving Core Guide Tube	1	0	0	1 021 005
10	Tripping Lever (F-122)	1	0	0	1 021 073
9	Bumper Spring (F-122)	1	0	1	1 035 810
10	Tripping Lever (F-124)	1	0	0	1 020 996
11	Bumper Spring (F-124)	1	0	1	1 035 809
12	Tripping Lever Link	1	0	0	1 020 992
13	Tripping Lever Spring	1	0	1	1 020 999
14	Main Latch	1	0	0	1 020 989
15	Main Latch Pin	1	0	0	673 870
16	Main Latch Spring	1	0	1	1 020 998
17	Trigger	1	0	0	1 017 949
18	Trigger Roller	1	0	0	1 016 906
19	Trigger Link	2	0	0	1 020 993
20	Hand Closing Lever	1	0	0	1 021 003
21*	Hand Closing Lever Spring	1	0	1	1 020 008
21*	Type W Auxiliary Switch— 6 Pole	1	0	0	501 821
22	Type W Auxiliary Switch—10 Pole	1	0	0	. ...
23‡	Operation Counter	1	0	0	. ...
24‡	Closing Coil	1	0	1	‡
25‡*	Trip Coil	1	1	1	‡
26‡*	Overload Trip Coil	1	0	1	‡
	Undervoltage Trip Coil	1	0	1	‡

* Not Illustrated.
‡ When ordering, specify identification number stamped on coil.
Parts indented are included in the part under which they are indented.

ORDERING INSTRUCTIONS

When ordering Renewal Parts, always specify the name of the part wanted as shown on the illustrations in this Instruction Book, giving Shop Order Number, and the type of Mechanism as shown on the nameplate. For example:

One tripping lever for Type SAF-2 solenoid operated mechanism, SO-31-F-187, shown in Instruction Book 5790.

To avoid delays and misunderstandings, note carefully the following points:

1. Send all correspondence and orders to the nearest Sales Office of the Company.

2. State whether shipment is to be made by freight, express or parcel post. In the absence of instructions, goods will be shipped at our discretion. Parcel post shipments will be insured only on request. All shipments are at purchaser's risk.

3. Small orders should be combined so as to amount to a value of at least $1.00 net. Where the total of the sale is less than this, the material will be invoiced at $1.00.

Westinghouse Products



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Auto Engine Heaters
Automatic Irons
Automatic Percolators
Automatic Ranges
Cozy Glow Heaters
Curling Irons
Fans
Hot Plates
Light and Power Plants
Lighting Equipment
Mazda Lamps
Motors for
  Buffers and Grinders
  Ice Cream Freezers
  Ironers and Washers
  Refrigerators
  Sewing Machines
  Vacuum Cleaners
Newel Posts
Panelboards
Radio Equipment
Rectigon Chargers for Automobiles and Radio Batteries
Rectox Trickle Charger
Refrigerators, Electrical
Safety Switches
Sollaire Luminaires
Sol-Lux Luminaires
Solar Glow Heaters
Table Stoves
Tumbler Water Heaters
Turnover Toasters
Vacuum Cleaners
Wall-Type Heaters
Waffle Irons
Warming Pads
Water Heaters



Buildings

Arc Welding Equip.
Circuit-Breakers
Elevators and Control
Glue and Solder Pots
Instruments and Relays
Kitchen Equipment
  Bake Ovens
  Hot Plates, Ranges
Lighting Equipment
  Brackets, Newels and Lanterns
  Reflectors & Lamps
  Sol-Lux Luminaires
Lightning Arresters
Micarta Trays
Meters
Meter Service Switches
Motor Generators
Motors and Control for:
  Coal and Ash-Handling Equipment
  Compressors
  Elevators
  Fans and Blowers
  Laundry Equipment
  Refrigerating Equip.
  Vacuum Cleaners
  Water & Sump Pumps
Panelboards
Radio Equipment
Synchronous Converters
Safety Switches
Solar Glow Heaters
Stokers
Switchgear
Transformers



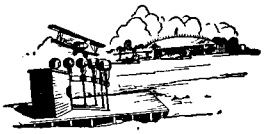
City Improvements

Airport Floodlights
Automatic Substations
Constant Current Regulators
Control Apparatus
Elec. Railway Equip.
Lighting Units
Mazda Lamps
Ornamental Standards
Parkway Cables
Street Brackets
Streethoods



Offices and Stores

Air Heaters
Bread-baking Oven
Elevators and Control
Fans, Desk and Exhaust
Fuses
Lighting Equipment
Mazda Lamps
Meters
Micarta Desk Tops
Motors for
  Adding Machines
  Addressing Machines
Motors for
  Coffee and Meat Grinders, etc.
  Dictaphones
  Envelope Sealers
  Fans and Blowers
  Pumps
  Refrigerating Machines
Panelboards
Safety Switches
Switches
Tumbler Water Heaters



Aviation

Approach, Boundary, Hangar, and Obstruction Lights
Arc Welding Equip.
Floodlight Projectors
Motor-Generators
Reflectors
Transformers
Mazda Lamps
Micarta
  Cabin-lining Plate
  Fairleads
  Hinge Bearings
  Propellers
  Pulleys
  Tailwheels
Radio Equipment



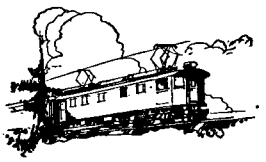
Ships

Circuit-Breakers
Condensing Equipment
Deck Winch Motors
Elec. Heating Appar.
Eng. Room Auxiliaries
Fans and Blowers
Fuses
Generating Equipment
Instruments
Light and Power Plants
Lighting Equipment
Micarta Trays
Motors and Controllers
Ovens, Ranges and Galley Equipment
Panelboards
Propulsion Equipment
  Diesel-Electric
  Geared Turbine
  Turbine Electric
Radio Equipment
Safety Switches
Switchgear



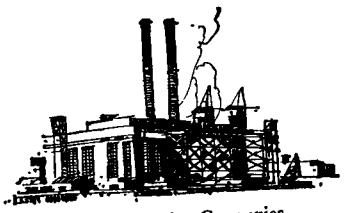
Electric Railways

Arc Welding Equip.
Automatic Substations
Babbitt, Solder & Pots
Baking Ovens
Circuit-Breakers
Elec. Trolley Coaches
Fans
Gas Electric Coaches
Gears and Pinions
Generators
Insulating Material
Insulators
Lighting Fixtures
Lightning Arresters
Line Material
Manual Substations
Mazda Lamps
Meters
Motors and Control
Panelboards
Portable Substations
Relays
Signal Equipment
Supervisory Control
Switchgear
Synchronous Convert's
Transformers
Trolley Poles



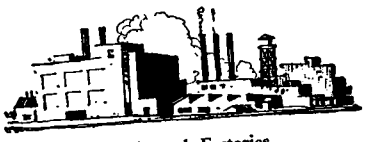
Railroads

Arc Welding Equipment
Automatic Substations
Babbitt, Solder & Pots
Baking Ovens
Battery Charging Equip.
Cars—Multiple-Unit. Gas-Elec., Oil-Elec.
Circuit-Breakers
Control Apparatus
Elec. Heating Apparatus
Fans
Gears and Pinions
Generators
Headlight Equipment
Instruments
Insulating Materials
Insulators
Lighting Equipment
Lightning Arresters
Line Material
Locomotives—Electric Gas-Elec., Oil-Elec.
Manual Substations
Mazda Lamps
Micarta Gears
Motors and Control
Outdoor Substations
Panelboards
Power House Apparatus
Radio Equipment
Safety Switches
Signal Equipment
Stokers
Supervisory Control
Switchgear
Transformers
Yard Lighting Equip.



Electric Service Companies

Automatic Switching Equipment
Circuit-breakers
Condensers
Cutouts
Fans
Frequency-converters
Fuses
Generators
Instruments & Meters
Insulating Material
Insulators
Line Material
Lighting Equipment
Lightning Arresters
Micarta
Motors and Control
Motor-Generators
Network Protectors
Network Transformers
Oil Testing and Purifying Equipment
Outdoor Substations
Panelboards
Porcelain Insulators
Relays
Safety Switches
Steam Turbines
Stokers
Supervisory Control
Switchgear
Synchronous Conden'rs
Synchronous Conv'ters
Transformers
Turbine Generators
Voltage Regulators



Mills and Factories

Arc Welding Equip.
Automatic Starters and Controllers
Babbitt & Babbitt Pots
Capacitors
Circuit-Breakers
Condensers
Fans, Desk and Exhaust
Furnaces and Ovens
Fuses
Generating Equipment
Insulating Materials
Knife Switches
Larry Car Equipment
Lighting Equipment
Lightning Arresters
Locomotives—Electric Gas-Elec., Oil Elec.
Mazda Lamps
Meters and Relays
Micarta Gears
Motors and Controllers
Panelboards
Pipe Fittings (Struct'al)
Power House Apparatus
Safety Switches
Solder & Glue Pots
Space Heaters
Stokers
Switchgear
Transformers
Turbines



Mines

Arc Welding Equip.
Auto. Feeder Equip.
Automatic Starters and Controllers
Automatic Substations
Battery Charging Equip.
Circuit-Breakers
Clamps
Elec. Heating Apparatus
Fans
Gears and Pinions
Headlights
Insulating Materials
Insulators
Larry Car Equipment
Lightning Arresters
Line Material
Locomotives
Manual Substations
Mazda Lamps
Meters & Instruments
Micarta
Motor Generators
Motors for Hoists, Pumps, Tipples, and Breakers
Panelboards
Portable Substations
Relays
Safety Switches
Switchgear
Synchronous Conv'ters
Transformers
Ventilating Outfits



Oil Fields

Arc Welding Equip.
Change House Heaters
Floodlight Projectors
Gear Units
Insulators
Mazda Lamps
Motors and Control
Panelboards
Reflectors
Rig Lighters
Safety Switches
Small Light Plants
Transformers
Vapor Proof Fixtures

RETURN TO ENGINEERING DIVISION OFFICE ELEC. & MFG. CO

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§RALEIGH, N. C., 322 S. Harrington St.
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*SACRAMENTO, CALIF., 20th and "R" Sts.
*SALT LAKE CITY, UTAH, 10 West First South St.
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§SALT LAKE CITY, UTAH, 235 W. S. Temple
*SAN ANTONIO, TEXAS, 212 East Houston St.
*SAN FRANCISCO, CALIF., 1 Montgomery St.
*SEATTLE, WASH., 603 Stewart St.
†#SEATTLE, WASH., 3451 East Marginal Way
xSHARON, PA., 469 Sharpsville Ave.
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†#ST. LOUIS, MO., 717 South Twelfth St.
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*Sales Office †Service Office xWorks #Warehouse *First Class Mail Only §Merchandising Only zHeadquarters

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Fully equipped sales offices and warehouses are maintained at all locations

ABILENE, KAN., Union Electric Co.
AKRON, OHIO, The Moock Electric Sup. Co.
ALBANY, N. Y., 360 Broadway
ALLENTOWN, PA., 522 Maple St.
ATLANTA, GA., 96 Poplar St., N. W.
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BALTIMORE, MD., 40 South Calvert St.
BANGOR, MAINE, 175 Broad St.
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BUFFALO, N. Y., McCarthy Bros. & Ford
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BUTTE, MONTANA, 50 East Broadway
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CHATTANOOGA, TENN., Mills & Lupton Sup. Co.
CHICAGO, ILL., 113 North May St.
CHICAGO, ILL., Hyland Electrical Sup. Co.
CINCINNATI, OHIO, The Johnson Electric Sup. Co.
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COLUMBUS, OHIO, The Hughes Peters Elec. Corp.
COLUMBUS, OHIO, Pixley Electric Sup. Co.
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GRAND RAPIDS, MICH., 507 Monroe Ave. N. W.
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HOUSTON, TEXAS, 1903 Ruiz St.
HUNTINGTON, W. VA., Banks-Miller Sup. Co.
①INDIANAPOLIS, IND., 137 So. Pennsylvania Ave.
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OMAHA, NEB., 117 North Thirteenth St.
PEORIA, ILL., 104 East State St.
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PHOENIX, ARIZONA, 315 West Jackson St.
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①Changed or added since previous issue.

5790

5790

Westinghouse

Oil Circuit-Breakers

Type GO-B—15,000 Volts—600 Amperes—50,000 KVA.
Type GO-1-B—15,000 Volts—600 Amperes—100,000 KVA.
Type GO-2-B—15,000 Volts—600 Amperes—250,000 KVA.
Type GO-2-B—15,000 Volts—1200 Amperes—250,000 KVA.
Type GO-1-B—23,000 Volts—600 Amperes—250,000 KVA.

INSTRUCTION BOOK

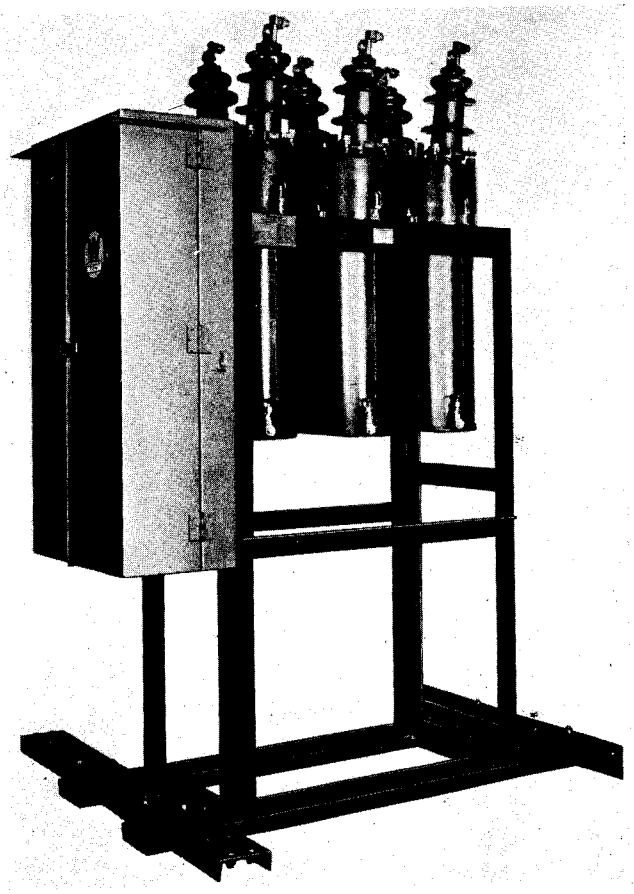


FIG. 1—TYPE GO-1-B, 15000 VOLT, 600-AMPERE, SOLENOID- AND MANUALLY-OPERATED BREAKER.

Westinghouse Electric Corporation
East Pittsburgh, Pa.

I. B. 5816
(Filing No. 33-000)

Printed in U.S.A. (Rep. 7-50)

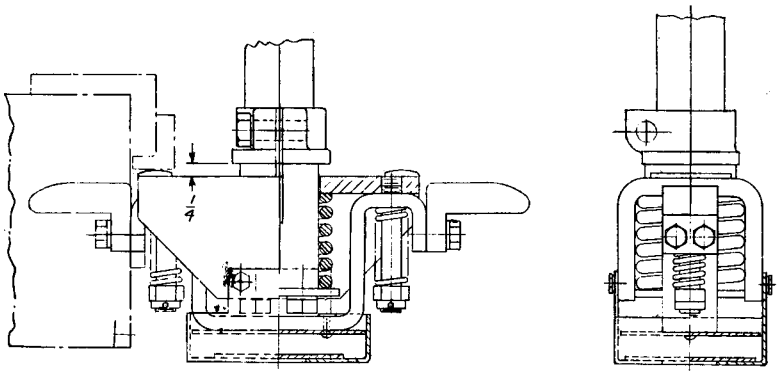


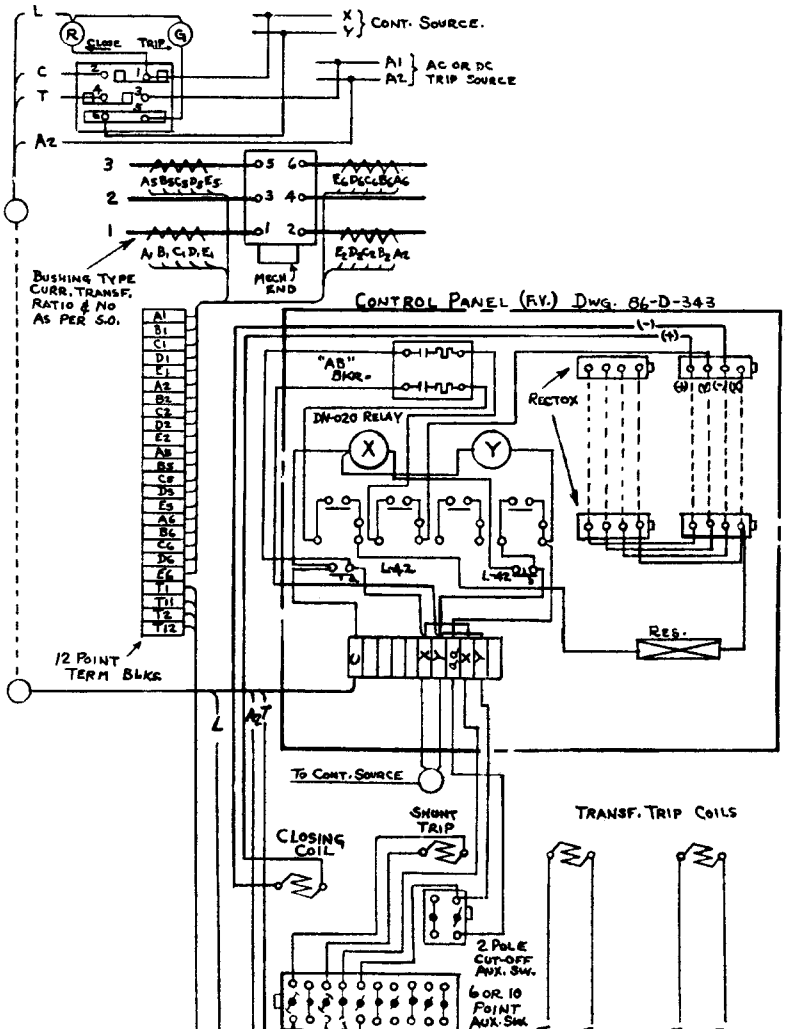
FIG. 5—DE-ION INTERRUPTER ASSEMBLY FOR GO-B CIRCUIT BREAKER

anism trigger and allow the breaker to open slowly.

4. Remove the tanks and examine the inside for evidence of moisture or foreign matter. Flush with benzine. Tanks should not be lowered in wet weather without provision for keeping moisture out of them. The internal parts of the breaker should be protected as well.
5. Examine the contacts to see that they are clean and in alignment. For adjustments, see section covering "Adjustments".
6. Operate the breaker by hand several times, watching each pole and the operating mechanism to be sure that all parts move freely.
7. Install connections to the breaker studs. All contact surfaces should be cleaned and should be free of burrs. The terminal studs are not designed to carry undue cable or bus bar loads. An excessive strain, which at first may have no apparent effect, will eventually loosen the porcelain weather casing and permit moisture to enter the breaker.
8. With the tanks removed, fill them with oil in accordance with name plate instructions or if more desirable, the oil can be added through a filling plug located in the breaker top after the tank has been bolted in place. Be sure to replace the filling plug and to see that tank is drawn up even and tight all around. See that the oil level is at the proper height on the oil gauge.
9. Connect the breaker frame to ground through the grounding pad provided on the breaker frame. The National Electric Code requires grounding cable to have one-fifth the main circuit capacity, except that it must never be smaller than No. 8 and
10. Remove the undrilled conduit entrance plate from the bottom of the mechanism housing and drill for the conduit entrance as desired.
11. Connect the control and transs former circuits to the proper point-on the terminal blocks, as shown on the diagram supplied (Ref. Fig. 6).

When the breaker is located a considerable distance from the battery or transformer, allowance should be made for the voltage drop between the battery, or transformer, and the terminals of the operating coil to secure proper operation at minimum control voltage. The bushing type current transformer name plate should be used as an indication of the proper taps to use, although the proper taps will be determined by the loading. It is always necessary to determine the proper taps by test. The following tables indicate the primary current necessary to trip the breaker for several standard attachments. Always be sure the transformer secondary connections are completed before impressing primary current on the breaker.

12. Check the operation of the breaker by operating it electrically, if for electrical operation.



Adjustments

These breakers used the wedge and finger type "De-ion" grid or interrupter contact shown in Figs. 3, 4 and 5. They are designed with sufficient pressure to carry rated current without the temperature rise exceeding A.I.E.E. limts.

GO-1-B to GO-2-B, 600 Amperes—The contacts are non-adjustable and are set properly at the factory. The distance between the top of the "De-ion" grid top plate and the top of the moving contact should be 1⅝ inches with the breaker closed. This dimension is only for new parts. Some allowance must of course be made when the contacts burn. The moving contacts are tipped with a special arc-resisting tungsten alloy to insure long life. This can only be replaced at the factory.

When fitting new stationary contact fingers the adjustment should be so made that the distance between the fingers is $\frac{5}{16}$ inch. See Fig. 3. The fingers should also be adjusted symmetrically with respect to the slot in the grids.

GO-2-B, 1200 Amperes—The auxiliary contacts (Fig. 4) are adjustable by turning the bracket up or down on the lift rod. With the breaker in the closed position the distance between the contact cross bar and cross bar bracket should be $\frac{5}{32}$ inch. It is important that this dimension be maintained.

These contacts make silver to silver contact and it is unnecessary to use an abrasive to keep them bright. In fitting new contacts it is unnecessary that perfect line contact be obtained. With the soft material (silver) good contact is obtained after a few operations. If it is necessary to renew the silver surfaces, use solder of at least 300°C. melting point. Use only "pure silver." Coin silver is unsatisfactory.

The moving contacts are tipped with a special arc-resisting tungsten alloy to ensure long life. This can only be replaced at the factory.

The adjustment of the stationary contact arcing fingers is the same as the 600 ampere breakers.



FIG. 7—GO-1-B CONDENSER BUSHING, 23,000 VOLTS

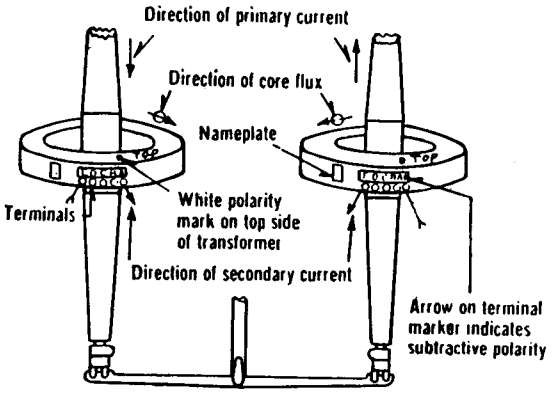


FIG. A

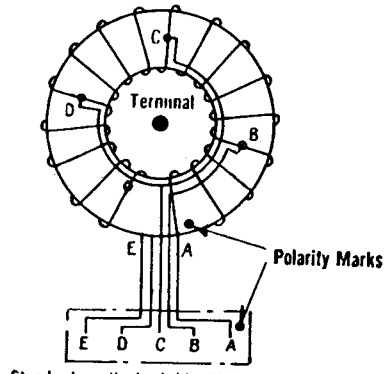


FIG. B

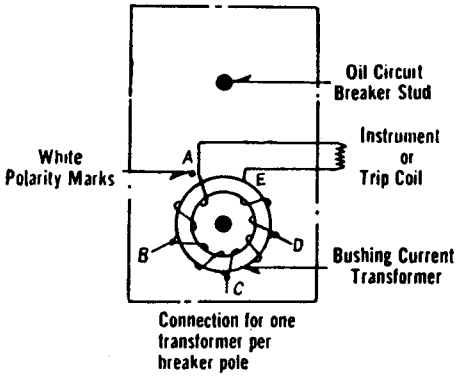


FIG. C

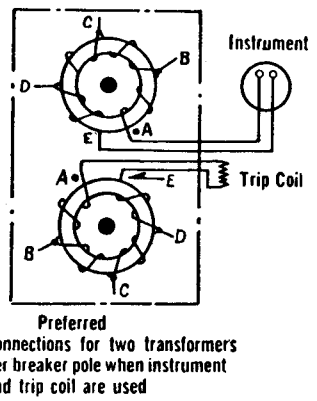


FIG. D

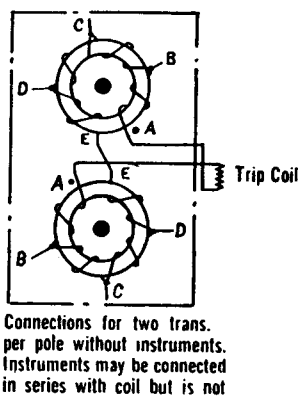


FIG. E

FIG. 8—TYPICAL BUSHING TYPE CURRENT TRANSFORMER CONNECTIONS

GO-B—The contact arrangement is shown in Fig. 5. The main and arcing contacts are both of the butt type, the ¼-inch lead of the arcing contacts being maintained by the thickness of the copper on the arcing tips. The contact pressure on the main contacts is obtained by a compression spring. With the breaker closed the top of the main moving contact should be ¼-inch below the shoulder on the lift rod end. If necessary to adjust, loosen the lift rod end and screw the assembly up or down as necessary.

It is important that the ¼-inch dimension be maintained as this determines the main contact pressure.

The main contacts make silver to silver contact and it is therefore unnecessary to use an abrasive to keep them clean. The oxide of silver does not increase the contact drop. In fitting new contacts it is unnecessary to secure perfect line contact; with the comparatively soft material (silver) good contact is secured after a few operations, as the silver flows slightly under pressure.

If the silver contacts on the moving contacts are replaced, use solder of at least 300°C. melting point. **Use only "pure silver", coin silver is unsatisfactory.**

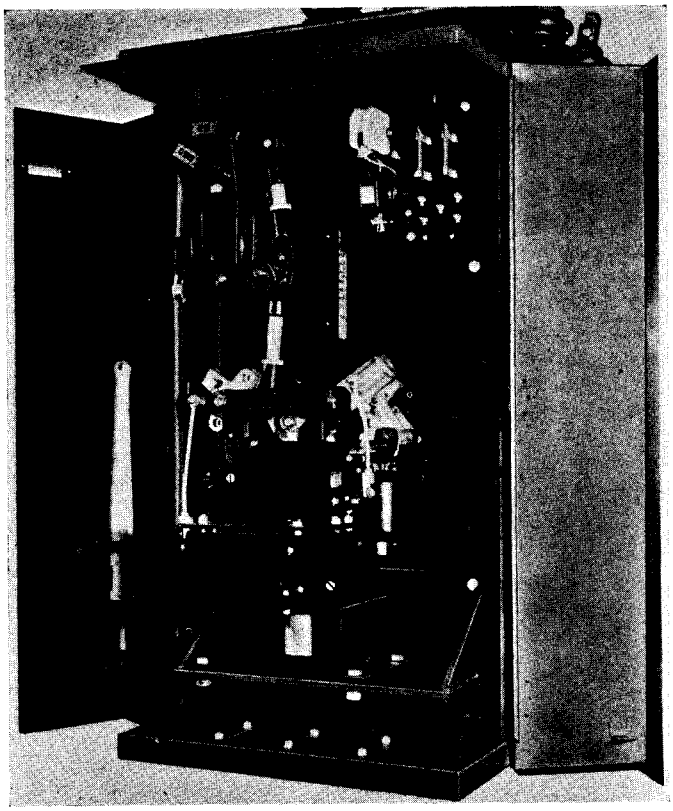


FIG. 9—TYPE SA-3 MECHANICALLY TRIP-FREE SOLENOID AND HOUSING

General:

Vertical and rotational adjustment of the contacts is secured by loosening the clamping bolt of the stationary contact foot and rotating the foot into alignment. If necessary to rotate the contact foot a complete turn, it will be necessary to remove the stationary contact bracket (with "De-ion" grid attached). Before rotating the foot a wedge should be driven into the saw cut to spread the foot. Never attempt to force the contact foot as the copper may "gall".

A limited amount of horizontal adjustment can be secured by adjusting the three clamp flange bolts on the top of the pole unit. This is done by loosening one or two bolts and tightening the remaining bolts. The bolts loosened should be checked for tightness after adjustment.

Before completing any adjustments, make sure that the contact support is turned so as to secure the minimum amount of friction or rubbing, between the moving contact and the stack or interrupter.

When removing the copper oxide from the contacts use sandpaper or a fine file. Do not use emery cloth; the particles of emery are electrical conductors and any particles remaining ower the insulating value of the oil.

Caution—Remember do not use an abrasive on silver contacts.

"De-ion" Grid Stacks—It is important that the arrangement of the plates in the "De-ion" grids be correct. Should it be necessary to renew parts of the stacks, it is recommended that they be returned to the factory for repair or completely new assembled stacks supplied.

"De-ion Interrupters"—The "De-ion Interrupters" control the arc and quickly extinguish it by de-ionization. These devices need little attention other than an occasional inspection. They must be kept securely tightened and properly aligned so that the moving contacts move freely and do not rub causing excessive friction. The fibre insulation is affected very little by the arc action but should be inspected occasionally and replaced if excessive deterioration is found.

Terminal Bushing—The surface of the bushing insulation should be smooth and well varnished. If the varnished surface is damaged or questionable, it should be smoothed off with fine sand paper and revarnished with three coats of good quality, clear, air-drying Spar varnish. Each coat should be allowed to dry for 24 hours.

Mechanical—Do not try to adjust the contacts by changing the toggle adjustment. The toggle of the breaker is set at the factory and should not be disturbed. The correct setting is ⅞-inch off center for the standard breaker. Refer to Fig. 10. Excessive overtravel of the contacts is prevented by the set screw stop in the top of the main casting. This stop should be set to secure $\frac{1}{16}$-inch clearance between the top of the pole unit main lever and the bottom of the set screw. This clearance can be approximated by screwing the set screw down until it touches the main lever, and then backing off one turn.

Maintenance

Points to be Observed in Maintenance—

1. Before making any adjustments, make sure that all lines are electrically dead.
2. Be sure the breaker frame is grounded.
3. Do not operate the breaker excessively with the operating mechanism when the tanks are removed.

4. Examine all contacts frequently especially after short-circuit. See that the contacts are properly aligned.
5. After making any adjustments, operate the apparatus carefully by hand to make sure that it operates smoothly and correctly.
6. Inspect the oil after severe faults. If it shows signs of moisture, carbonization or dirt, filter and retest it.
7. Remove all oil and thoroughly clean the tanks, tank liners, lift rods, terminal bushings, etc., at least once a year.
8. Occasionally inspect and tighten clamping nuts around bushings on top of breaker.
9. Any pitting of the contacts should be smoothed, or, if badly burned, the contacts should be replaced.
10. Keep the bearing surfaces of the mechanism and breaker units adequately oiled.
11. **Operating Mechanism**—For instructions covering the Type SA-3 solenoid mechanism, see Instruction Book 5567.

Insulating Oil

Dielectric tests of the oil should be made every three months, to show if it is reasonably good for circuit-breaker work. Samples should not be taken until the oil has remained undisturbed for at least four hours. In testing for indication of water, take the sample from the bottom of the tank. If for indication of carbon, and after a heavy short-circuit, take the sample from the surface of the oil.

The care of the insulating oil in circuit-breakers is of the utmost importance in their successful operation. Contamination by dirt, moisture, metallic particles, lint, etc., all reduce the dielectric strength, upon which the operation and current-interrupting ability largely depend. Consequently, the most careful attention should be given to keeping the oil clean, not only in filling the tanks originally but in later maintenance or other work on the breakers which might involve opening the tanks.

Only the highest grade, such as Wemco "C" or other approved oil, should be used in the breakers. The oil should be new or at least thoroughly reconditioned by means of a filter press or centrifuge. In any case, before using, it should be given a dielectric test which should show a minimum of 22,000 volts (preferably 25,000 to 30,000) measured between 1-inch diameter discs spaced .1 inch apart.

Before filling, the tanks should be thoroughly cleaned, and flushed out with insulating oil. The same treatment should be given the inside of the top of the breaker and the operating linkage and contact system. In doing this, rags which will leave lint should not be used as lint absorbs and holds moisture.

The same care should be used during inspection or maintenance work on the breaker, which should preferably be done only under favorable weather conditions. If the oil is to be reconditioned following operation of the breaker under short-circuit, the tank and entire inside of the breaker should be cleaned before the oil is returned to the tank. If the work merely involves lowering or removal of the tank, care should be taken to keep the tank covered until it is replaced so that dirt, dust, metallic particles, etc., cannot fall into the oil.

The above precautions may appear academic to those familiar with the maintenance and operation of oil circuit-breakers, but a little more than ordinary care in oil-handling will be well repaid in reliable and dependable operation for which the breaker is designed and built.

For instructions as to the care and testing of insulating oil, see Instruction Book 5336.

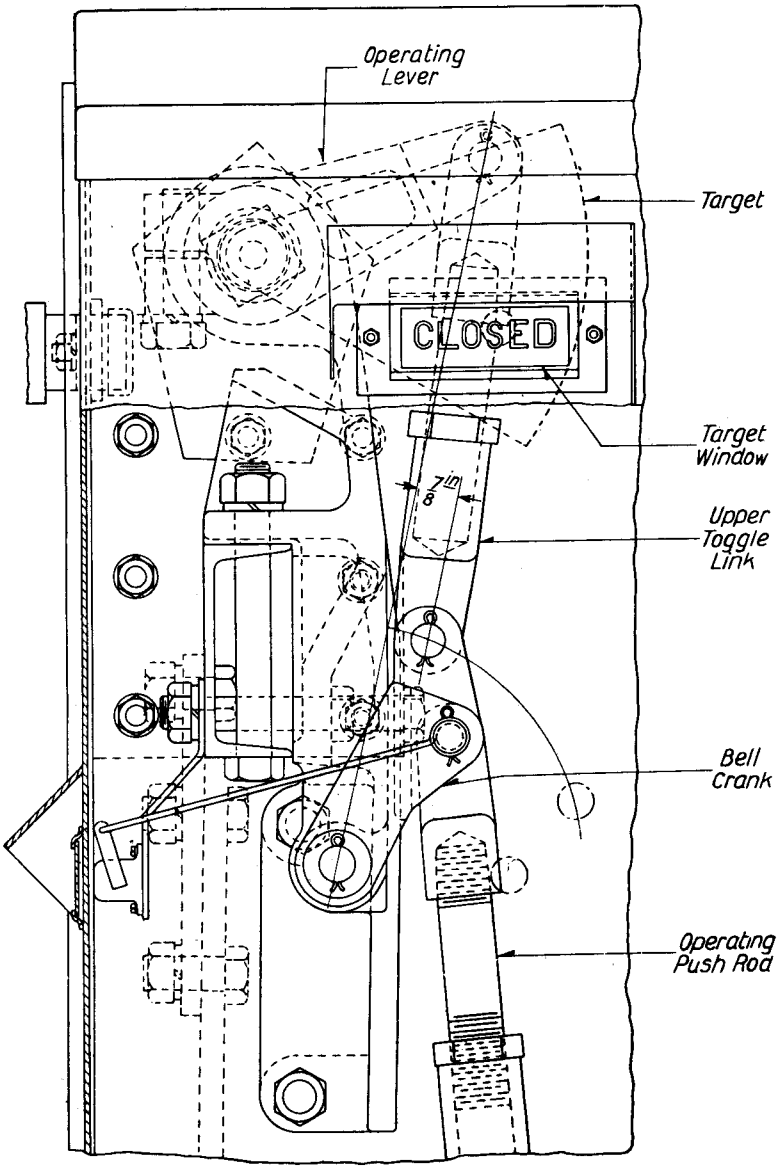


FIG. 10—TOGGLE MECHANISM

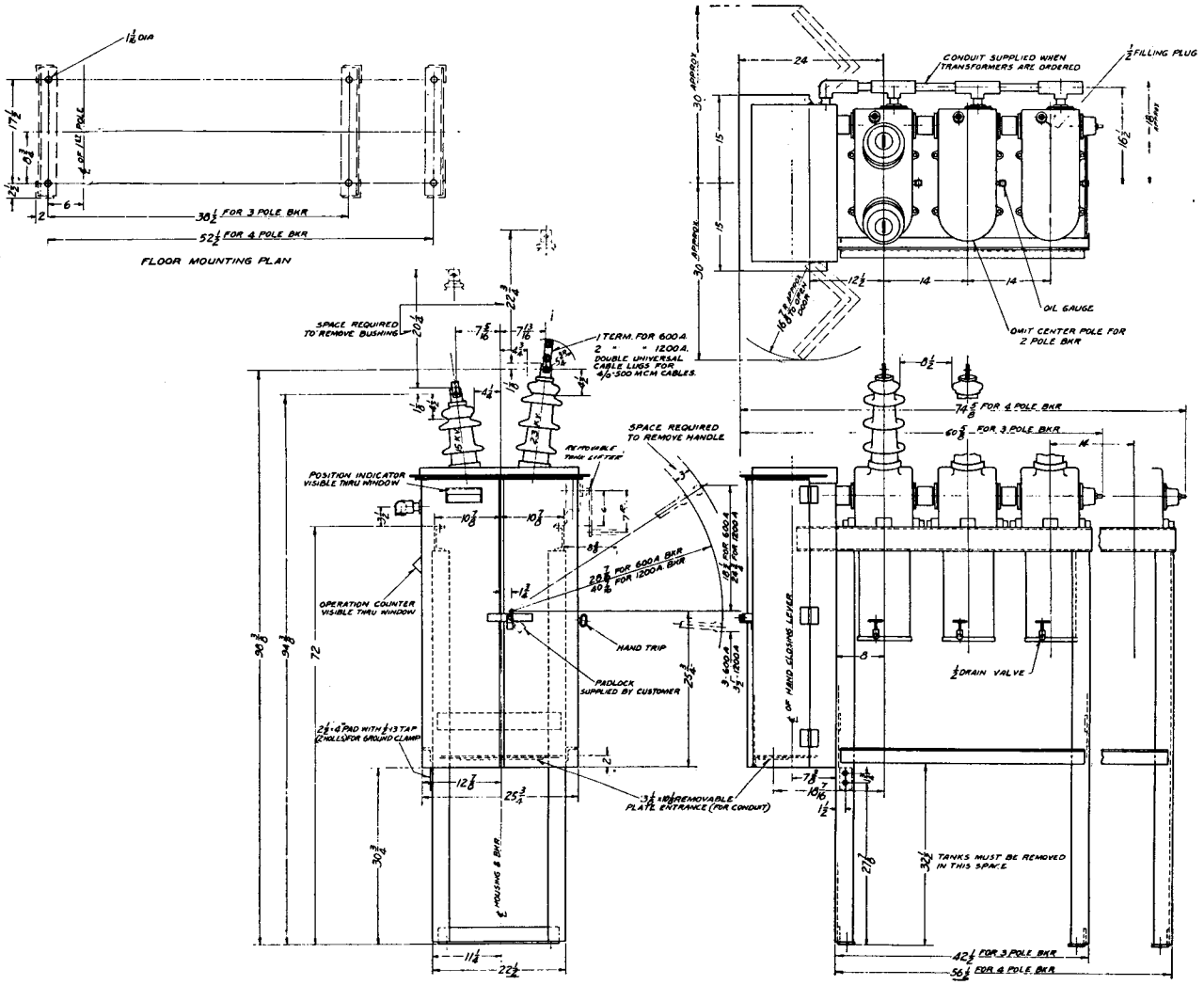


FIG. 11—TYPE GO-B, GO-1-B AND GO-2-B OIL CIRCUIT-BREAKER, FRAME MOUNTING

Type GO-B, GO-1-B and GO-2-B Breakers

DATA APPLYING TO 600–5 AND 1200–5 TRANSFORMERS

ACTUAL PRIMARY CURRENTS NECESSARY TO PRODUCE 5 AMPERES IN SECONDARY FOR ATTACHMENTS INDICATED

60 CYCLES

GO-B	15000 Volts	600 Amperes	50000 Kv-a.
GO-1-B	15000 Volts	600 Amperes	100000 Kv-a.
GO-2-B	15000 Volts	600 and 1200 Amps.	250000 Kv-a.
GO-1-B	23000 Volts	600 Amperes	250000 Kv-a.

Minimum Primary Tripping Currents for Bushing Type Current Transformers.

Ratio	TAPS — Without Relays Inst and I.T.L. Trip 5 Amps.	With Circuit Closing Relays and Shunt Trip 4 Amps. Tap	With Circuit Opening Relay and Inst. Trip 4 Amps. Tap	With Circuit Closing Relay and Direct Trip 5 Amps. Tap	With Circuit Closing Relay and Tripping Trans. 5 Amps. Tap
			600/5 M. R.		
50/5 BC	90	49	82	70*	85*
100/5 AB	120	84	98	110*	115*
150/5 AC	165	122	135	175	185
200/5 DE	210	165	175	215	220
250/5 CD	260	202	215	265	270
300/5 BD	305	245	245	310	315
400/5 AD	407	324	330	410	415
450/5 CE	455	362	370	457	460
500/5 BE	505	405	420	508	510
600/5 AE	605	483	490	605	610
			1200/5 M. R.		
100/5 BC	125	85	110	115*	120*
200/5 AB	220	185	175	220	225
300/5 AC	315	248	250	315	320
400/5 DE	415	326	335	415	420
500/5 CD	510	406	420	510	515
600/5 BD	610	486	495	610	615
700/5 AD	805	645	650	808	808
900/5 CE	905	723	730	905	905
1000/5 BE	1005	803	810	1005	1005
1200/5 AE	1205	963	965	1205	1205

Note—Minimum trip values based on one transformer per phase unless otherwise indicated.

* Two transformers in series.

ORDERING INSTRUCTIONS

When ordering Renewal Parts, always specify the name of the part wanted as shown on the illustrations in this Instruction Book, giving Shop Order Number and the type of Oil Circuit-Breaker, as shown on the name plate. For example:

One Moving or Stationary Contact Complete, 600 Amperes, for Type GO-B Oil Circuit-Breaker, S. O. 30-F-171, shown in Instruction Book 5816, Figure 2.

To avoid delays and misunderstandings, note carefully the following points:

1. Send all correspondence and orders to the nearest Sales Office of the Company.

2. State whether shipment is to be made by freight, express or parcel post. In the absence of instructions, goods will be shipped at our discretion. Parcel post shipments will be insured only on request. All shipments are at purchaser's risk.

3. Small orders should be combined so as to amount to a value of at least $1.00 net. Where the total of the sale is less than this, the material will be invoiced at $1.00.

RENEWAL PARTS DATA

Recommended Stock of Renewal Parts for
TYPES GO-B, GO-1-B AND GO-2-B OIL CIRCUIT-BREAKERS
Outdoor Service
Manually or Solenoid Operated—Frame Mounting
600 or 1200 Amperes—15 or 23 KV.—3 Pole-Single Throw

FOR ILLUSTRATION OF PARTS SEE FIGURES 2, 3, 4, 5, 6 AND 9

The following is a list of the Renewal Parts and the quantities of each that we recommend should be stocked by the user of this apparatus to minimize interrupted operation caused by breakdowns. The parts recommended are those most subject to wear in normal operation or those subject to damage or breakage due to possible abnormal conditions. This list of Renewal Parts is given only as a guide. When continuous operation is a primary consideration, additional insurance against shut-downs is desirable. Under such conditions more renewal parts should be carried, the amount depending upon the severity of the service and the time required to secure replacement.

TYPE GO-B OIL CIRCUIT BREAKER

Breakers in use up to and including		1	5
Name of Part	**No. Per 3-Pole Breaker**	**Recommended For Stock**	
Breaker Complete	1	0	0
Breaker Pole Unit Complete	3	0	0
Bumper Spring	3	0	1
Moving Contact Complete	3	0	0
Lift Rod	3	0	1
Main Moving Contact	3	0	1
*Main Moving Contact Spring	3	0	1
Moving Arcing Contact Breaker	3	0	0
Moving Arcing Contact	6	6	12
Moving Arcing Contact Spring	6	2	6
Stationary Contact Complete	6	0	0
Condenser Bushing	6	0	2
Main Stationary Contact	6	0	2
Stationary Arcing Contact	6	6	12
Stationary Arc Shield	6	0	2
Oil Tank Complete	3	0	0
Oil Tank	3	0	1
*Oil Gauge Glass	3	0	1
Tank Liner	3	0	1
*Type SA-3 Solenoid Operated Mechanism	1	0	0
*†Closing Coil	1	0	1
*†Trip Coil	1	0	1
*†Rectox Rectifier	1	0	0

* Not illustrated.
† When ordering, specify identification number stamped on part.
Parts indented are included in the part under which they are indented.

TYPE GO-1-B AND GO-2-B OIL CIRCUIT BREARERS

Breakers in use up to and including		1	5
Name of Part	**No. Per Breaker**	**Recommended For Stock**	
Breaker Complete	1	0	0
Breaker Pole Unit Complete	3	0	0
Bumper Spring	3	0	1
Moving Contact Complete	3	0	0
Lift Rod	3	0	1
Moving Contact	3	0	1
Stationary Contact Complete	6	0	0
Condenser Bushing	6	0	2
Stationary Contact	6	0	0
De-ion Grid Stack	6	0	0
Stationary Contact Finger	12	12	24
Stationary Contact Finger Spring	12	4	12
Stationary Arcing Horn	6	6	12
Oil Tank Complete	3	0	0
Oil Tank	3	0	0
*Oil Gauge Glass	3	0	1
Tank Liner	3	0	1
*Type SA-3 Solenoid Operated Mechanism	1	0	0
*†Closing Coil	1	0	1
*†Trip Coil	1	0	1
*†Rectox Rectifier	1	0	0
Current Transformer 600/5	.	.	.
Current Transformer 1200/5	.	.	.

* Not listed on illustration.
† When ordering, specify identification number stamped on part.
Parts indented are included in the part under which they are indented.

Ordering Instructions on Page 9

MEMORANDUM

5816

Westinghouse

Type FO-22-A Oil Circuit-Breakers

400 and 600 Amperes, 7500 Volts
Manually or Electrically Operated—
Automatic or Non-Automatic Trip

INSTRUCTION BOOK

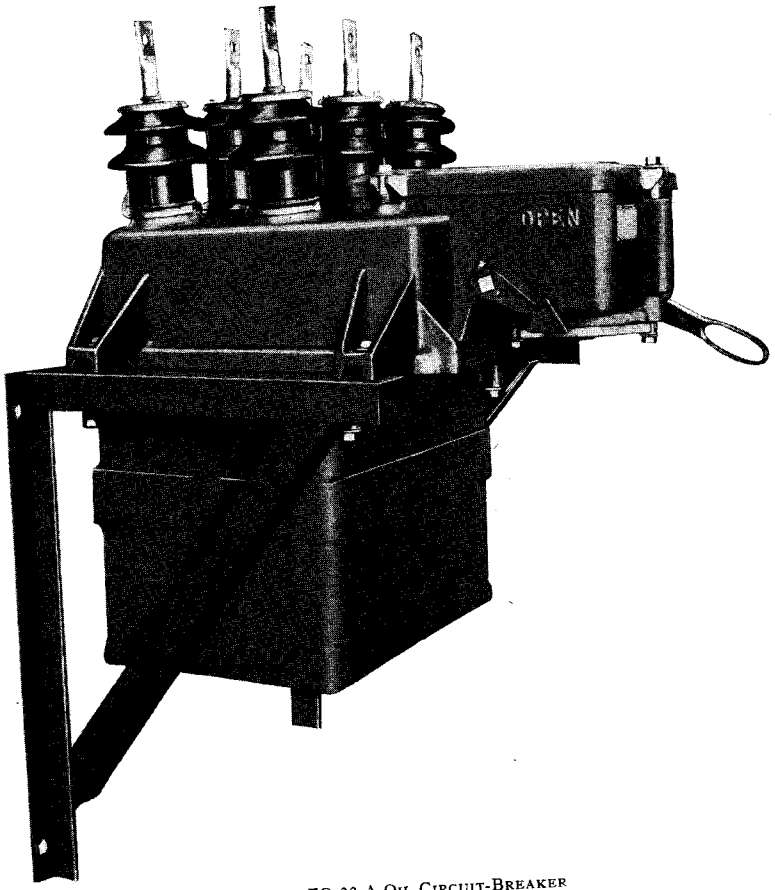


FIG. 1—TYPE FO-22-A OIL CIRCUIT-BREAKER
(WALL MOUNTING)

Westinghouse Electric Corporation

East Pittsburgh Works **East Pittsburgh, Pa.**

I. B. 5766
(Filing No. 33-000)

Printed in U.S.A. (Reprinted 2-47)

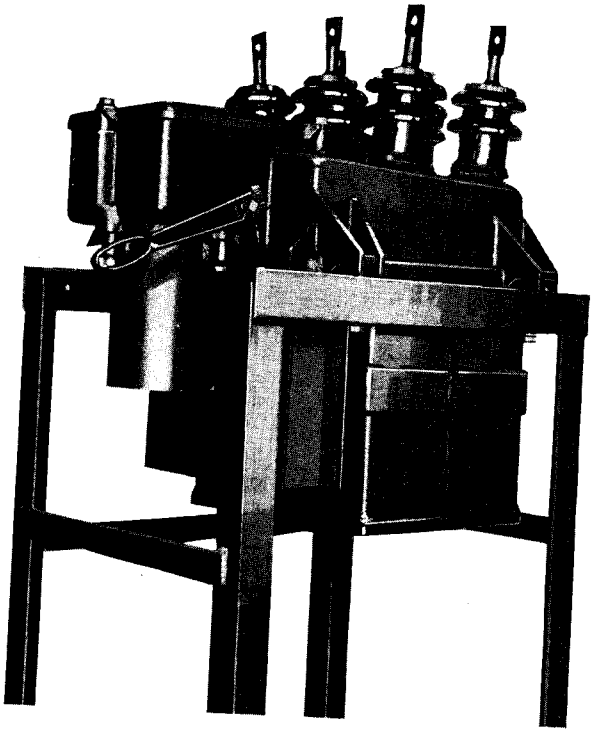


FIG. 2—TYPE FO-22-A OIL CIRCUIT-BREAKER COMPLETE (FRAME MOUNTED)

Westinghouse

Type FO-22-A Oil Circuit-Breakers

400 and 600 Amperes, 7500 Volts

Manually or Electrically Operated—Automatic or Non-Automatic Trip

General Description

The FO-22-A outdoor oil breakers are built in 400- and 600-ampere, 7500-volt, 2- and 3-pole single-throw sizes.

They can be either frame-, wall- or pole-mounted, manually or electrically operated. Automatic breakers can be equipped with either series or transformer trip coils.

They embody the desirable features of larger breakers, including internal mechanism, wound type condenser bushings, heavy butt type contacts, "De-ion Interruptors" and silver-to-silver main contacts.

This breaker has a large factor of safety in interrupting capacity, having been thoroughly tested in the testing laboratories at East Pittsburgh. The "De-ion Interruptor" assures speedy and positive operation with a minimum of disturbance.

The contacts are of large cross section, to withstand long service without renewal. The silver-to-silver contacts eliminate the formation of high resistance contact due to copper oxide.

The breaker will give excellent service with a reasonable amount of care. The instructions which follow should be used as a guide in servicing this breaker.

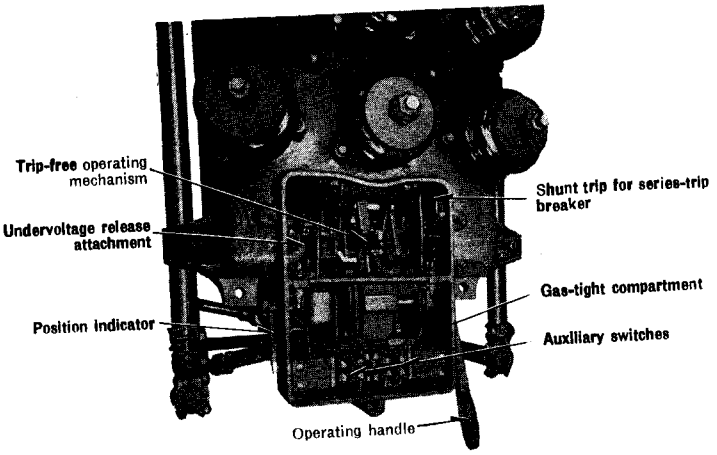


FIG. 3—TYPE FO-22-A OIL CIRCUIT-BREAKER, TOP VIEW SHOWING HOUSING WITH COVER REMOVED

Shipment

The breakers are shipped completely assembled with all attachments and auxiliaries mounted in place. Do not remove the crating until the breaker reaches its permanent location.

Installation

1. Remove the crating and frame skids.

2. Mount the breaker on its foundation. The four mounting bolts should be left loose, until the frame is leveled by inserting shims under the feet. The breaker must be perfectly level.

If the supporting frame for the breaker unit is to be fabricated in the field, the horizontal members supporting the breaker unit must be either 1¼" pipe, or 2, 2½" or 3" angle, depending upon the span. The tank lifter is designed for use with the above structural steel members only, and cannot be used with other sections.

A standard ½" washer (1⅜" O.D.) must be placed under the heads of the breaker unit mounting bolts. The washer prevents the breaker unit from slipping sidewise on the horizontal supports by wedging in the supporting lug vee.

3. Remove the breaker cover and knock the blocking out of the mechanism. **Do not insert hands in breaker when removing this blocking as the mechanism may snap open.**

4. Remove the tank and examine the inside for evidence of moisture or foreign matter. Flush with benzine. Tanks should not be lowered in wet weather without provision for keeping moisture out of them. The internal parts of the breaker should also be protected.

5. Examine the contacts to see that they are clean and in alignment. For adjustment, see section covering adjustments.

6. Operate the breaker by hand several times, watching each pole and the operating mechanism to be sure that all parts move freely.

7. Install connections to the breaker studs. All contact surfaces should be cleaned and should be free of burrs. The terminal studs are not designed to carry undue cable or bus bar loads. An excessive strain, which at first may have no apparent effect, will eventually loosen the porcelain weather casing and permit moisture to enter the breaker.

8. With the tank removed, fill with oil in accordance with name plate instructions. When bolting in place, be sure the tank is drawn up evenly and tightly all around.

9. Connect the breaker frame to ground through one of the mounting bolts. The National Electric Code requires grounding cable to have one-fifth the main circuit capacity, except that it must never be smaller than No. 8 and need not be larger than No. 0, B. & S. gauge.

10. Run the conduits to the breaker mechanism and transformer trip coil housing (when supplied). The breaker casting is tapped for 1¼-inch conduit and the transformer trip coil housing (when supplied) has a 1⅜-inch hole for 1-inch conduit. See the outline drawing for conduit locations. Fig. 20.

11. Connect the control and transformer circuits to the proper points on the auxiliary switch, or to the proper coil leads—Due to space limitations terminal blocks are not supplied. When the breaker is located a considerable distance from the battery or power transformer,

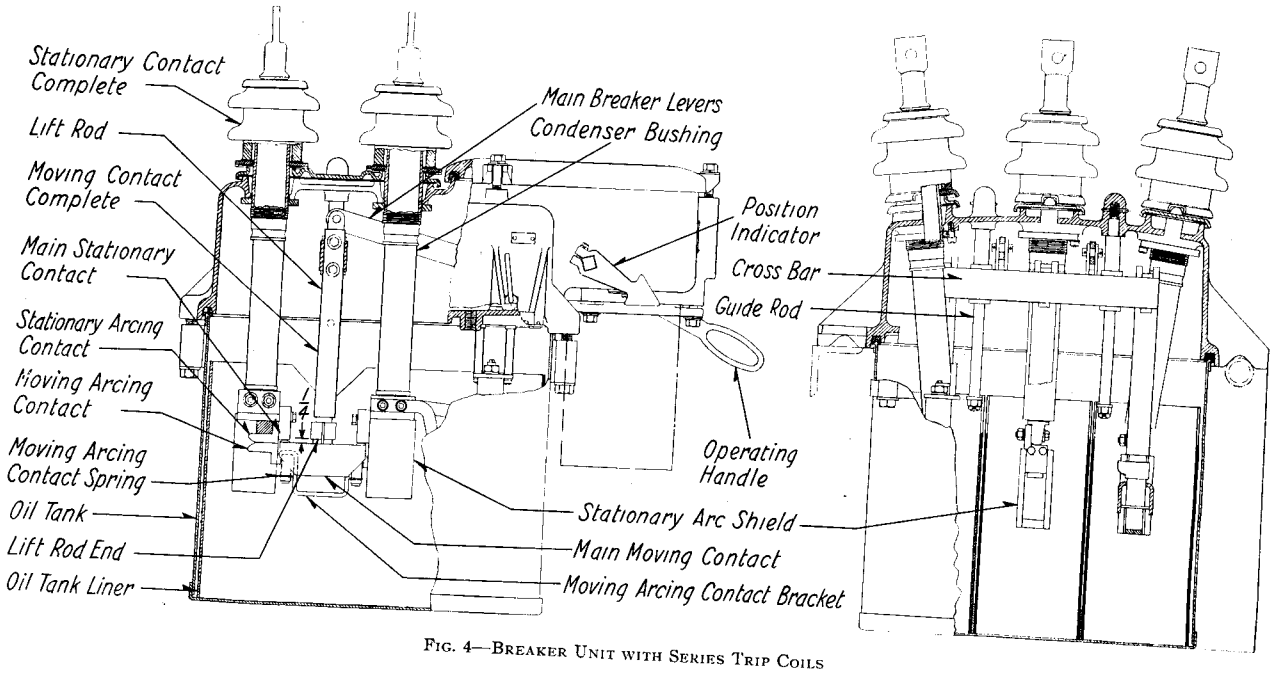


FIG. 4—BREAKER UNIT WITH SERIES TRIP COILS

allowance should be made for the voltage drop between the battery, or the transformer, and the terminals of the closing coil to secure proper operation at minimum control voltage. Always be sure the current transformer secondary connections are completed before impressing primary current on the breaker.

12. Check the operation of the breaker and attachments by operating it electrically, if for electrical operation.

Adjustments

Contacts—The contact arrangement is shown in Fig. 4. The main and arcing contacts are both of the butt type, the ¼-inch lead of the arcing contacts being maintained by the thickness of the copper on the arcing tips. The contact pressure on the main contacts is obtained by a compression spring. With the breaker closed the top of the main moving contact should be ¼-inch below the shoulder on the lift rod end. If necessary to adjust, remove the moving arcing contact bracket with arcing contacts, loosen the lift rod end and screw the assembly up or down as necessary.

It is important that the ¼-inch dimension be maintained as this determines the main contact pressure. A limited amount of horizontal adjustment can be secured by loosening the stationary clamp nut and shifting the stationary contact in the top casting.

The main contacts make silver-to-silver contact and it is therefore unnecessary to use an abrasive to keep them clean. The oxide of silver does not increase the contact drop. In fitting new contacts it is unnecessary to secure perfect line contact. With the comparatively soft material (silver) good contact is secured after a few operations, as the silver flows slightly under pressure.

If the silver contact tips on the moving contacts are replaced, use solder of at

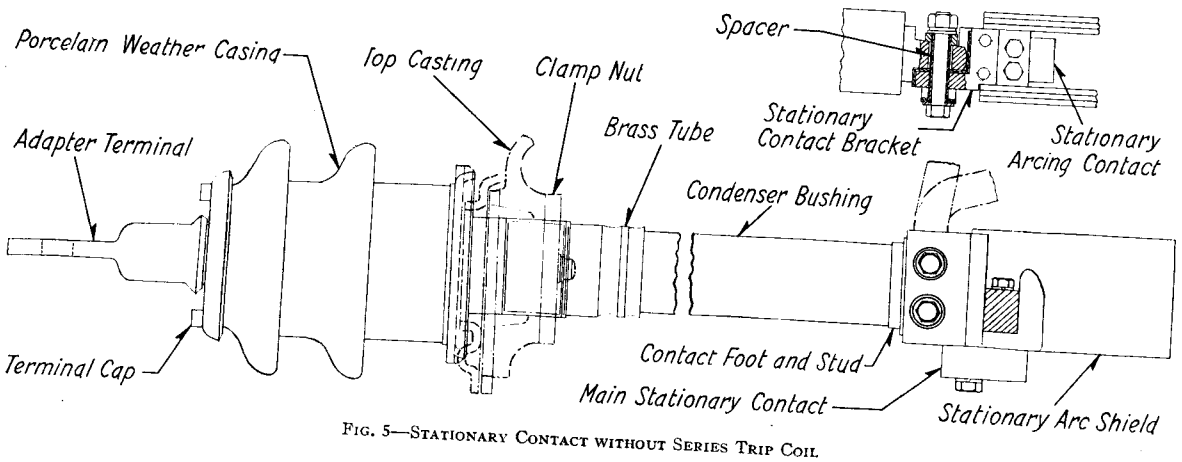


FIG. 5—STATIONARY CONTACT WITHOUT SERIES TRIP COIL

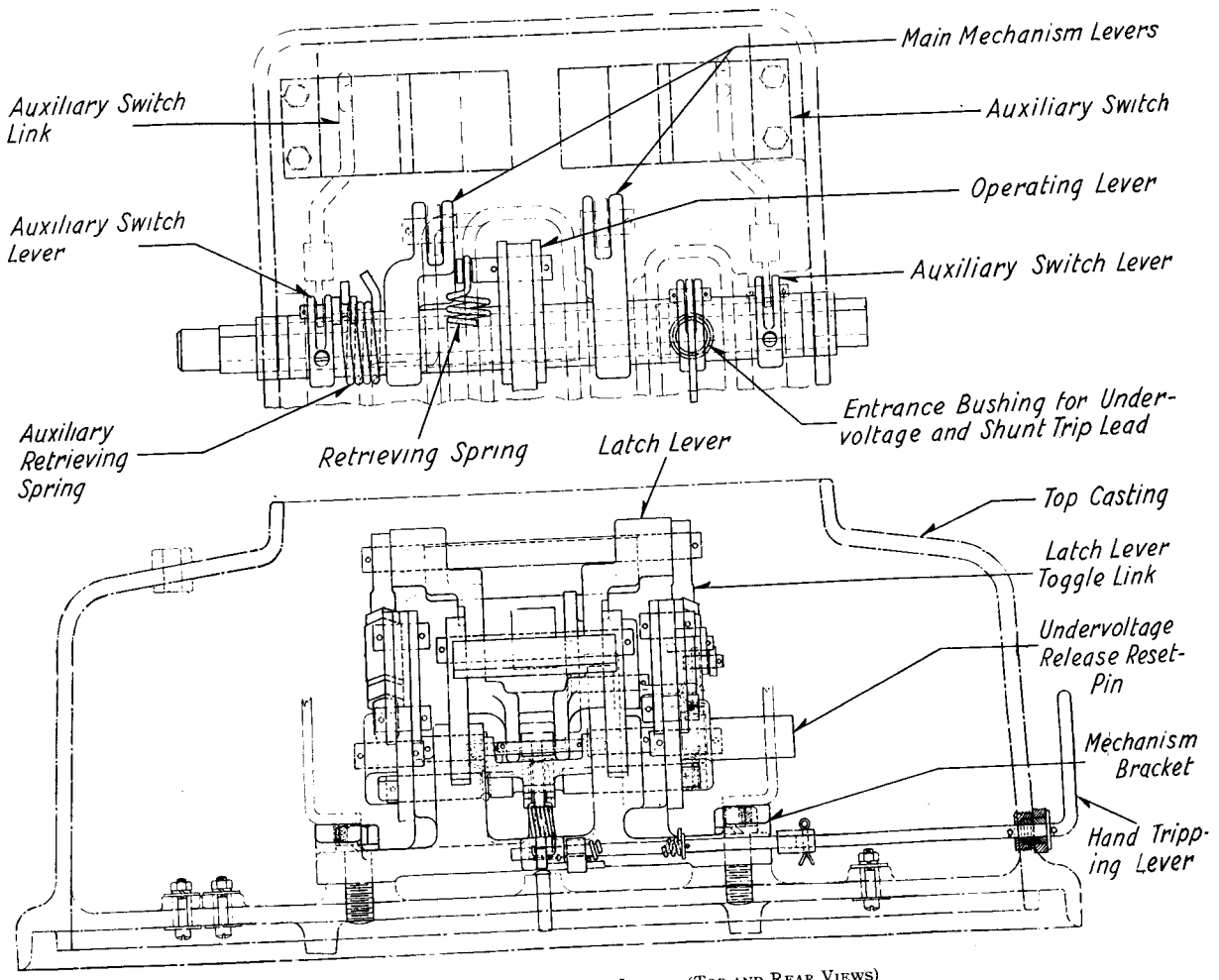


FIG. 6—MECHANISM OPERATING LEVERS (TOP AND REAR VIEWS)

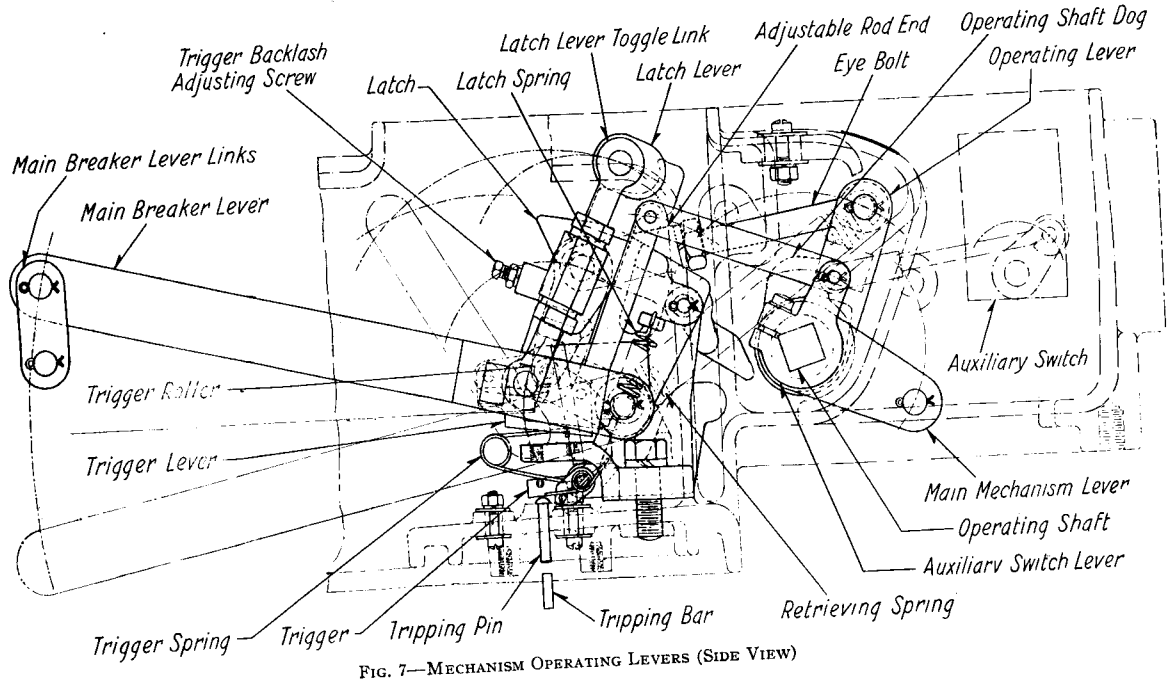


FIG. 7—MECHANISM OPERATING LEVERS (SIDE VIEW)

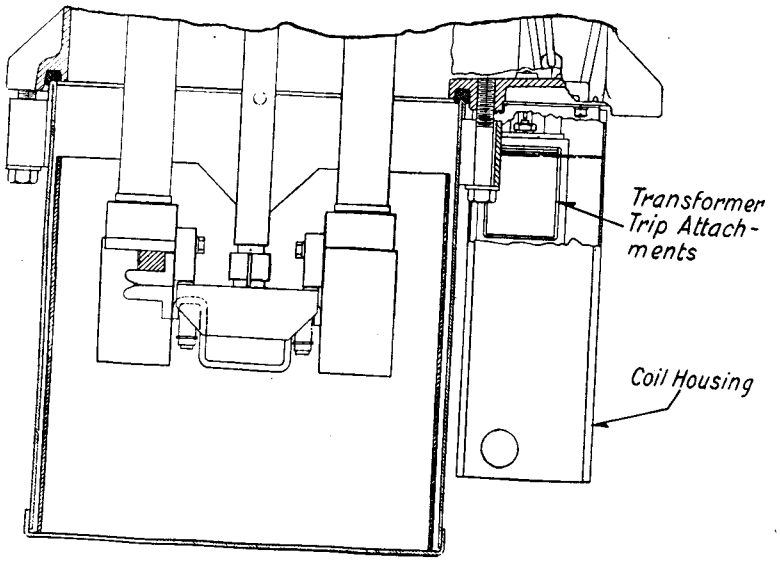


FIG. 8—BREAKER UNIT WITH TRANSFORMER TRIP COIL

least 300° C. melting point. Use only "pure silver," coin silver is unsatisfactory.

"De-ion Interruptors"—The "De-ion Interruptors" control the arc and quickly extinguish it by de-ionization. These devices need little attention other than an occasional inspection. They must be kept securely tightened and properly aligned so that the moving contacts move freely and do not rub, causing excessive friction. The fibre insulation is affected very little by the arc action but should be inspected occasionally and replaced if excessive deterioration is found.

Terminal Bushing—The surface of the condenser-bushing insulation should be smooth and well varnished. If the varnished surface is damaged it should be smoothed with fine sandpaper and revarnished with three coats of good quality, clear, air-drying spar varnish. Each coat should be allowed to dry 24 hours.

Mechanical—Do not try to adjust the contacts by changing the toggle adjustment. Ref. Fig. 8. The toggle is set at the factory and should not be disturbed.

Two guide rods, Fig. 4, are used to align and guide the moving contacts for straight line motion. The cross bar must move freely on these rods. The lower end of the guide rods and part of the cross bar cooperate to form hydraulic bumpers. No adjustment is necessary, other than to be sure the moving contacts open to the full position. Do not operate the breaker excessively without oil.

WARNING—Always remove the closing lever before tripping the breaker.

Mechanism—When the operating shaft is rotated to the closed position, by either the solenoid or the operating handle, the operating shaft dog engages with the operating lever, which is connected to the trip free mechanism by an eye-bolt and an adjustable rod end, and closes the breaker. The breaker is held in the closed position by the latch. The breaker is tripped manually by the hand tripping lever. When the breaker trips automatically the tripping bar strikes the tripping pin, which in turn strikes the trigger, the trigger is disengaged from the trigger lever bracket which drops and permits the latch lever to rotate upward and open the breaker. During the last part of the latch lever rotation, it strikes the latch and allows the trip free mechanism to retrieve.

The only adjustment possible on the mechanism is that for securing the proper setting of the trigger lever back-lash (distance between the trigger roller and trigger lever latching surface). The trigger lever back-lash should be approximately $\frac{1}{64}$ inch. This is secured by means of the trigger back-lash adjusting screw.

Care should be used to see that the operating lever does not strike the web of the top casting when in the closed position.

The auxiliary retrieving spring should be disengaged on manually operated breakers.

D-C. Operation

The solenoid bolts directly to the top casting and is connected to the mechanism through the main mechanism levers on the operating shaft. When installing the solenoid, it is necessary to remove the cast cover supplied with manually operated breakers. It is necessary only to observe that the clamp casting rests firmly on the brass tube and coil and that the clamp casting is placed against the proper grooves in the top casting. The solenoid must operate without friction and the solenoid plunger must strike the stationary core when the latch has $\frac{1}{16}$-inch back-lash. This latch requirement is secured by lengthening or shortening the eye-bolt and adjustable rod end linkage connecting between the operating shaft and the mechanism.

Undervoltage Release Attachment

Refer to Fig. 10.

This attachment is mounted in the left side of the top casting (facing mechanism end) by means of the two mounting bolts indicated. Operation is secured by means of the operating pin included as part of the mechanism. Be sure that the set-up is rigid and agrees with the illustration.

Connect leads from the external circuit to the terminals on the undervoltage coil. The undervoltage coil should be connected directly across the line, but should be protected by fuses. No atten-

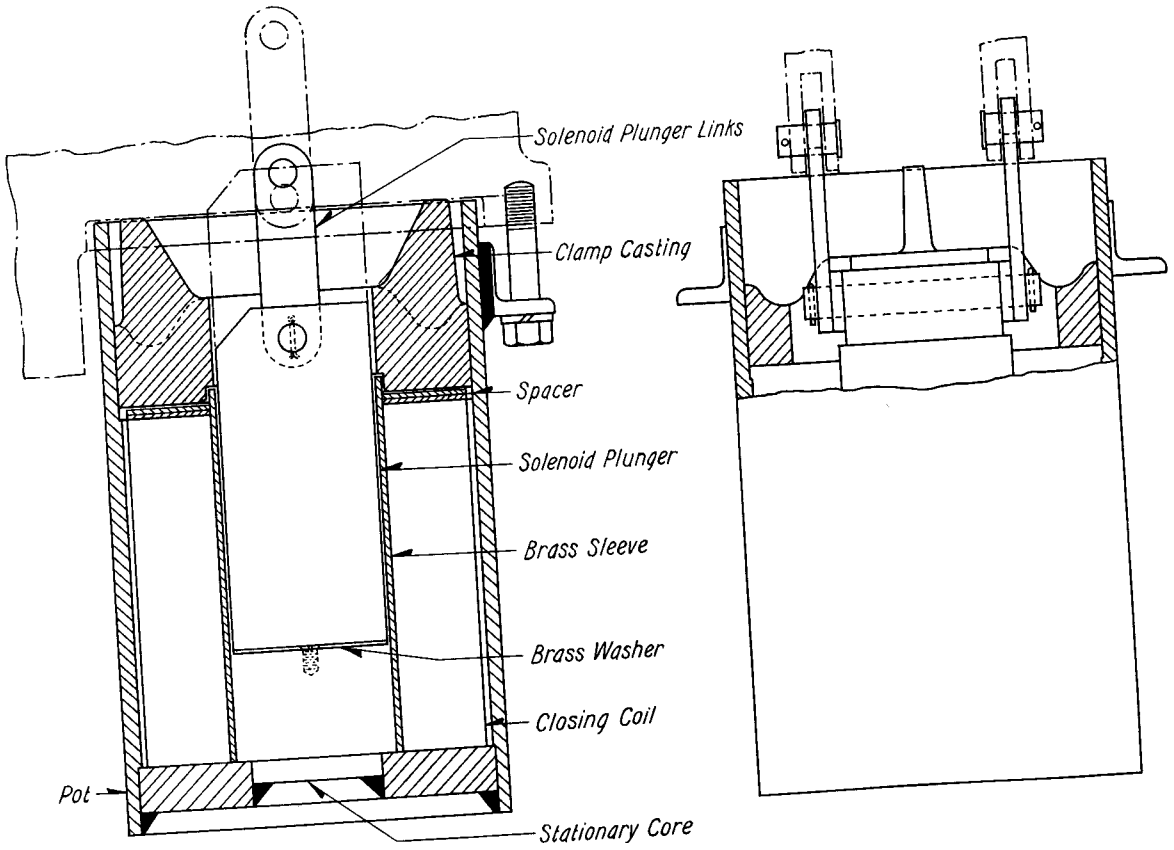


FIG. 9—SOLENOID OPERATING MECHANISM

tion need be paid to correct connection as regards polarity. The undervoltage coils should be connected to the line side of the breaker. Check the control voltage stamped on the name plate to make sure that it agrees with that on which the attachment is to be used.

Do not run the coil circuit through an auxiliary switch as this will result in "pumping."

Make sure that the retrieving spring retrieves the armature to within $\frac{1}{16}$ inch of the stationary core with the breaker in the open position. The low voltage coil is not a pickup coil and consequently is not capable of picking up the low voltage release armature when the distance exceeds this amount. If normal voltage is applied after this dimension is exceeded, the coil will burn out.

If noise develops, the faces of the armature and stationary core should be examined to see that a good clean seat is obtained when they are together. If necessary to clean these faces, be sure to leave them bearing over their entire area.

The attachment should be inspected periodically to make sure that all parts are rigidly assembled and functioning properly.

Shunt Trip Attachment

The shunt trip attachment for use with series trip breakers is mounted in the right side of the top casting (facing mechanism end) by the two mounting bolts indicated. Refer to Figure 11.

Be sure that the set-up is rigid and agrees with the illustration.

Connect lead from the external circuit to the terminals on the shunt trip coil.

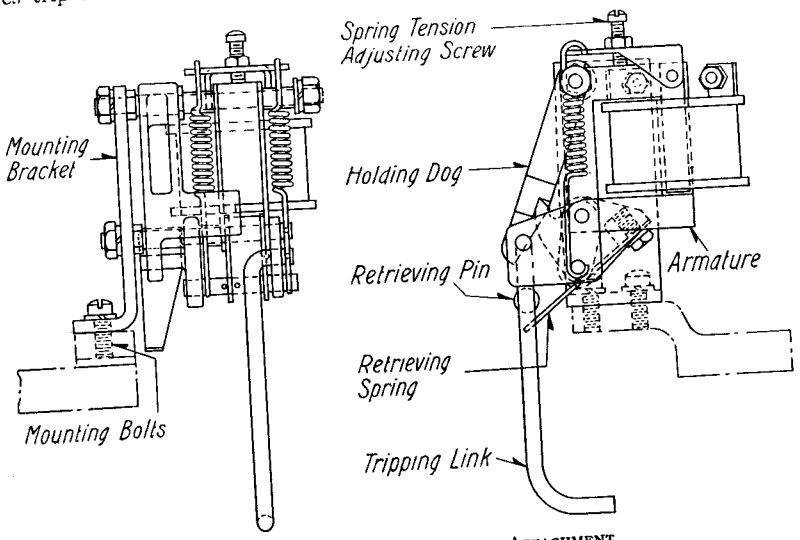


FIG. 10—UNDERVOLTAGE RELEASE ATTACHMENT

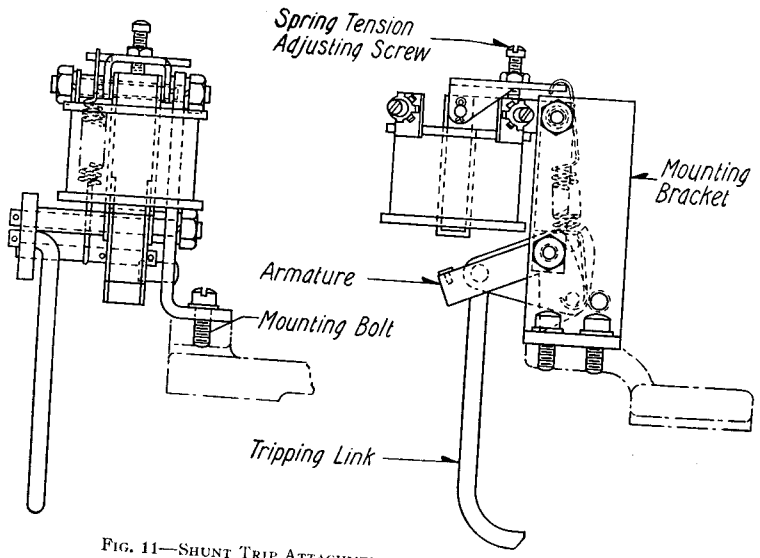


FIG. 11—SHUNT TRIP ATTACHMENT FOR SERIES TRIP BREAKERS

No attention need be paid to the correct connection as regards polarity. Check the control voltage on the name plate to make sure that it agrees with that on which the attachment is to be used.

The shunt trip circuit should be run through an auxiliary switch to break the tripping current when the breaker opens.

The shunt trip attachment for use with transformer trip or non-automatic breakers is mounted on the transformer trip coil mounting plate in the coil housing, as shown in Figure 15.

Bushing Type Current Transformers

The breaker may be equipped with a maximum of 6 breaking type current transformers. The table below indicates the minimum primary tripping currents for the various attachments.

Transformer Trip Attachments

The mounting is illustrated in Figure 15. The attachments are calibrated at the factory and need only to be mounted, the calibration adjustments set at the proper value and the attachments given a preliminary trial.

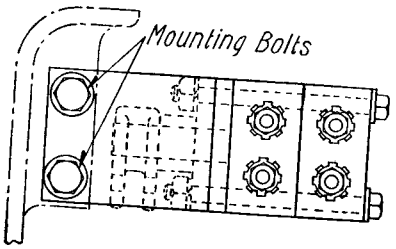
Auxiliary Switches

The auxiliary switch is mounted in the top casting and connected to the switch lever on the operating shaft as indicated in Figures 6 and 12.

MINIMUM PRIMARY TRIPPING CURRENT OF FO-22-A OIL CIRCUIT BREAKERS WITH BUSHING TYPE, SINGLE RATIO, TRANSFORMERS

Transformer Rating in Amps. (5-Amp. Secondary)	Secondary Turns	Without Relays Inst. Trip and I. T. L. (5 Amps.)	With Circuit Closing Relay and Shunt Trip Coil *	With Circuit Opening Relay and Inst. Trip Attachment (4 Amps.)	With Circuit Closing Relay and Direct Trip Attachment (5 Amps.)	Primary Current for Full Scale Deflection on Secondary Ammeter ‡
50	7	...	40†	...	...	50
75	11	...	65†	...	...	75
100	17	...	80	...	...	100
125	19	...	100	...	...	125
150	26	150†	120	150†	...	150
200	37	200	160	200	...	200
250	48	250	200	240	...	250
300	58	300	240	275	300†	300
400	78	400	320	370	400†	400
500	98	500	400	450	500†	500
600	118	600	480	525	600†	600

† Two transformers in series.
* 4-ampere tap. Breaker will trip at 125% of these values on 5-ampere tap.
‡ Requires special calibration.



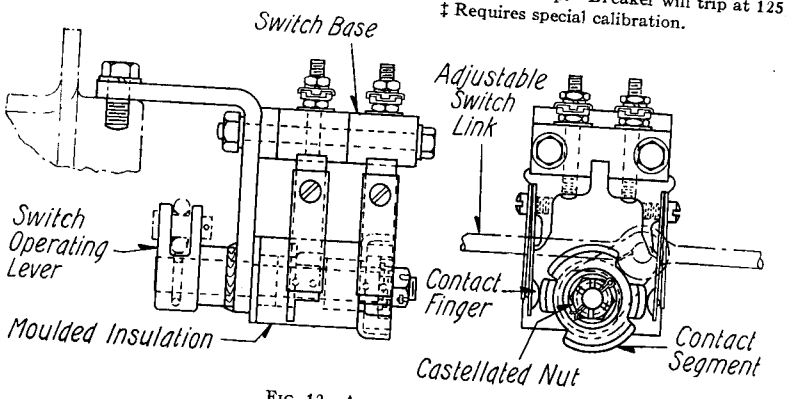


FIG. 12—AUXILIARY SWITCH

The contact segment can be varied in 15-degree steps by removing the castellated nut and shifting the segment one or more notches on the moulded insulation.

Operation Counter

The Operation counter is shown in Figure 16. It is only necessary to observe that the counter adds one unit for each operation of the breaker.

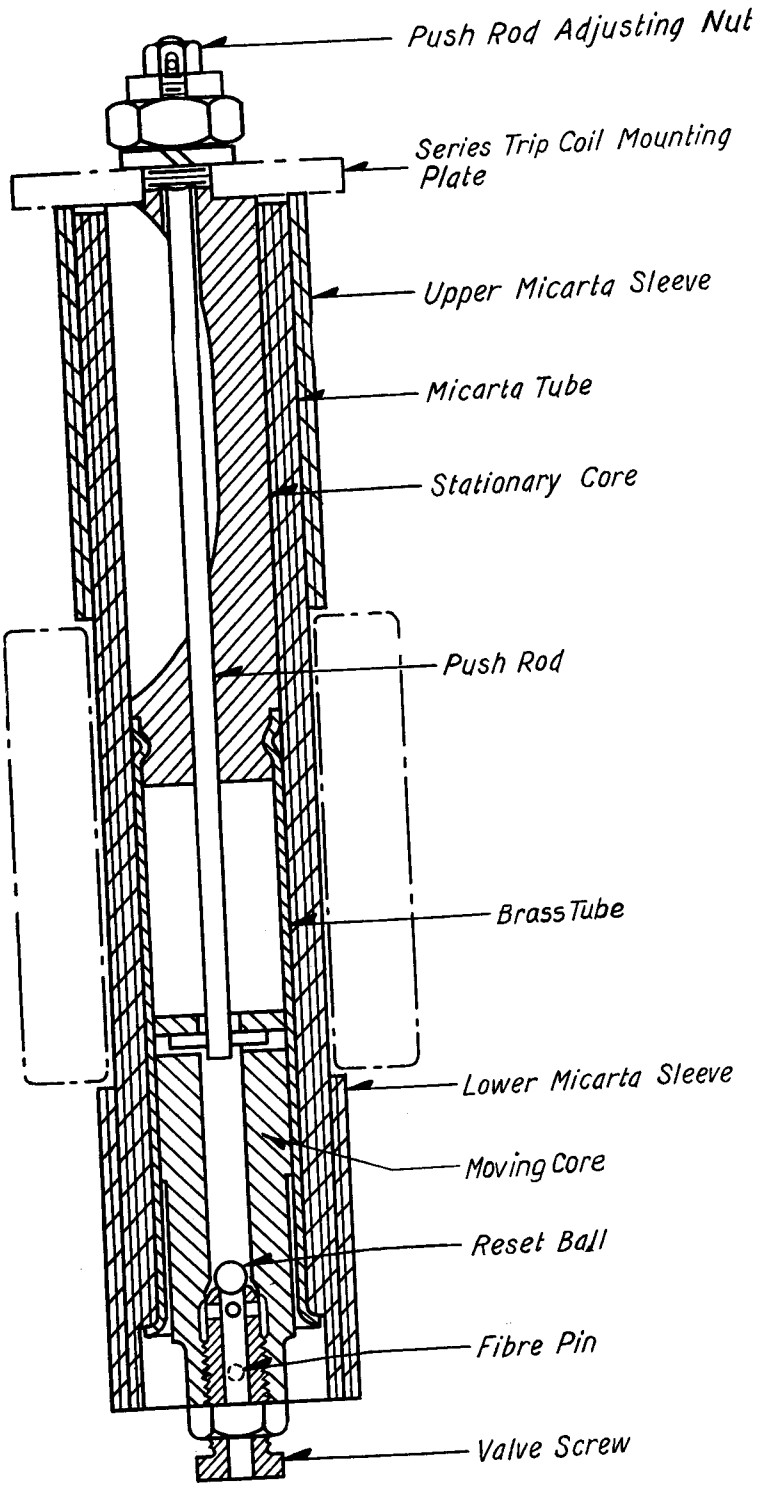


FIG. 13—SERIES TRIP ATTACHMENT

Series Trip Attachment

The series trip attachment mounts on the series trip coil mounting plate and is connected to the series trip mechanism as indicated in Figures 13 and 14.

The oil entrapped between the moving and stationary cores retards the upward motion of the moving core by a varying amount, depending upon the setting of the valve screw. The valve screw is not calibrated and the correct setting must be determined by test. The reset ball is for the purpose of allowing the moving core to reset with reasonable speed. During the downward motion of the moving core, the reset ball is forced from its seat and allows the oil to flow rapidly into the chamber between the moving and stationary cores.

The push rod adjusting nut is used to adjust the distance between the moving and stationary cores so that the various coils will pick up and trip the breaker at the same time. It is sometimes necessary to file the tops of the push rod so that the breaker trips during the last $\frac{1}{16}$ inch of the moving core travel, as the greatest power is developed when the moving and stationary cores are close together. When the coils are mounted at the factory, this adjustment is properly made and should not be disturbed.

The series coils should be set to trip at the desired current by removing the calibration rod cap, loosening the calibration rod clamp and screwing the calibration rod up or down until the proper marking is flush with the top of the calibration rod clamp. Be sure to tighten the clamp after adjustment. If a setting in between the actual markings is required, the actual markings can be interpolated with reasonable accuracy.

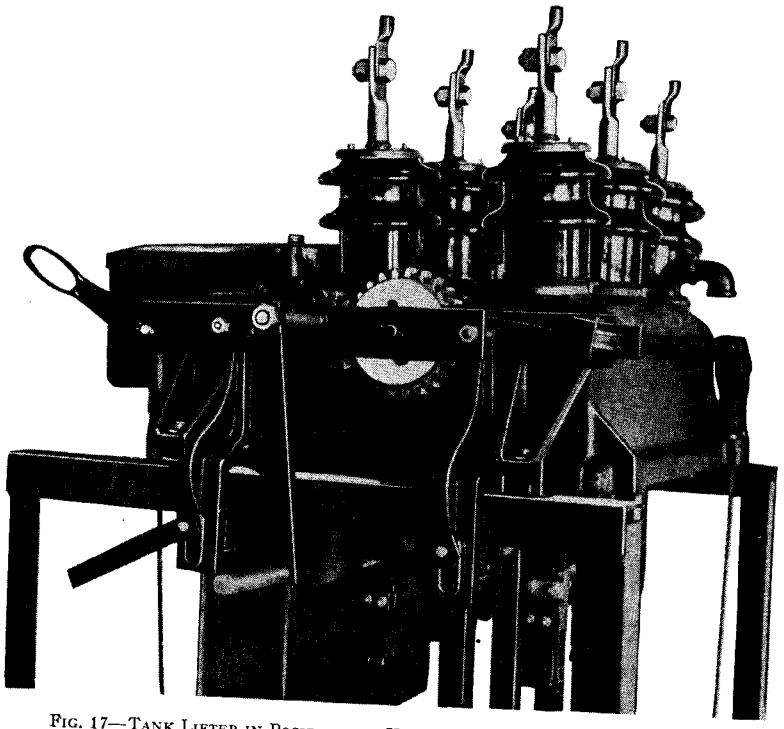


FIG. 17—TANK LIFTER IN POSITION FOR USE ON RIGHT HAND SIDE OF BREAKER

is returned to the tank. If the work merely involves lowering or removal of the tank, care should be taken to keep the tank covered until it is replaced so that dirt, dust, metallic particles, etc., cannot fall into the oil.

The above precautions may appear academic to those familiar with the maintenance and operation of oil circuit-breakers, but a little more than ordinary care in oil handling will be well repaid in reliable and dependable operation for which the breaker is designed and built.

For instructions as to the care and testing of insulating oil, see Instruction Book 5336.

Tank Lifter

Refer to Figs. 17, 18 and 19.

The tank lifter can be mounted on either the right or left hand side of the breaker, and can be used with either the small or the large tank.

As received, the lifter will be assembled for use on the **left** hand side of the breaker, and with the cable arranged for use with the large tank.

The lifter is mounted on the supporting frame-work as indicated in Figure 17. The two mounting brackets are to be located between the top casting mounting lugs, and the swivel bracket is to be extended behind the breaker unit to the opposite tank lug, into which the swivel bracket fits. It is necessary to remove the two tank bolts before using the lifter, as the lifting lugs fit into the tank lugs in place of the mounting bolts. The remaining two tank bolts can then be removed or replaced, depending upon whether the tank is being raised or lowered. The centerline of the lifting lug must be parallel to the tank side, as indicated in Fig. 18.

The tank lifter can be shifted sidewise on the supporting framework to eliminate any minor interferences that may exist.

If the tank lifter is to be mounted on the right hand side of the breaker, as shown in Fig. 17, remove the mounting bracket bolts and rotate the mounting brackets 180 degrees. The cable position should be as indicated in the following: (See Fig. 19).

1. Lifter on left hand side—Large tank —Cable run at "a", over pulley 1 and down to tank.
2. Lifter on left hand side—Small tank —Cable run at "c" around pulley 2 and down to tank.
3. Lifter on right hand side—Large tank—Cable run under pulley 2 to "b", over pulley 1 and down to tank.
4. Lifter on the right hand side—Small tank—Cable run at "d" around pulley 2 and down to tank.

The operating handle should always rotate in a clockwise direction, when raising the tank, in order that the dog may function properly.

The swivel bracket can be adjusted to the proper length by screwing it in or out on the pipe threads.

All bearing surfaces, gearing and cable should be kept well oiled.

Maintenance

The following points should be observed in maintenance.

1. Before making any adjustments, make sure that all lines are electrically dead.
2. Be sure the breaker frame is grounded.
3. Do not operate the breaker excessively with the operating mechanism when the tank is removed.
4. Examine all contacts frequently, especially after short-circuit. See that the contacts are properly aligned.
5. After making any adjustments, operate the apparatus carefully by hand to make sure that it operates smoothly and correctly.
6. Inspect the oil after severe faults. If it shows signs of moisture, carbonization or dirt, filter and retest it.
7. Remove all oil and thoroughly clean the tanks, tank liners, lift rods, terminal bushings, etc. at least once a year.
8. Occasionally inspect all spring cotters and bolt nuts.
9. Any pitting of the contacts should be smoothed, or, if badly burned, the contacts should be replaced.
10. Keep the bearing surfaces of the mechanism and breaker adequately oiled.

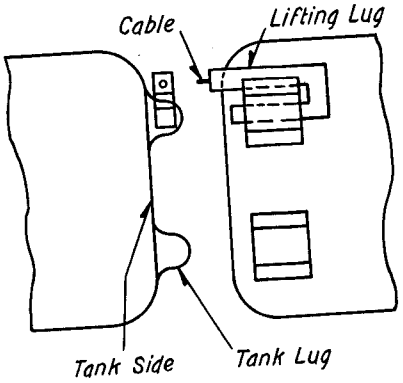
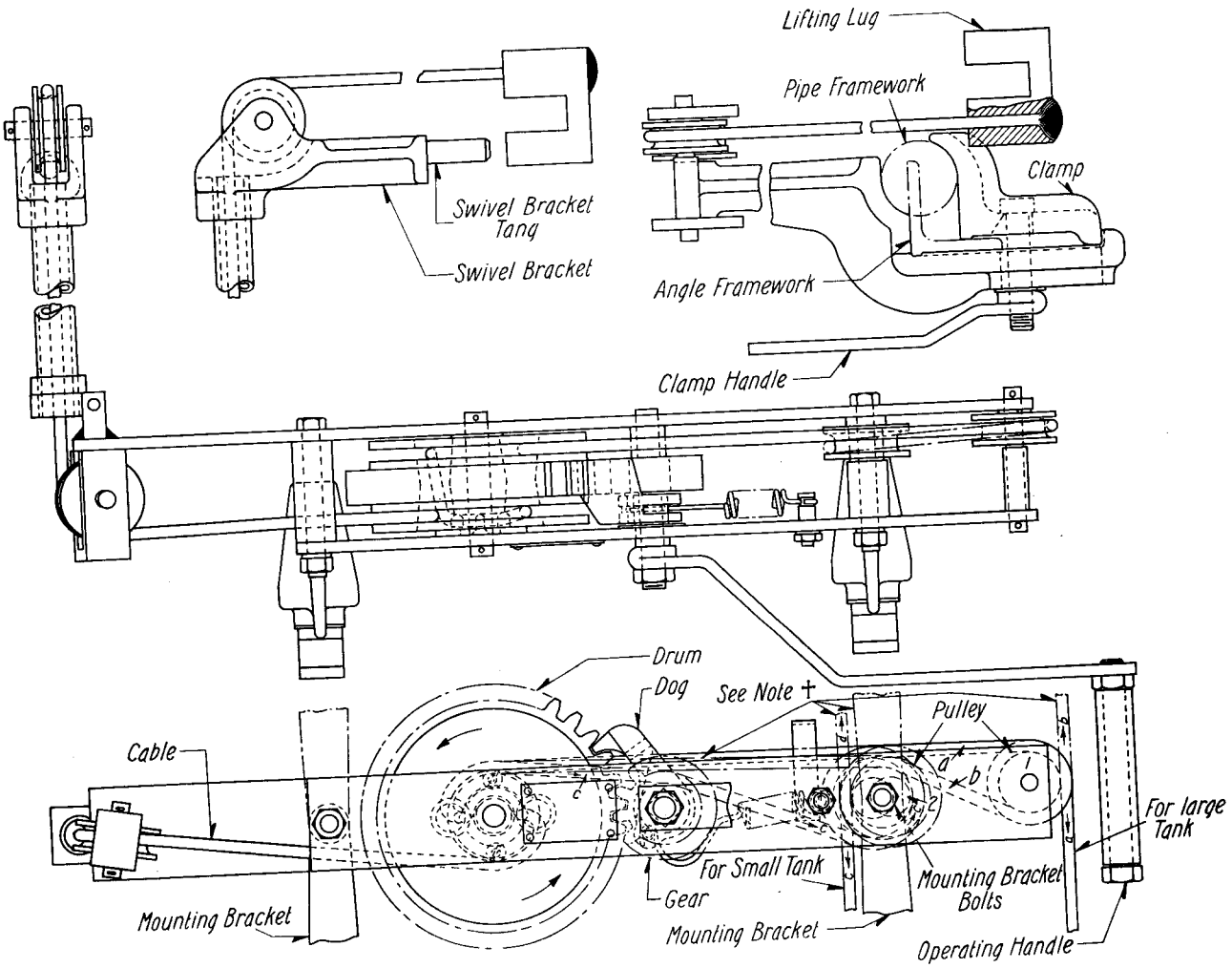


FIG. 18—METHOD OF ENGAGING TANK AND LIFTING LUGS



† Cable and brackets to be as shown in dot and dash lines when tank lifter is used on opposite side of breaker.

FIG. 19—TANK LIFTER ASSEMBLY

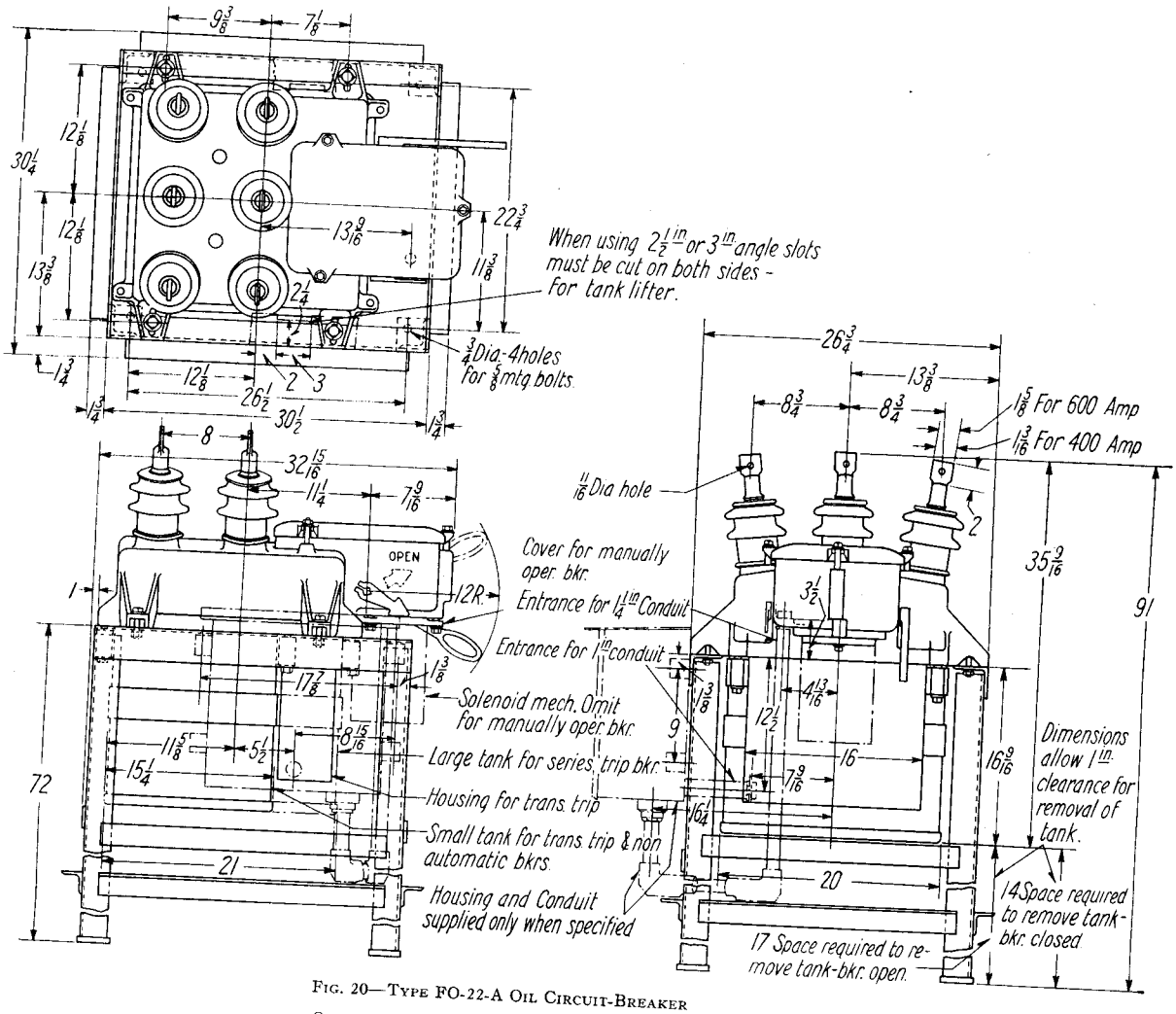


FIG. 20—TYPE FO-22-A OIL CIRCUIT-BREAKER
OUTLINE DRAWING——DIMENSIONS IN INCHES

RENEWAL PARTS DATA

Recommended Stock of Renewal Parts for

TYPE FO-22-A OIL CIRCUIT BREAKER

Outdoor Service

Manually or Electrically Operated—Automatic or Non-Automatic Trip

400—600 Amperes; 7500 Volts; 2- or 3-Pole; Single Throw

FOR ILLUSTRATION OF PARTS SEE FIGURES 4, 5, 6, 7, ETC.

The following is a list of the Renewal Parts and the quantities of each that we recommend should be stocked by the user of this apparatus to minimize interrupted operation caused by breakdowns. The parts recommended are those most subject to wear in normal operation or those subject to damage or breakage due to possible abnormal conditions. This list of Renewal Parts is given only as a guide. When continuous operation is a primary consideration, additional insurance against shut-downs is desirable. Under such conditions more renewal parts should be carried, the amount depending upon the severity of the service and the time required to secure replacement.

For Breakers in use up to and including	2-POLE			3-POLE			Style No. of Part
		1	5		1	5	
Name of Part	No. Per Breaker	Recommended for Stock		No. Per Breaker	Recommended for Stock		
Breaker Complete	..	..	..	1	0	0	... ...
Breaker Unit Complete	1	0	0	3	0	1	949 462
Moving Contact Complete	2	0	1	3	0	3	998 182
Lift Rod	2	0	2	3	0	1	944 187
Main Moving Contact	2	0	1	3	0	0	944 349
Main Moving Contact Spring	2	0	0	3	0	12	947 450
Moving Arcing Contact Bracket	2	4	8	6	6	6	969 731
Moving Arcing Contact	4	2	4	6	4	0	... ...
Moving Arcing Contact Spring	4	0	0	6	0	2	716 174
Stationary Contact Complete	4	0	2	6	0	2	949 478
Condenser Bushing—400 Amperes	4	0	2	6	0	6	1 017 077
Condenser Bushing—600 Amperes	4	2	4	6	2	12	947 450
Main Stationary Contact	4	4	8	6	6	2	947 454
Stationary Arcing Contact	4	0	2	6	0	0	712 239
Stationary Arc Shield	1	0	0	1	0	0	759 376
Oil Tank Complete	1	0	0	1	0	1	687 130
Oil Tank	3	0	1	3	0	0	... ...
Tank Liner	1	0	0	1	0	0	685 788
Breaker Operating Mechanism	1	0	0	1	0	1	949 464
Operating Lever	1	0	0	1	0	1	685 799
Auxiliary Retrieving Spring	1	0	0	1	0	0	1 017 079
Retrieving Spring	1	0	0	1	0	0	1 017 080
Main Lever—Right Hand	1	0	0	1	0	0	998 104
Main Lever—Left Hand	1	0	0	1	0	0	685 795
Trigger Lever	1	0	0	1	0	1	685 797
Trigger	1	0	0	1	0	0	570 112
Trigger Spring	1	0	0	1	0	0	998 128
Trigger Roller	1	0	0	1	0	0	1 017 078
Latch Lever	1	0	0	1	0	1	685 798
Latch	1	0	0	1	0	0	685 789
Latch Spring	1	0	0	1	0	0	†
Operating Shaft Dog	1	0	0	1	0	1	†
*†Closing Coil	1	0	1	1	0	1	†
*†Trip Coil	1	0	1	1	0	1	†
*†Overload Trip Coil	1	0	1	1	0	1	†
*†Direct Trip Coil	1	0	1	1	0	1	†
*†Undervoltage Release Coil	1	0	1	1	0	1	†

* Not listed on illustration.
† When ordering, specify identification number stamped on part.
Parts indented are included in the part under which they are indented.

ORDERING INSTRUCTIONS

When ordering Renewal Parts, always specify the name of the part wanted as shown on the illustrations in this Instruction Book, giving Shop Order Number, and the type of Oil Circuit Breaker, as shown on the nameplate. For example:

One Moving or Stationary Contact Complete, 600 Amperes, for Type FO-22-A Oil Circuit-Breaker, S.O. 33-F-737, shown in Instruction Book 5766, Fig. 4.

To avoid delays and misunderstandings, note carefully the following points:

1. Send all correspondence and orders to the nearest Sales Office of the Company.

2. State whether shipment is to be made by freight, express or parcel post. In the absence of instructions, goods will be shipped at our discretion. Parcel post shipments will be insured only on request. All shipments are at purchaser's risk.

3. Small orders should be combined so as to amount to a value of at least $1.00 net. Where the total of the sale is less than this, the material will be invoiced at $1.00.

WESTINGHOUSE BUSINESS ADDRESSES

Headquarters—306 4th Ave., Pittsburgh 30, Pa., P.O. Box 1017

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¶#†*ATLANTA 2, GA., 1299 Northside Drive, N. W., P.O. Box 4808
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†BALTIMORE 24, MD., 4015 Foster Ave.
xBALTIMORE 3, MD., 2519 Wilkens Ave.
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*BINGHAMTON 62, N. Y., Suite 704, Marine Midland Bldg., 86 Court St.
*BIRMINGHAM 3, ALA., 1407 Comer Bldg.
¶*BLUEFIELD, W. VA., Appalachian Elec. Power Co. Bldg., Room 620, 704 Bland St., P.O. Box 848
#BOSTON 10, MASS., 146 Summer St.
¶*BOSTON 10, MASS., 10 High St.
†BOSTON 27, MASS., 235 Old Colony Ave., So Boston, Mass.
¶*†BRIDGEPORT 8, CONN., 540 Grant St.
¶*BUFFALO 3, N. Y., 814 Ellicott Square Bldg.
#BUFFALO 2, N. Y., 445 Pearl St.
†BUFFALO 10, N. Y., 1132 Seneca St.
*BURLINGTON, VT., 208 Flynn Ave.
*BUTTE, MONTANA, 52 East Broadway
#BUTTE, MONTANA, 50 East Broadway
*CANTON 2, OHIO, 901 First National Bank Bldg., 120 W. Tuscarawas
xCANTON 4, OHIO, Canton Ordnance Division, P.O. Box 710
*CEDAR RAPIDS, IOWA, 361 21st St., S. E., P.O. Box 148
xCENTER LINE, MICH., 23500 Mound Road
*CHARLESTON, S. C., 89 G. Smith St., P.O. Box 303
*CHARLESTON 23, W. VA., 610 Union Bldg., P.O. Box 911
¶*†#CHARLOTTE 1, N. C., 210 East Sixth St.
*CHATTANOOGA 2, TENN., Volunteer State Life Bldg., Georgia Ave. & East Ninth St.
①¶*CHICAGO 6, ILL., 20 N. Wacker Drive, P.O. Box B Zone 90
†CHICAGO 9, ILL., 2211 W. Pershing Road, P.O. Box 1103 Zone 90
#CHICAGO 23, ILLINOIS, 3201 S. Kedzie Ave.
¶*†CINCINNATI 2, OHIO, 207 West Third St
①#CINCINNATI 12, OHIO, Mentor & Houston Ave.
xCLEVELAND 1, OHIO, 1216 W. Fifty-Eighth St.
¶*CLEVELAND 13, OHIO, The Standard Bldg., 1370 Ontario Street
†CLEVELAND 2, OHIO, 5901 Breakwater Avenue, Station A
#CLEVELAND 14, OHIO, 1748 E. 22 Street
*COLUMBUS 15, OHIO, 85 E. Gay St.
*DALLAS 1, TEXAS, 209 Browder St.
#DALLAS 2, TEXAS, 1712 Laws St.
*DAVENPORT, IOWA, 206 E. Second St., P.O. Box 29
*DAYTON 2, OHIO, 30 North Main St.
¶*DENVER 2, COLORADO, 910 Fifteenth St.
#DENVER 2, COLORADO, 1700 Sixteenth St.
†DENVER 4, COLORADO, 988 Cherokee St.
xDERRY, PA.
*DES MOINES 8, IOWA, 1400 Walnut St.
¶*†#DETROIT 31, MICH., 5757 Trumbull Ave., P.O. Box 828
¶*DULUTH 2, MINN., 10 East Superior St.
x#EAST PITTSBURGH, PA.
*EL PASO, TEXAS, Oregon and Mills St.
#EL PASO, TEXAS, 450 Canal St.
†*EMERYVILLE 8, CALIF., 5915 Green St.
#EMERYVILLE 8, CALIF., 6101 Green St.
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*HAMMOND, IND., 235 Locust St.
*HARTFORD 3, CONN., 36 Pearl St.
*HONOLULU, T. H., Hawaiian Elec. Co., Agt.
¶*HOUSTON 2, TEXAS, 1314 Texas Ave.
#HOUSTON 3, TEXAS, 815 Live Oak St.
#HOUSTON 2, TEXAS, 2301 Commerce Ave.
†HOUSTON 2, TEXAS, 2315 Commerce Ave.
¶†*#HUNTINGTON 1, W. VA., 1029 Seventh Ave., P.O. Box 1150
¶*INDIANAPOLIS 9, IND., 137 S. Penna. St.
†INDIANAPOLIS 2, IND., 551 West Merrill St.
*JACKSON, MICH., 212 West Michigan Ave.
①*JACKSON, MISS., 1011 Pecan Blvd.
*JACKSONVILLE 3, FLA., 37 South Hogan St., P.O. Drawer K
#JERSEY CITY, N. J., 415-421 Montgomery St.
#*†JOHNSTOWN, PA., 107 Station St.
¶*KANSAS CITY 6, MO., 101 W. Eleventh St.
#KANSAS CITY 8, MO., 2020-2024 Walnut Street, c/o Walnut Warehouse, Inc.
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LESTER 13, PA., Merchant Marine Plant, P.O. Box 9177, Phila., Pa.
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xLOUISVILLE 1, KY., P.O. Box 1860
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xMANOR, PA., Benolite Corporation
xMANSFIELD, OHIO, 246 E. Fourth St.
*MEMPHIS 3, TENN., 130 Madison Ave.
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¶*MILWAUKEE 2, WISC., 538 N. Broadway
†MILWAUKEE 3, WISC., 424 North Fourth St.
¶†*#MINNEAPOLIS 13, MINN., 2303 Kennedy St., N.E.
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*NASHVILLE 3, TENN., 219 Second Ave., N.
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¶z*PITTSBURGH 30, PA., 306 4th Ave., Box 1017
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5-46

Westinghouse

Type F-75 Oil Circuit-Breakers

600 Amperes, 15,000 Volts
1200 Amperes, 7,500 Volts
2000 Amperes, 5,000 Volts
} 2 or 3 Pole—Single Throw

INSTRUCTION BOOK

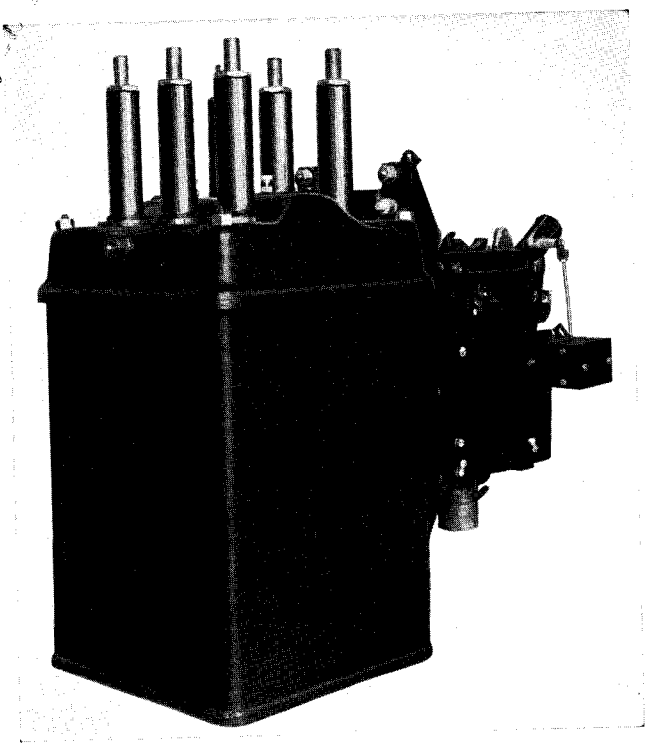


FIG. 1—TYPE F-75 OIL CIRCUIT-BREAKER, 15,000 VOLTS, 600 AMPERES, SOLENOID-OPERATED

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East Pittsburgh, Pa.

Printed in U.S.A. (Rev. 10-37)

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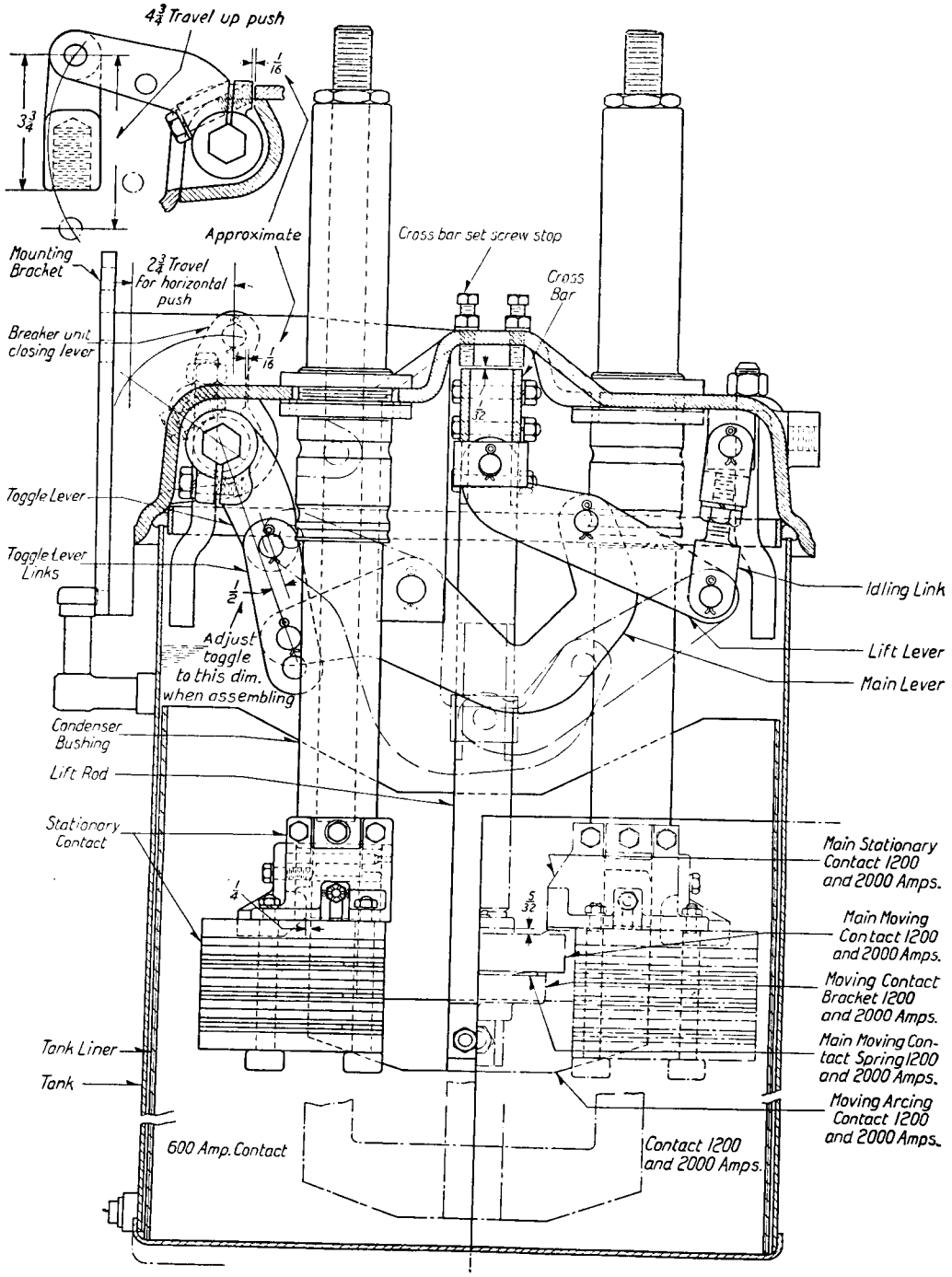


FIG. 2—CROSS SECTION OF TYPE F-75 OIL CIRCUIT-BREAKER

Westinghouse

Type F-75 Oil Circuit-Breakers

600 Amperes, 15,000 Volts
1200 Amperes, 7,500 Volts } **2 or 3 Pole—Single Throw**
2000 Amperes, 5,000 Volts

MANUALLY AND ELECTRICALLY OPERATED
(Lift-up, Cell, Frame or Truck Mounted)

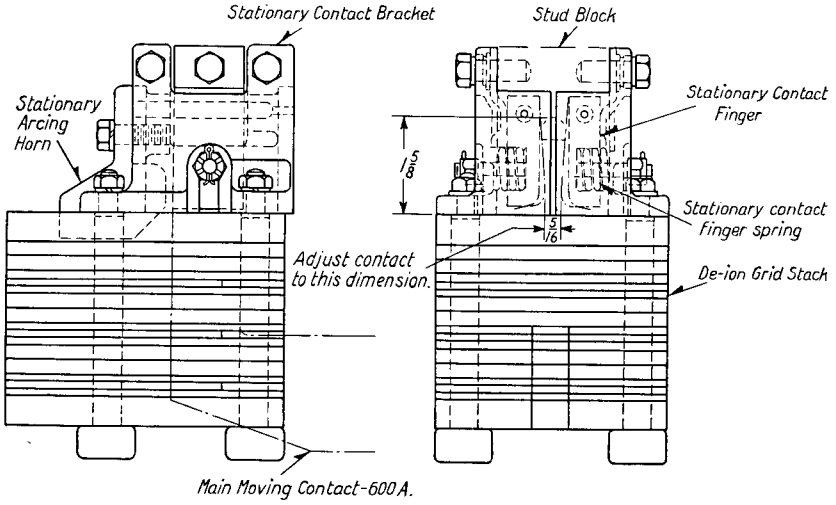


FIG. 3—DE-ION GRID ASSEMBLY, F-75, 600-AMPERE CIRCUIT-BREAKER

General Description

The F-75 oil circuit-breaker is a 3-pole, single throw breaker of non-oil-throwing design, with all poles contained in a single tank.

The breaker may be mounted in cells, trucks, on steel or pipe frames or as lift-up units. It is also adaptable to wall mounting for horizontal operation.

Electrical operation may be by solenoid when direct-current is available or by solenoid plus Rectox or motor mechanism when alternating-current is available. The breaker may also be operated manually.

This breaker is equipped with De-ion Grid contacts. Fig. 3. The arc interruption takes place in the De-ion Grid chambers supported from the terminals. This device consists of a series of insulating plates having interspersed plates of magnetic material, all so disposed and vented that the arc is moved laterally into all pockets where it vaporizes the oil. The resultant gases are then forced transversely through the conducting gases of the arc stream in such a manner as to deionize them and extinguish the arc.

Shipment

The breaker is shipped in the following manner:

1. Breaker and operating mechanism are assembled as a complete switching unit with the breaker tied in the closed position.
2. For remote control, the breaker and operating mechanism will be created separately.

Installation

1. Attach the breaker to the supporting structure, first making sure that the structure is level.
2. Remove the tank and examine the inside for evidence of moisture and foreign matter. Flush with benzine.
3. Remove the wire which holds the breaker in the closed position and allow the breaker to open slowly.
4. When the mechanism is mounted separately from the breaker, connect the breaker and operating mechanism, making sure that full contact is secured and that the breaker rests on the bumpers when open.
5. Examine the contacts and note that they are clean and in alignment. For adjustment, see Section covering Adjustment.
6. Operate the circuit-breaker by hand several times, watching each pole and the operating mechanism to be sure that all parts move freely.
7. Install connections to the breaker studs.
8. Insulate the connections with varnished cambric and non-elastic webbing in accordance with Westinghouse Standards for the various operating potentials. See Fig. 6.
9. Connect the vent pipe to the top of the venting valve. This pipe should be connected to the main venting header pipe, or outside the cell or truck in which the breaker is mounted. It should be so arranged that it will be impossible for rain or condensation to enter the piping. The piping should also be free of any pockets which would retard the drainage of any oil that might be discharged, back to the circuit-breaker.
10. With the tank removed, fill it with oil in accordance with name plate instructions or if more desirable, the oil can be added through a filling plug located in

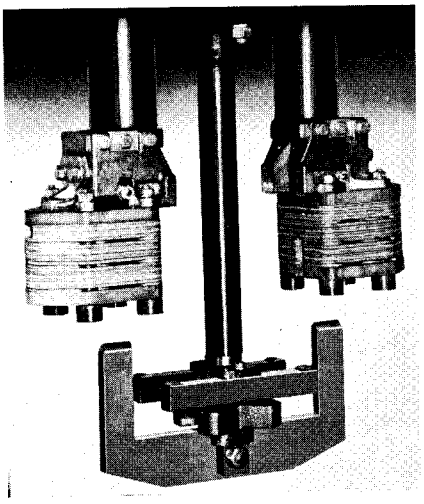


FIG. 4—DE-ION GRID CONTACT ASSEMBLY, TYPE F-75, 1200-AMPERE BREAKER

the breaker top after the tank has been bolted in place. Be sure to replace the filling plug and to see that tank is drawn up even and tight all around, otherwise oil may leak or be forced out.

11. See that the oil level is at the proper height as indicated by the oil gauge. Be sure the plug in the top of the gauge is removed. If this plug is not removed the oil will form an air trap and gauge will not indicate correctly. Replace the plug after securing the proper oil level.
12. Connect the breaker frame through one of the mounting bolts to ground. The National Electric Code requires grounding cable to have one-fifth of the main circuit capacity, except that it must never be smaller than No. 8 and need not be larger than No. 0, B. & S. gauge.
13. Check the operation of the breaker by operating it electrically in accordance with the instructions covering the mechanism used.

Adjustments

Breaker Mechanism—The toggle mechanism is non-reversible and non-adjustable. The proper setting is made at the factory and is such, that with the breaker in the closed position, there is a clearance of $\frac{1}{16}$ inch between the operating lever and the breaker top. The toggle is then ½ inch off center. See Fig. 2.

The clearance between the stop screws and the moving crossbar should be approximately $\frac{1}{32}$ inch. This adjustment can be made with the breaker in the closed position. Loosen the nuts and turn the stop screws until they touch the crossbar. Then back-off about ½ turn and lock.

CAUTION—Do not interchange links, levers or cross bars between breakers of different ampere capacities as certain parts are made of non-magnetic material. To interchange these parts may result in excessive heating.

The hydraulic bumper action is secured by reaction of the moving cross bar on the guide rods. This action is non-adjustable and requires no attention. Do not operate the breaker excessively without oil.

Contacts—The contact arrangement for 600-ampere capacity breaker is shown in Figs. 2, 3 and 5. The contacts are non-adjustable and are set properly at the factory. The distance between top of the De-ion grid top plate and the top of the moving contact should be $1\frac{5}{8}$ inches with breaker closed. This dimension is only for new parts. Some allowance must of course be made when the contacts burn.

When fitting new stationary contact fingers the adjustment should be so made that the distance between the fingers is $\frac{5}{16}$ inch. See Fig. 3. The fingers should also be adjusted symmetrically with respect to the slot in the grids.

The auxiliary contacts of the 1200 and 2000 ampere moving contact (Figs. 2 and 4) are adjustable by turning the bracket up or down on the lift rod. With the breaker in the closed position the distance between the contact cross bar and cross bar bracket should be $\frac{5}{32}$ inch. It is important that this dimension be maintained.

These contacts make silver to silver contact and it is unnecessary to use an abrasive to keep them bright. In fitting new contacts it is unnecessary that perfect line contact be obtained. With the soft material (silver) good contact is obtained after a few operations. If it is necessary to renew the silver surfaces, return the parts to the factory as the blocks of silver are put on with special solder.

The moving contacts are tipped with a special arc-resisting tungsten alloy to ensure long life. This can only be replaced at the factory.

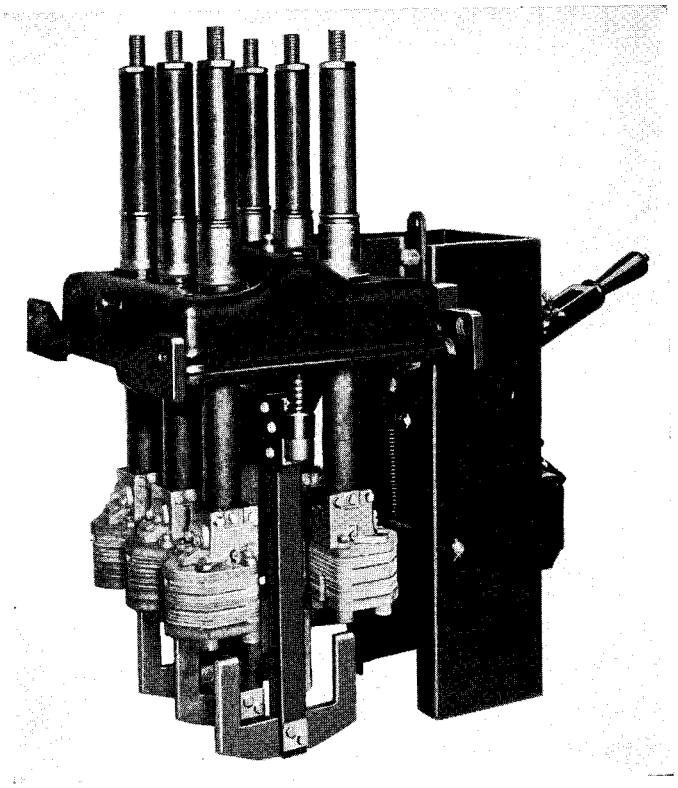


FIG. 5—TYPE F-75, 600-AMPERE, 15,000-VOLT, HAND-OPERATED OIL CIRCUIT-BREAKER. TANK REMOVED, SHOWING "DE-ION GRID" CONTACTS

De-ion Grid Stacks—It is important that the arrangement of the plates in the De-ion grids be correct. Should it be necessary to renew parts of the stacks, it is recommended that they be returned to the factory for repair or completely new assembled stacks supplied.

Connections to Operating Mechanisms—When the breaker unit and its operating mechanism are shipped separately, it is important that the operating rod between the two units be properly adjusted. The adjustment should be made, so that there is a full $\frac{1}{16}$ inch clearance between the operating lever and the breaker top, when the breaker is fully closed and latched. See Fig. 2.

The adjustment should also be made, so that the opening shock is absorbed on the bumpers and not on the operating mechanism.

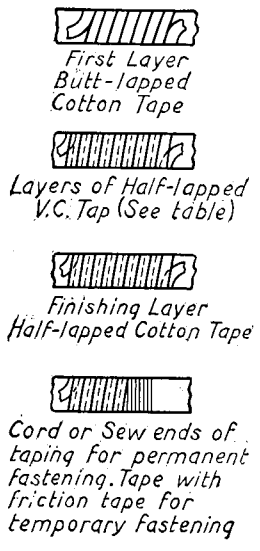
Terminal Bushing—The surface of the bushing insulation should be smooth and well varnished. If the varnished surface is damaged or questionable, it should be smoothed off with fine sand paper and revarnished with three coats of good quality, clear, air drying Spar varnish. Each coat should be allowed to dry for 24 hours.

Maintenance

Points to be Observed in Maintenance

1. Before making any adjustments to oil circuit-breakers, make sure that all lines leading to them are electrically dead.
2. Be sure that the breaker frame is grounded.
3. Do not operate the breaker excessively by the operating mechanism when the oil tanks are removed.
4. Examine all contacts frequently, especially after severe short-circuits. See that the contacts are aligned properly.
5. After making any adjustments, operate the apparatus carefully by hand to make sure that it operates smoothly and correctly.
6. When testing, coat the contacts with a thin film of vaseline.
7. Inspect the oil regularly and after severe short-circuits. If it shows signs of moisture, carbonization or dirt, filter and retest it, before replacing it in service. See that the oil level in the tanks is maintained at the proper height.
8. Remove all oil and thoroughly clean the tanks, tank liner, lift rod, terminal bushings, etc., at least once a year.
9. Occasionally inspect and tighten clamping nuts around the bushing on top of the breaker.
10. Arrange for regular inspection to see that the apparatus is in adjustment as explained.

Insulating Oil—Dielectric tests of the oil should be made every three months, to show that it is reasonably good for circuit-breaker work. Samples should not be taken until the oil has remained undisturbed for at least four hours. In testing for indication of water, take the sample from the bottom through the tank drain. If for indication of carbon, and after a heavy short-circuit, take the sample from the surface of the oil.



Service Volts	Layers of Varnished Cambric Tape
2500	4
4000	5
4500	6
6600	7
7500	8
15000	13

Wrap the conductor with butt-lapped layer of ".007 white cotton tape and cover with one coat of No. 9 insulating varnish (Westinghouse Catalog No. 311.) Then wrap with half-lapped layers of ".010 varnished cambric tape (Westinghouse No. 1225 Tan Treated Cloth) applying as many layers as given in the above table. Apply a coat of No. 9 insulating varnish (Westinghouse No. 311) between layers. Tape over the cambric with one layer of ".007 cotton tape and wrap the ends with cord to keep them in place. Finish with two coats of M-1736 black insulating varnish (Westinghouse Catalog No. 414.)

FIG. 6—INSTRUCTIONS FOR TAPING CONNECTIONS

Care of Circuit-Breaker Oil—The care of the insulating oil in circuit-breakers is of the utmost importance in their successful operation. Contamination by dirt, moisture, metallic particles, lint, etc., all reduce the dielectric strength, upon which the operation and current interrupting ability largely depend. Consequently, the most careful attention should be given to keeping the oil clean, not only in filling the tanks originally but in later maintenance or other work on the breakers which might involve opening the tanks.

Only the highest grade, such as Wemco "C" or other approved oil should be used in the breakers. The oil should be new or at least thoroughly reconditioned by means of a filter press or centrifuge. In any case, before using, it should be given a dielectric test which should show a minimum of 22,000 volts (preferably 25,000 to 30,000) measured between 1-inch diameter discs spaced .1 inch apart.

Before filling, the tanks should be thoroughly cleaned and flushed out with insulating oil. The same treatment should be given the inside of the top of the breaker and the operating linkage and contact system. In doing this, rags which will leave lint should not be used as this absorbs and holds moisture.

The same care should be used during inspection or maintenance work on the breaker, which should preferably be done only under favorable weather conditions. If the oil is to be reconditioned following operation of the breaker under short-circuit, the tank, and entire inside of the breaker should be cleaned before the oil is returned to the tank. If the work merely involves lowering or removal of the tank, care should be taken to keep the tank covered until it is replaced so that dirt, dust metallic particles, etc., cannot fall into the oil.

The above precautions may appear academic to those familiar with the maintenance and operation of oil circuit-breakers, but a little more than ordinary care in oil handling will be well spent in reliable and dependable operation for which the breaker is designed and built.

For instructions as to the care and testing of insulating oil, see Instruction Book 5336.

Operating Mechanisms—For instructions covering the SA-3 solenoid mechanism, see Instruction Book 5567. For instructions covering the type CFO motor mechanism, see Instruction Book 5334. For instructions covering Rectox unit see Instruction Leaflet 1782.

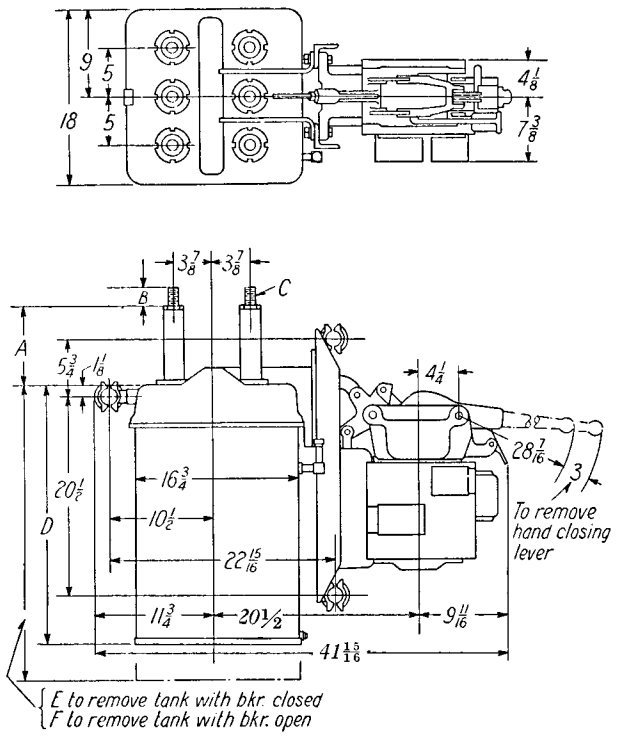


FIG. 7—OUTLINE OF F-75 SOLENOID-OPERATED OIL CIRCUIT-BREAKER.

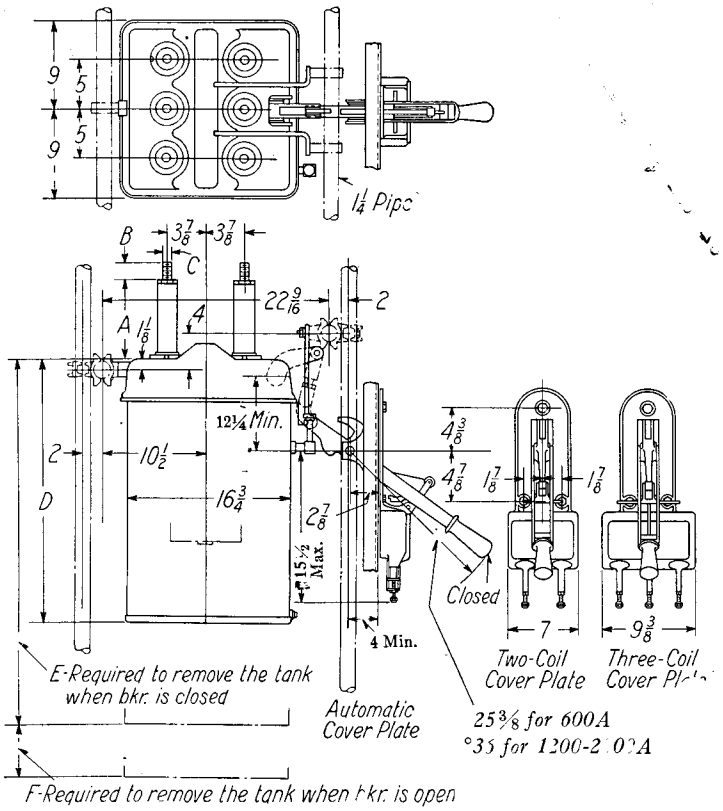


FIG. 8—OUTLINE OF F-75 HAND-OPERATED OIL CIRCUIT-BREAKER.

Type	Kv.	Amps.	DIMENSIONS IN INCHES A	B	C	D	E*	F*
F-75	15.0	600	8 5/16	1⅞	1-14 Thds.	27⅛	†48¼	50¼
F-75	7.5	1200	6¾	3	1½-12 Thds.	27⅛	†48¼	50¼
F-75	5.0	2000	5¼	3½	2-12 Thds.	27⅛	†48¼	50¼

* These dimensions allow one-inch clearance for removal of tank.
Dimensions are for reference only. For official dimensions apply to nearest district office.
† Where tank can be shifted 4 inches sideways or tilted in removing, 43¼ inches may be used.
° Removable hand closing lever.

See Figs. 12-13 of Descriptive Data 33-560.

RENEWAL PARTS DATA

Recommended Stock of Renewal Parts for

TYPE F-75 OIL CIRCUIT-BREAKERS

600, 1200 or 2000 Amperes—15,000, 7,500 or 5,000 Volts; 2 or 3-Pole; Single Throw

FOR ILLUSTRATION OF PARTS, SEE FIGURES 2 AND 3

The following is a list of the Renewal Parts and the quantities of each that we recommend should be stocked by the user of this apparatus to minimize interrupted operation caused by breakdowns. The parts recommended are those most subject to wear in normal operation or those subject to damage or breakage due to possible abnormal conditions. This list of Renewal Parts is given only as a guide. When continuous operation is a primary consideration, additional insurance against shut-downs is desirable. Under such conditions more renewal parts should be carried, the amount depending upon the severity of the service and the time required to secure renewals.

Breakers in use up to and including	2-POLE			3-POLE			Style Number
		1	5		1	5	
Description	No. Req.	Recommended for Stock		No. Req.	Recommended for Stock		
Breaker Complete	1	0	0	1	0	0	... ...
Breaker Unit Complete	1	0	0	1	0	0	... ...
Moving Contact Complete	1	0	0	1	0	0	... ...
Accelerating Spring	2	0	1	2	0	1	809 985
Lift Rod—600 Amperes	2	0	1	3	0	1	850 329
Lift Rod—1200 Amperes	2	0	1	3	0	1	850 331
Lift Rod—2000 Amperes	2	0	1	3	0	1	850.335
Moving Contact—600 Amperes	2	0	1	3	0	1	850 330
Main Moving Contact—1200 Amperes	4	0	2	6	0	2	850 333
Main Moving Contact—2000 Amperes	4	0	2	6	0	2	850 337
Main Moving Contact Bracket—1200 Amperes	2	0	0	3	0	0	881 670
Main Moving Contact Bracket—2000 Amperes	2	0	0	3	0	0	850 336
Main Moving Contact Spring—1200/2000 Amperes	8	1	4	12	1	4	841 729
Moving Arcing Contact—1200/2000 Amperes	2	0	1	3	0	1	850 334
Stationary Contact Complete	4	0	0	6	0	0	... ...
Condenser Bushing—600 Amperes, Standard	4	0	2	6	0	2	825 644
Condenser Bushing—600 Amperes, Lift-Up	4	0	2	6	0	2	841 629
Condenser Bushing—1200 Amperes, Standard	4	0	2	6	0	2	1019 393
Condenser Bushing—1200 Amperes, Lift-Up	4	0	2	6	0	2	825 676
Condenser Bushing—2000 Amperes, Standard	4	0	2	6	0	2	948 926
Condenser Bushing—2000 Amperes, Lift-Up	4	0	2	6	0	2	841 683
Main Stationary Contact—2000 Amperes	4	0	2	6	0	2	850 338
Starting Contact	4	0	0	6	0	0	... ...
Main Stationary Contact—1200 Amperes, R. H.	4	0	2	6	0	2	809 989
Main Stationary Contact—1200 Amperes, L. H.	4	0	2	6	0	2	809 988
De-ion Grid Stack—600/1200 Amperes	4	0	2	6	0	2	1041 954
De-ion Grid Stack—2000 Amperes	8	8	16	12	12	24	948 919
Stationary Contact Finger	8	1	4	12	1	4	834 159
Stationary Contact Finger Spring	4	4	8	6	6	12	841 665
Stationary Arcing Horn	1	0	0	1	0	0	850 328
Oil Tank Complete—600/1200 Amperes	1	0	0	1	0	0	850 325
Oil Tank Complete—2000 Amperes	1	0	0	1	0	0	850 326
Oil Gauge	3	0	1	3	0	1	948 931
Tank Liner	1	0	0	1	0	0	850 327
★Type SA-3 Solenoid Oper. Mechanism	1	0	0	1	0	0	See I.B. 5567
★Closing Coil	1	0	0	1	0	0	*
★Trip Coil	1	0	1	1	0	1	*
★Type CF-O Motor Operated Mechanism	1	0	0	1	0	0	See I.B. 5334
★Rectox Unit	1	0	0	1	0	0	*

★Not Illustrated.
* When ordering, specify Number Stamped on part.
Parts indented are included in the part under which they are indented.

ORDERING INSTRUCTIONS

When ordering Renewal Parts, always specify the name of the part wanted as shown on the illustrations in this Instruction Book, giving Shop Order Number, and the type of Circuit-Breaker as shown on the nameplate. For Example:

One Moving or Stationary Contact Complete, 600 Amperes, for Type F-75 Circuit-Breaker, S.O. 6-Y-470, shown in Instruction Book 5789, Figure 2.

To avoid delays and misunderstandings, note carefully the following points:

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2. State whether shipment is to be made by freight, express or parcel post. In the absence of instructions, goods will be shipped at our discretion. Parcel post shipments will be insured only on request. All shipments are at purchaser's risk.

3. Small orders should be combined so as to amount to a value of at least $1.00 net. Where the total of the sale is less than this, the material will be invoiced at $1.00.

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October 1937

579

Westinghouse

Type F-124 Oil Circuit-Breakers

600 Amperes, 15,000 Volts
1200 Amperes, 7500 Volts

INSTRUCTION BOOK

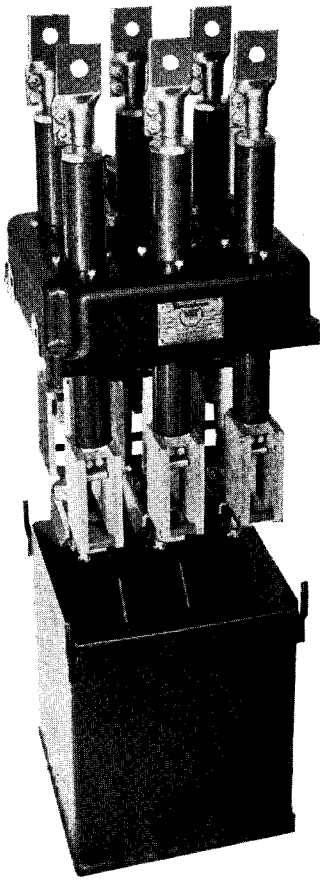


FIG. 1—TYPE F-124 OIL CIRCUIT-BREAKER UNIT, 600 AMPERES, 15,000 VOLTS

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Westinghouse Electric & Manufacturing Company

East Pittsburgh Works — **East Pittsburgh, Pa.**

I. B. 5767-A
(Filing No. 33-000)

Printed in U.S.A. (Rev. 3-40)

Westinghouse

Type F-124 Oil Circuit-Breakers

600 Amperes, 15,000 Volts—1200 Amperes, 7500 Volts
2- or 3-Pole
Manually or Electrically Operated

RETURN TO ENGINEERING DIVISION BUFFALO OFFICE WESTINGHOUSE ELEC. & MFG. CO.

General Description

The Type F-124 Oil Circuit-Breaker is a low interrupting capacity breaker embodying the desirable features of larger breakers, including internal mechanism, condenser bushings, heavy butt type contacts, "De-ion Interruptors" and silver-to-silver main contacts.

This breaker has a large factor of safety in interrupting capacity, having been thoroughly tested in the testing laboratories at East Pittsburgh. The "De-ion Interruptor" assures speedy and positive operation with minimum disturbance.

The contacts are of large cross section, to withstand long service without renewal. The silver-to-silver contact eliminates the formation of high resistance contact due to copper oxide.

The breaker will give excellent service with a reasonable amount of care. The instructions which follow should be used as a guide in servicing this breaker.

Shipment

The breaker may be shipped as follows:

1. Breaker and solenoid mechanism assembled as a complete switching unit with the breaker blocked in the closed position.
2. Breaker and solenoid mechanism crated separately and marked for easy identification.
3. Breaker and manual mechanism crated separately and marked for easy identification.

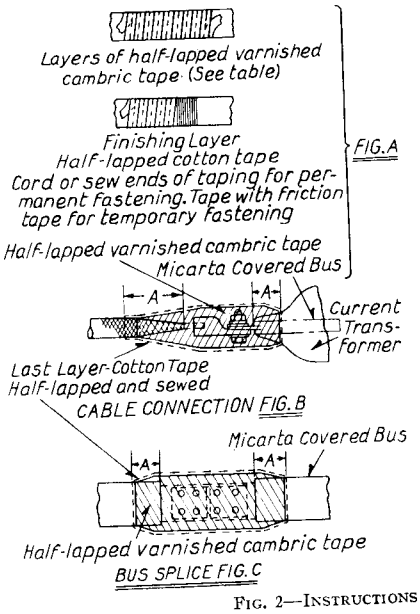
Unpacking

Care should be used in unpacking the circuit-breaker, so that small parts are not damaged. Extra precautions should be taken to make certain the bushings are not damaged.

A careful inspection should be made to insure that no parts have been broken or damaged during shipment. In case of damage the proper claims should be made to the transportation company.

Installation

1. Attach the breaker to the supporting structure, first making sure that the structure is level. Use the outline drawing for the correct dimensions in mounting these circuit-breakers.
2. Remove the tank and examine the inside for evidence of moisture and foreign matter. Flush with insulating oil.
3. Connect the breaker to the operating mechanism. Remove the steel rod which holds the breaker in the closed position and allow the breaker to open slowly.
4. Examine the contacts and note that they are clean and in alignment. For adjustment see section covering "Adjustment."
5. Operate the circuit-breaker by hand several times, watching each pole and the operating mechanism to be sure all parts move smoothly and freely.
6. Adjust the connections between the breaker and operating mechanism so that full contact is obtained and the breaker rests on the bumpers when in the open position.
7. Install connections to the breaker studs.
8. Insulate the connections with varnished cambric and non-elastic cotton tape in accordance with Westinghouse Standards for the various operating potentials. See Fig. 2.
9. With the tank removed, fill with Wemco "C"oil as directed on the breaker name plate.
10. Bolt the tank in place, being sure that it is drawn up evenly all around.
11. Connect the breaker frame, through one of the mounting bolts, to ground. The National Electric Code requires grounding



The following instructions should be followed in taping all main connections on circuit-breakers, trucks and switchhouses. In order to obtain maximum safety of the equipment do not fail to complete taping before putting into service.

Service Voltage	Layers of Varnished Cambric Tape	"A" Creepage Inches
750	3	1
2500	4	1
4000	5	1
4500	6	1½
6600	7	1½
7500	8	1½
13200	12	1½ to 2
15000	13	1½ to 2

Wrap with half-lapped layers of ".010 varnished cambric tape (Westinghouse No. 1225 Tan Treated Cloth) applying as many layers as given in the above table. Apply a coat of No. 9 insulating varnish (Westinghouse No. 311) between layers. Tape over the cambric with one layer of ".007 cotton tape and wrap the ends with cord to keep them in place. Finish with two coats of M-1736 black insulating varnish (Westinghouse No. 414).

FIG. 2—INSTRUCTIONS FOR TAPING CONNECTIONS

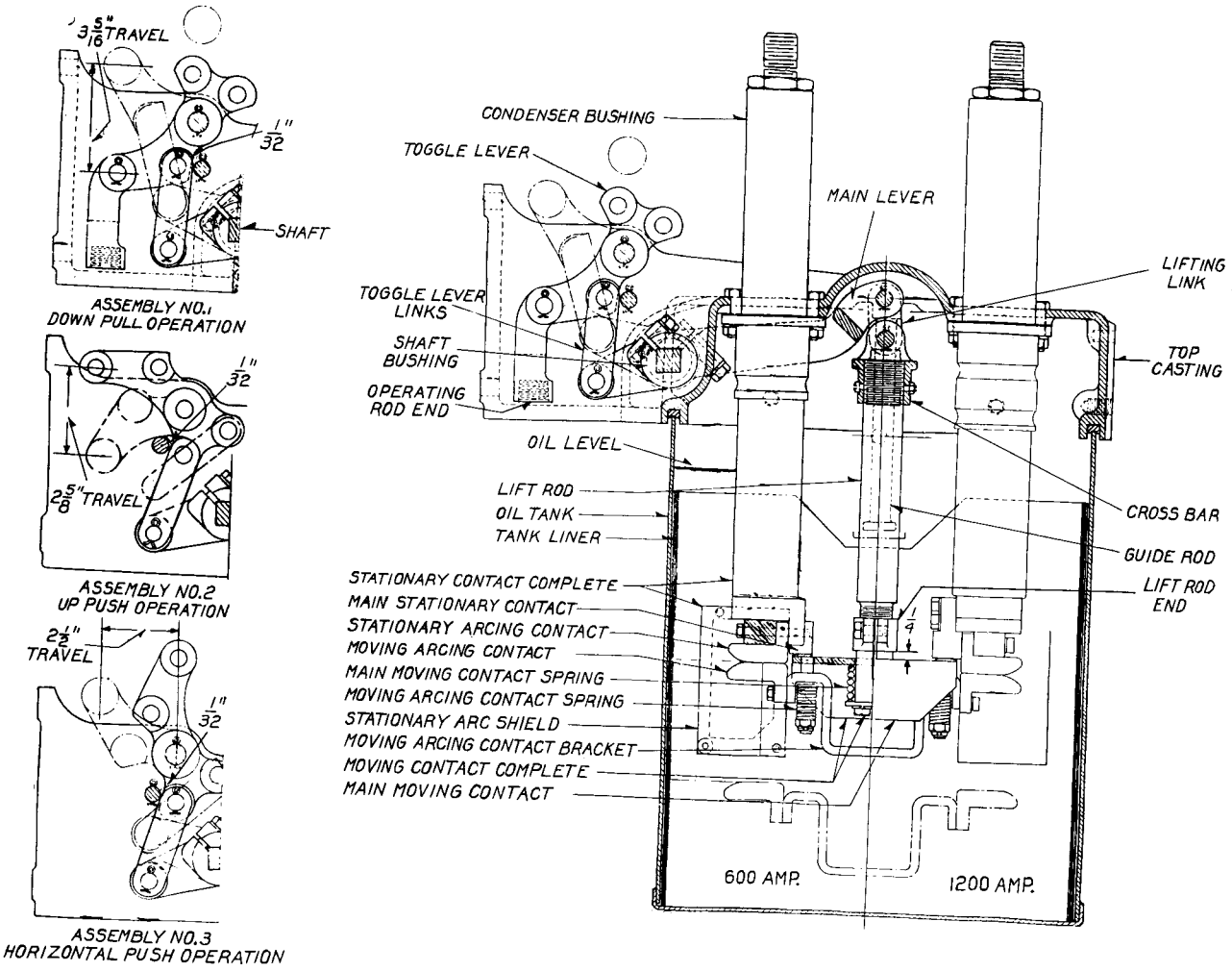


FIG. 3—BREAKER POLE UNIT—SIDE VIEW—CROSS SECTION

cable to have one-fifth of the main circuit capacity except that it must never be smaller than No. 8 and need not be larger than No. 0, B. & S. gauge.

Adjustments

Breaker Mechanisms—The toggle mechanism is designed for reversible operation, so that the direction of operation can be changed by a simple change in the position of the toggle lever and toggle lever links. Three assemblies are shown in Fig. 3. To change from one direction of operation to the other the toggle lever and links are assembled as shown. The clearance between the operating links and the stop pin should be approximately $\frac{1}{32}$-inch in either case, when the contacts are in full contact.

The breakers are assembled for "up push" operation as standard (assem. 2). See Fig. 3. For remote manual operation reverse the toggle for "down pull" operation (assem. 1). Check the $\frac{1}{4}$-inch contact dimension described under "Contacts", and adjust if necessary.

Two guide rods, Figs. 3 and 4, are used to align the moving contacts and guide the contacts for straight line motion. The cross bar must move up and down freely on these rods. The lower end of the guide rods and the lower surface of the moving cross bar cooperate to form hydraulic bumpers. No adjustment is necessary, other than to be sure the moving contacts open to the full position. **Do not operate the breaker excessively without oil.**

Contacts—The contact arrangement is shown in Fig. 3. The main and arcing contacts are both of the butt type, the $\frac{1}{4}$-inch lead of the arcing contacts being maintained by the thickness of copper on the arcing tips, while the contact pressure on the main contacts is obtained by a compression spring. With the breaker closed the main contact should be $\frac{1}{4}$-inch below the shoulder on the lift rod end. If necessary to adjust, the moving arcing contacts together with connecting bracket should be removed, the lift rod end loosened and the contact assembly screwed up or down as necessary.

It is important that the $\frac{1}{4}$-inch dimension is maintained as this determines the contact pressure on the main contacts.

The main contacts make silver-to-

silver contact and it is therefore unnecessary to use an abrasive to keep them clean. The oxide of silver does not increase the contact drop, consequently the temperature of the contacts will not progressively increase as is the case with plain copper contacts. In fitting new contacts it is unnecessary that perfect line contact be obtained. With the comparatively soft material (silver) good contact is obtained after a few operations, as the silver flows slightly under pressure.

If the silver contacts on the moving contacts are replaced, use solder of at least 300° C. melting point. **Use only "pure silver", coin silver is unsatisfactory.**

"De-ion Interruptors"—The "De-ion Interruptors" control the arc and quickly extinguish it by de-ionization. These devices need little attention other than an occasional inspection. They must be kept securely tightened and properly aligned so that the moving contacts move freely and do not rub causing excessive friction. The fibre insulation is affected very little by the arc action but should be inspected occasionally and replaced if excessive deterioration is found.

Terminal Bushings—The surface of the bushing insulation should be smooth and well varnished. If the varnished surface is damaged it should be smoothed with fine sandpaper and re-varnished with three coats of good quality, clear, air-drying spar varnish. Each coat should be allowed to dry for 24 hours.

Coverplates

The general construction of the coverplates is shown in Figs. 5 and 6. The handle and tripping levers are a part of the coverplate. The operating levers travel through an angle of approximately 71 degrees.

The operating handle consists of an outside handle lever carrying the trigger which engages with the inside tripping lever to which the breaker unit is fastened. The handle lever is held in the closed position by a latch located on the coverplate. When the moving core is drawn upward by the tripping coil, the push rod, which is fastened to the moving core, strikes the handle lever trigger and frees the tripping lever, thus allowing the breaker to open. Pushing the handle lever button, disengages the

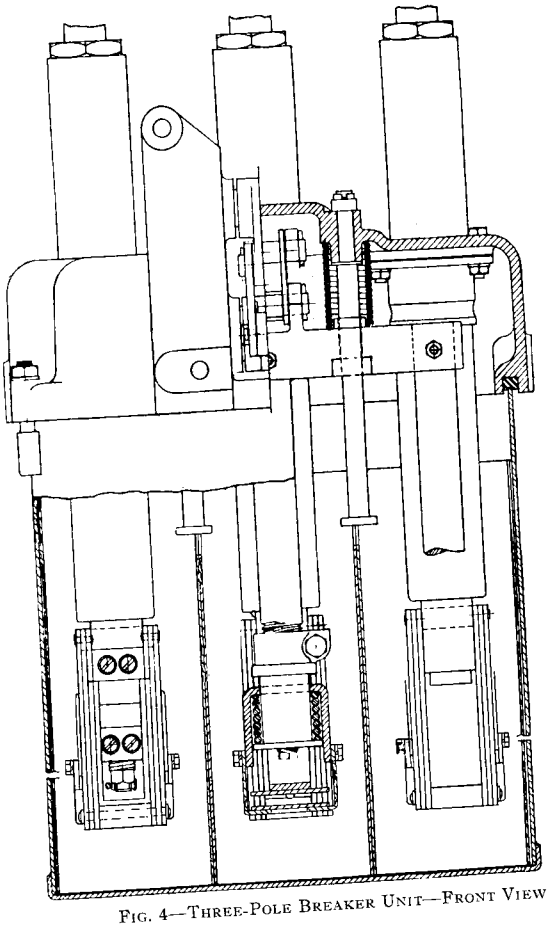


FIG. 4—THREE-POLE BREAKER UNIT—FRONT VIEW

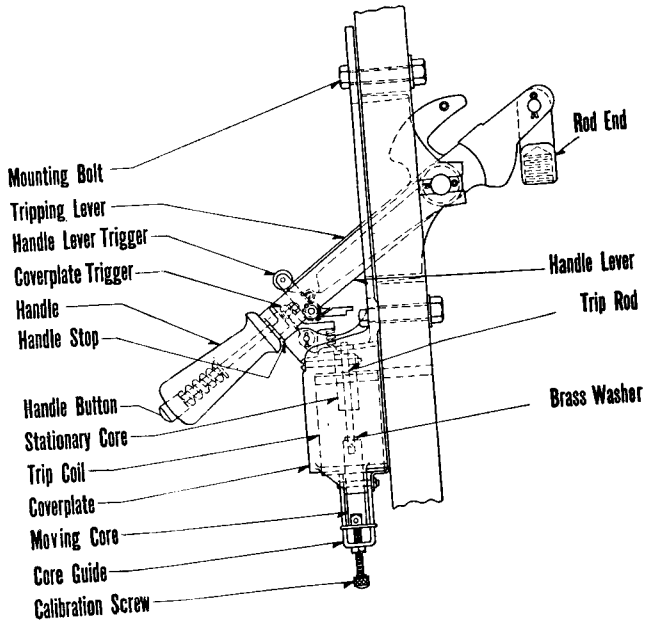


FIG. 5—SINGLE HANDLE COVERPLATE

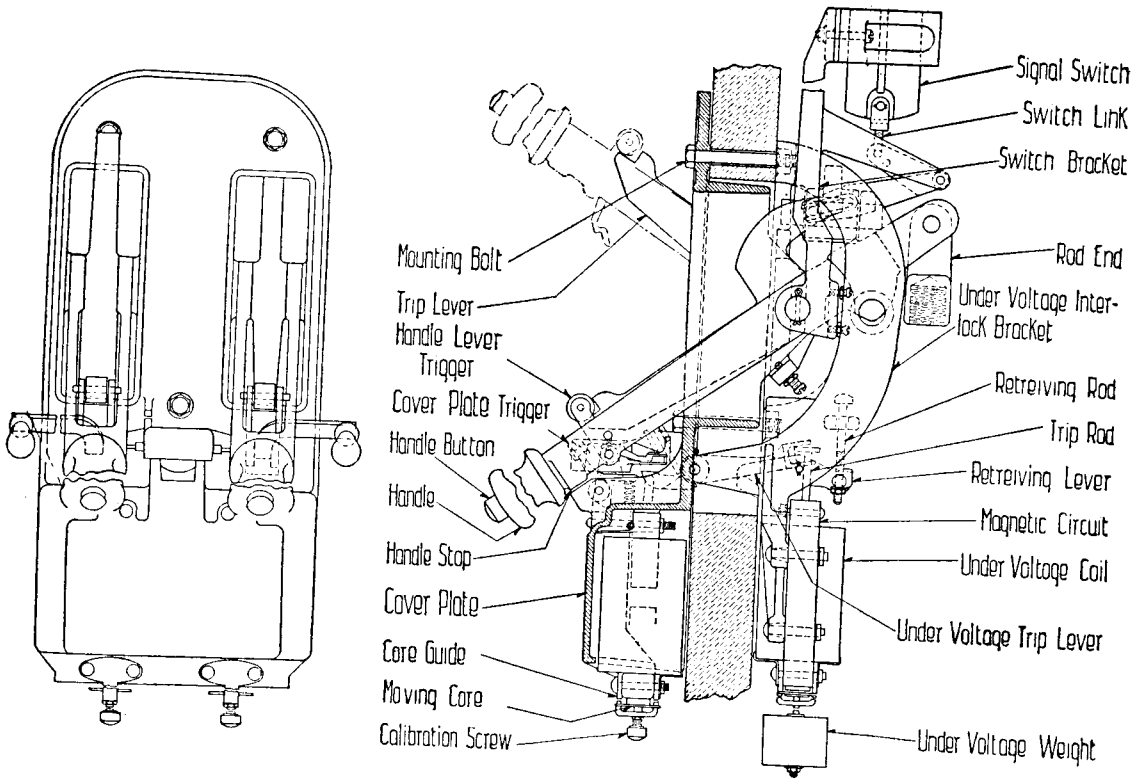


FIG. 6—DOUBLE HANDLE COVERPLATE

coverplate trigger and permits the raising of the handle lever to re-engage the tripping lever.

For automatic tripping, the handle lever trigger should disengage the tripping lever just before the moving core strikes the stationary core.

The current required to trip the breaker can be varied from 100 to 180% of coil rating. The various settings being obtained by raising or lowering the moving core, by means of the calibration screw, until the plate on the bottom of the moving core coincides with the required ampere setting on the moving core guide. The calibration markings are given in secondary amperes required to trip the breaker and are approximate only.

When two or more breakers are used as a double-throw breaker, as for the starting and running throws of a motor-starting combination, the double-handle coverplate shown in Fig. 6 is used. The construction and operation are identical with the above.

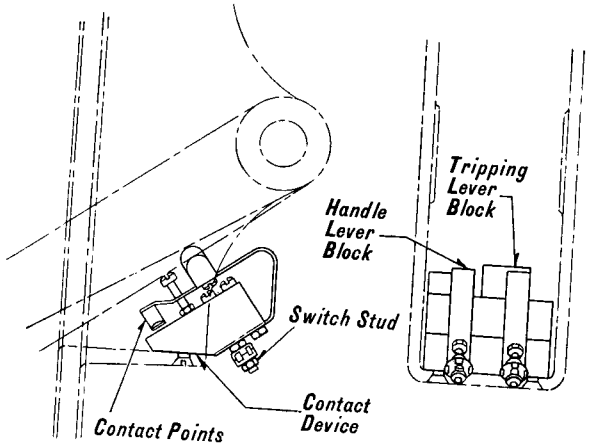
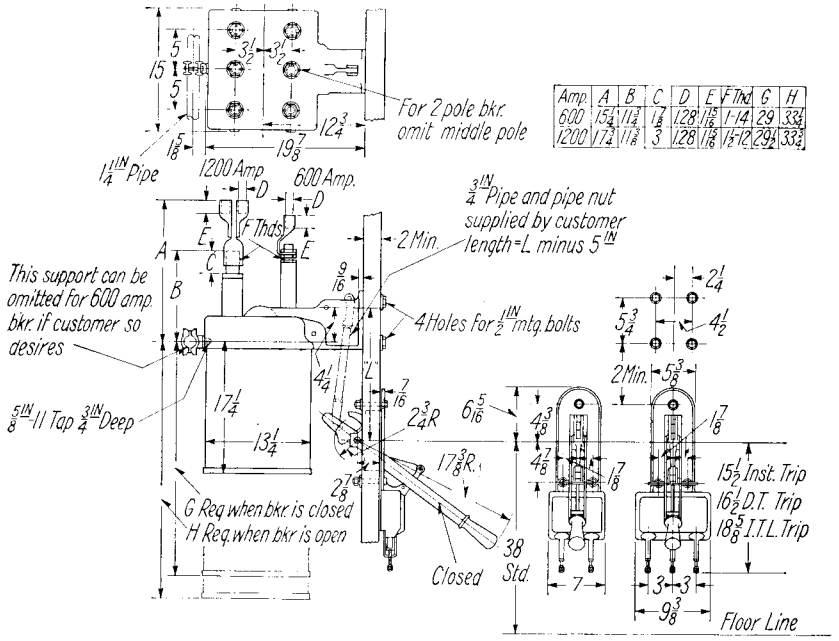


FIG. 7—BELL ALARM ATTACHMENT



Amp	A	B	C	D	E	F Thd	G	H
600	15 1/4	11 1/4	1 1/8	1 28	1 15/16	1-14	29	33 1/4
1200	17 3/4	11 3/8	3	1 28	1 15/16	1 1/2-12	29 1/2	33 1/4

FIG. 8—OUTLINE OF TYPE F-124, 600 AND 1200 AMPERE HAND-OPERATED OIL CIRCUIT-BREAKER, SWITCHBOARD MOUNTING

(*Dimensions in Inches*)

Bell Alarm Switch (Fig. 7)—The bell alarm switch makes contact only when the handle is drawn down with the circuit-breaker open, as would be the case if tripped by any attachment. The upper block is depressed by the handle side bars and the lower block by the tripping lever. It should be examined occasionally to make sure that the contacts and all connections are secure.

Attachments

All attachments are mounted on the main breaker parts before shipment from the factory. The location and operation of the various attachments are described in the following instruction cards.

1. Undervoltage Release Attachment—I.C. 592.
2. Inverse Time Limit Attachment—I.C. 539.
3. Direct Trip Attachment—I.C. 591.

All attachments should be given a preliminary trial before putting the breaker in service to make sure that they will fulfill their respective functions in a reliable manner.

Maintenance

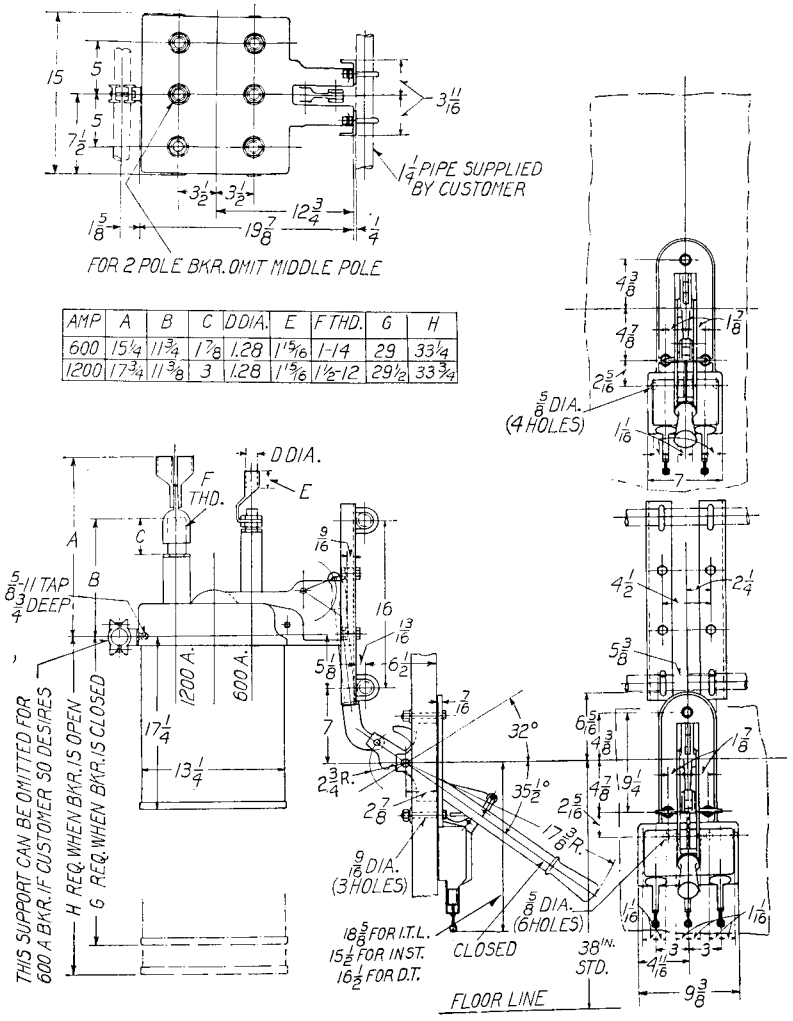
Points to be observed in maintenance—

1. Before making any adjustment to an oil circuit-breaker, make sure that all lines leading to it are electrically dead.
2. Be sure the breaker frame is grounded.
3. Do not operate the breaker excessively by the electric operating mechanism when the oil tank is removed.
4. Examine all contacts frequently, especially after severe short-circuits. See that contacts are aligned properly. Replace those badly burned.
5. After making adjustments, operate the breaker carefully by hand to make sure that it operates smoothly and correctly.
6. Inspect the oil regularly and after severe short-circuits. If it shows signs of moisture, carbonization or dirt, filter and retest it before replacing it in service. See that the oil level in the tanks is maintained at the proper height.
7. Remove all oil and thoroughly clean the tanks, tank liners, lift rods, terminal bushings, etc., at least once a year.
8. Thoroughly inspect all bolts and nuts—and tighten if necessary. Inspect all pins, links and bearings especially for excessive wear. Check all cotter pins. Do not use thin lock washers on moving contact parts.
9. Arrange for regular inspection to see that the apparatus is in adjustment; the oil is of good quality; and that the complete breaker functions as required.

Insulating Oil

Dielectric tests of the oil should be made every three months, to show if it is reasonably good for circuit-breaker work. Samples should not be taken until the oil has remained undisturbed for at least four hours. In testing for indication of water, take the sample from the bottom of the tank. If for indication of carbon, and after a heavy short-circuit, take the sample from the surface of the oil.

The care of the insulating oil in circuit-breakers is of the utmost importance in their successful operation. Contamination by dirt, moisture, metallic particles, lint, etc., all reduce the dielectric strength, upon which the operation and current interrupting ability largely depend. Consequently, the most careful



AMP	A	B	C	D DIA.	E	F THD.	G	H
600	15 1/4	11 3/4	1 7/8	1.28	1 15/16	1-14	29	33 1/4
1200	17 3/4	11 3/8	3	1.28	1 15/16	1 1/2-12	29 1/2	33 3/4

FIG. 9—OUTLINE OF TYPE F-124, 600 AND 1200 AMPERE HAND-OPERATED OIL CIRCUIT-BREAKER, PANEL-FRAME MOUNTING

(Dimensions in Inches)

attention should be given to keeping the oil clean, not only in filling the tanks originally but in later maintenance or other work on the breakers which might nvolve opening the tanks.

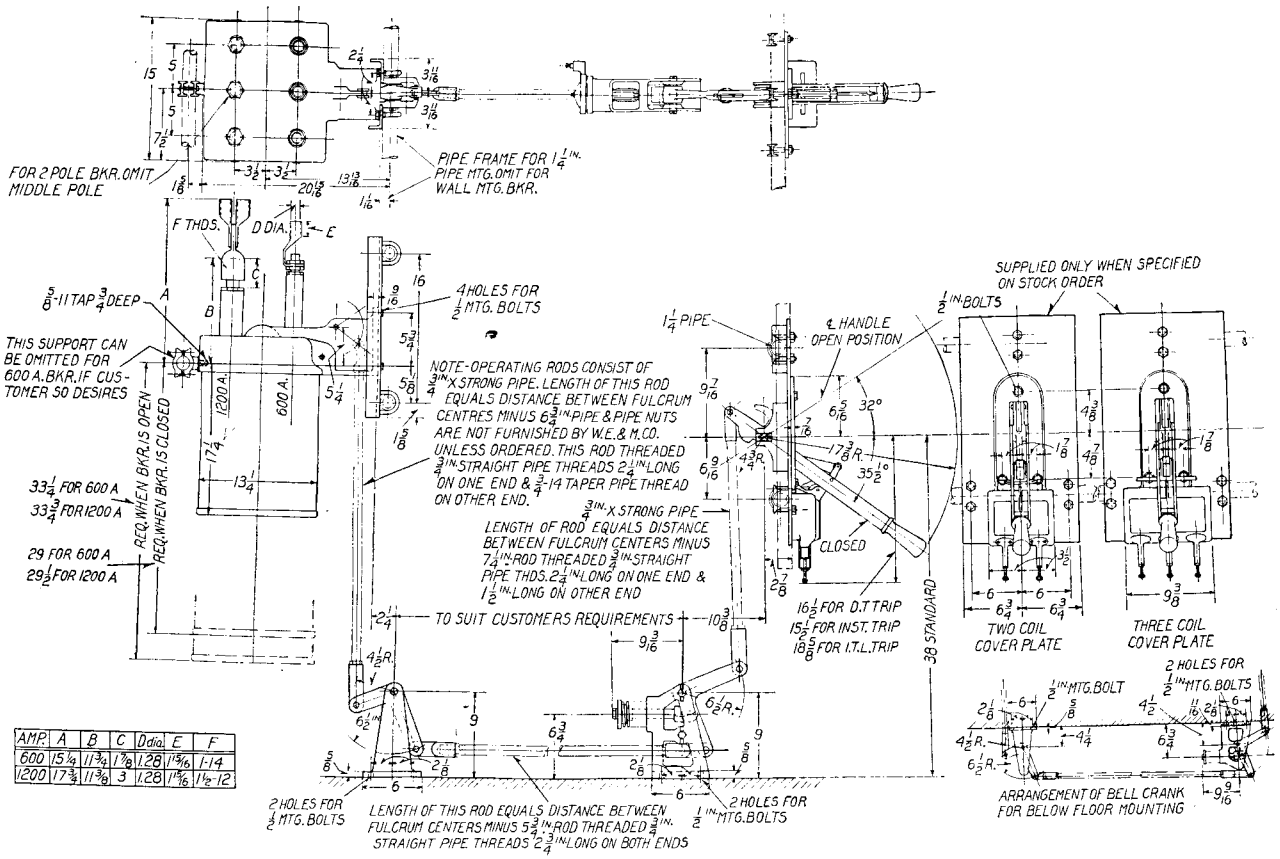
Only the highest grade, such as Wemco "C" or other approved oil should be used in the breakers. The oil should be new or at least thoroughly reconditioned by means of a filter press or centrifuge. In any case, before using, it should be given a dielectric test which should show a minimum of 22,000 volts (preferably 25,000 to 30,000) measured between 1-inch diameter discs spaced .1 inch apart.

Before filling, the tanks should be thoroughly cleaned and flushed out with insulating oil. The same treatment should be given the inside of the top of the breaker and the operating linkage and contact system. In doing this, rags which will leave lint should not be used as this absorbs and holds moisture.

The same care should be used during inspection or maintenance work on the breaker, which should preferably be done only under favorable weather conditions. If the oil is to be reconditioned following operation of the breaker under short-circuit, the tank, and entire inside of the breaker should be cleaned before the oil is returned to the tank. If the work merely involves lowering or removal of the tank. care should be taken to keep the tank covered until it is replaced so that dirt, dust, metallic particles, etc., cannot fall into the oil.

The above precautions may appear academic to those familiar with the maintenance and operation of oil circuit-breakers, but a little more than ordinary care in oil handling will be well repaid in reliable and dependable operation for which the breaker is designed and built.

For instructions as to the care and testing of insulating oil, see Instruction Book 5336.



AMP.	A	B	C	D dia.	E	F
600	15¼	11¾	1⅞	1.28	1⅝	1-14
1200	17¾	11⅜	3	1.28	1⅝	1½-12

FIG. 10—OUTLINE, SHOWING REMOTE MOUNTING DETAILS FOR TYPE F-124 OIL CIRCUIT-BREAKER

(*Dimensions in Inches*)

Renewal Parts Data

Recommended Stock of Renewal Parts
TYPE F-124 OIL CIRCUIT-BREAKER
Indoor Service
600 Amperes—15,000 Volts—2 or 3 Pole—Single Throw
1200 Amperes— 7,500 Volts—2 or 3 Pole—Single Throw

FOR ILLUSTRATION OF PARTS SEE FIGURE 3

The following is a list of the Renewal Parts and the quantities of each that we recommend should be stocked by the user of this apparatus to minimize interrupted operation caused by breakdowns. The parts recommended are those most subject to wear in normal operation or those subject to damage or breakage due to possible abnormal conditions. This list of Renewal Parts is given only as a guide. When continuous operation is a primary consideration, additional insurance against shut-downs is desirable. Under such conditions more renewal parts should be carried, the amount depending upon the severity of the service and the time required to secure renewals.

Breakers in use up to and including	2-POLE			3-POLE			Style No. of Part
		1	5		1	5	
Name of Part	No. Per Breaker	Recommended for Stock		No. Per Breaker	Recommended for Stock		
Breaker Complete	1	0	0	1	0	0	... ...
Breaker Unit Complete	1	0	0	1	0	0	... ...
*Moving Contact Complete	1	0	0	1	0	0	... ...
*Accelerating Spring	2	0	1	2	0	1	1 017 217
Lift Rod	2	0	1	3	0	1	1 017 220
Main Moving Contact	2	0	1	3	0	1	998 181
Main Moving Contact Spring	2	1	2	3	1	2	969 910
Moving Arcing Contact Bracket— 600 Amperes	2	0	0	3	0	0	1 043 938
Moving Arcing Contact Bracket—1200 Amperes	2	0	0	3	0	0	1 043 939
Moving Arcing Contact	4	4	8	6	6	12	947 450
Moving Arcing Contact Spring	4	1	2	6	1	2	1 014 379
Stationary Contact Complete	4	0	0	6	0	0	... ...
Condenser Bushing—600 Amperes (Standard)	4	0	2	6	0	2	1 124 190
Condenser Bushing—600 Amperes (Lift-Up)	4	0	2	6	0	2	1 124 192
Condenser Bushing—1200 Amperes (Standard)	4	0	2	6	0	2	948 915
Condenser Bushing—1200 Amperes (Lift-Up)	4	0	2	6	0	2	1 014 328
Main Stationary Contact—600 Amperes	4	0	2	6	0	2	947 451
Main Stationary Contact—1200 Amperes	4	0	2	6	0	2	1 016 979
Stationary Arcing Contact—600/1200 Amperes	4	4	8	6	6	12	947 450
Stationary Arc Shield—600/1200 Amperes	4	0	0	6	0	0	947 454
Oil Tank	1	0	0	1	0	0	... ...
Oil Gauge	1	0	0	1	0	0	948 931
Tank Liner	3	0	1	3	0	1	1 017 231
†Type SAF-2 Solenoid-Operated Mechanism	1	0	0	1	0	0	†
†Closing Coil	1	0	0	1	0	0	†
†Trip Coil	1	0	1	1	0	1	†

* Not listed on illustration.
† When ordering, specify identification number stamped on part.
Parts indented are included in the part under which they are indented.

ORDERING INSTRUCTIONS

When ordering Renewal Parts, always specify the name of the part wanted as shown on this illustrations in this Instruction Book, giving Shop Order Number, and type of Circuit-Breaker, as shown on the name plate. For example:

One Moving or Stationary Contact Complete, 600 Amperes, for Type F-124 Oil Circuit-Breaker, S.O. 29-F-94 shown in I.B. 5767, Figure 3.

To avoid delays and misunderstandings, note carefully the following points:

1. Send all correspondence and orders to the nearest Sales Office of the Company.

2. State whether shipment is to be made by freight, express or parcel post. In the absence of instructions, goods will be shipped at our discretion. Parcel post shipments will be insured only on request. All shipments are at purchaser's risk.

3. Small orders should be combined so as to amount to a value of at least $1.00 net. Where the total of the sale is less than this, the material will be invoiced at $1.00.

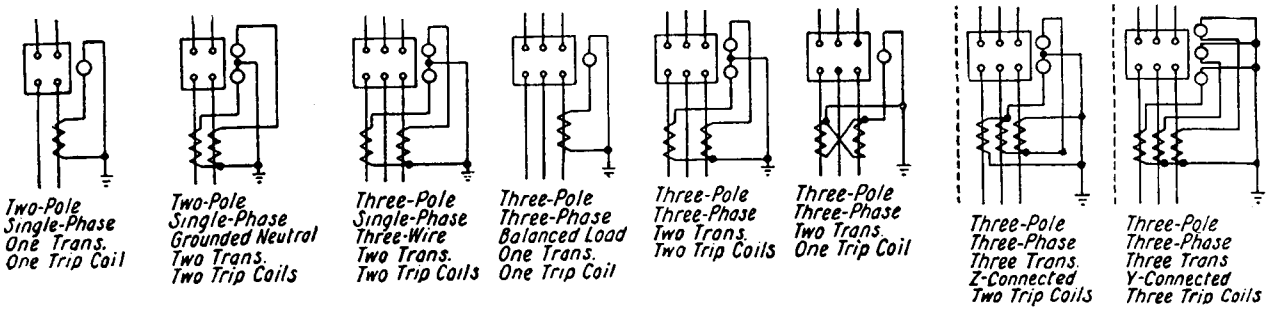


FIG. 11-A—TYPICAL TRANSFORMER TRIP COIL CONNECTIONS

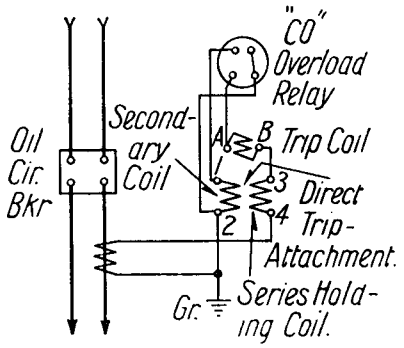


FIG. 11-B—SCHEMATIC DIAGRAM OF CONNECTIONS FOR DIRECT TRIP ATTACHMENT

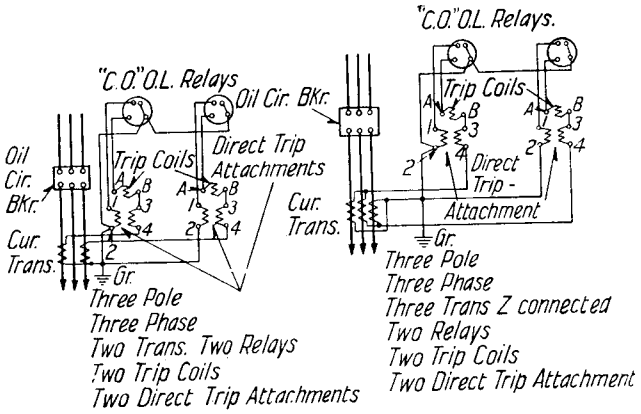


FIG. 11-C—DIAGRAMS OF CONNECTIONS FOR DIRECT TRIP ATTACHMENTS



RETURN
TO
ENGINEERING DIVISION
BUFFALO OFFICE
WESTINGHOUSE ELEC. & MFG. CO.

11-1965

Westinghouse

Type SAF-2 Operating Mechanism

for

Type F-122, 400, 600 & 800 Amp. 2 & 3 P. S. T.
and
Type F-124 600 & 1200 Amp. 2 & 3 P. S. T.
Oil Circuit Breakers

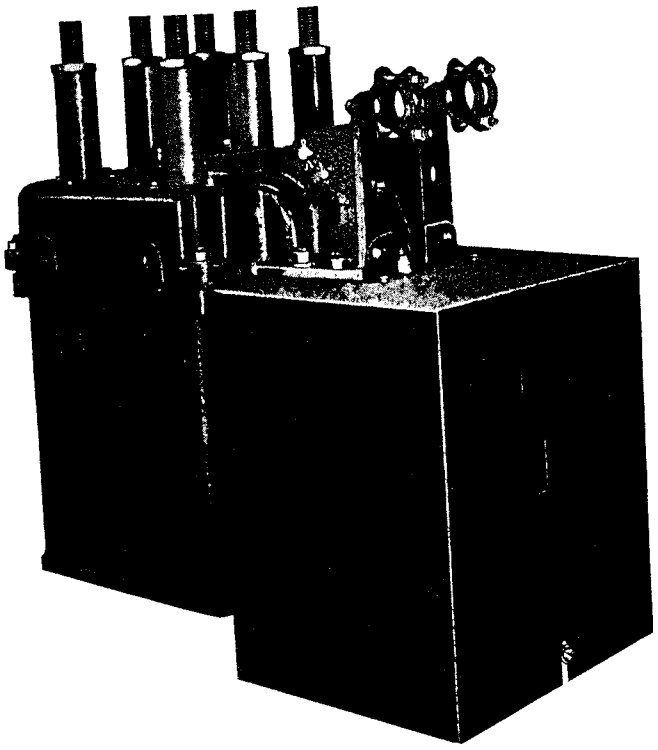


FIG. 1—TYPE F-122, SOLENOID-OPERATED BREAKER

Westinghouse Electric Corporation
East Pittsburgh, Pa.

I. B. 33-216★
(Filing No. 33-000)

Printed in U.S.A. (Reprinted 8-53)
★Supersedes I. B. 5790-A

Westinghouse Type SAF-2 Operating Mechanism

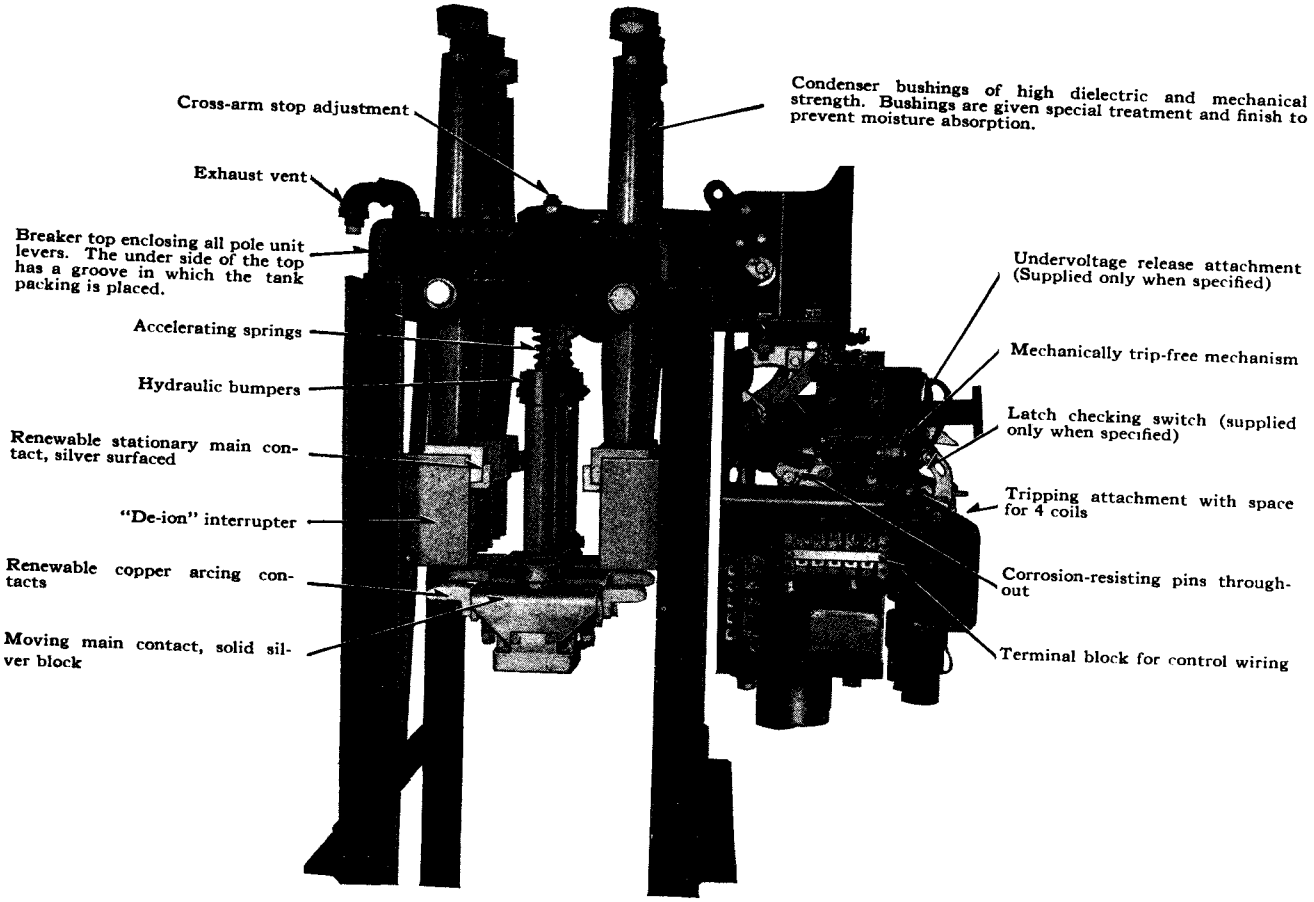


FIG. 2—TYPE F-124-A, 600 OR 1200-AMPERE, SOLENOID-OPERATED BREAKER WITH TANK REMOVED FROM THE BREAKER AND COVER REMOVED FROM THE TYPE SAF-2 SOLENOID

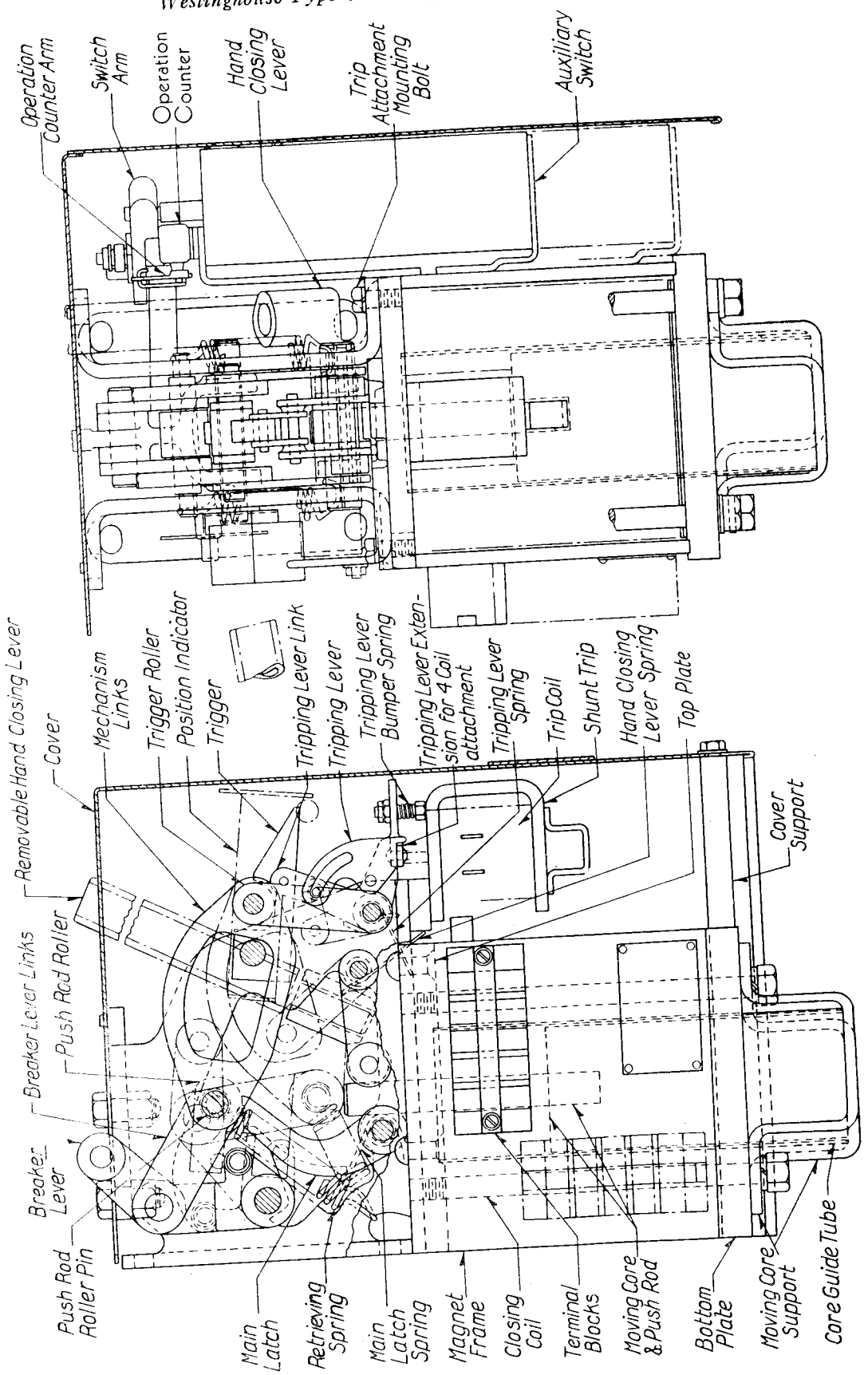


FIG. 3—CIRCUIT BREAKER—OIL-TYPE "SAF-2" MECHANISM ASSEMBLY

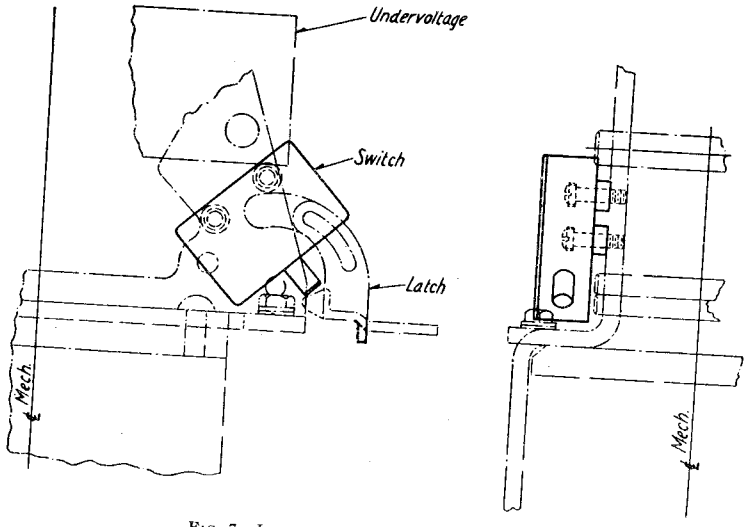


FIG. 7—LATCH CHECKING SWITCH ASSEMBLY

8. With operation #7 completed, the main moving contact of the breaker should be ¼" below the lift rod end as described in I.B. 5746 or 5767.

9. Mount the control panel in a convenient location.

10. Wire the control panel to the mechanism in accordance with one of the typical diagrams Figs. 8 and 9, or in accordance with the diagram covering the complete installation. (The control panel is not wired at the factory; all wiring must be done at the time of installation.)

11, Operate the attachments to make sure they are functioning properly, as described under adjustments.

12. Apply voltage to the closing coil and check the electrical operation of the solenoid. The mechanism should operate satisfactorily with 72% of normal voltage applied, measured at the coil.

ADJUSTMENTS

Mechanism Operation:

Ref. Fig. 2.

Energizing the closing coil forces the moving core and push rod upwards against the push rod roller (located at the junction of the breaker lever links and the mechanism links). This upward force straightens the toggle formed by the breaker lever links and the mechanism links which in turn rotates the breaker lever counter-clockwise, as the trigger roller (which is fastened to the mechanism links) is held stationary by the trigger. Just before the moving core strikes the top plate, the main latch is forced under the push rod roller by the main latch spring, thus locking the mechanism in the closed position. The toggle formed by the breaker lever links and the mechanism links is prevented from going over center by the push rod roller pin striking the top of the frame.

Energizing the trip coil rotates the tripping lever counter-clockwise to break the tripping toggle, and pull the trigger out of engagement with the trigger roller. This permits the entire linkage (mechanism links, breaker lever links and breaker lever) to slide horizontally off the main latch, thus permitting the mechanism to open. As the push

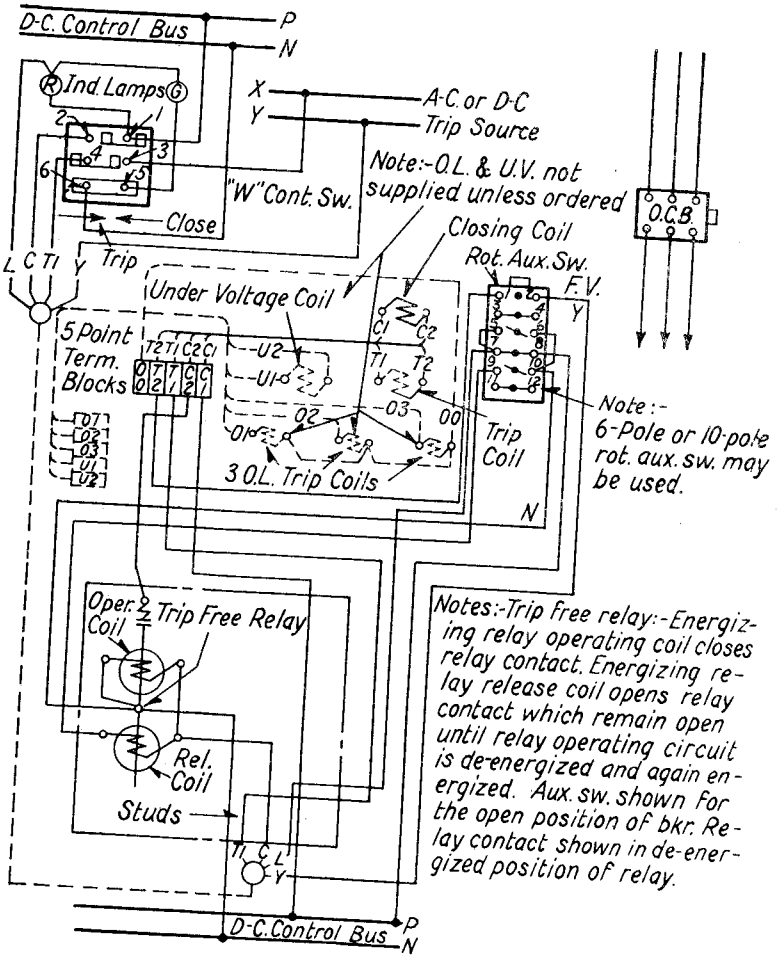


FIG. 8—DIAGRAM OF CONTROL PANEL CONNECTIONS

rod roller slides off the main latch, the retrieving springs pull the push rod roller downwards to reset the mechanism.

The mechanism tripping toggle should be set either on toggle or slightly over toggle to prevent trigger failure when closing on maximum voltage.

Four Coil Attachment

Ref. Fig. **5** and Fig. **2**

The four coil attachment bolts to the mechanism frame, in place of the single coil shunt trip attachment. In bolting the attachment in place it is only necessary to observe that the coil plungers push the tripping lever upwards sufficiently to trip the mechanism. A tripping lever with suitable extensions must be used with the four coil attachment.

Overload Release

See I.C. 1488.

AUXILIARY SWITCH

Ref. Fig. **3.**

The adjustable linkage between the mechanism breaker lever and the switch arm should be adjusted so that the switch arm travels equally on either side of a line thru the switch arm shaft.

The length of the switch arm should be adjusted so that the contact segments make good contact with the contact fingers in both the opened and closed position of the mechanism. Make certain the operating arm of the auxiliary switch is not in dead center, otherwise damaged parts will result.

UNDERVOLTAGE RELEASE

Ref. Fig. **6, 2** and **11.**

The undervoltage mounts on the left hand side of the mechanism frame

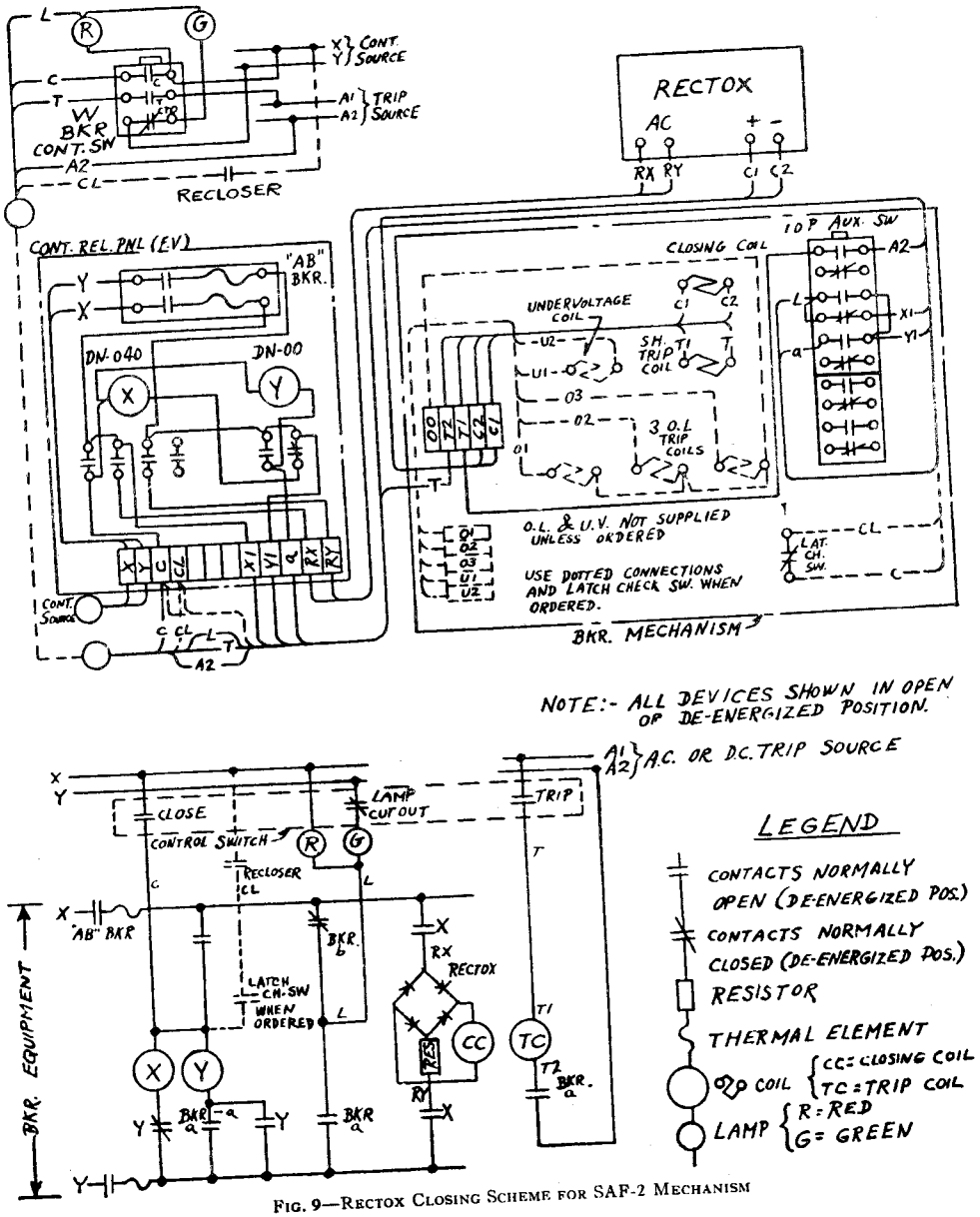


FIG. 9—RECTOX CLOSING SCHEME FOR SAF-2 MECHANISM

with the two mounting screws shown. The undervoltage reset extension of the breaker lever should operate between the undervoltage reset spring and the undervoltage hold in latch. As the mechanism closes, the reset extension of the breaker lever strikes the undervoltage hold in lever, which frees the undervoltage armature for operation on voltage failure. As the mechanism opens, the reset extension of the breaker lever strikes the undervoltage reset spring, retrieving the armature to its fully closed position; failure to reset the undervoltage armature properly will result in improper operation, as the coil is not capable of picking up the armature.

The adjustable trip rod should be set to secure ⅛" clearance between the end of the slot in the mechanism tripping lever and the trip rod, with the armature in the closed position.

The drop out voltage is influenced by the small brass pin in the armature, which controls the air gap in the magnetic circuit.

LATCH CHECKING SWITCH

Ref. Fig. **7.**

The latch checking switch block mounts on the two screws shown. The switch operates directly from the tripping lever and makes contact when the tripping lever is in the normal position, and breaks contact when the tripping lever is raised.

CUT OFF SWITCH

Ref. Fig. **10.**

The single pole cut off switch mounts on the right side of the mechanism behind the rotary auxiliary switch. It is a normally closed contact switch but is held in the open position by means of a spring-biased operating lever. During the last portion of the closing stroke the mechanism roller pin strikes the switch operating lever which rotates the switch lever to release the switch push button and permit the switch to make contact.

OPERATION COUNTER

Ref. Fig. **3.**

The operation counter mounts on the upper rotary auxiliary switch bracket. After mounting in place and connecting to the auxiliary switch extension of the breaker lever the operation counter arm should be loosened and set so that **only** one number is recorded for each operation of the mechanism. This setting should be checked for both manual and electrical operation.

MAINTENANCE

Arrange for regular inspection to see that the apparatus is in good adjustment and functions as required.

Thoroughly inspect all bolts and nuts—and tighten if necessary. Inspect all pins, links and bearings for excessive wear. Check all cotter pins.

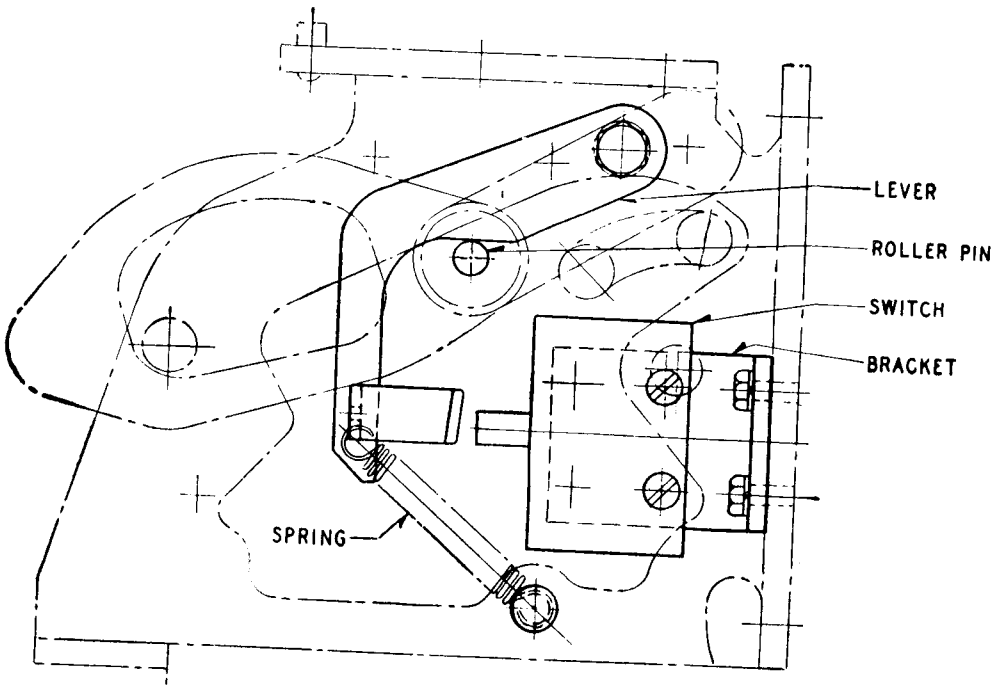


FIG. 10—CUT OFF SWITCH

Westinghouse Type SA F-2 Operating Mechanism

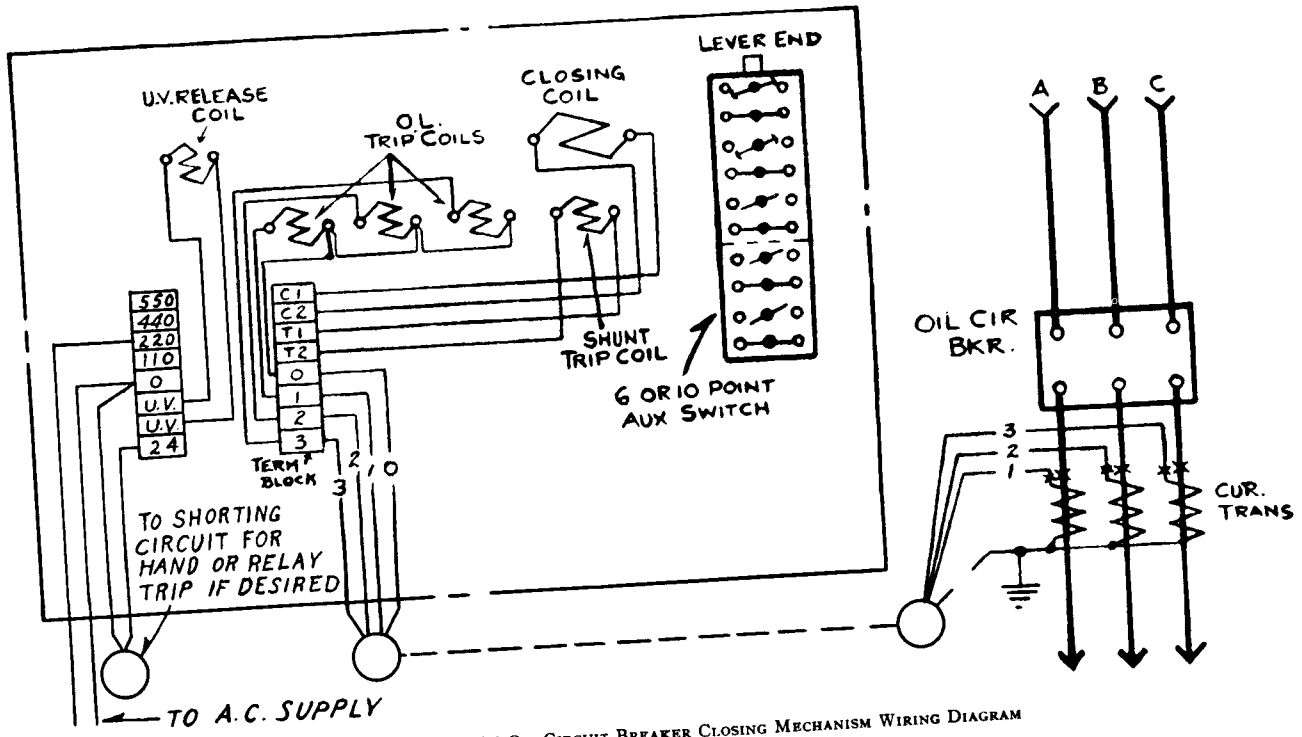


FIG. 11—TYPE SAF-2 OIL CIRCUIT BREAKER CLOSING MECHANISM WIRING DIAGRAM

RENEWAL PARTS DATA

Type SAF-2 Solenoid-operated Mechanism For Oil Circuit Breakers

Style No. 1020985, A, B—Vertical-Push—F-122
Style No. 1020986, A, B—Vertical-Push—F-124

Style No. 1021052, A—Horizontal-Push—F-124
Style No. 1021053, A—Horizontal-Push—F-124

(For Illustration of Parts—See Figure 3)

Mechanisms in use up to and including			1	5	
Ref. No.	Name of Part	Number Per Unit	Recommended for Stock		Style No. of Part
..	Mechanism Complete				
1	Breaker Lever (Vertical-Push—F-122)	1	0	0	. ...
1	Breaker Lever (Horizontal-Push—F-122)	1	0	0	1 021 011
1	Breaker Lever (Vertical-Push—F-124)	1	0	0	1 021 054
1	Breaker Lever (Horizontal-Push—F-124)	1	0	0	1 021 012
2	Breaker Lever Link	1	0	0	1 021 055
3	Mechanism Lever	2	0	0	1 020 990
4	Mechanism Lever Retrieving Spring	2	0	0	1 020 991
5	Moving Core and Push Rod	2	0	1	1 021 000
6	Moving Core Push Rod Roller	1	0	0	1 020 988
7	Moving Core Push Rod Roller Pin	1	0	0	970 132
8	Moving Core Guide Tube	1	0	0	1 020 994
9	Tripping Lever (F-122)	1	0	0	1 021 005
10	Bumper Spring (F-122)	1	0	0	1 021 073
9	Tripping Lever (F-124)	1	0	1	1 035 810
10	Bumper Spring (F-124)	1	0	0	1 020 996
11	Tripping Lever Link	1	0	1	1 035 809
12	Tripping Lever Spring	1	0	0	1 020 992
13	Main Latch	1	0	1	1 020 999
14	Main Latch Pin	1	0	0	1 020 989
15	Main Latch Spring	1	0	0	673 870
16	Trigger	1	0	1	1 020 998
17	Trigger Roller	1	0	0	1 017 949
18	Trigger Link	1	0	0	1 016 906
19	Hand Closing Lever	2	0	0	1 020 993
20	Hand Closing Lever Spring	1	0	0	1 021 003
21*	Type W Auxiliary Switch—6 Pole	1	0	1	1 020 008
21*	Type W Auxiliary Switch—10 Pole	1	0	0	501 821
22	Operation Counter	1	0	0	. ...
23‡	Closing Coil	1	0	0	. ...
24‡	Trip Coil	1	0	1	‡
25‡*	Overload Trip Coil	1	1	1	‡
26‡*	Undervoltage Trip Coil	1	0	1	‡
		1	0	1	‡

* Not Illustrated.

‡ When ordering, specify identification number stamped on coil.

Parts indented are included in the part under which they are indented.

ORDERING INSTRUCTIONS

When ordering Renewal Parts, always specify the name of the part wanted as shown on the illustrations in this Instruction Book, giving Shop Order Number, and the type of Mechanism as shown on the nameplate. For example:

One tripping lever for Type SAF-2 solenoid operated mechanism, SO-31-F-187, shown in Instruction Book 5790.

To avoid delays and misunderstandings, note carefully the following points:

1. Send all correspondence and orders to the nearest Sales Office of the Company.

2. State whether shipment is to be made by freight, express or parcel post. In the absence of instructions, goods will be shipped at our discretion. Parcel post shipments will be insured only on request. All shipments are at purchaser's risk.

3. Small orders should be combined so as to amount to a value of at least $1.00 net. Where the total of the sale is less than this, the material will be invoiced at $1.00.

MEMORANDUM

(Use Ink)


WESTINGHOUSE
W

Westinghouse

Type SAF-2 Operating Mechanism

for

Type F-122, 400, 600 & 800 Amp. 2 & 3 P. S. T.
and
Type F-124 600 & 1200 Amp. 2 & 3 P. S. T.
Oil Circuit Breakers

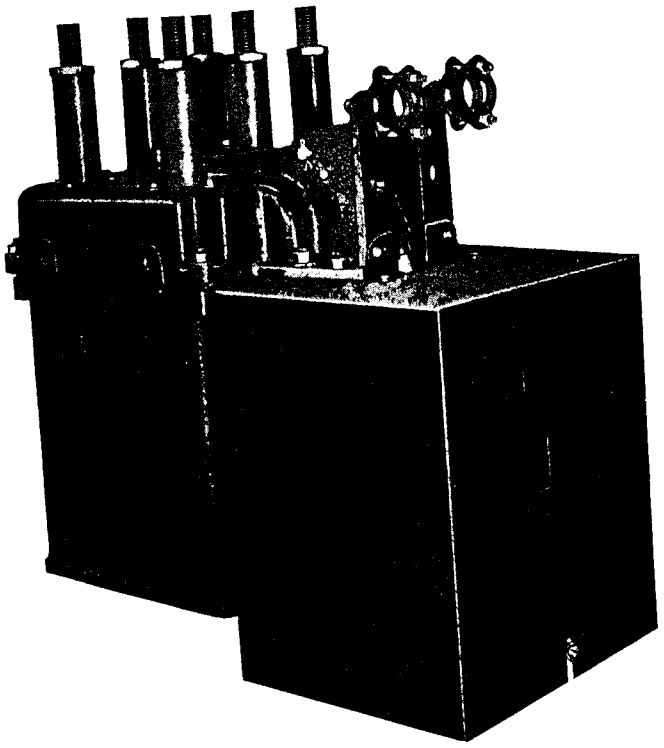


FIG. 1—TYPE F-122, SOLENOID-OPERATED BREAKER

Westinghouse Electric Corporation
East Pittsburgh, Pa.

I. B. 33-216★
(Filing No. 33-000)

Printed in U.S.A. (Reprinted 8-53)
★Supersedes I. B. 5790-A

Westinghouse Type SAF-2 Operating Mechanism

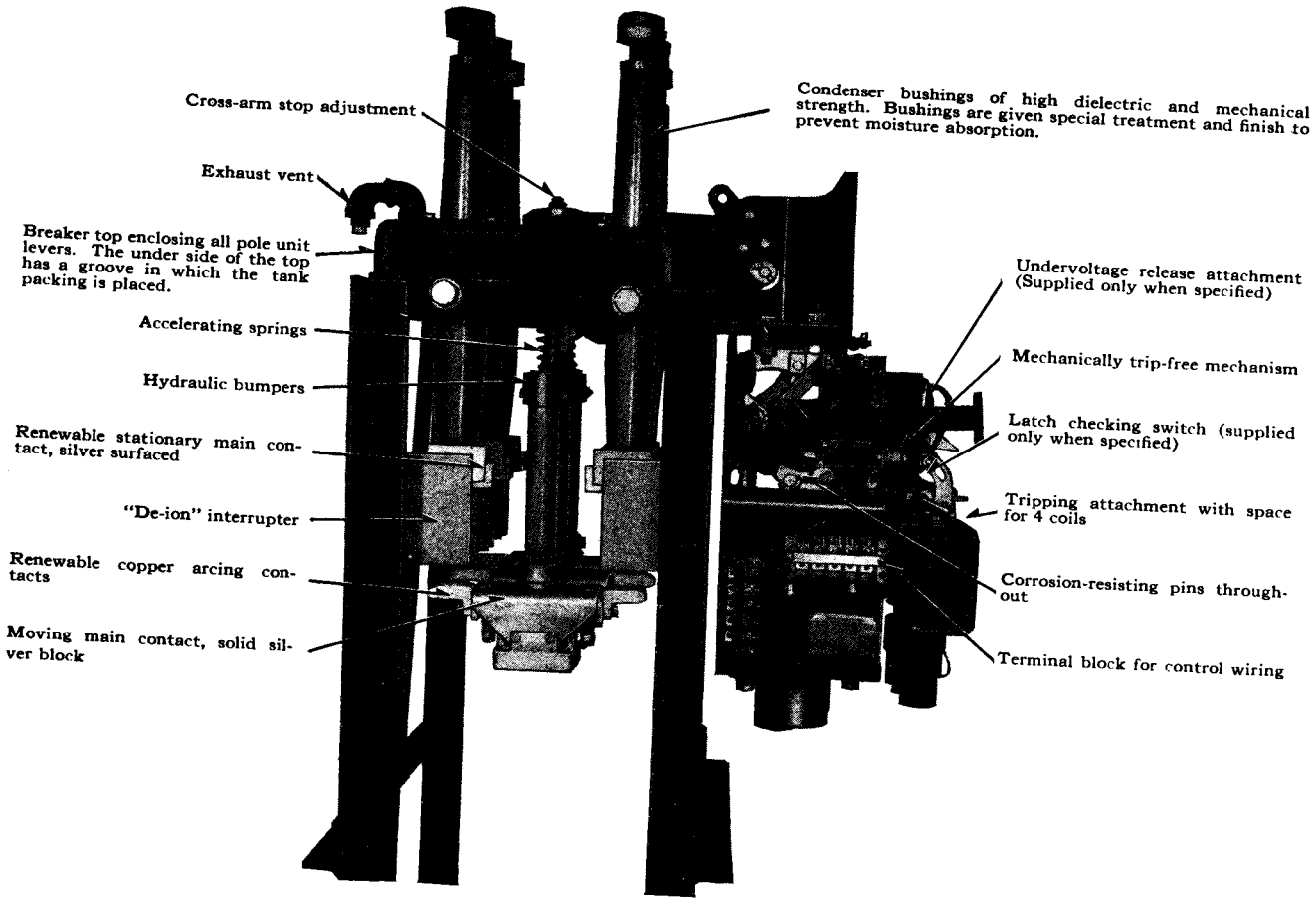


FIG. 2—TYPE F-124-A, 600 OR 1200-AMPERE, SOLENOID-OPERATED BREAKER WITH TANK REMOVED FROM THE BREAKER AND COVER REMOVED FROM THE TYPE SAF-2 SOLENOID

Westinghouse Type SAF-2 Operating Mechanism

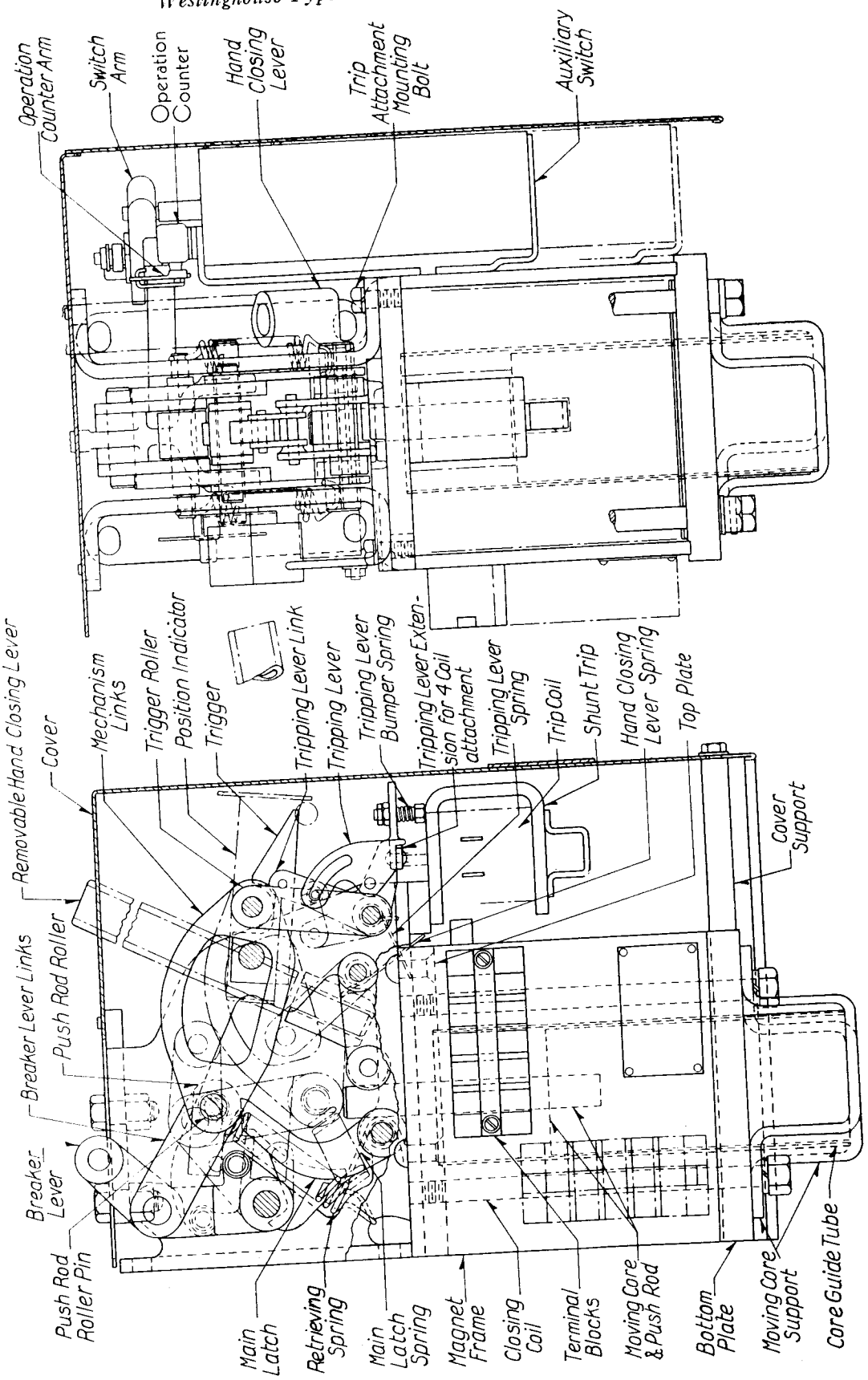


FIG. 3—CIRCUIT BREAKER—OIL-TYPE "SAF-2" MECHANISM ASSEMBLY

Westinghouse
Type SAF-2 Operating Mechanism

INTRODUCTION

This mechanism is the direct-current solenoid type. It operates on standard direct-current control voltages or when equipped with a rectox unit, on alternating-current. It is a mechanically full automatic mechanism, trip free in all positions.

This mechanism is used principally to electrically operate the 400, 600 and 800 ampere type F122 and the 600 and 1200 ampere type F124 oil circuit breakers. This instruction book applies to the mechanism only. Instructions on adjustments and maintenance of the type F122 and F124 breakers can be found in Instruction Books 5746 and 5767 respectively.

The standard mechanism is supplied with a single shunt trip coil, a 6 pole auxiliary switch, cover, position indicator and control relay. The mechanism can be equipped with additional attachments, such as, operation counter, latch checking switch, four coil tripping attachments (in place of single shunt trip coil), a 10 pole auxiliary switch instead of a 6 pole, an undervoltage tripping attachment and a single pole cut off switch.

SHIPMENT

Ordinarily the mechanism will be mounted on the breaker unit, with all adjustments complete, ready for installation as described in I.B. 5746 or 5767. Occasionally, however, the mechanism will be shipped separately, fastened in the closed position.

HANDLING

Do not attempt to lift the mechanism by its attachments or levers; or to move the attachments by the coil leads. Always grasp the frame, which is designed to withstand handling.

INSTALLATION

1. When the mechanism is mounted on the breaker before shipment, it is only necessary to follow the installation procedure outlined in the breaker Instruction Books and operations 8 to 12 of this book.

2. When the mechanism is shipped separately, however, it is necessary to first mount the breaker unit as described in the above Instruction Books and then mount the mechanism to the breaker as shown in Fig. 4, or the outline supplied with the breaker.

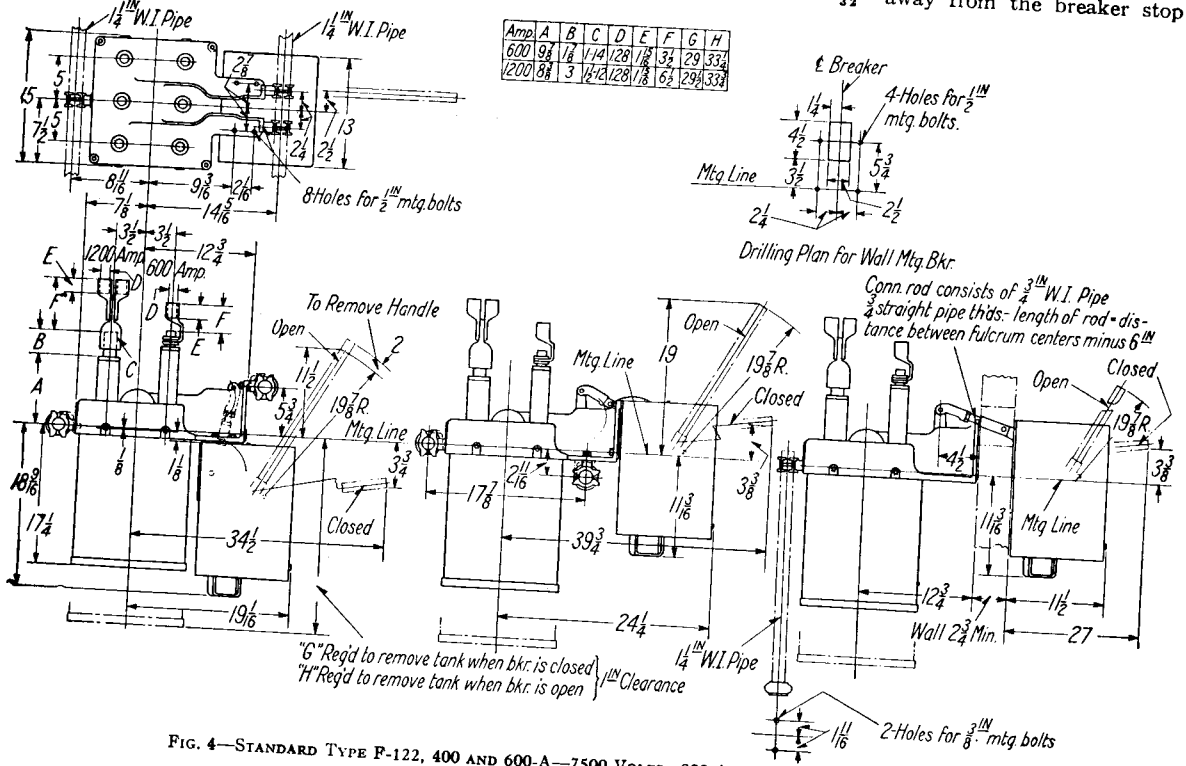
3. Bolt the mechanism to the breaker frame, floor or wall with four bolts. If the mechanism is for wall or floor mounting, structural steel members should be inserted between the mechanism and wall or floor to prevent disintegration of the wall by the closing shock.

4. Remove the rod end from breaker lever of the mechanism; remove the fulcrum pin from the toggle lever of the breaker, and the pin from the operation rod end of the breaker.

5. Screw the operating rod into the operation rod end, with the lock nut and lock washer in place as shown.

6. Replace the rod end assembly and pins, and check the operation of the mechanism.

7. Operations #4, 5 and 6 should be repeated until the length of the operating rod assembly is such, that, with the mechanism in the closed position, the breaker toggle lever links will be $\frac{1}{32}$" away from the breaker stop pin.



Amp	A	B	C	D	E	F	G	H
600	9⅜	1⅛	1 1/4	1/28	1⅝	3¼	29	33¾
1200	8⅜	3	1 1/4	1/28	1⅛	6½	29⅜	33¾

FIG. 4—STANDARD TYPE F-122, 400 AND 600-A—7500 VOLTS., 800 AMPERES, 5000 VOLTS—OUTLINE

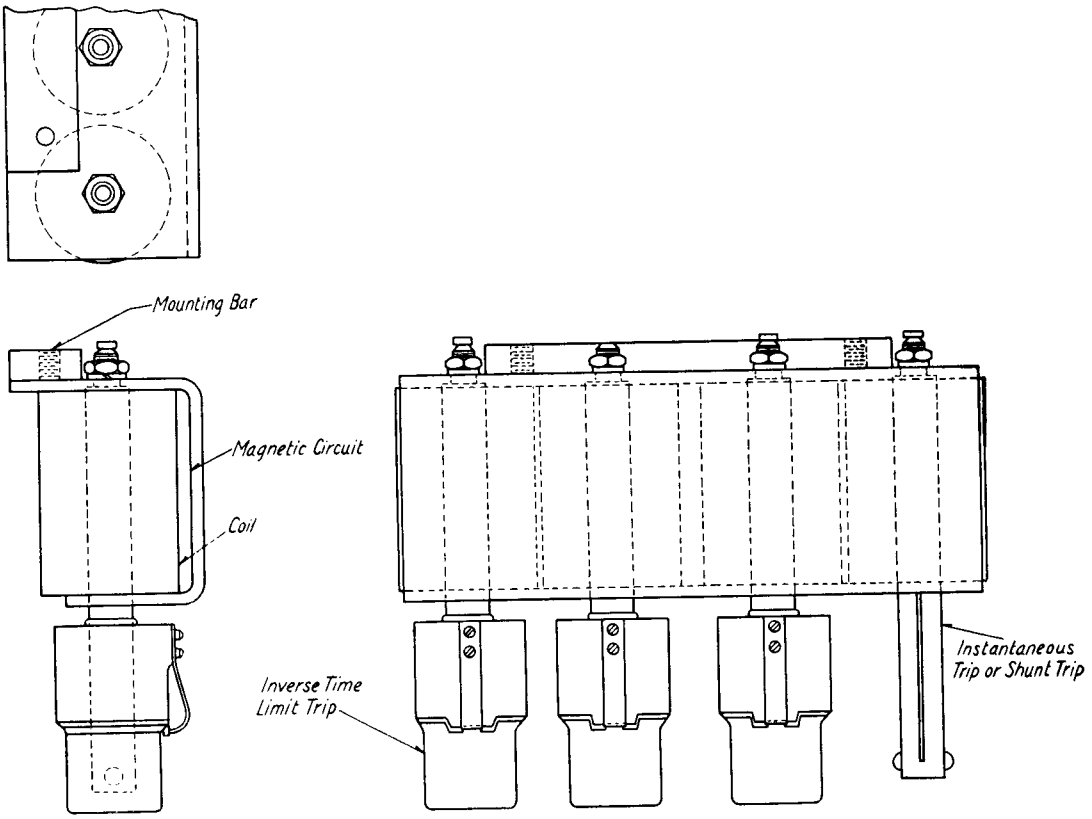


FIG. 5 — INVERSE TIME LIMIT ASSEMBLY

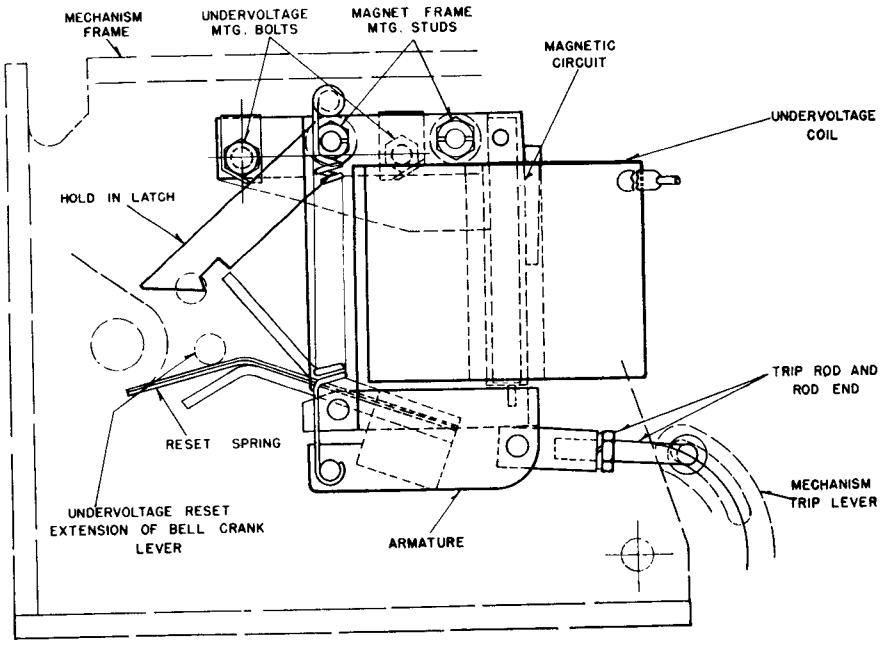


FIG. 6—UNDERVOLTAGE OPERATING ASSEMBLY

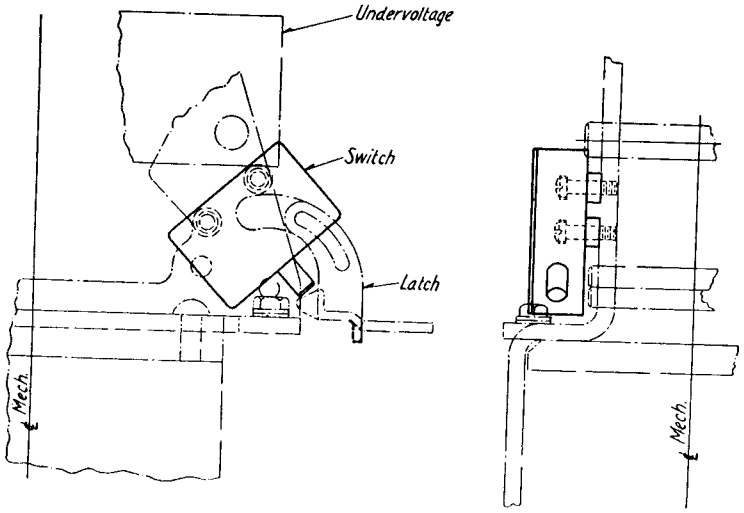


FIG. 7—LATCH CHECKING SWITCH ASSEMBLY

8. With operation #7 completed, the main moving contact of the breaker should be ¼" below the lift rod end as described in I.B. 5746 or 5767.

9. Mount the control panel in a convenient location.

10. Wire the control panel to the mechanism in accordance with one of the typical diagrams Figs. **8** and **9**, or in accordance with the diagram covering the complete installation. (The control panel is not wired at the factory; all wiring must be done at the time of installation.)

11, Operate the attachments to make sure they are functioning properly, as described under adjustments.

12. Apply voltage to the closing coil and check the electrical operation of the solenoid. The mechanism should operate satisfactorily with 72% of normal voltage applied, measured at the coil.

ADJUSTMENTS

Mechanism Operation:

Ref. Fig. **2.**

Energizing the closing coil forces the moving core and push rod upwards against the push rod roller (located at the junction of the breaker lever links and the mechanism links). This upward force straightens the toggle formed by the breaker lever links and the mechanism links which in turn rotates the breaker lever counter-clockwise, as the trigger roller (which is held stationary by the trigger. Just before the moving core strikes the top plate, the main latch is forced under the push rod roller by the main latch spring, thus locking the mechanism in the closed position. The toggle formed by the breaker lever links and the mechanism links is prevented from going over center by the push rod roller pin striking the top of the frame.

Energizing the trip coil rotates the tripping lever counter-clockwise to break the tripping toggle, and pull the trigger out of engagement with the trigger roller. This permits the entire linkage (mechanism links, breaker lever links and breaker lever) to slide horizontally off the main latch, thus permitting the mechanism to open. As the push

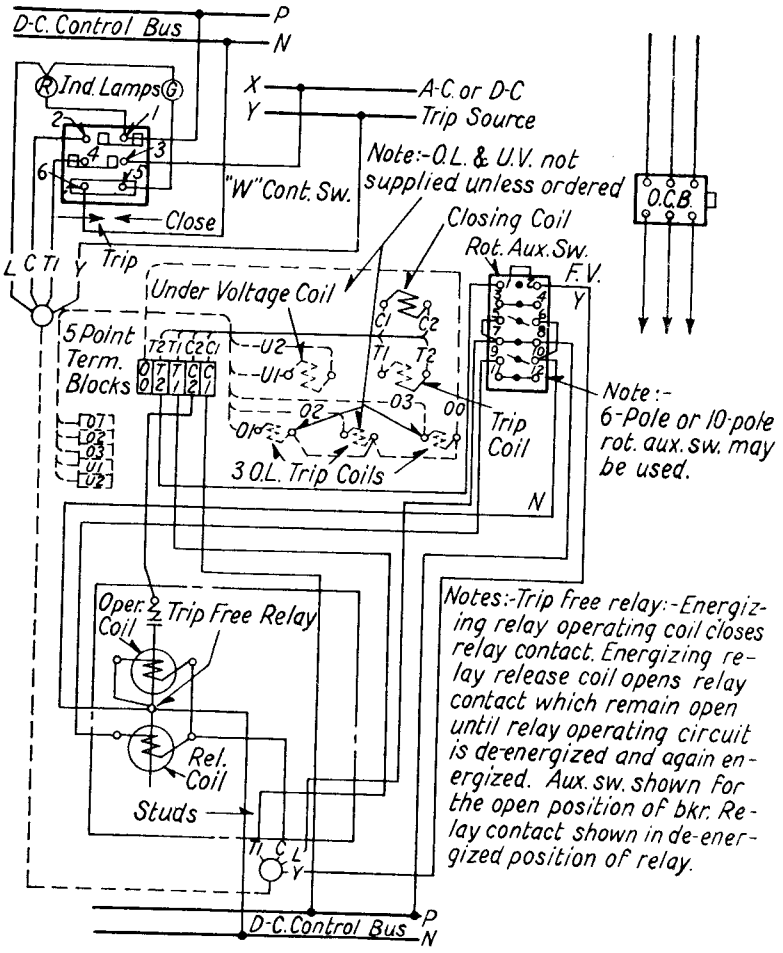


FIG. 8—DIAGRAM OF CONTROL PANEL CONNECTIONS

rod roller slides off the main latch, the retrieving springs pull the push rod roller downwards to reset the mechanism.

The mechanism tripping toggle should be set either on toggle or slightly over toggle to prevent trigger failure when closing on maximum voltage.

Four Coil Attachment

Ref. Fig. **5** and Fig. **2**

The four coil attachment bolts to the mechanism frame, in place of the single coil shunt trip attachment. In bolting the attachment in place it is only necessary to observe that the coil plungers push the tripping lever upwards sufficiently to trip the mechanism. A tripping lever with suitable extensions must be used with the four coil attachment.

Overload Release

See I.C. 1488.

AUXILIARY SWITCH

Ref. Fig. **3.**

The adjustable linkage between the mechanism breaker lever and the switch arm should be adjusted so that the switch arm travels equally on either side of a line thru the switch arm shaft.

The length of the switch arm should be adjusted so that the contact segments make good contact with the contact fingers in both the opened and closed position of the mechanism. Make certain the operating arm of the auxiliary switch is not in dead center, otherwise damaged parts will result.

UNDERVOLTAGE RELEASE

Ref. Fig. **6, 2** and **11.**

The undervoltage mounts on the left hand side of the mechanism frame

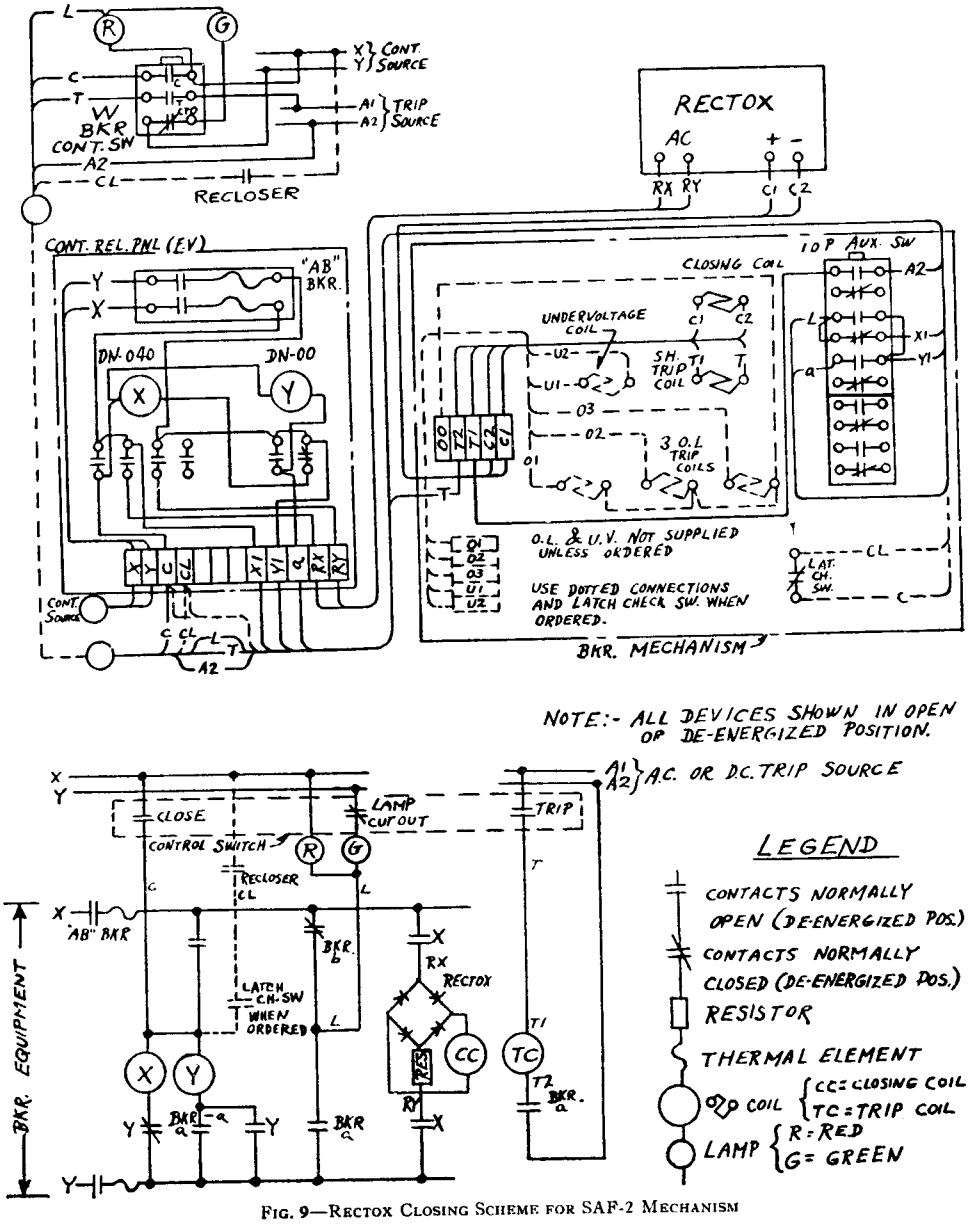


FIG. 9—RECTOX CLOSING SCHEME FOR SAF-2 MECHANISM

with the two mounting screws shown. The undervoltage reset extension of the breaker lever should operate between the undervoltage reset spring and the undervoltage hold in latch. As the mechanism closes, the reset extension of the breaker lever strikes the undervoltage hold in lever, which frees the undervoltage armature for operation on voltage failure. As the mechanism opens, the reset extension of the breaker lever strikes the undervoltage reset spring, retrieving the armature to its fully closed position; failure to reset the undervoltage armature properly will result in improper operation, as the coil is not capable of picking up the armature.

The adjustable trip rod should be set to secure $\frac{1}{8}$" clearance between the end of the slot in the mechanism tripping lever and the trip rod, with the armature in the closed position.

The drop out voltage is influenced by the small brass pin in the armature, which controls the air gap in the magnetic circuit.

LATCH CHECKING SWITCH

Ref. Fig. **7.**

The latch checking switch block mounts on the two screws shown. The switch operates directly from the tripping lever and makes contact when the tripping lever is in the normal position, and breaks contact when the tripping lever is raised.

CUT OFF SWITCH

Ref. Fig. **10.**

The single pole cut off switch mounts on the right side of the mechanism behind the rotary auxiliary switch. It is a normally closed contact switch but is held in the open position by means of a spring-biased operating lever. During the last portion of the closing stroke the mechanism roller pin strikes the switch operating lever which rotates the switch lever to release the switch push button and permit the switch to make contact.

OPERATION COUNTER

Ref. Fig. **3.**

The operation counter mounts on the upper rotary auxiliary switch bracket. After mounting in place and connecting to the auxiliary switch extension of the breaker lever the operation counter arm should be loosened and set so that **only** one number is recorded for each operation of the mechanism. This setting should be checked for both manual and electrical operation.

MAINTENANCE

Arrange for regular inspection to see that the apparatus is in good adjustment and functions as required.

Thoroughly inspect all bolts and nuts—and tighten if necessary. Inspect all pins, links and bearings for excessive wear. Check all cotter pins.

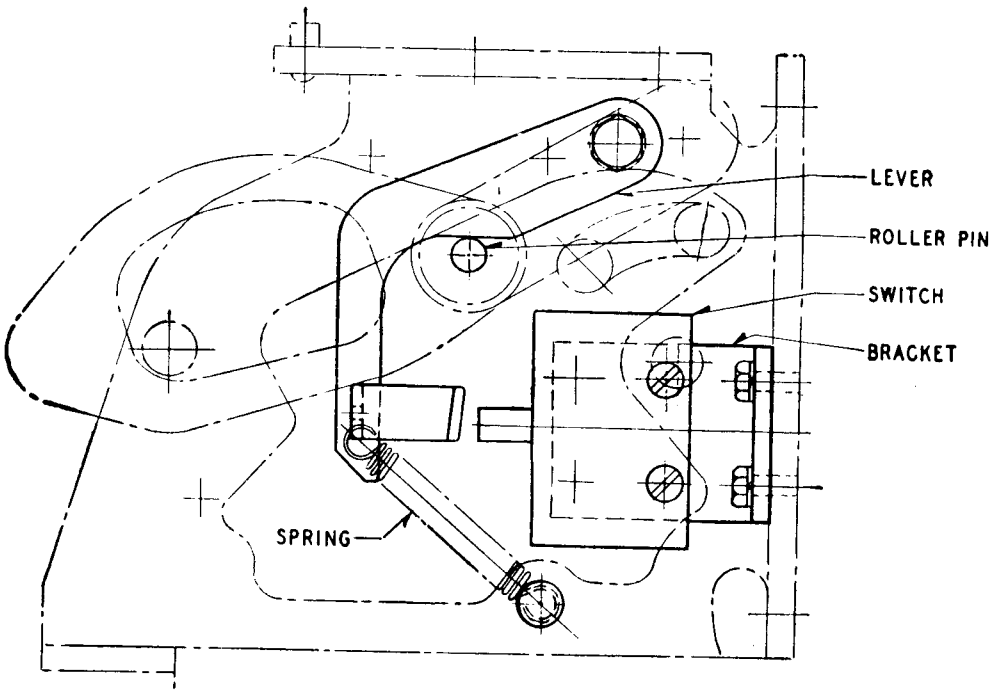


FIG. 10—CUT OFF SWITCH

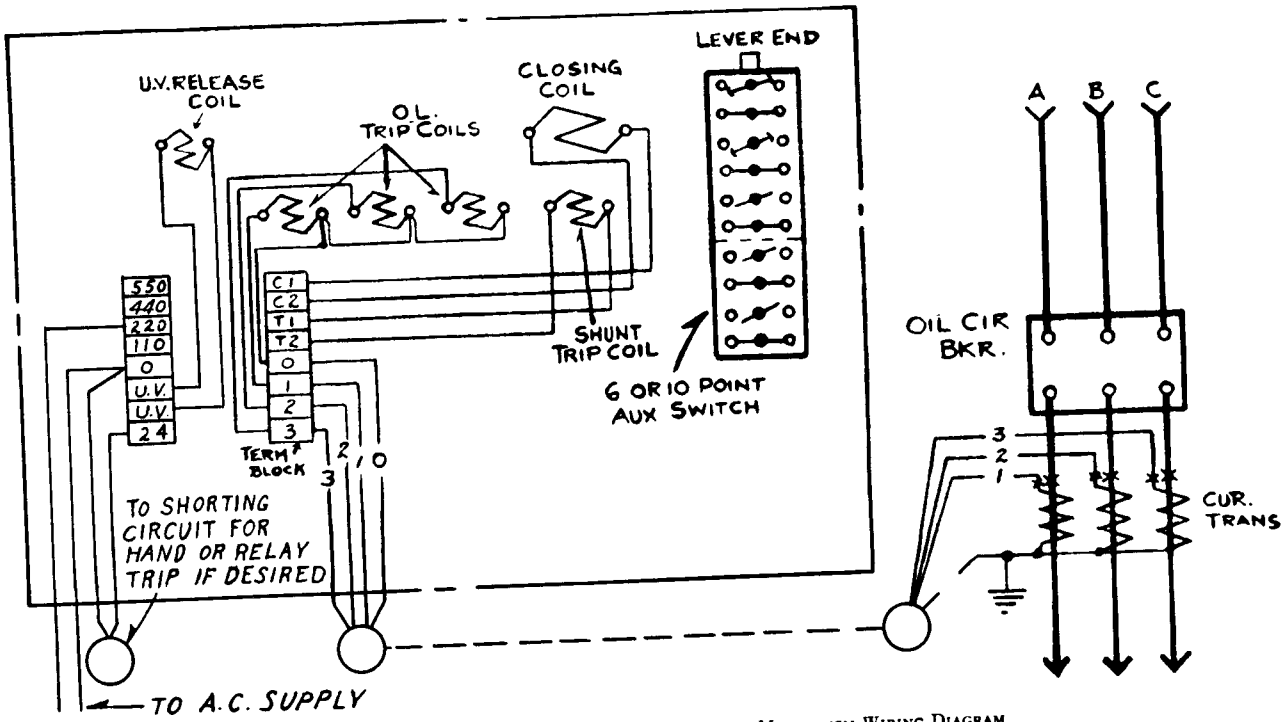


FIG. 11—TYPE SAF-2 OIL CIRCUIT BREAKER CLOSING MECHANISM WIRING DIAGRAM


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WESTINGHOUSE ELEC. & MFG. CO.

Westinghouse

Type SA-3 Solenoid-Operated Mechanism for Oil Circuit-Breakers

INSTRUCTION BOOK

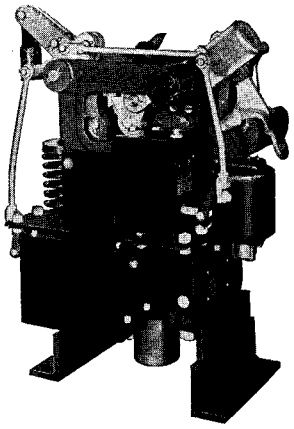


FIG. 1—TYPE SA-3 SOLENOID-OPERATING MECHANISM

Westinghouse Electric & Manufacturing Company
East Pittsburgh, Pa.

Westinghouse Press
Printed in U.S.A. (Rev. 6-41)

I. B. 5567-C
(Filing No. 33-000)

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Westinghouse

Type SA-3 Solenoid-Operated Mechanism for Oil Circuit-Breakers

Introduction

This mechanism is the direct-current solenoid type. It operates on standard direct-current control voltages or, when equipped with a Rectox unit, on alternating-current. It is a mechanically full automatic mechanism, trip free in all positions.

Application may be made to indoor or outdoor breakers within the limits of power of the mechanism. For indoor service, it is mounted on the foundation or on the breaker structure. For outdoor service it is placed in a weatherproof metal box with enclosed connections to the breaker.

A control relay is supplied with the mechanism to handle the closing coil current. The necessary tripping devices form a part of the mechanism. A cut-off switch and the desired auxiliary contacts are mounted on the mechanism and mechanically connected to the linkage. A Veeder counter is supplied to record the number of operations. A position indicator connected to the breaker lever is also supplied.

Shipment and Storage

Whether the mechanism is shipped as a part of the breaker or separately, it is carefully inspected, tested and packed at the factory and should be received in good condition. It should be inspected for damage caused in shipment when received.

If the mechanism is to be stored for any length of time, it should be kept in a clean dry place, protected from dirt and moisture. The insulation particularly should be kept dry and reasonable care should be exerted to prevent it being damaged.

Unpacking should be done carefully so as to avoid damage. Care should be taken to remove all parts from the packing material. An instruction book and identification tags should accompany each mechanism.

Operation

Fig. 7 indicates the various parts of the mechanism as referred to. Referring to Figs. 7, 8, and 9, the breaker is connected to the bell crank lever by the pull rod end which is as shown in Fig. 7 for down pull. It can also be connected for vertical or horizontal pull. The bell crank lever is linked to the trip free lever which is inside the closing lever. The closing lever is connected direct to the moving core. In closing, as the core rises the closing lever and trip free lever, acting together, rotate clockwise about their fulcrum, pushing up on the toggle link and thus rotating the bell crank lever counter-clockwise about its fulcrum. In the closed position the locking lever slips under the pin in the moving core eye bolt and holds the mechanism closed. The right hand end of the trip free lever has a roller which is held down by the trigger. Behind the trigger, to hold it in place, is a toggle formed of a link and the tripping lever. In tripping, the trip rod rises, strikes the trip lever rotating it clockwise. This releases the roller on the trip free lever from the trigger. The trip free lever then rotates counter-clockwise about the pin in the eye bolt. This allows the toggle link to move down, and the bell crank lever to rotate clockwise opening the breaker. The mechanism is then in the position shown in Fig. 8. The trip free lever in rotating, kicks the locking lever out from under the core pin and the linkage drops back to the position shown in Fig. 9, the roller re-engaging with the trigger. The mechanism is then ready for the next operation. Should the trip be energized at any point in the closing stroke, the breaker would be released as previously explained.

It will be noted that no dash pots are used on this mechanism.

An accelerating spring is provided on the rear of the mechanism to increase the speed of opening of the breaker. This spring acts on the bell crank lever. Ordinarily the standard spring is used but in certain applications a special spring is supplied to meet the particular requirements of the breaker.

Fig. 6 shows a typical wiring scheme for d-c. operation. This scheme includes a Type S-1 trip free control relay. Moving the control switch to the "close" position energizes the operating coil on the relay which closes, energizing the closing coil, and closing the breaker. When the closed position is reached, the release coil is energized through the cut-off contacts of the 2-pole switch which is operated by the closing lever. This releases the latch on the relay and allows it to open, even though the operat-

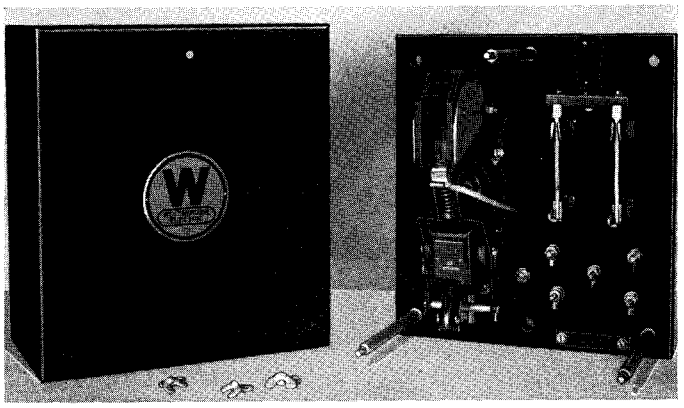


FIG. 2—CONTROL PANEL AND COVER

ing coil is still energized. The relay cannot be closed to energize the breaker closing coil again until the control switch is turned to the neutral position. To trip, the control switch is turned to the trip position energizing the trip coil through the auxiliary switch which is operated by the bell crank lever. As the breaker opens, the trip coil is de-energized by this switch. The 2-pole knife switch is arranged to isolate the breaker from the control circuit.

Hand closing is provided by means of a removable lever which is inserted in a socket of the closing lever. The breaker may be tripped free of the hand closing lever the same as it is from the closing core.

The auxiliary switches are Type W rotary switches. The 2-pole switch is connected to the closing lever and thus moves with the core. It serves to cut-off the closing coil when the cores come together in closing and also provides an extra contact. The 6 or 10-pole switch is connected to the bell crank lever and moves with the breaker. Two sets of contacts, connected in series, are used to de-energize the trip coil and to allow is to be energized when the breaker is closed.

Latch Checking Switch

The latch checking switch is intended primarily for use on circuits where automatic reclosures are desired. It is designed so that the reclosing circuit is not completed until the solenoid mechanism levers have reached the retrieved positions.

When the mechanism has been tripped out, the trip lever is locked out by means of a locking lever until the trip free lever has returned to the retrieved position, at which point the latching lever is disengaged, allowing the switch operating lever to retrieve and close the contacts of the plunger type switch.

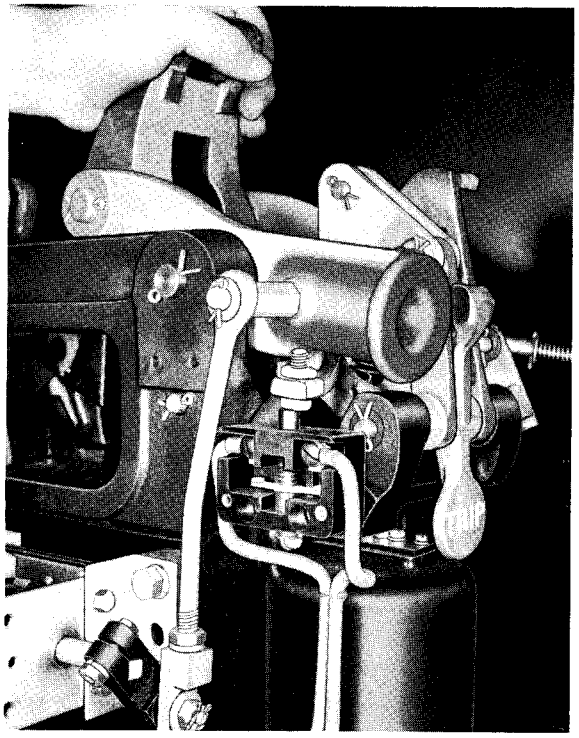


FIG. 5—SA-3 NORMAL LATCHING POSITION

Adjustments

Fig. 3 shows the switch contacts in the closed position with a clearance of $\frac{1}{16}$ to $\frac{3}{16}$ inch between the top of the plunger and the head of the adjusting screw. This clearance is important

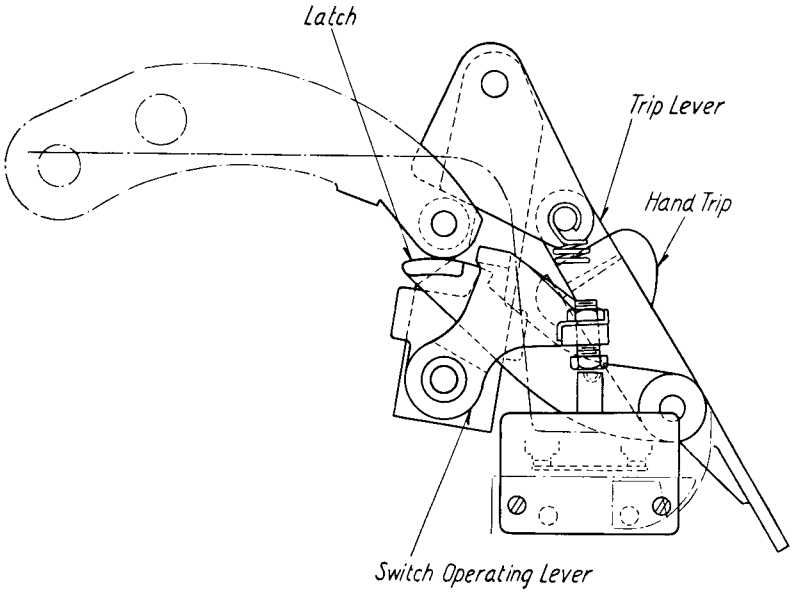


FIG. 3

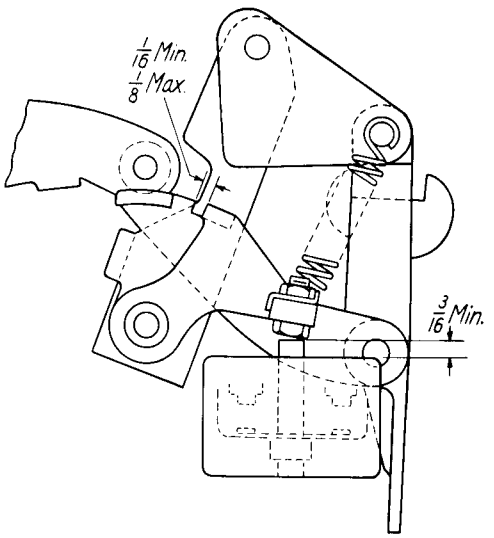


FIG. 4

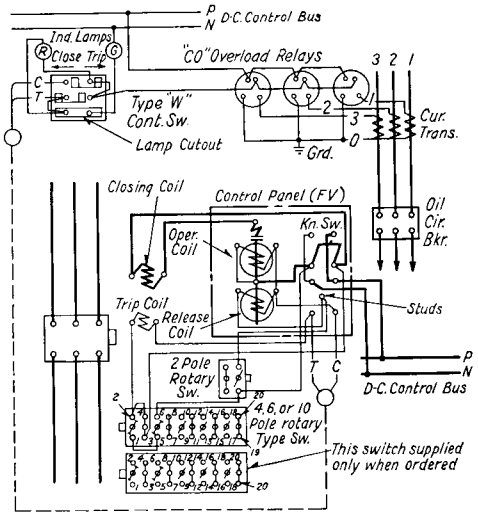


FIG. 6—TYPICAL WIRING DIAGRAM FOR MECHANISM

and must be maintained in order to insure good contact. The adjusting screw may be turned in or out as required to secure the clearance specified. After final adjustments have been made be sure that the lock-nut is securely locked in place.

Fig. 4 shows the switch operating lever in the maximum open position with the contacts of the switch open. In this position there should be a clearance of $\frac{1}{16}$ to $\frac{1}{8}$ inch between the latch and the switch operating lever. The top of the plunger should also be extending approximately $\frac{3}{16}$ inch minimum above the top of the switch. This dimension should not be less as the plunger will go solid and damage the switch beyond repair.

Fig. 5 shows the normal latching position. Failure to latch out may be due to incorrect angle on latch, insufficient clearance at latching point, or a combination of both.

Tripping Devices

The tripping latch consists of a trigger, which has been hardened and ground, engaging a roller on the trip free lever. This is a slip-off trigger, that is, the surface of the trigger which engages the roller is ground at such an angle that it tends to slip off. It is held engaged by a toggle formed by a pair of links and the tripping lever. This toggle is held slightly over center, against a stop, by the tripping lever spring. When the trip rod strikes the trip lever it breaks this toggle and allows the trigger to slip off. When the mechanism retrieves, the toggle is broken by the roller striking the links on each side of the trigger. A bumper spring is provided on the tripping lever so the toggle will not be disturbed by the closing operation.

Shunt Trip—The standard shunt trip consists of a magnetic circuit, coil, and a stationary and moving core, the upper end of which extends out through the top. A bracket on the bottom retains the moving core and limits its travel to about one inch. A thin brass washer prevents the cores from coming tight together.

4-Coil Trip Attachment—This tripping device, illustrated in Fig. 10, is to be used when transformer trips coils, capacitor trip, or undervoltage release is required. Space is provided for a total of four trip coils, including shunt trip, overload trip, with or without inverse time attachment or direct trip, and undervoltage trip. Only three direct trips and one under-voltage trip can be used. Otherwise, any combination up to four may be obtained.

The trip attachment is bolted to the mechanism in the place of the standard shunt trip. It is flexibly mounted so that the shock of operation will not jar the tripping devices. Referring to Fig. 10, the trip rod is located under the trigger. The trip rod is held down by a toggle linkage which engages it in the notched portion. This linkage consists of links and a U lever which are normally down over center. When the linkage is struck in the center from below, the toggle is broken, the latch pin moves to the right and the trip rod is forced upward by the trip rod spring.

This toggle linkage is located right over the four tripping devices. An "H" shaped bar rests on the four bushings through which the trip rods slide. The

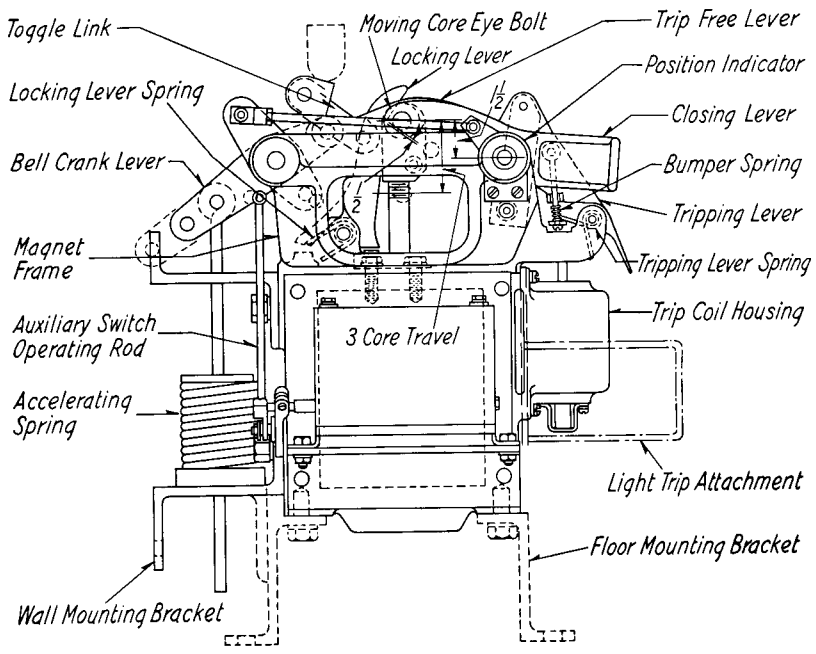


FIG. 7—TYPE "SA" 3-INCH SOLENOID MECHANISM DETAILS

operation of any one of the trips tilts up that corner of the "H" bar and raises the center enough to push the toggle up over center. In case one or more of the trips is omitted, a dummy bushing is used and the operation of the others is not affected.

As already explained, the force to trip the breaker comes from the trip spring. After tripping, and before another operation can take place, the trip rod must be reset. This is accomplished by the reset rod which is connected to the mechanism closing lever. The reset rod operates a reversing lever at the bottom, which in turn acts on the lower end of the trip rod, through a tube when the breaker is tripped, the reset rod rises and the trip rod which has just hit the trigger lever is moved downward and engaged with the latching pin. Then, on closing, the reset rod moves down and the lower end of the trip spring moves upward. Thus it stays until the breaker is tripped again.

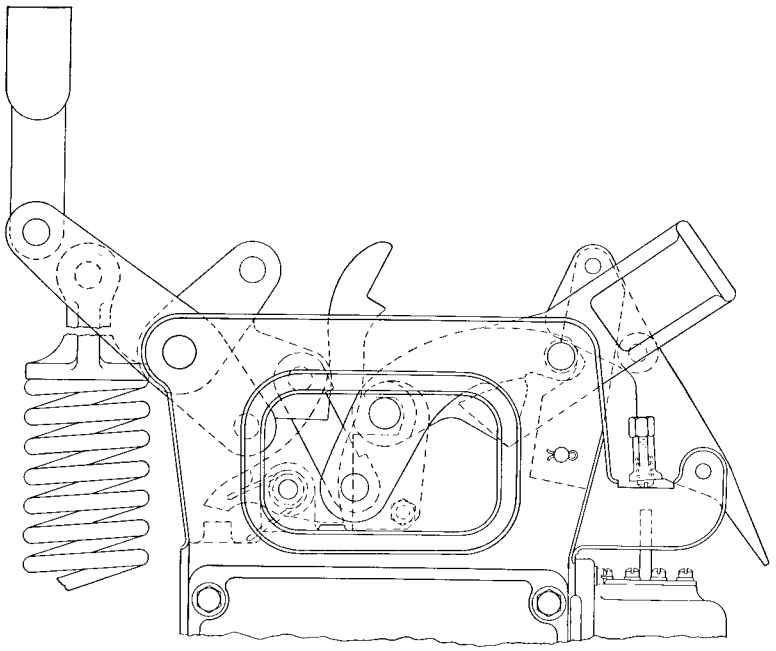


FIG. 9—MECHANISM—OPEN

Undervoltage Trip—The undervoltage device is mounted in the left hand rear space. A separate magnetic circuit surrounds the coil so that positive action of this part of the device is obtained. When the coil is energized the upper core is held down against the stationary core against the pull of the spring which is bias across the diamond shaped toggle device just below the mounting bracket. When the voltage across the undervoltage coil falls to a value of from 60 to 40 percent of normal, the undervoltage coil is no longer able to retain the upper core against the force of the spring. The spring then causes the core to rise and drives the trip against the trip bar.

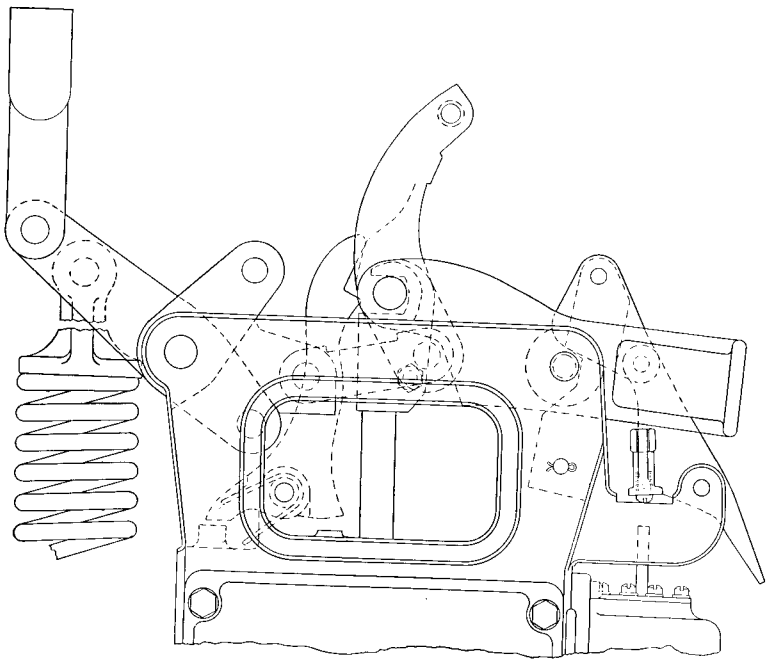


FIG. 8—MECHANISM—TRIPPED FREE

As the breaker returns to the open position the movement of the resetting rod and the reversing lever draws the diamond shaped toggle downward, bringing the undervoltage coils together. At the end of the stroke a small latch engages the inner end of the diamond shaped toggle to prevent the undervoltage release from tripping the breaker until the closing position of the breaker is reached. This latch is released by the rising of the reversing lever during the closing stroke of the breaker as it compresses the tripping spring.

5-Ampere Transformer Trip on Overload Trip—This is shown by Fig. 11 and is a duplicate of the shunt trip except for the coil. It is calibrated for tripping current of from 5 to 9 amperes. It is set to pick up and trip at 5 amperes. The setting is changed by raising or lowering the moving core, by means of the screw which extends from the lower end of the tube cap. The screw is secured by a locking nut which should be loosened before adjusting and retightened after setting is correct. Lowering the plunger gives higher pick up and current values and raising the plunger gives lower values.

Inverse Time Element Trip—Fig. 12 shows an attachment which can be adapted to a 5-ampere overload where tripping is not desired unless overload

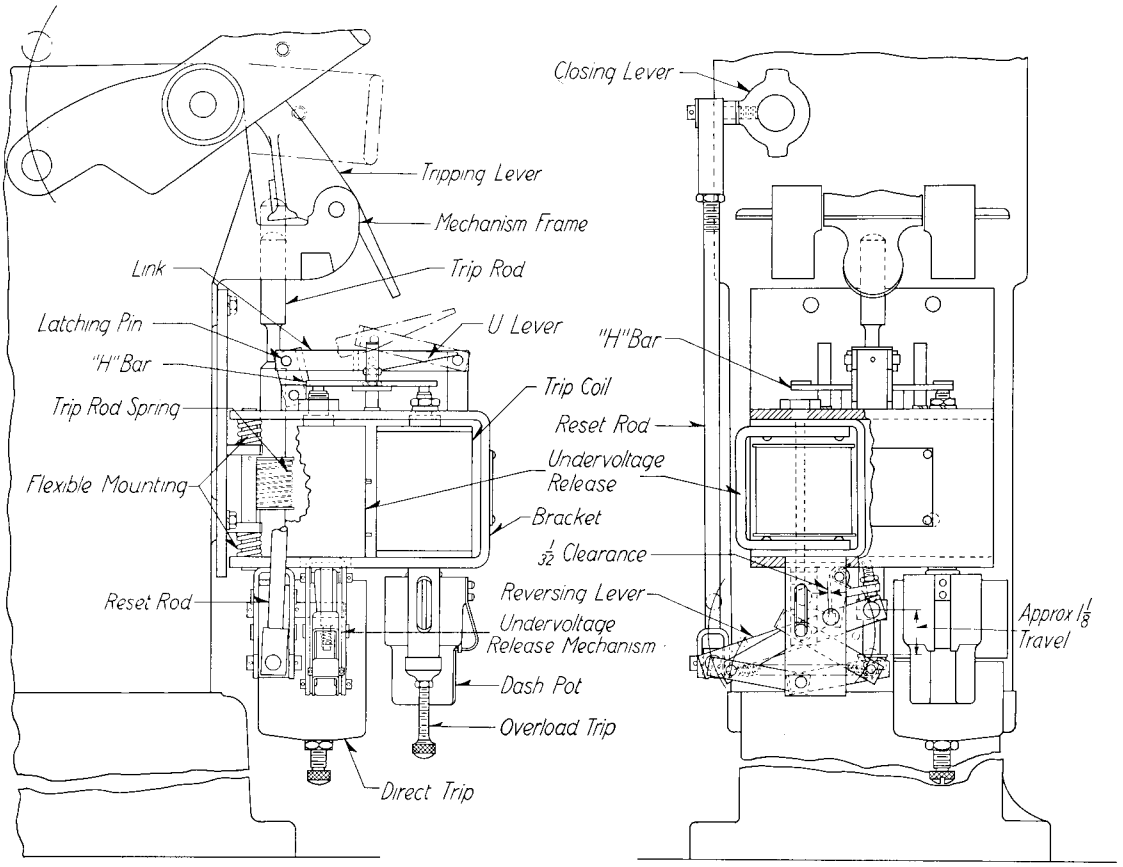


FIG. 10—FOUR COIL TRIPPING ATTACHMENT

continues for a predetermined length of time. The calibration is inscribed on the dashpot and is varied by screwing the pot into the cover.

The time is varied by changing the number of holes in the bottom of the piston uncovered by the diaphragm. Instantaneous resetting is possible because the check valve action of the washer at the time of tripping varies inversely with the amount of overload and directly with the variation in the viscosity of the oil. Fig. 13 shows variations of the time with the variations of the overload and the effect of changed temperature on the standard dashpot oil as supplied with the dashpot.

THE INVERSE TIME LIMIT ATTACHMENT should not be used when temperature is below 15°C. unless special oil is provided for dashpot.

Direct Trip Attachment—For low temperature which makes the dashpot unreliable, or where a definite time delay in tripping is desired, the trip with the attachment shown in Fig. 15 is available. This is used with a 5 ampere transformer trip and is connected as shown schematically for one phase in Fig. 14.

The device consists essentially of two concentric coils wound to oppose each other with a suitable magnetic circuit and a flat plate armature fastened to the lower end of the trip core. The outer or holding coil, with leads marked 3 and 4, is connected in series with the transformer trip coil and the CO relay operating coil. The current flowing in this coil serves to hold and seal the flat plate

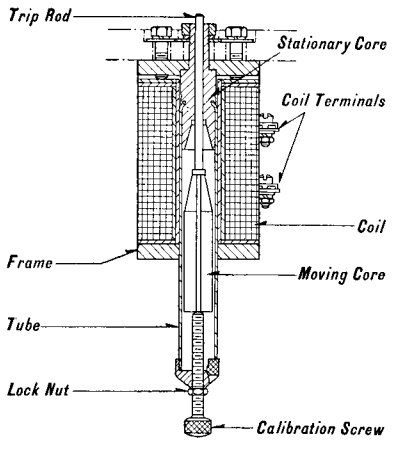


FIG. 11—SHUNT TRIP AND 5-AMP. TRANSFORMER TRIP

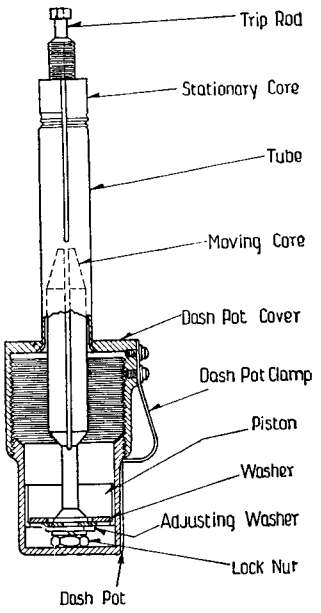


FIG. 12—INVERSE TIME ELEMENT TRIP

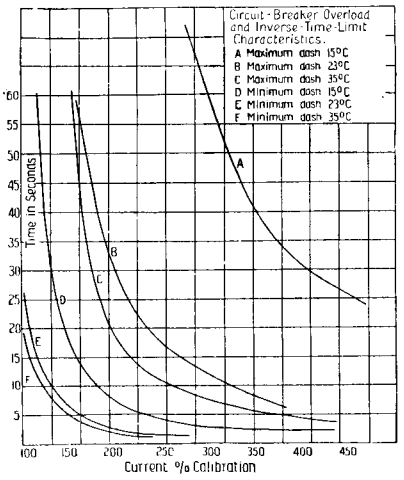


FIG. 13—CURVES FOR INVERSE TIME ELEMENT

armature to the pole pieces. The inner or secondary coil, with red leads, marked 1 and 2, is connected to the CO relay contacts and is short circuited by the action of this relay. When short circuited by the relay, the current induced in this circuit serves to set up a flux opposed to that holding the armature which is released allowing the transformer trip to function. An adjusting screw, balance spring and adjusting pin are provided to balance weight of the moving parts so that the armature will just touch the pole pieces when no current is flowing.

The armature and pole pieces must be kept clean and free from foreign matter as the breaker would be tripped out without functioning of relays if armature is not properly seated. Care must be observed in cleaning that the non-magnetic plating which covers the flat plate armature is not removed or injured. The pole pieces and the armature are accurately flat and care should be taken that the armature is not bent by mishandling, if it is removed for any reason. Variation in time delay with this device is obtained by adjusting the CO relays, The transformer trip and coils are the same as for the 5 ampere transformer trip.

Adjustment

When the mechanism is shipped from the factory attached to the breaker, it has been thoroughly inspected, adjusted and tested and no changes should be necessary. If it is to be assembled in the field certain relations must be obtained.

When setting up and connecting the breaker and mechanism, be sure the leverages and travel relations indicated on the assembly drawings are maintained. In the closed position the connecting rods should be adjusted to allow clearance at the breaker stops. The core should have approximately $\frac{1}{16}''$ overtravel, after latching, with the breaker stops still clear. In the open position the breaker should rest on its bumpers with clearance at the mechanism stop. After setting up, check the complete operation. Operate electrically and be sure that there is not an excessive amount of slamming.

The auxiliary switches are adjustable both in stroke and position. These switches are adjusted and set at the factory and should be correct. Certain conditions may necessitate a change in the cut-off switch adjustment as it is rather particular. However it is not always the cause of the mechanism failing to latch should this occur.

Should it be necessary to change contacts on the auxiliary switch from closed to open or vice versa in a given position, remove the switch and take the rotor out and remove the bolt in the end of the shaft opposite the lever. Take off the parts and rotate to the new position. Be sure to replace all parts in the proper relation and tighten up. Then check the operation of the switch when connected.

The control relay is adjusted and tested at the factory. The contacts should be kept clean by using sandpaper occasionally. **Never use emery cloth.** Coils can be identified by the style number stamped on them.

The shunt trip should require no adjustment. It should be kept tight and its mounting bolts should not be allowed to loosen as there is a definite relation to maintain between the trip rod and the tripping lever.

The 4 coil tripping attachment when used is mounted in place of the shunt trip. If shipped with the mechanism, it is tested and adjusted at the factory. If it is shipped separately to replace the shunt trip in the field, the shunt trip is removed and it is bolted on. The shoulder screw is put in the closing lever and the resetting rod put on.

With the mechanism trigger held in the open position the hand closing lever of the breaker should be moved slowly to the closed position. Before reaching the closing position, the latch of the mechanism can be released and the toggle latch disengaged. See that with the solenoid mechanism latch out of the way, the trip rod rises $\frac{7}{8}''$. With the mechanism in the closed position the distance from the cross head of the under side of the bracket should be $\frac{13}{16}''$ as indicated in Fig. 10. The resetting rod should be adjusted to obtain this dimension.

Raise any one of the tripping cores slowly by hand. The clearance between the screw in the "H" bar and the pin in the center of the toggle latch should not be over $\frac{1}{32}''$.

In the open position of the breaker check to see that the undervoltage release is drawn downward so that the

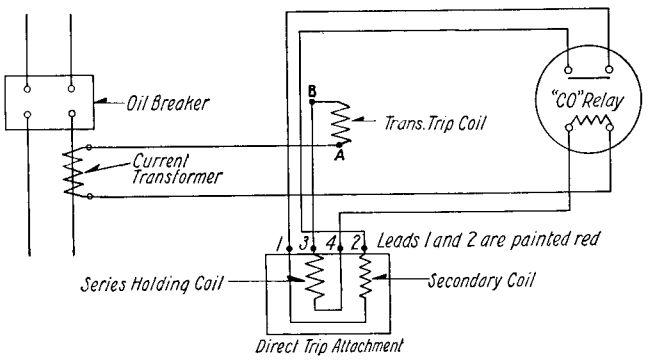


FIG. 14—SCHEMATIC DIAGRAM OF CONNECTIONS FOR DIRECT-TRIP ATTACHMENT

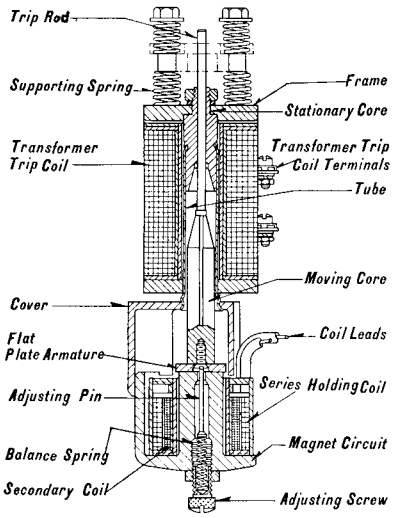


FIG. 15—OVERLOAD WITH DIRECT TRIP ATTACHMENT

lockout trigger engages positively. The screw on the inner end of this trigger should be adjusted so that with the mechanism in the closed position the latching surface of the trigger clears the end of the diamond shaped toggle by $\frac{1}{32}$" as shown in Fig. 10.

The adjustment of the tripping devices on the 4 coil attachment is explained under the heading of Operation.

Inspection

The electric solenoid closing mechanism contains a number of moving joints and operating parts all of which are subject to wear or sticking, if not kept in the proper condition. It is desirable to inspect the mechanism at regular intervals and be assured of its good condition by making a number of operations, regular adjustments and repair. It is desirable to apply a light lubricating oil to the various pins but it should not be done to the extent of causing the joints to become gummed or sticky. It is necessary to keep the moving parts, particularly the trigger and switches, clean and free from foreign matter.

In case there is any trouble in operation, the mechanism should be taken out of service at once and put into the proper condition. The circuit-breaker is highly dependent on the proper functioning of the mechanism and therefore it should always be kept in good condition.

Rectox Rectifiers

General—This rectifier is designed to deliver direct-current at the amperage and voltage stamped on the name plate at any commercial frequency. The normal value of a-c. voltage at which the rated d-c. output may be obtained appears on the name plate.

The complete unit consists of a full wave rectifying element, adjustable series resistor in the a-c. line, a fuse in each a-c. line and suitable mounting plate or enclosing tank.

The rectifier units should not be immersed in oil.

See Fig. 1 for schematic diagram of the complete rectifier.

Operation—This rectifier is designed for intermittent operation only and must not be used to supply other loads than the breaker solenoid.

Unless otherwise indicated on the name plate the a-c. voltage must not be applied to the rectifier for longer than one second nor more than 10 operations within a five-minute period.

The rectifier rating must not be exceeded, as for instance by the operation of two solenoids at once.

Maintenance and Adjustment

Fuses—Use fuses having rating of approximately $\frac{3}{8}$ of the maximum d-c. load current drawn by the breaker solenoid. Fuses of this rating are used in order to protect the rectifying unit in case load should remain connected to the outfit for longer than the permissible time.

Resistor—The resistor is included as a means of compensating for variables such as line voltage, lead resistance, rectifier resistance, temperature, breaker mechanism variation, etc.

When the rectox is shipped from the factory it is set to give proper breaker operating speed at rated a-c. line voltage. When installing, the breaker closing time should be checked to see that correct operation is obtained, since line voltage conditions may be different from those at the factory. This should be done by means of a cycle counter after all mechanical and dashpot adjustments have been checked.

If closing time is incorrect, the series resistor in the rectox assembly must be adjusted.

To obtain quicker breaker operation, reduce the series resistance.

To obtain slower breaker operation, increase the series resistance.

Note—No further adjustment of the series resistor should be necessary except as may be required by the normal aging of the rectifier unit. Approximately 30 days after the unit has been installed, the breaker closing time should again be checked under the same conditions of supply voltage as existed during installation. Adjustment to take care of any change during the first 30 days, is again made by means of the series resistor. Following this adjustment, no further attention should be necessary except at normal periods of breaker maintenance, say every 6 months.

Current and Voltage Measurements—Measurements of rectifier output voltage and current can be made only by means of an Osiso, oscillograph, or coded meter, as the time required to use ordinary indicating instruments may damage the rectifier. Measurement of the closing time of the breaker, with a cycle counter, is usually sufficient indication of the rectifier output.

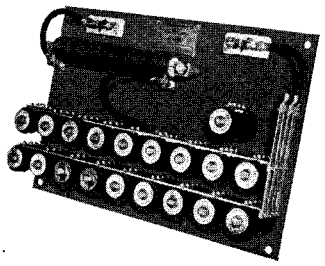


FIG. 16—PLATE-MOUNTED RECTOX FOR A-C. OPERATION

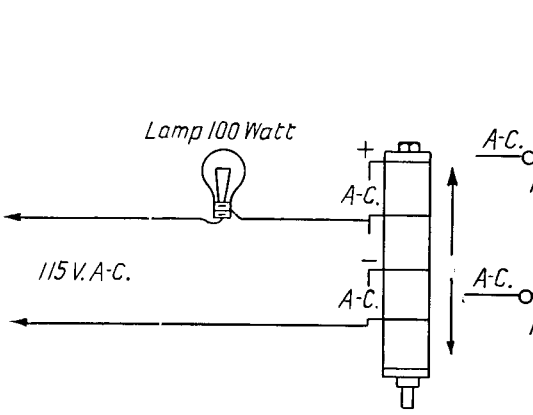


FIG. 17

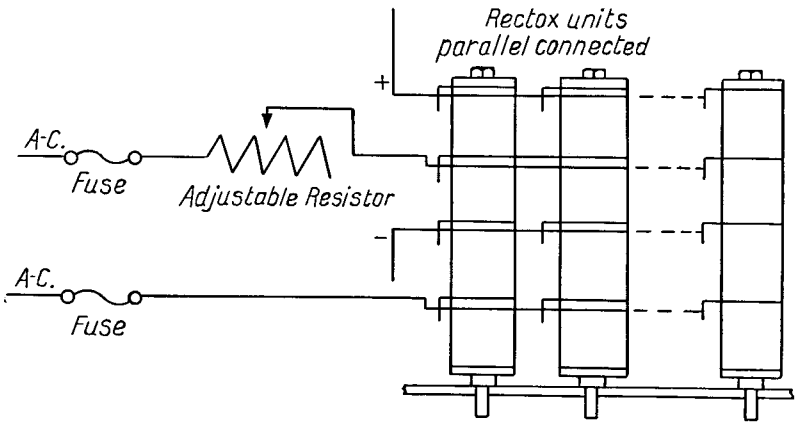


FIG. 18

Investigation of Troubles—If the unit fails to close the breaker, proceed as follows:

a. Check the a-c. supply source to see that adequate voltage is available when the full load is being drawn.

b. Check the Rectox fuses to see that they are not blown.

c. Inspect all connections to see that none is open.

d. If all of the above appear to be satisfactory then probably a Rectox unit has failed unless the breaker mechanism is out of adjustment.

A. The failed unit may be detected as follows:

a. Disconnect the Rectox from the a-c. and d-c. circuits.

b. Apply 110 volts a-c. with a 100 watt lamp in series to the a-c. terminals of the rectifier for not more than one second.

c. If the lamp lights, one or more of the individual stacks have failed.

B. By means of the same test the particular unit or units that have failed can be picked out.

a. Disconnect all the units from each other.

b. Apply to the a-c. terminals of each stack in turn the 110 volt a-c. with the 100 watt lamp in series as before.

c. All units which light the lamp should be removed.

Emergency Operation—If an emergency exists, defective units can be removed and remaining units reconnected and put back into service temporarily. Some adjustment of the series resistor may be necessary to get the proper output. Replacement of failed units should be made as soon as possible.

10.6

Renewal Parts Data

Recommended Stock of Renewal Parts
TYPE SA-3 SOLENOID-OPERATED MECHANISM
For Oil Circuit Breakers
For Illustration of Parts See Figure 3

The following is a list of the Renewal Parts and the quantities of each that we recommend should be stocked by the user of this apparatus to minimize interrupted operation caused by breakdowns. The parts recommended are those most subject to wear in normal operation or those subject to damage or breakage due to possible abnormal conditions. This list of Renewal Parts is given only as a guide. When continuous operation is a primary consideration additional insurance against shut-downs is desirable. Under such conditions more renewal parts should be carried, the amount depending upon the severity of the service and the time required to secure replacement.

Mechanisms in use up to and including		1	5	
Name of Part	No. Per Mechanism	Recommended for Stock		Style No. of Part
Mechanism Without Coils	1	0	0	...
Closing Lever	1	0	0	546 015
Trip Free Lever	1	0	0	546 016
Moving Core	1	0	0	998 441
Moving Core Eye Bolt	1	0	0	546 014
Stationary Core with Brass Sleeve	1	0	0	998 442
Tripping Lever	1	0	0	...
Bumper Spring	1	0	1	584 274
Tripping Lever Spring	1	0	1	546 018
* Tripping Lever Roller	1	0	0	940 210
* Trip Moving Core	1	0	0	562 132
* Trip Stationary Core	1	0	0	562 133
* Latch	1	0	0	546 037
Locking Lever	1	0	0	546 023
Locking Lever Spring	1	0	1	546 017
Accelerating Spring	1	0	1	...
Type W Auxiliary Switch—2 Pole	1	0	0	1 105 178
* Moving Contact Segment	2	0	1	545 626
* Stationary Contact Finger	4	1	4	519 279
Type W Auxiliary Switch—10 Pole	1	0	0	676 966
* Moving Contact Segment—Large	2	0	1	545 837
* Moving Contact Segment—Small	8	1	4	545 626
* Stationary Contact Finger	20	4	20	519 279
* Operation Counter	1	0	0	1 166 922
*Latch Checking Switch	1	0	0	1 114 956
†Closing Coil	1	0	0	†
†Trip Coil	1	0	1	†

* Not listed on illustration.
† When ordering, specify identification number stamped on part.
Parts indented are included in the part under which they are indented.

ORDERING INSTRUCTIONS

When ordering Renewal Parts, always specify the name of the part wanted as shown on the illustrations in this Instruction Book, giving Shop Order Number, and the type of Mechanism, as shown on the nameplate. For example:

One Tripping Lever, for Type SA-3 Solenoid Operated Mechanism, S. O. 28-F-283, shown in Instruction Book 5567, Figure 3.

To avoid delays and misunderstanding, note carefully the following points:

1. Send all correspondence and orders to the nearest Sales Office of the Company.

2. State whether shipment is to be made by freight, express or parcel post. In the absence of instructions, goods will be shipped at our discretion. Parcel post shipments will be insured only on request. All shipments are at purchaser's risk.

3. Small orders should be combined so as to amount to a value of at least $1.00 net. Where the total of the sale is less than this, the material will be invoiced at $1.00.

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DALLAS, TEXAS, 405 No. Griffin St.
DAVENPORT, IOWA, 402 E. Fourth St.
DES MOINES, IOWA, 1400 Walnut St.
DETROIT, MICH., 547 Harper Ave.
DULUTH, MINN., 308 W. Michigan St.
EVANSVILLE, IND., 201 N. W. First St.
FLINT, MICH., 1314 N. Saginaw St.
FORT WAYNE, IND., 612 S. Harrison St.
FORT WORTH, TEXAS, 210 Jones St.
GRAND RAPIDS, MICH., 511 Monroe Ave. N. W.
GREENVILLE, S. C., 226 Pendleton St.
HOUSTON, TEXAS, 1903 Ruiz St.
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JACKSONVILLE, FLA., 37 South Hogan St.
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MEMPHIS, TENN., 366 Madison Ave.
MIAMI, FLA., 11 N. E. Sixth St.
MILWAUKEE, WISC., 546 N. Broadway
MINNEAPOLIS, MINN., 215 South Fourth St.
NEWARK, N. J., 49 Liberty St.
NEW HAVEN, CONN., 240 Cedar St.
zNEW YORK, N. Y., 150 Varick St.
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PEORIA, ILL., 104 East State St.
PHILADELPHIA, PA., 1101 Race St.
PHOENIX, ARIZONA, 315 West Jackson St.
PITTSBURGH, PA., 575 Sixth Ave.
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SPOKANE, WASH., 152 So. Monroe St.
SPRINGFIELD, MASS., 46 Hampden St.
SYRACUSE, N. Y., 961 W. Genesee St.
①TACOMA, WASH., 1115 "A" St.
TAMPA, FLA., 417 Ellamae St.
TERRE HAUTE, IND., 234 So. 3rd St.
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①TULSA, OKLA., 303 East Brady St.
UTICA, N. Y., 113 N. Genesee St.
WASHINGTON, D. C., 1216 "K" St., N.W
WATERLOO, IOWA, 328 Jefferson St.
WHEELING, W. VA., 1117 Main St.
WICHITA, KANSAS, 233 So. St. Francis Ave.
WILLIAMSPORT, PA., 348 W. Fourth St.
WILMINGTON, DEL., 216 E. Second St.
①WORCESTER, MASS., 17 Mulberry St.
YORK, PA., 143 S. George St.

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①Changed or added since previous issue.

October, 1940

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RETURN
TO
ENGINEERING DIVISION
BUFFALO OFFICE
WESTINGHOUSE ELEC. & MFG. CO.

Westinghouse

Type SA-6 Solenoid Operated Mechanism for Circuit-Breakers

INSTRUCTION BOOK

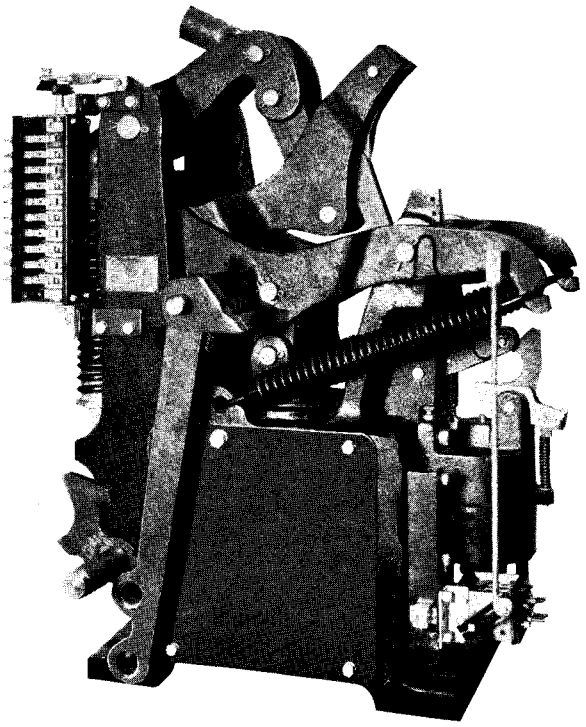


FIG. 1—MECHANISM—TRIPPED FREE

Westinghouse Electric & Manufacturing Company
East Pittsburgh, Pa.

Printed in U.S.A. (Rep. 7-30)

I. B. 5657
(Filing No. 33-000)

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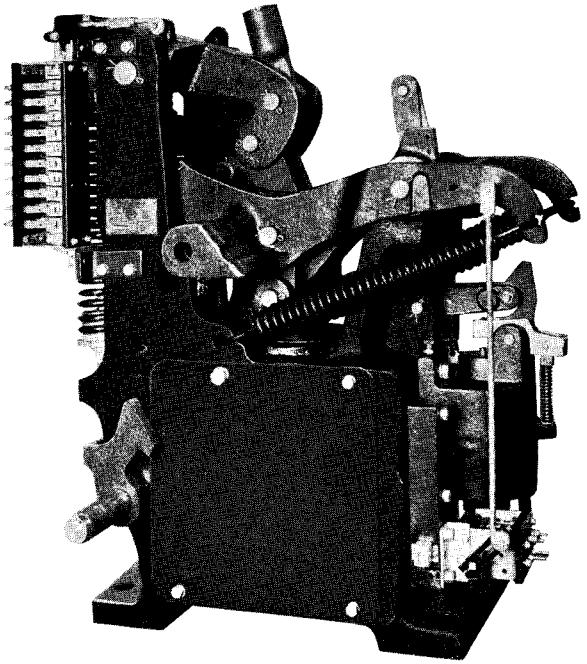


FIG. 2—MECHANISM—CLOSED POSITION

Westinghouse

Type SA-6 Solenoid Operated Mechanism for Circuit-Breakers

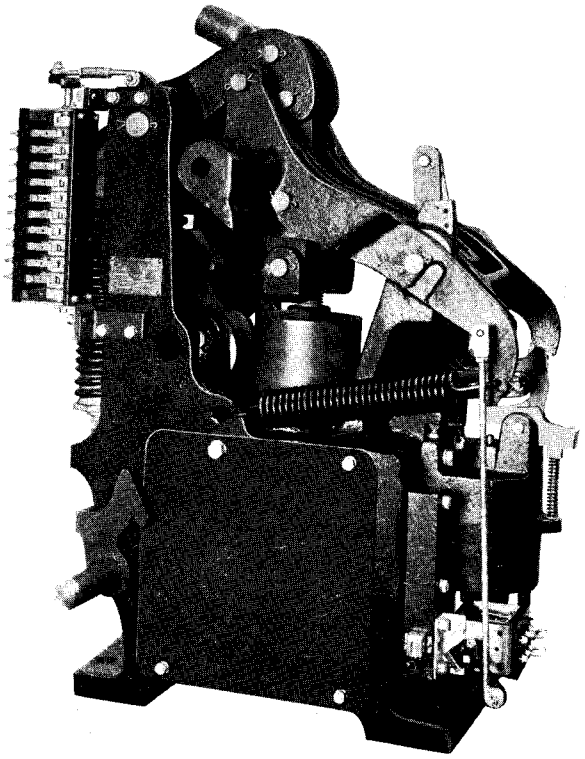


FIG. 3—MECHANISM—OPEN POSITION

Introduction

This mechanism is the direct current solenoid type, mechanically full automatic, trip free in all positions. It is applicable to indoor and outdoor circuit-breakers and, in the case of the latter, is mounted in a steel weatherproof housing and connected to the breaker by enclosed pull rods. It is supplied complete with a control panel on which is mounted the control relay, knife switch and terminals for external connections. The standard mechanism is equipped with a single coil shunt trip, a 10-pole auxiliary switch, a Veeder counter and the control panel. Special combinations of switches may be obtained with as many as 18 auxiliary contacts. Also a double shunt trip can be provided.

Shipment and Storage

Each mechanism is carefully inspected and tested at the factory and should be in good condition when received. It should be carefully inspected for damages caused in shipment, when received.

If the mechanism is to be stored for any length of time, it should be kept in a clean, dry place, protected from corrosion and moisture. It should never be allowed to stand where moisture can reach the insulated parts. It should be handled with reasonable care to prevent breakages.

Unpacking should be done carefully so as not to damage the mechanism. All parts should be checked with the shipping list and care taken not to leave any part in the packing material. An Instruction Book should accompany the mechanism along with proper identification tags.

Operation

Figure 4 shows the mechanism in the closed position and gives the names of the various parts. Referring to this figure, the breaker is connected to the operating lever either at the down-pull rod end as shown or an up-pull rod end on the other end of the operating lever, depending upon the application. Usually only the one of these which is used is supplied. This operating lever is pivoted on the frame at C and is connected by a link to the full automatic lever. The full automatic lever is inside of the main lever and the two rotate

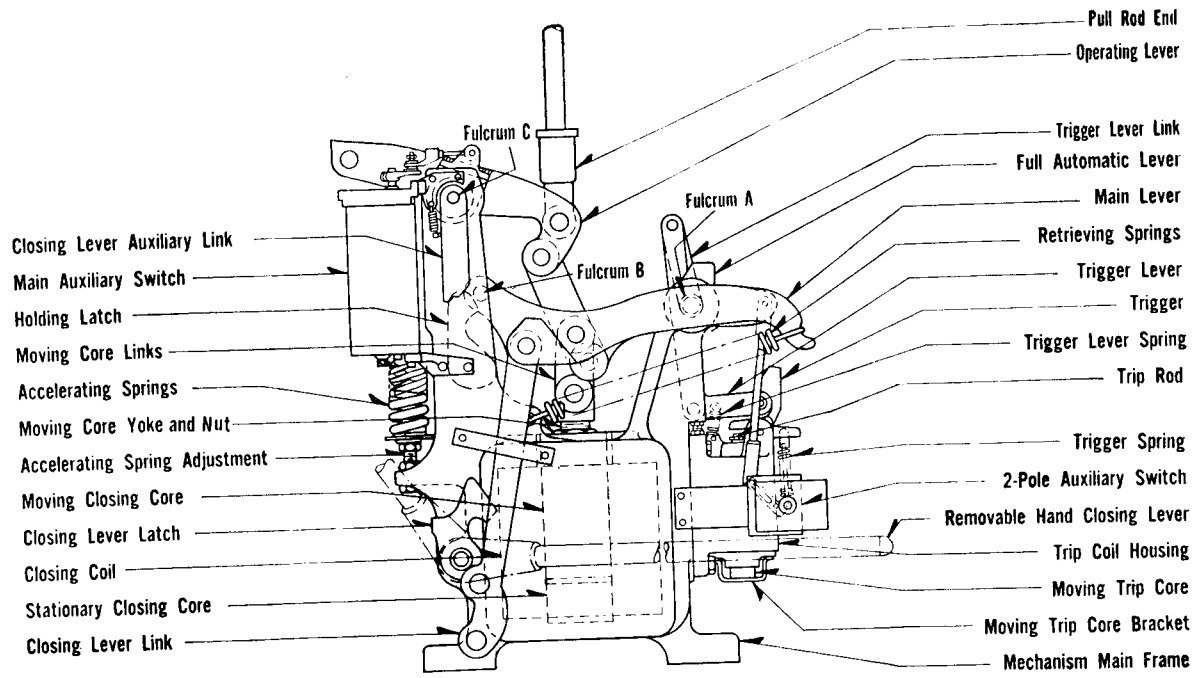


FIG. 4—SOLENOID MECHANISM, TYPE SA-6 (CLOSED POSITION) WITH LEVER TYPE HAND CLOSING

together in closing about the fulcrum A. These two levers are pivoted together at B. The operating lever is connected to the closing core through links and the moving core yoke. From the open position (Fig. 6) when the control switch on the switchboard is moved to the position for closing, the contactor on the control panel is closed. This energizes the closing coil and causes the closing core to move downward. The main and full automatic levers rotate together counterclockwise about A as the core moves down. This rotates the operating lever clockwise about C closing the breaker. When the closed position (Fig. 4) is reached, the closing core strikes the stationary core and the holding latch engages with the full automatic lever and holds the breaker closed.

When the trip coil is energized the trip plunger rises, striking the trigger which rotates clockwise. This releases the roller allowing the trigger lever to rotate counterclockwise about its center. The trigger lever link which is holding the right hand end of the full automatic lever down moves out of the way and allows the right hand end of the full automatic lever to rise as it rotates about B. The link attached to this lever moves upward allowing the operating lever to rotate counterclockwise about C opening the breaker. Figure 5 shows this position. Almost simultaneously with this action the holding latch is released due to the upward rotation of the full automatic lever about B. The main lever is then rotated clockwise about A by the retrieving springs and the mechanism returns to the open position (Fig. 6). It is then ready for a subsequent closing operation.

It is essential to have the mechanism connected to the control power supply by leads of sufficient capacity to maintain full control voltage at the mechanism. Otherwise, the voltage may fall below that required for closing.

Two accelerating springs are provided on the rear of the mechanism, attached to the operating lever. They act to speed up the opening stroke and make the action more positive.

It will be noted that the 10 pole auxiliary switch is connected to the operating lever and thus indicates the position of the breaker. The 2 pole, or cut off switch, is connected to the main lever and thus indicates the position of the closing core.

Several types of hand closing devices are available for this mechanism. The one used depends upon the application. Whatever type is used is attached to the main lever.

The jack type hand closing lever is constructed like an automobile jack arranged to pull if attached on the side of the mechanism and to push if attached to the front extension on the operating lever. Fig. 7 shows the pull type designed for application at the side on the operating lever. The jack consists of a double worm gear arrangement operated by a hand crank or lever. Pin holes are provided in each end to attach to the mechanism lever. The jack must always be removed so as not to interfere with the breaker operation.

Some applications use an ordinary link and lever arrangement. The lever is either pivoted on the mechanism frame (Fig. 4) or else at a convenient point on the structure. A long detachable handle is used to rotate this lever and close the breaker.

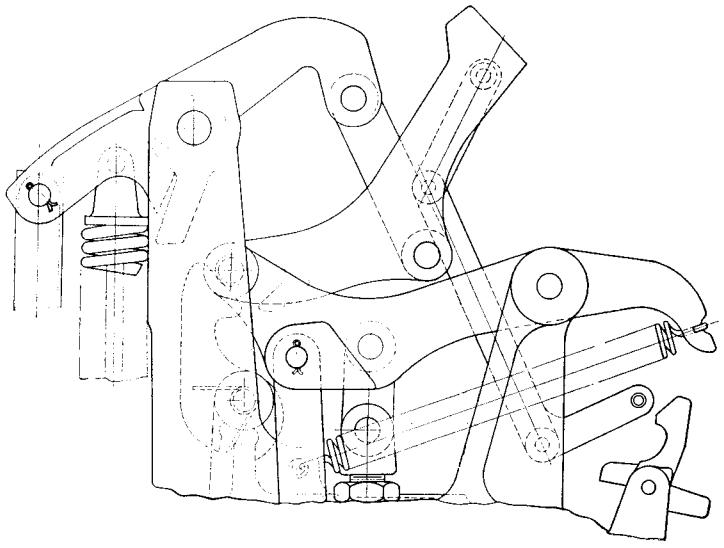


FIG. 5—MECHANISM TRIPPED FREE

In certain cases a "two bite" lever is used. This consists of a link with two holes in the lower end. The link attaches at the side (Fig. 4). The lever fits on the pin on the mechanism frame and has a pin which is inserted first in the lower hole in the link. The mechanism is then pulled half way closed and held by the closing lever latch. Then the handle is rotated back and its pin inserted in the second hole in the link. The mechanism is then pulled to the closed position.

A control panel is always supplied with the mechanism and is connected according to the wiring diagram which is furnished with the breaker. Details of the control relay, connections, etc. will be found in the breaker instruction book.

Adjustment

The mechanism is completely adjusted and tested with the breaker at the factory and it is only necessary to check to see that these adjustments have not been changed. In case the mechanism is connected to the breaker in the field, considerable care must be taken to obtain the proper travel relations and stop adjustments. The breaker stops must be set according to the setting given in the breaker instruction book. The adjustment of the moving core yoke at the top of the operating core in the mechanism determines the core clearance when the holding latch is engaged in the closed position, Fig. 4. This adjustment should be such that there is $\frac{1}{32}$ inch clearance between the holding latch face and the lever it engages when the moving and stationary cores are touching. This is determined by pulling down on the hand closing device until the cores touch and then checking the clearance at the holding latch. This adjustment is properly made at the factory. Owing to the lost motion in the linkage it will be found that it is possible to draw the levers down and obtain somewhat more than $\frac{1}{32}$ inch back lash at the holding latch. Adjustment is made by rotating the core after loosening the lock nut.

If the core is set too low, the mechanism will fail to stay latched because the holding latch cannot engage properly with the core too high there will be excessive overtravel and perhaps insufficient power for pulling the breaker completely closed.

The 2 pole cut-off switch must be adjusted to function late in the closing stroke so as to allow the latch to engage properly. The cut-off coming too early will cause failure in this respect. Correction can be made by adjustment of the 2 pole cut-off switch.

An open position stop is provided on the underside of the operating lever to engage the mechanism frame. There should be clearance at this stop when the breaker is fully open. In other words, the breaker must stop on its bumpers in the open position and not on this stop. It may be noted that the lever strikes this stop in opening due to overtravel, which is permissible as long as the blow is taken on the breaker bumpers.

The trigger is made of hardened tool steel and so designed as to present a

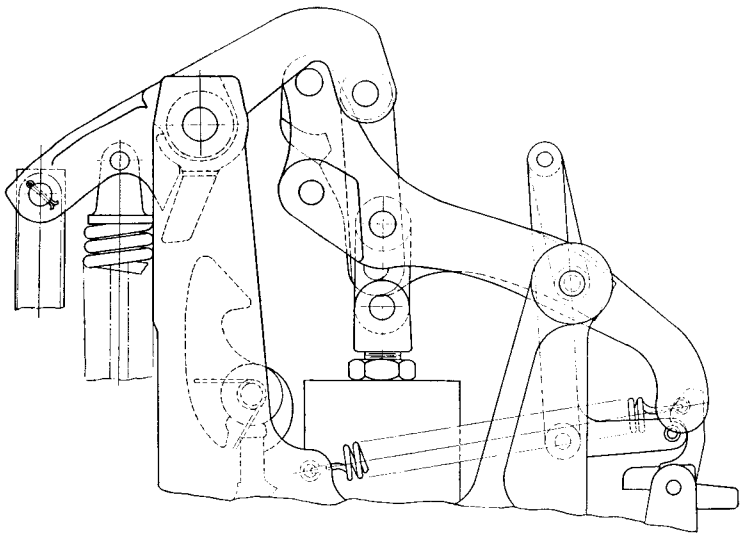


FIG. 6—MECHANISM OPEN

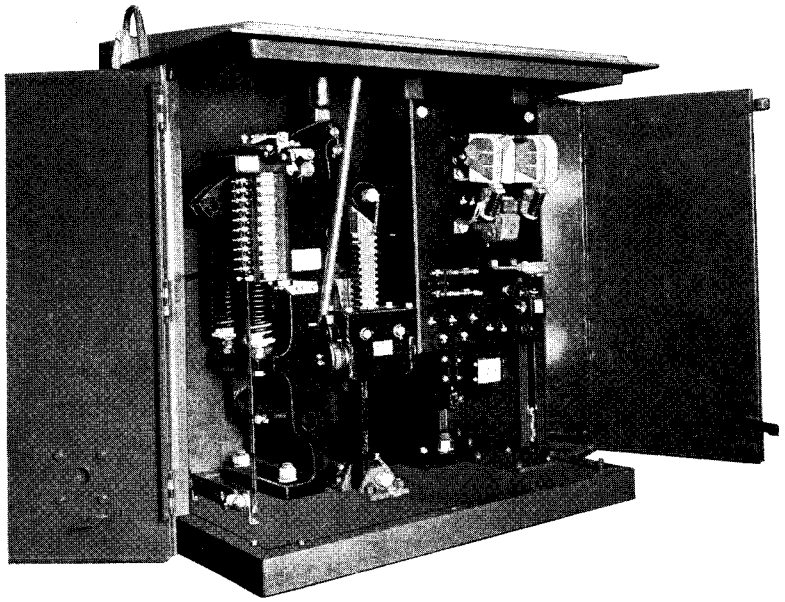


FIG. 7—SOLENOID MECHANISM TYPE SA-6 (OPEN POSITION) WITH JACK TYPE HAND CLOSING

flat surface normal to the direction of travel of the roller in the end of the trigger toggle lever. The length of the latching surface is such that with the trigger hooked on the roller as far as it will go the latching surface will extend approximately ⅛ inch past the center of the roller. When the trip core of the tripping magnet is raised by hand to its maximum upper position, the nose of the trigger should not be more than $\frac{3}{16}$ inch the other side of the center of the roller. Otherwise the mechanism may not trip on minimum voltage. Pulling back on the trigger itself with the roller opposite the nose of the trigger, it should not be possible to move the trigger away from the roller more than ⅛ inch. This motion is limited by a stop on the frame which the trigger engages. This is called the throw of the trigger. A spring restrains this throw, and snaps the trigger into the latched position. It should be only slightly compressed when the trigger is in the latched position. The trigger engaging surface may be polished with fine emery cloth if it becomes dirty or rusty. Do not attempt to grind the surface or change the angle of the face. When the mechanism is in the open position there should be just sufficient clearance between the trigger and the roller to allow the trigger to engage freely when the mechanism retrieves.

The accelerating springs can be adjusted by changing the position of the adjusting bolts and nuts shown in Fig. 4. However, such adjustment should not be necessary as it is properly set at the factory.

In order to open the mechanism slowly by hand during adjustment the hand closing lever must be attached and the main lever pulled down until the load is relieved from the holding latch. It can then be pushed back out of engagement with a long screw driver or rod. The main lever can then be allowed to raise up slowly holding it with the hand closing lever.

Auxiliary Switches

Rotary, type W auxiliary switches are used on this mechanism. They are operated by a link attached to the switch lever which turns the rotor on which the switch segments are mounted. The switch is designed to operate through an angle of 90°. The individual segments can be rotated 90° so that any grouping of the contacts is possible. Special segments may be obtained for special switching arrangements.

The switch lever has an adjustable crank so that the angle of travel can be adjusted. The position of the lever can be adjusted by shortening or lengthening the link connecting to the mechanism lever. The switches are supplied with covers on indoor applications not otherwise housed. Provision is made for bringing the connections in at either end of the switch.

Inspection

The electric solenoid closing mechanism contains a number of moving joints and operating parts all of which are subject to wear or sticking, if not kept in the proper condition. It is desirable to inspect the mechanism at regular intervals and be assured of its good condition by making a number of operations, regular adjustments and repair. It is desirable to apply a light lubricating oil to the various pins but it should not be done to the extent of causing the joints to become gummed or stuck. It is necessary to keep the moving parts, particularly the trigger and switches, clean and free from foreign matter.

In case there is any trouble in operation, the mechanism should be taken out of service at once and put into the proper condition. The circuit-breaker is highly dependent on the proper functioning of the mechanism and therefore it should always be kept in good condition.

Renewal Parts

Ordering Instructions

When ordering renewal parts, specify the name of the part wanted and give the type and stock order number of the mechanism which will be found on the nameplate.

Refer to the back of this book for the nearest Sales Office from which to order parts.

Recommended Stock of Renewal Parts

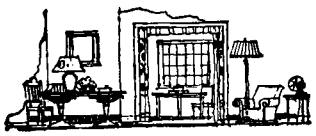
Below is a list of the renewal parts and the minimum quantities of each that should be carried in stock. These are the parts most subject to wear in ordinary operation, and to damage or breakage due to possible abnormal conditions. The maintenance of such stock will minimize service interruptions due to breakdown.

Recommended Stock of Renewal Parts

Total number of Mechanisms up to and including.....		2	5	15
Name of Part	No. Per Breaker	Recommended for Stock		
Electrically Operated Mechanism.....	1	0	0	1
10 Pole Auxiliary Switch.....	1	0	0	1
2 Pole Auxiliary Switch.....	1	0	0	1
Latch Spring.....	1	0	1	2
Holding Latch.....	1	0	1	1
Retrieving Spring.....	2	0	1	2
Trigger.....	1	0	1	1
Trigger Spring.....	1	0	1	2
Accelerating Spring.....	1	0	1	1
Trip Coil.....	1	0	0	1
Closing Coil.....	1	0	0	1

Parts indented are included in the part under which they are indented.
Recommendations for stocking Renewal Parts for your complete equipment will be supplied upon request to the nearest Sales Office.

Westinghouse Products



Homes—Farms

- Air Heaters
- Auto Engine Heaters
- Automatic Irons
- Automatic Percolators
- Automatic Ranges
- Cozy Glow Heaters
- Curling Irons
- Fans
- Hot Plates
- Light and Power Plants
- Lighting Equipment
- Mazda Lamps
- Motors for
  - Buffers and Grinders
  - Ice Cream Freezers
  - Ironers and Washers
  - Refrigerators
  - Sewing Machines
  - Vacuum Cleaners
- Newel Posts
- Panelboards
- Radio Equipment
- Rectigon Chargers for Automobiles and Radio Batteries
- Rectox Trickle Charger
- Refrigerators, Electrical
- Safety Switches
- Sollaire Luminaires
- Sol-Lux Luminaires
- Solar Glow Heaters
- Table Stoves
- Tumbler Water Heaters
- Turnover Toasters
- Vacuum Cleaners
- Wall-Type Heaters
- Waffle Irons
- Warming Pads
- Water Heaters



Buildings

- Arc Welding Equip.
- Circuit-Breakers
- Elevators and Control
- Glue and Solder Pots
- Instruments and Relays
- Kitchen Equipment
  - Bake Ovens
  - Hot Plates, Ranges
- Lighting Equipment
  - Brackets, Newels and Lanterns
  - Reflectors & Lamps
  - Sol-Lux Luminaires
- Lightning Arresters
- Micarta Trays
- Meters
- Meter Service Switches
- Motor Generators
- Motors and Control for:
  - Coal and Ash-Handling Equipment
  - Compressors
  - Elevators
  - Fans and Blowers
  - Laundry Equipment
  - Refrigerating Equip.
  - Vacuum Cleaners
  - Water & Sump Pumps
- Panelboards
- Radio Equipment
- Synchronous Converters
- Safety Switches
- Solar Glow Heaters
- Stokers
- Switchgear
- Transformers



City Improvements

- Airport Floodlights
- Automatic Substations
- Constant Current Regulators
- Control Apparatus
- Elec. Railway Equip.
- Lighting Units
- Mazda Lamps
- Ornamental Standards
- Parkway Cables
- Street Brackets
- Streethoods



Offices and Stores

- Air Heaters
- Bread-baking Oven
- Elevators and Control
- Fans, Desk and Exhaust
- Fuses
- Lighting Equipment
- Mazda Lamps
- Meters
- Micarta Desk Tops
- Motors for
  - Adding Machines
  - Addressing Machines
- Motors for
  - Coffee and Meat Grinders, etc.
  - Dictaphones
  - Envelope Sealers
  - Fans and Blowers
  - Pumps
  - Refrigerating Machines
- Panelboards
- Safety Switches
- Switches
- Tumbler Water Heaters



Aviation

- Approach, Boundary, Hangar, and Obstruction Lights
- Arc Welding Equip.
- Floodlight Projectors
- Motor-Generators
- Reflectors
- Transformers
- Mazda Lamps
- Micarta
  - Cabin-lining Plate
  - Fairleads
  - Hinge Bearings
  - Propellers
  - Pulleys
  - Tailwheels
- Radio Equipment



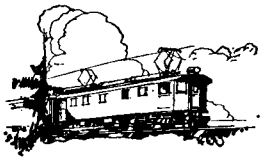
Ships

- Circuit-Breakers
- Condensing Equipment
- Deck Winch Motors
- Elec. Heating Appar.
- Eng. Room Auxiliaries
- Fans and Blowers
- Fuses
- Generating Equipment
- Instruments
- Light and Power Plants
- Lighting Equipment
- Micarta Trays
- Motors and Controllers
- Ovens, Ranges and Galley Equipment
- Panelboards
- Propulsion Equipment
  - Diesel-Electric
  - Geared Turbine
  - Turbine Electric
- Radio Equipment
- Safety Switches
- Switchgear



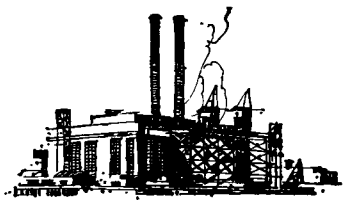
Electric Railways

- Arc Welding Equip.
- Automatic Substations
- Babbitt, Solder & Pots
- Baking Ovens
- Circuit-Breakers
- Elec. Trolley Coaches
- Fans
- Gas Electric Coaches
- Gears and Pinions
- Generators
- Insulating Material
- Insulators
- Lighting Fixtures
- Lightning Arresters
- Line Material
- Manual Substations
- Mazda Lamps
- Meters
- Motors and Control
- Panelboards
- Portable Substations
- Relays
- Signal Equipment
- Supervisory Control
- Switchgear
- Synchronous Convert's
- Transformers
- Trolley Poles



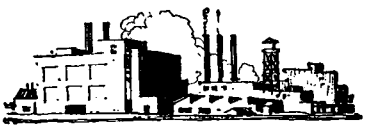
Railroads

- Arc Welding Equipment
- Automatic Substations
- Babbitt, Solder & Pots
- Baking Ovens
- Battery Charging Equip.
- Cars—Multiple-Unit, Gas-Elec., Oil-Elec.
- Circuit-Breakers
- Control Apparatus
- Elec. Heating Apparatus
- Fans
- Gears and Pinions
- Generators
- Headlight Equipment
- Instruments
- Insulating Materials
- Insulators
- Lighting Equipment
- Lightning Arresters
- Line Material
- Locomotives—Electric Gas-Elec., Oil-Elec.
- Manual Substations
- Mazda Lamps
- Micarta Gears
- Motors and Control
- Outdoor Substations
- Panelboards
- Power House Apparatus
- Radio Equipment
- Safety Switches
- Signal Equipment
- Stokers
- Supervisory Control
- Switchgear
- Transformers
- Yard Lighting Equip.



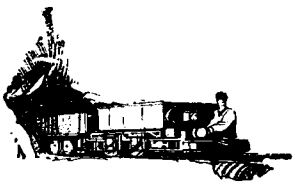
Electric Service Companies

- Automatic Switching Equipment
- Circuit-breakers
- Condensers
- Cutouts
- Fans
- Frequency-converters
- Fuses
- Generators
- Instruments & Meters
- Insulating Material
- Insulators
- Line Material
- Lighting Equipment
- Lightning Arresters
- Micarta
- Motors and Control
- Motor-Generators
- Network Protectors
- Network Transformers
- Oil Testing and Purifying Equipment
- Outdoor Substations
- Panelboards
- Porcelain Insulators
- Relays
- Safety Switches
- Steam Turbines
- Stokers
- Supervisory Control
- Switchgear
- Synchronous Conden'rs
- Synchronous Conv'ters
- Transformers
- Turbine Generators
- Voltage Regulators



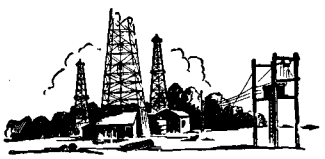
Mills and Factories

- Arc Welding Equip.
- Automatic Starters and Controllers
- Babbitt & Babbitt Pots
- Capacitors
- Circuit-Breakers
- Condensers
- Fans, Desk and Exhaust
- Furnaces and Ovens
- Fuses
- Generating Equipment
- Insulating Materials
- Knife Switches
- Larry Car Equipment
- Lighting Equipment
- Lightning Arresters
- Locomotives—Electric Gas-Elec., Oil Elec.
- Mazda Lamps
- Meters and Relays
- Micarta Gears
- Motors and Controllers
- Panelboards
- Pipe Fittings (Structural)
- Power House Apparatus
- Safety Switches
- Solder & Glue Pots
- Space Heaters
- Stokers
- Switchgear
- Transformers
- Turbines



Mines

- Arc Welding Equip.
- Auto. Feeder Equip.
- Automatic Starters and Controllers
- Automatic Substations
- Battery Charging Equip.
- Circuit-Breakers
- Clamps
- Elec. Heating Apparatus
- Fans
- Gears and Pinions
- Headlights
- Insulating Materials
- Insulators
- Larry Car Equipment
- Lightning Arresters
- Line Material
- Locomotives
- Manual Substations
- Mazda Lamps
- Meters & Instruments
- Micarta
- Motor Generators
- Motors for Hoists, Pumps, Tipples, and Breakers
- Panelboards
- Portable Substations
- Relays
- Safety Switches
- Switchgear
- Synchronous Conv'ters
- Transformers
- Ventilating Outfits



Oil Fields

- Arc Welding Equip.
- Change House Heaters
- Floodlight Projectors
- Gear Units
- Insulators
- Mazda Lamps
- Motors and Control
- Panelboards
- Reflectors
- Rig Lighters
- Safety Switches
- Small Light Plants
- Transformers
- Vapor Proof Fixtures

5957

Westinghouse

"De-ion" Grid Oil Circuit-Breakers

INSTRUCTION BOOK

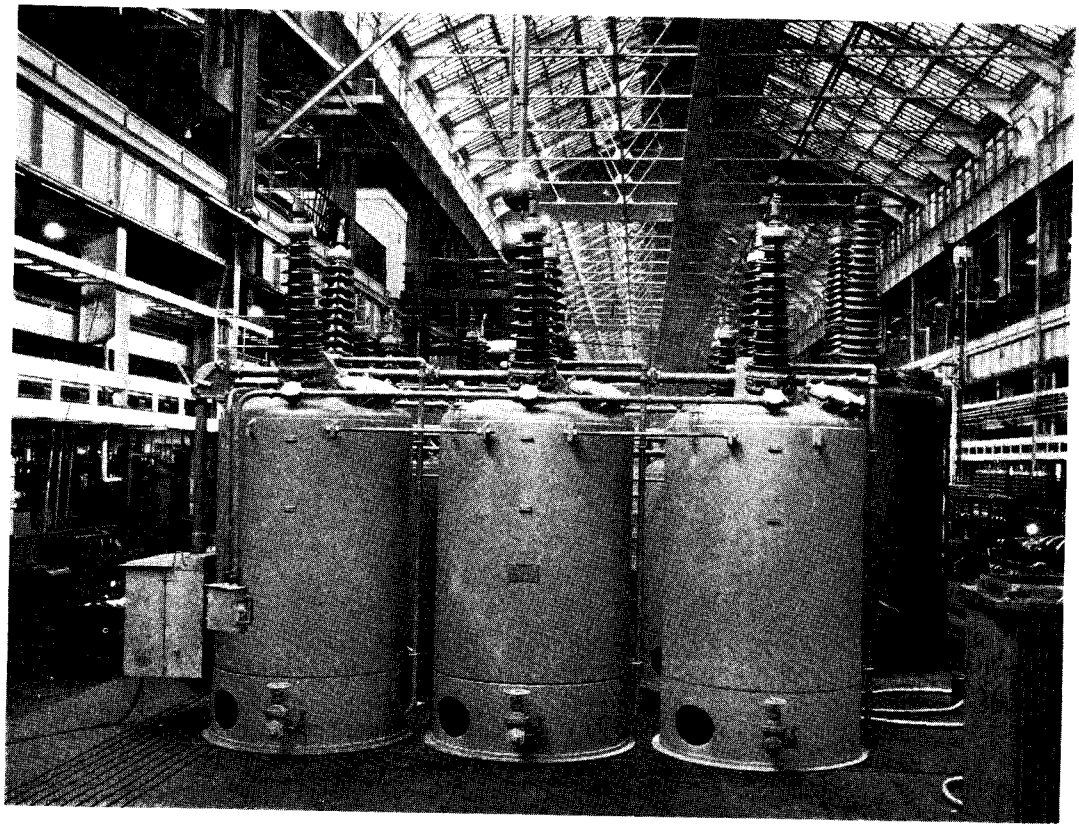


FIG. 1—TYPE GO-2, 138-KV., OIL CIRCUIT-BREAKER

Westinghouse Electric & Manufacturing Company
East Pittsburgh, Pa.

Printed in U.S.A. (Rev. 10-36)

I.B. 5502-C

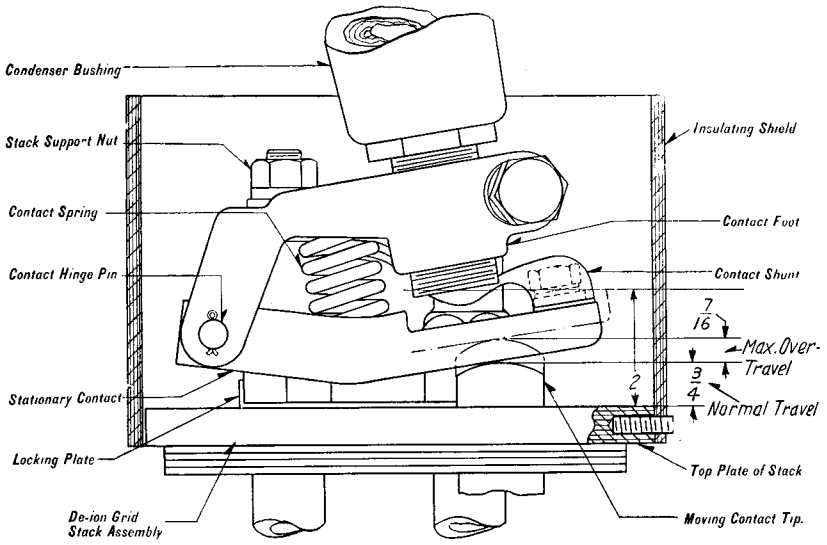


FIG. 9—"DE-ION" GRID, SIZE C, STATIONARY CONTACT ASSEMBLY

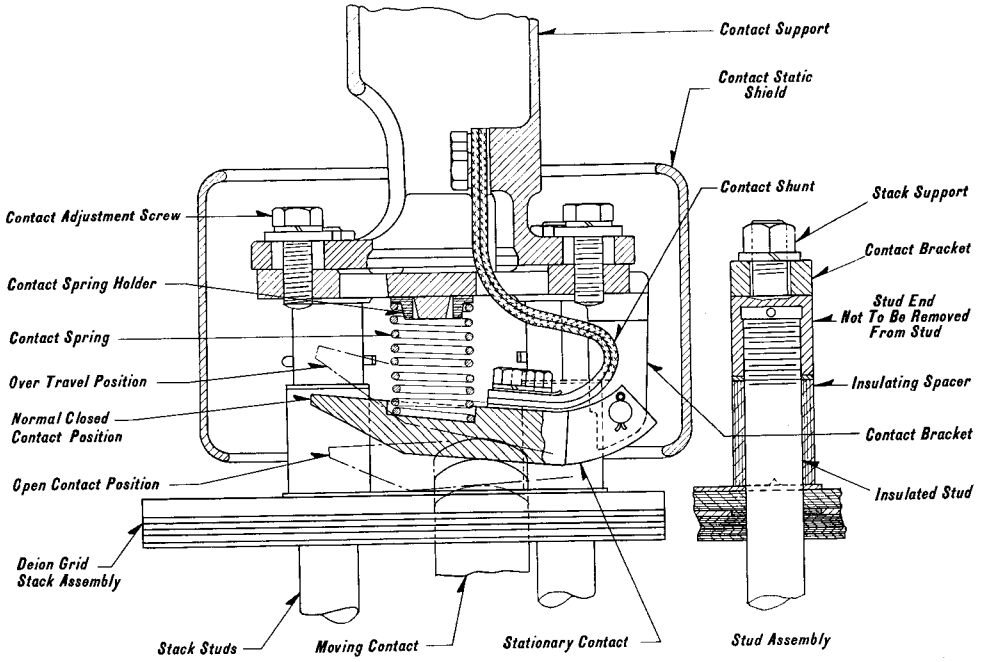


FIG. 10—"DE-ION" GRID, SIZE B, STATIONARY CONTACT ASSEMBLY

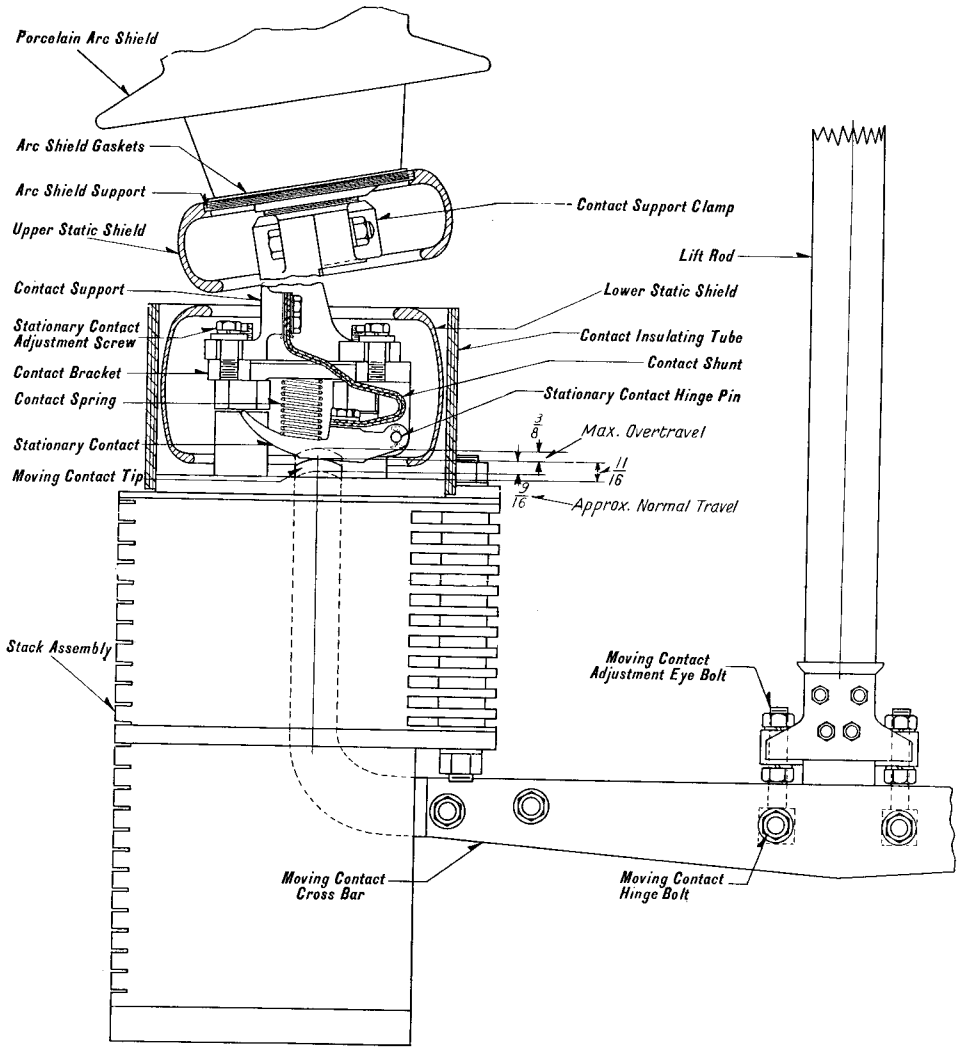


FIG. 11— "DE-ION" GRID SIZE A, STATIONARY CONTACT ASSEMBLY

The pole units of the floor mounted breakers should be adjusted one at a time. Starting with the pole nearest the mechanism, this pole unit is connected to the mechanism through the pull rod, and the other poles disconnected. The length of the pull rod from the mechanism to the breaker unit can be adjusted by screwing the rod end up or down on the end of the pull rod. With the breaker mechanism latched, and the breaker unit in the closed position, check the clearance between the lever and the stop to see that the lever is approximately $\frac{3}{32}$ inch from the stop. The pole unit may then be opened and a check made to see that the moving parts strike against the bumper. With the unit having been checked in both the open and closed position, it may then be tripped by hand to make sure that the action is correct and that the shock of opening is taken up by the bumper.

The setting of the lift rod stop may be observed by opening the vent pipe at the top of the pole unit and looking into this opening.

The toggle stop setting may be observed by removing the pipe plug from the side of the mechanism box on the top of the tanks.

For the purpose of releasing the breaker slowly by hand, the load of the breaker may first be taken up by the hand closing lever and then the holding latch in the solenoid mechanism, as shown in Figs. 26, 27, and 29, may be pushed back to allow the mechanism to come to the open position.

The pull rod to the second pole unit can be connected and the operation of this unit made to conform with that of the first pole unit. The adjustment of the horizontal pull rod between these units is made in the same manner as the vertical adjustment from the first unit to the operating mechanism. After the second unit has been checked and adjusted, the operation should be repeated with the third pole.

It will be found somewhat difficult to set up the last pole unit of the breakers because they have the accelerating spring on this unit. This work may be made easier by unbolting the cap at the rear end of the spring housing. This relieves a large portion of the pressure from the accelerating spring. After this pole unit has been connected to the others, it can be closed in the usual manner and, in the closed position, the cap can be easily assembled. When all of the poles have been adjusted in this way, a re-check should be made on the first and second, as some read-

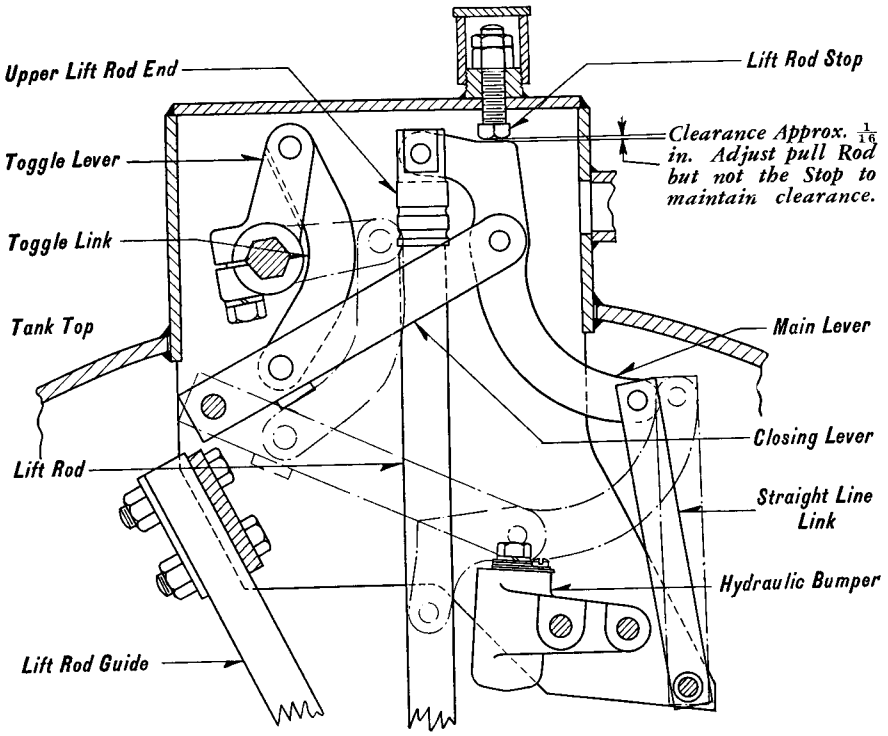


FIG. 12—POLE UNIT LEVER ASSEMBLY FOR SMALL FRAME MOUNTED BREAKERS

justments of the pull rods may be found necessary due to the added weight of the second and third poles. Each toggle position, stop and bumper should be re-checked before attempting to operate the breaker electrically. The breaker units should not be allowed to drop open freely more times than is absolutely necessary before the oil has been placed in the tanks because, without the cushioning effect of the oil, damage to the moving part is liable to occur.

Connections

Before making any connections every precaution must be taken to see that all leads to be connected to the oil circuit-breaker are dead.

Leads should be flexible and brought down from above the circuit breaker if possible. Ample room must be provided between these leads and parts of the station or overhead steel structure.

All terminals must be fastened securely to the leads and tightly clamped to the connection studs. Connections to the breaker are usually made by copper tube terminals fastened to the ends of the bushings. When tightening the terminal or clamp bolts, care must be taken not to place unnecessary strain on the top of the condenser bushing.

All joints must be clean, bright and free from dents or burrs.

All nuts on the current carrying parts must be securely tightened to obtain good contact. If the joints are not made correctly, dangerous heating of the breaker may result at these points.

Cables should be properly supported so that the breaker is not subjected to unnecessary strain. Any strain which at first has no apparent effect may eventually loosen the insulator cap and permit moisture to enter the bushings.

To avoid heating, the connection leads must be of a current carrying capacity at least equal to that of the current carrying part of the breaker.

Control Wiring

All control wires should be run in conduit when practicable. A diagram is supplied with each breaker which shows the proper connections for operating circuits and indicating lamps (See pages 23, 24 and 25 for typical diagrams).

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 transformer connections are illustrated on page 17.

The cover on the lower end of the transformer case must not touch the grounding band on the bushing.

Grounded Connections

The frame of each breaker should be permanently grounded. The usual practice is to connect a heavy cable to the frame and to the ground. A good permanent low resistance ground is essential for adequate protection. A poor ground may be worse than no ground at all, since it gives a false 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 test should be made:

1. The electrical operation may be checked a few times without oil in the tanks. Excessive operation without oil may damage the breaker and should be avoided.
2. 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. The tank linings should be examined for possible mechanical damage.
3. See that the breaker is properly set up and leveled on its foundation.
4. See that all bearing surfaces of the operating mechanism have been lubricated.
5. Close the breaker slowly by hand, noting that the operating rod and contacts are properly adjusted for correct alignment and that good contact is made when the breaker is closed. The movement of the breaker on opening and closing should be free and without friction.
6. The muffler setting should be examined and, if it has not loosened

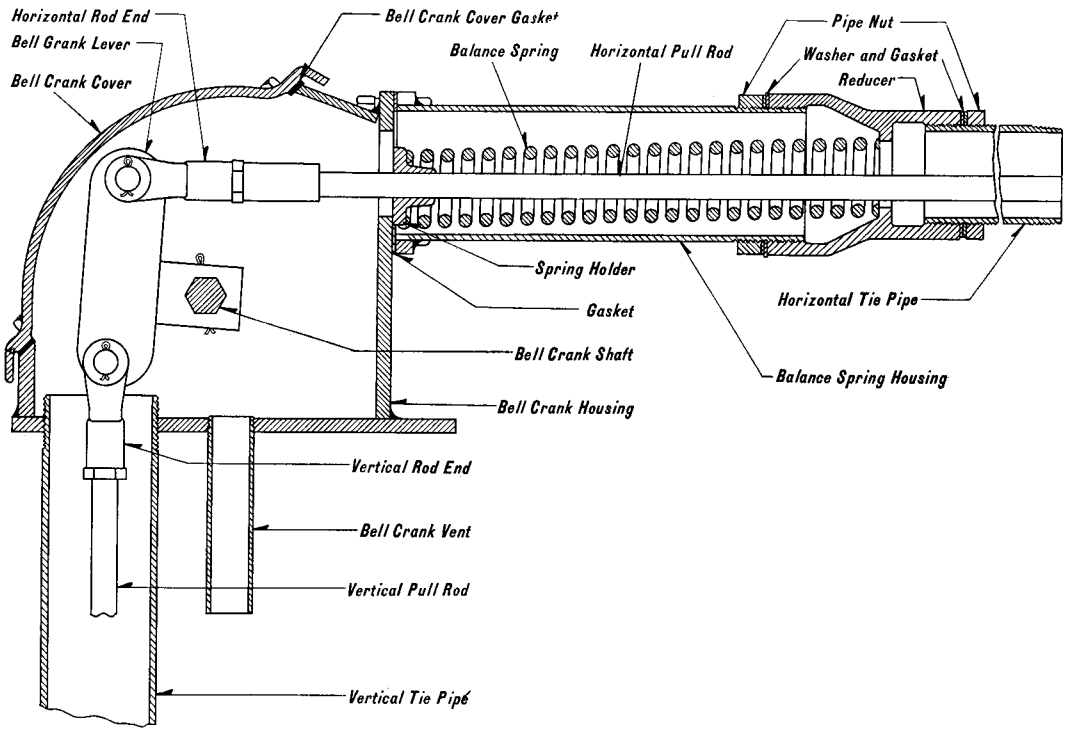


FIG. 13—BELL CRANK ASSEMBLY FOR FLOOR MOUNTED BREAKERS

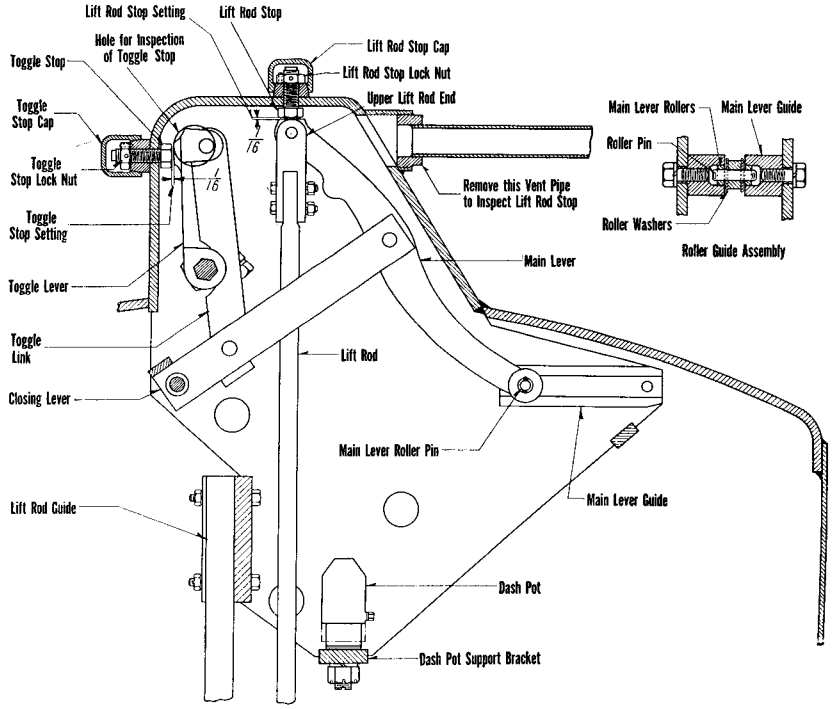


FIG. 14—POLE UNIT LEVER ASSEMBLY FOR FLOOR MOUNTED BREAKERS

during shipment, should be left alone. Otherwise, the setting should be made as explained on page 17.

7. All nuts must be tightened so that moisture cannot enter the circuit breaker. The bolts on the bushing, flanges, tanks and fittings must be kept tight.

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

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

10. 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.

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 exposed and stored in open 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.

First fill the arc shield with oil known to be clean and dry, until the level of the oil has reached the level of the filling hole in the arc shield hood. Then plug this hole and fill to the top of the filling pipe; and cap the pipe.

Some oil may seep out along the threads on the arc shield fittings. This is not serious as long as this does not materially lower the level of the oil in the arc shield before the tank has been completely filled.

Fill the oil tanks to the proper level with Wemco "C" oil. Special precaution must be used in handling the oil in accordance with detailed instructions given on page 19 and Westinghouse Instruction Book 5336.

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. Don't allow the tank-holding bolts to go without one or two inspections after the breaker is installed. The nature of the packing against which the tanks are drawn up, permits it to adjust itself slowly under pressure. 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 Operation

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 Mechanism

This mechanism, located in the upper part of each pole unit, operates the lift rod which carries the moving contact. It is somewhat hidden from view and reference to the illustrations should help in a better understanding of the operation of this mechanism.

It should be remembered that the stops have been set and locked at the factory. Unless it is obvious that they have been disturbed, all adjustments should be made to give the approximate $\frac{1}{16}$ inch clearance at the stops without changing the position of the stop screws. This clearance should exist with the breaker in the normal latched closed position.

The toggle must not be permitted to pass over center as such a condition would prevent the breaker from tripping open.

There must be clearance at the stops in the normal closed position so that the closing mechanism will not put an undue strain on any of the parts.

With the toggle too far from center in the closed position the breaker will be hard to close.

Lifting Rod Stop

In the top of all of these breakers will be found the lifting rod stop or moving contact stop. This is to prevent overtravel of the lift rod and moving contacts. It will prevent the inertia of the moving contacts from taking up the clearance in the various links and pins. The clearance at this stop can be checked with a thickness gauge by removing the vent pipe and reaching into the mechanism compartment through the vent pipe opening.

Toggle Stop

The smaller breakers, such as the 46 kv. illustrated in Fig. 15 do not require a toggle stop.

The larger breakers all have a toggle stop in addition to the lift rod stop. The setting at this stop should be approximately $\frac{1}{16}$", the same as for the lift rod stop.

The toggle stop in the large frame mounted breakers, as illustrated in Fig. 16, may be checked with a gauge by reaching up into the top when the tank is lowered.

In the floor mounted breakers, an inspection hole is available for use when checking the toggle stop. This hole is illustrated in Fig. 14. It must be closed tightly after the inspection is complete.

Bumpers

These breakers are all provided with the hydraulic type of bumper using the oil in the circuit-breaker tank to cushion the shock at the end of the opening stroke. The form of the dashpot varies with the size of the breaker but the principle of operation remains the same

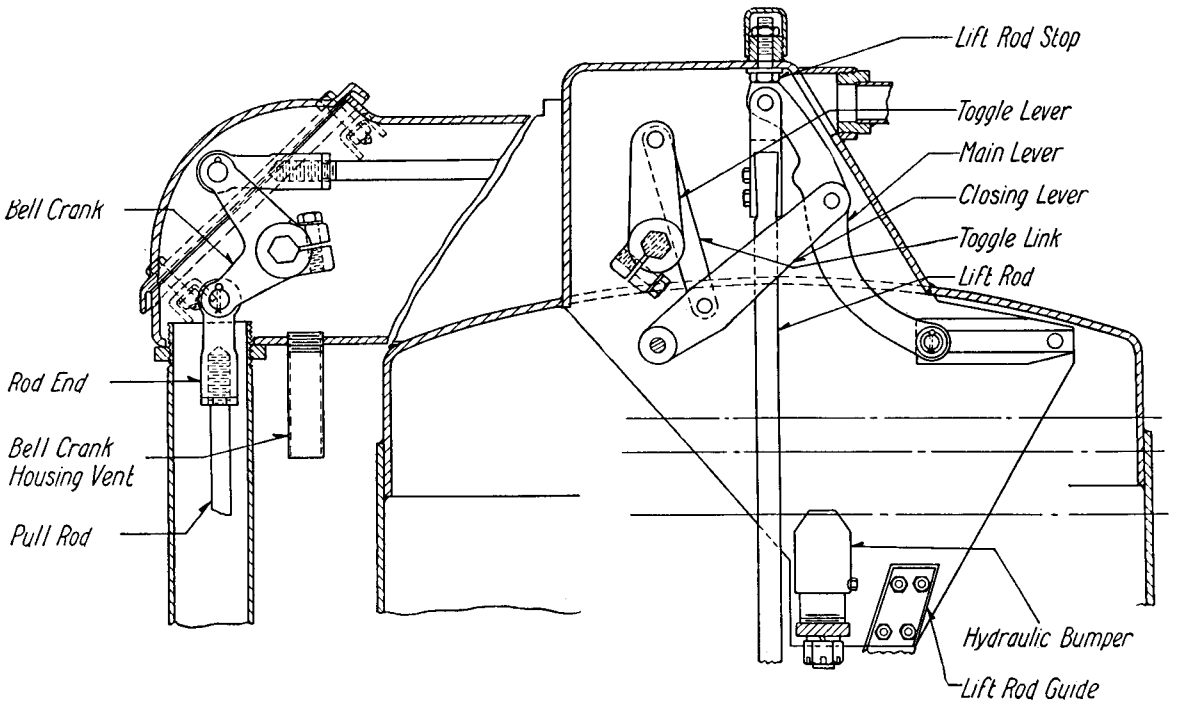


FIG. 15—TOGGLE MECHANISM FOR TYPE GO-1, 115,000 VOLT BREAKER

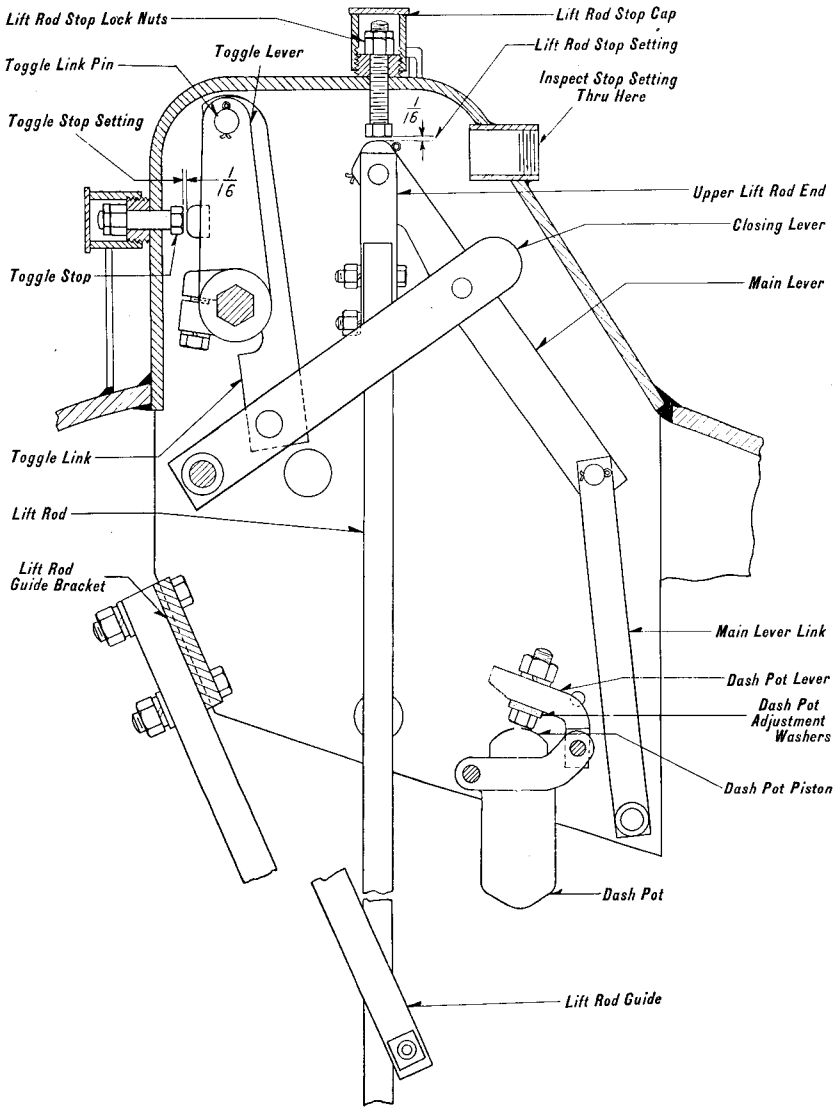


FIG. 16—TOGGLE MECHANISM FOR LARGE FRAME MOUNTED BREAKER

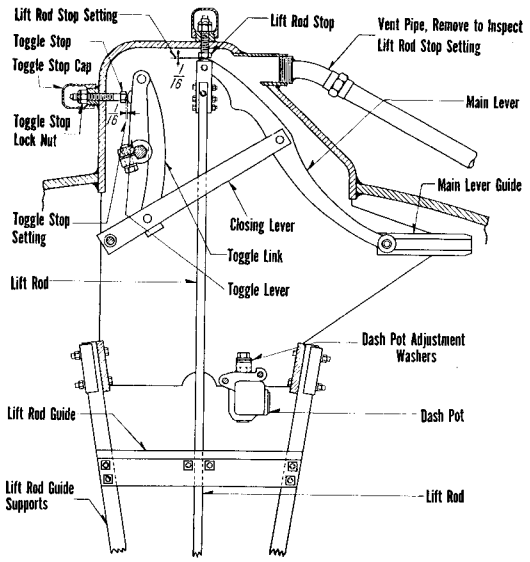
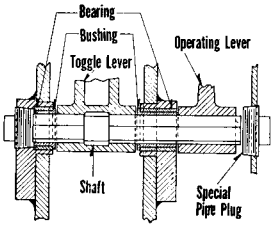


FIG. 17—TOGGLE MECHANISM FOR 230,000 VOLT BREAKERS



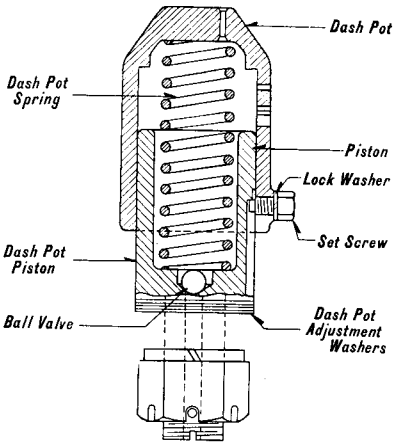


FIG. 18—HYDRAULIC BUMPER (DASH POT)

Fig. 18 illustrates one of these bumpers. When the tank is empty, the bumpers will also be empty. It is therefore desirable to avoid unnecessary tripping of breaker without having the tanks filled to the proper oil level.

In the open position, the levers of all three poles must rest on the bumpers which should be solid in the full open position. Care must be taken to see that no one bumper is taking all of the load, but that each is taking the load of its pole unit.

Current Transformers

Current transformers, supplied only when ordered, are mounted in the transformer cases in the top of the pole units. Transformers are usually of the multi-ratio type having five leads which provide a wide range of ratio as illustrated by the accompanying tables. All of the leads are brought out and numbered for external connections. When transformers are ordered with the breaker the leads are run through conduit to a terminal block box at the end of the breaker. Connections to relays may be made at the terminals in this box.

Do not confuse the polarity of the bushing transformers. The diagram Fig. 21 shows 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, care must be taken to see that the end of the current transformer carrying the white mark is placed upward. The terminal foot or stationary contact must be removed. After disconnecting the transformer, the support for it is removed and the transformer slid down over the bushings. In replacing the transformer, care must be taken that the micarta disc at the top is in position and that the pad on the support is in place. **The transformer case must not touch the ground banding on the terminal bushings.**

Multi-Ratio Transformers

Multi-ratio transformers are shown schematically by Fig. 19. Ratio tables for standard transformers are:

600-AMPERE 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-AMPERE 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

2000-AMPERE MULTI-RATIO TABLE

Approximate *Ratio	Turn Ratio	Secondary Taps
800 to 5	160 to 1	B—C
1200 to 5	240 to 1	A—C
1400 to 5	280 to 1	B—D
1600 to 5	320 to 1	B—E
1800 to 5	360 to 1	A—D
2000 to 5	400 to 1	A—E

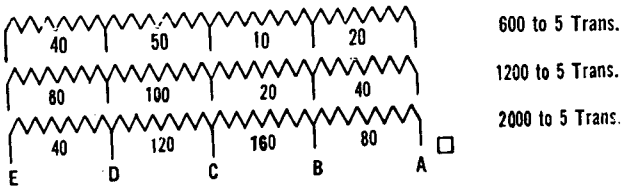
*Not compensated for secondary loading ratio curves for various loadings.

These transformers are not compensated for any given loading.

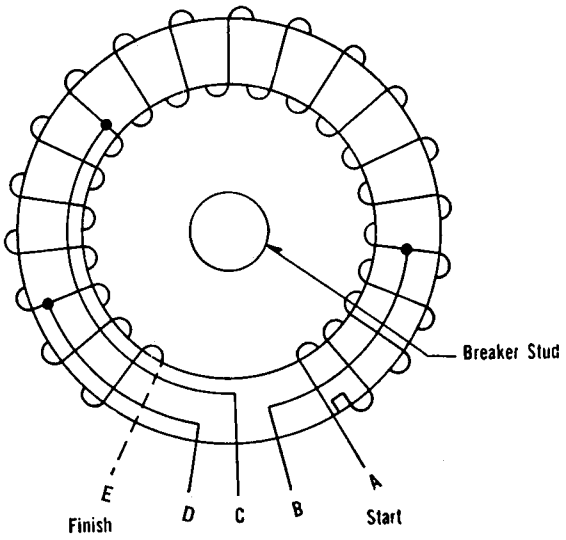
Where accuracy of load ratio is required, ratio curves should be referred to. The curves for standard transformers may be obtained from the East Pittsburgh Works. A separate curve sheet is made for each turn ratio on each transformer. Ratio curves are not available for special transformers except where provision was made for these curves at the time the order entered. In requesting curves the approximate burden and normal ratio should be specified, together with the stock order number, breaker type, and rating, as given on the nameplate. A typical curve is illustrated by Fig. 20.

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 subtractive polarity and the direction of flux and current are the same as for the



Development of winding giving number of turns between taps



Subtractive polarity indicated by white polarity mark. With any combination of taps. The tap nearest A has the same relative polarity as terminal A.

Bushing-Type current transformer

FIG. 19—MULTI-RATIO BUSHING TYPE CURRENT TRANSFORMERS

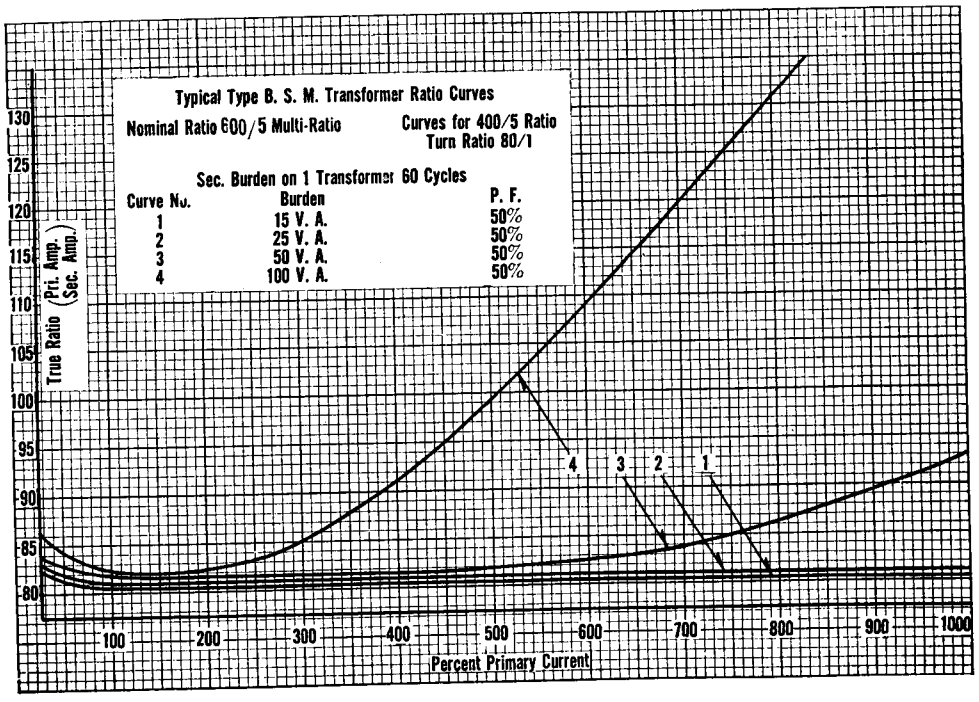


FIG. 20—TYPICAL TRANSFORMER RATIO CURVE

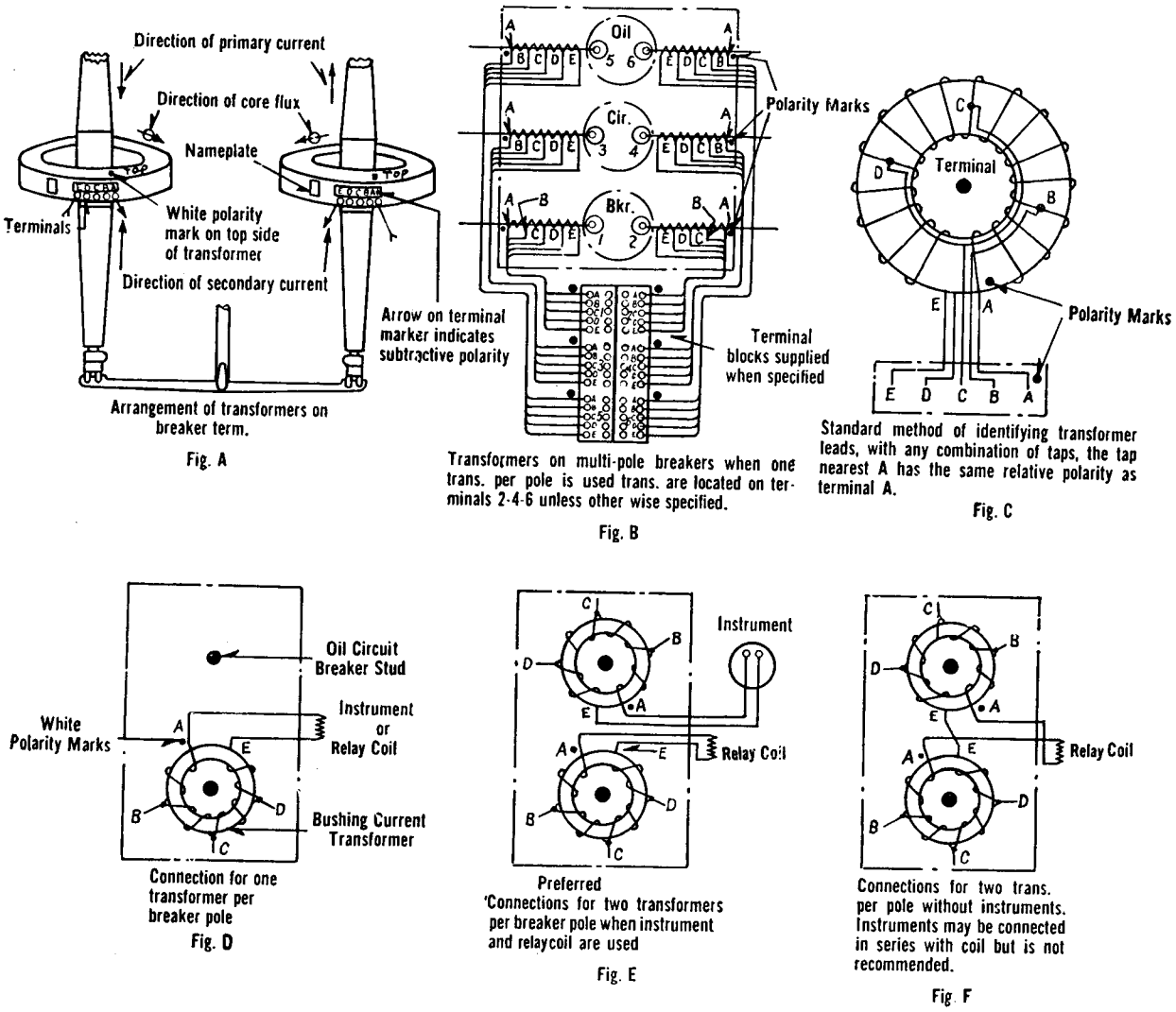


FIG. 21—TYPICAL BUSHING TYPE CURRENT TRANSFORMER CONNECTIONS

multi-ratio transformers. The low ratio is A-B, the next higher ratio A-C and the next higher ratio A-D, etc., for high steps.

Hipernik Transformers

Hipernik transformers of special nickel steel are used for accurate metering and very low load ratios. When used for watthour metering, phase-angle curves are recommended for each transformer. When phase-angle curves have been made on individual transformers, the transformers are identified by serial numbers on the nameplate. This serial number should be given as reference when extra copies of curves are required for this transformer.

The Hipernik saturates sooner than the silicon steel, and care should be taken to avoid applications where there would be over-burden on the transformer.

Condenser Terminals

General instructions for installing have been given under the subject of "Terminal Bushing Assembly" on page 5. However, certain precautions are necessary to insure satisfactory service.

Do not store these bushings under a leaking roof, or where water may drop on them, or in any extremely damp place.

When in service do not permit the grounding band on the bushing to touch the metal plate which holds the transformer in place.

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.

Venting

Frame mounted breakers are supplied with mufflers having adjustable valves, and the setting should not be changed unless local conditions require. Then the change should only be made after it has been shown to be necessary. When shipped from the factory, the valve setting is one-half open. This adjustment should be satisfactory for all ordinary installations. The function of the muffler is to separate the oil from the arc gasses, which are discharged when the breaker interrupts the circuit. The circuit-breaker is shipped with the passage half closed with screw Style No. 555630. This

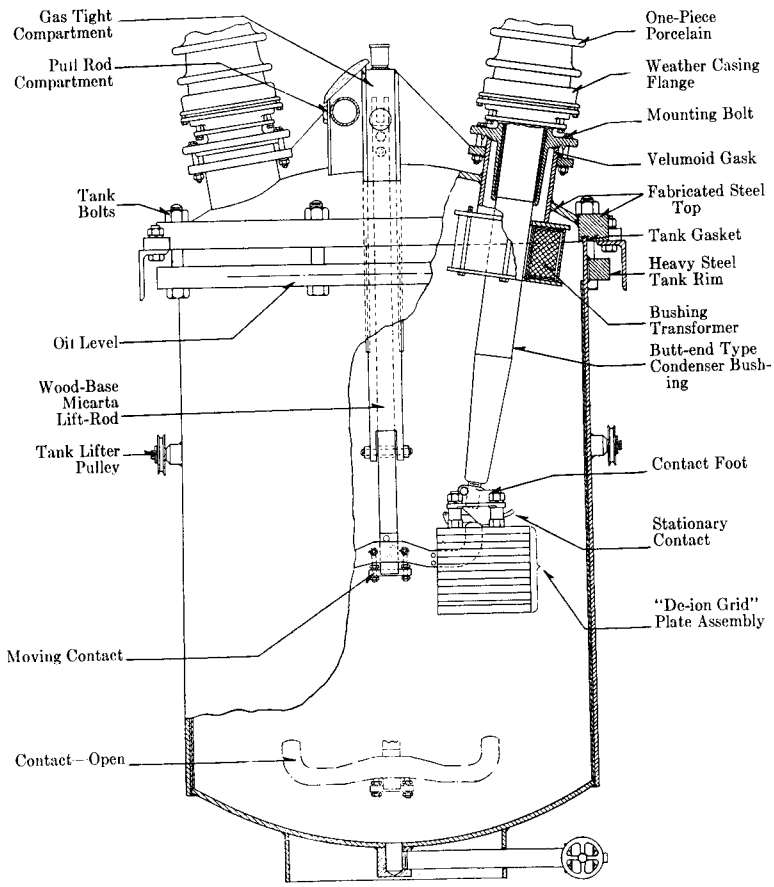


FIG. 22—POLE UNIT FOR 69,000 VOLT BREAKER

is the normal condition. For light rupturing duty it is permissible to increase the opening by using screw Style No. 555631 without causing oil throw. On extreme or heavy duty the passage must be closed more by using screw Style No. 555629 to decrease the velocity of the gas entering the muffler and assist in the separation of the oil and the gas.

Gasket—Style Number 555632 is used with all screws.

Floor mounted breakers do not have mufflers, but are supplied with long vent pipes which extend down, outside the tank and require no adjustment.

Contacts

(a) Contacts once properly installed should not require further adjustment.

(b) When the contacts become burned or pitted from subsequent operations, they should be filed smooth.

(c) At regular inspection periods it is desirable to clean the contact surfaces to remove any signs of oxidization which may have occurred.

(d) 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 start to break.

(e) Keep the contact travel as near as possible to the original setting.

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

Lift Rod and Guide

The only adjustment provided for the lift rod is in the floor mounted breakers where it passes through the guide. Insulated studs are used to prevent excessive side movement of the lift rod and moving contact. These studs may be moved to a new set of holes if necessary to take up clearance or make a closer adjustment on the lift rod. After changing the position of the studs, the nuts must be sealed on by the use of Bakelite cement.

Tanks

Frame mounted 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. If the wrench handle is not long enough, it is well to use a piece of pipe 3 or 4 feet long so as to obtain a good leverage.

The covers on the tops of the floor mounted breaker and the frame mounted breakers should be carefully tightened.

Tanks should not be left off the breaker, nor the man-hole covers left off over night because this would permit entrance of moisture in the form of dew or as a result of a sudden storm. Tanks should not be lowered in wet weather without provision for keeping rain out of them and off of the internal parts of the breaker.

Oil Gauges

All tanks are provided with glass gauges for indication of the level of oil within the tank. 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° Centigrade.

Reference to the illustrations, figures 23, 24 and 25 should be helpful in case it is necessary to replace a broken gauge glass or tighten the gaskets.

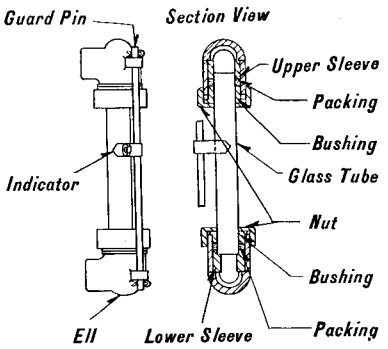


FIG. 23—OIL GAUGE ASSEMBLY

For oil gauge Fig. 23 Westinghouse packing P.D. Spec. 6057 should be used. Assemble fittings on tank with red plumber's cement, at the threaded joints. Line up fittings so that glass will be vertical. Make sure all threaded joints are tight. Place small counterbored sleeve in lower fitting and plain sleeve in upper fitting (Holding it in place). Place gland nuts and glands around glass and put in place, putting the top end in first.

Pack upper gland first, using black plastic packing which is supplied with gauges. Glands can be packed more easily, by hammering a piece of plastic packing out flat, approximately, ¼" thick, and then pushing it down around the glass with a small rod or screwdriver. Use only enough packing to fill space and still allow gland nuts to be started on. Start nut on, then pack lower gland in same way. Nuts should be screwed down by hand and guard pins put in place. Care should be taken in tightening nuts to avoid breaking the glass.

Oil

The Westinghouse Electric & 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 which an insulating oil receives, the greater the opportunity for contamination, unless adequate precautions are taken.

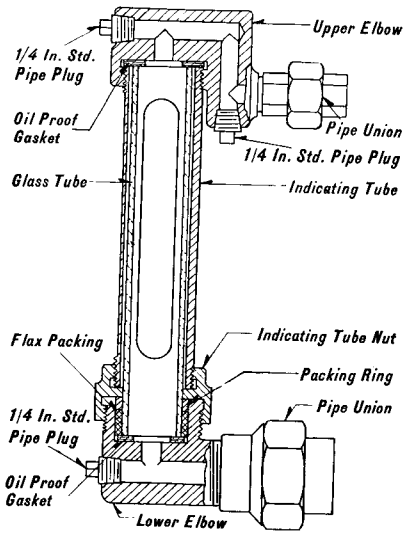


FIG. 24—OIL GAUGE ASSEMBLY

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 three 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 18,000 volts when tested by one of the usual methods with electrodes 1" diameter 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 of temperature, evaporation, rupturing of heavy currents, or possible leakage of oil. Low oil levels may cause flashover of bushings or failure to properly handle heavy overloads. Attention is again called to Westinghouse Instruction Book 5336 which is a manual covering the care and maintenance of oil and which should be referred to before any attempt is made to test or purify the oil.

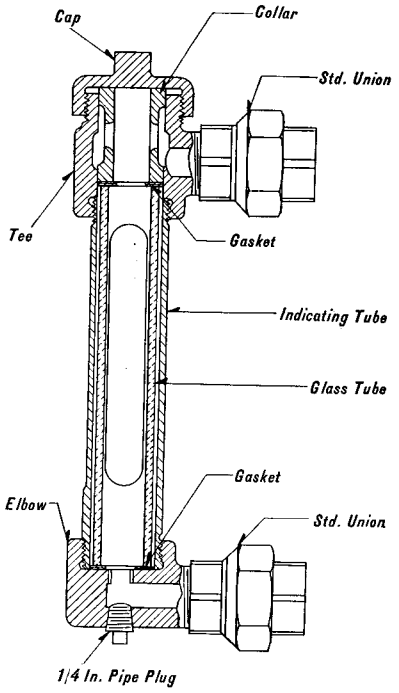


FIG. 25—OIL GAUGE ASSEMBLY

Electric Operating Mechanisms

The mechanisms should be opened slowly by hand except when attached to a breaker.

The type "SA-4" solenoid mechanism is standard for the frame mounted breakers. It is illustrated in Fig. 26. A detail description of the operation of this mechanism will be found in Instruction Book 5467 which covers this mechanism.

The trigger stop indicated in Fig. 26 controls the action of the trigger. Adjustment is made by loosening the nut on the eccentric bolt and rotating it to the proper position. This has been set at the factory so that the throat of the trigger clears the roller by approximately $\frac{1}{16}$".

The magnet core has a range of adjustment and is set at the factory so that there is approximately $\frac{1}{16}$" overtravel at the holding latch when the cores are pulled together.

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 very near the end of the stroke so that the mechanism will close completely. The length of the switch lever and the length of the operating rod are adjustable.

The latching surface of the trigger can be polished by fine emery if it becomes dirty or rusty. **Do not attempt to grind or change the angle of the latch.**

The type "SA-6" solenoid mechanism is used with the majority of the floor mounted breakers. It is illustrated in Fig. 27 and 28, and its operation is very similar to that of the type "SA-4".

The moving closing core is connected to the outer lever by an eye bolt yoke which is adjustable in the core to secure the proper relationship between the latch on the end of the inner lever and the latching surface. The mechanism is adjusted at the factory to latch properly when the moving core is drawn down by the solenoid so that there is a clear-

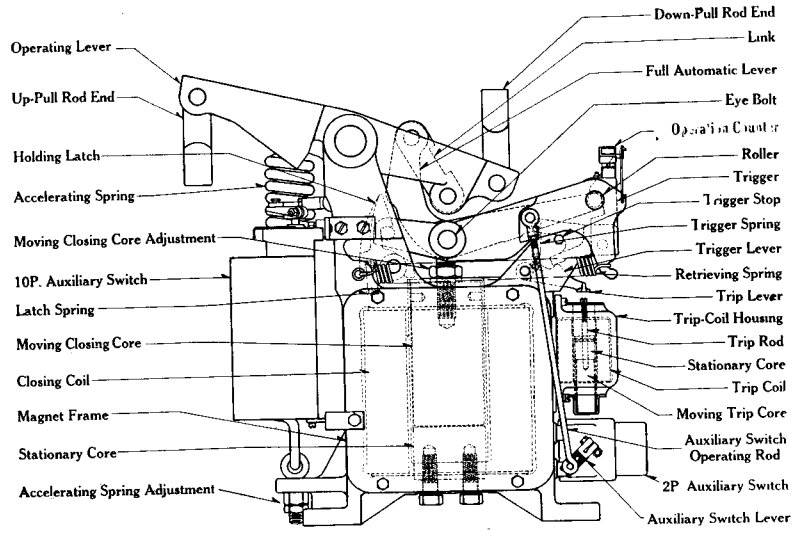


FIG. 26—SOLENOID MECHANISM, TYPE SA-4 (CLOSED POSITION)

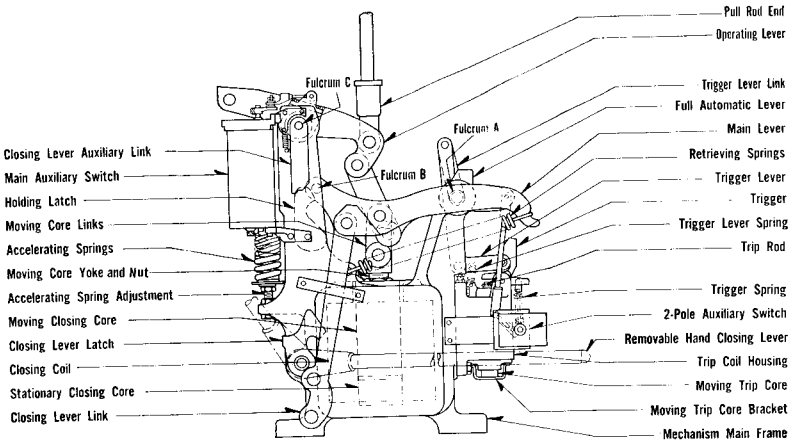


FIG. 27—SOLENOID MECHANISM, TYPE SA-6 (CLOSED POSITION) WITH LEVER TYPE HAND CLOSING

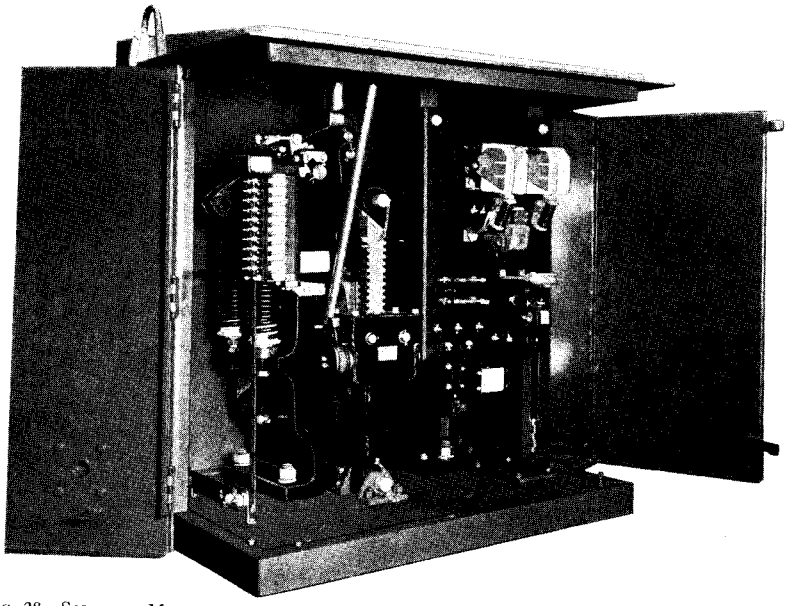


FIG. 28—SOLENOID MECHANISM TYPE SA-6 (OPEN POSITION) WITH JACK TYPE HAND CLOSING.

ance of approximately $\frac{1}{32}$ of an inch between the holding latch and the latch surface. This condition should be kept as closely as possible in actual operation. Owing to lost motion on the linkage, it is possible to draw the levers down manually to obtain a somewhat greater back-lash than $\frac{1}{32}$ of an inch. Adjustment of this back-lash which is very important to the successful operation of the circuit breaker, is made by loosening the lock nut on the eyebolt and running the moving closing core up or down on the eye bolt until correct adjustment is obtained. Great care must be taken to tighten the lock nuts securely after any adjustments.

The trigger is made of hardened tool steel and so designed as to present a flat surface, normal to the direction of travel of the roller in the end of the trigger lever. The length of the latching surface on the trigger is such that with the trigger hooked on the roller as far as it will go, the latching surface will extend approximately $\frac{1}{8}$ inch past the center of the roller. When the trip core of the tripping magnet is raised fully by hand to its maximum travel, the edge of the latching faces should not be more than $\frac{3}{16}$ inch on the other side of the center of the roller. If the cores come together when the trigger is pushed off a greater distance than this, the breaker may not trip on minimum voltage. The raising of the trip core fully by hand should always trip the circuit-breaker. The functioning of the device should not depend upon the hammer blow delivered by the tripping magnet.

The latching surface can be polished by fine emery if it becomes dirty or rusty. **Do not attempt to grind or change the angle of the latch.**

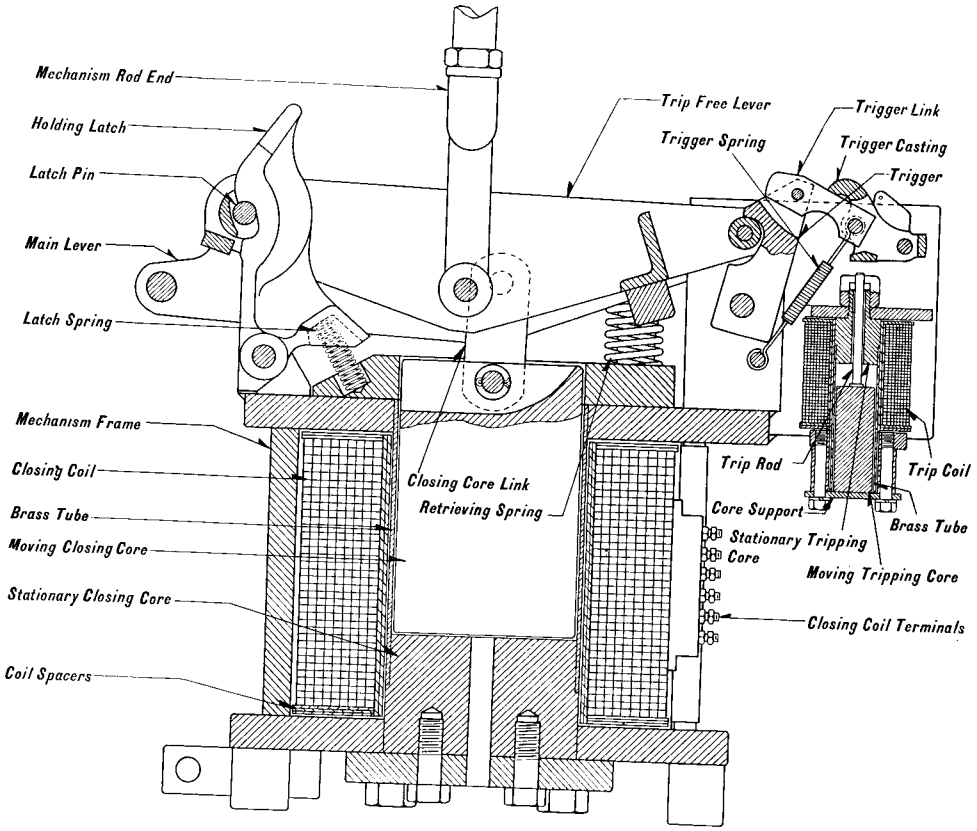


FIG. 29—SOLENOID MECHANISM, TYPE SA-7 (SECTIONAL VIEW)

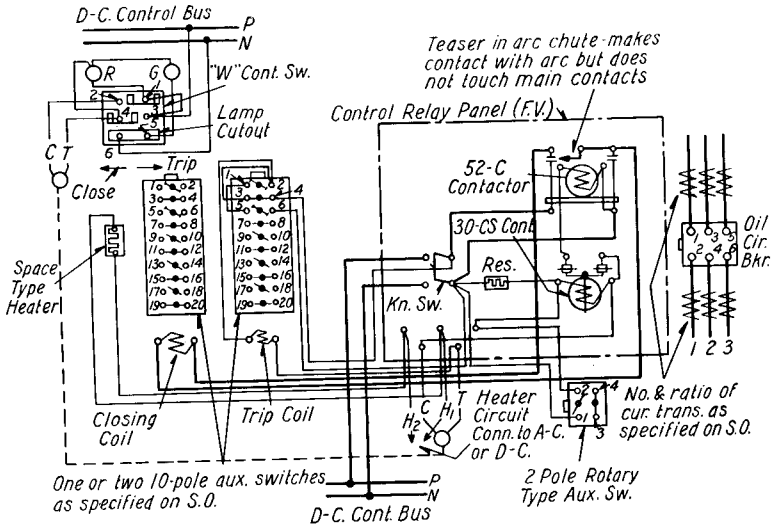


FIG. 34—CONTROL DIAGRAM FOR SOLENOID MECHANISM, TYPE SA-6

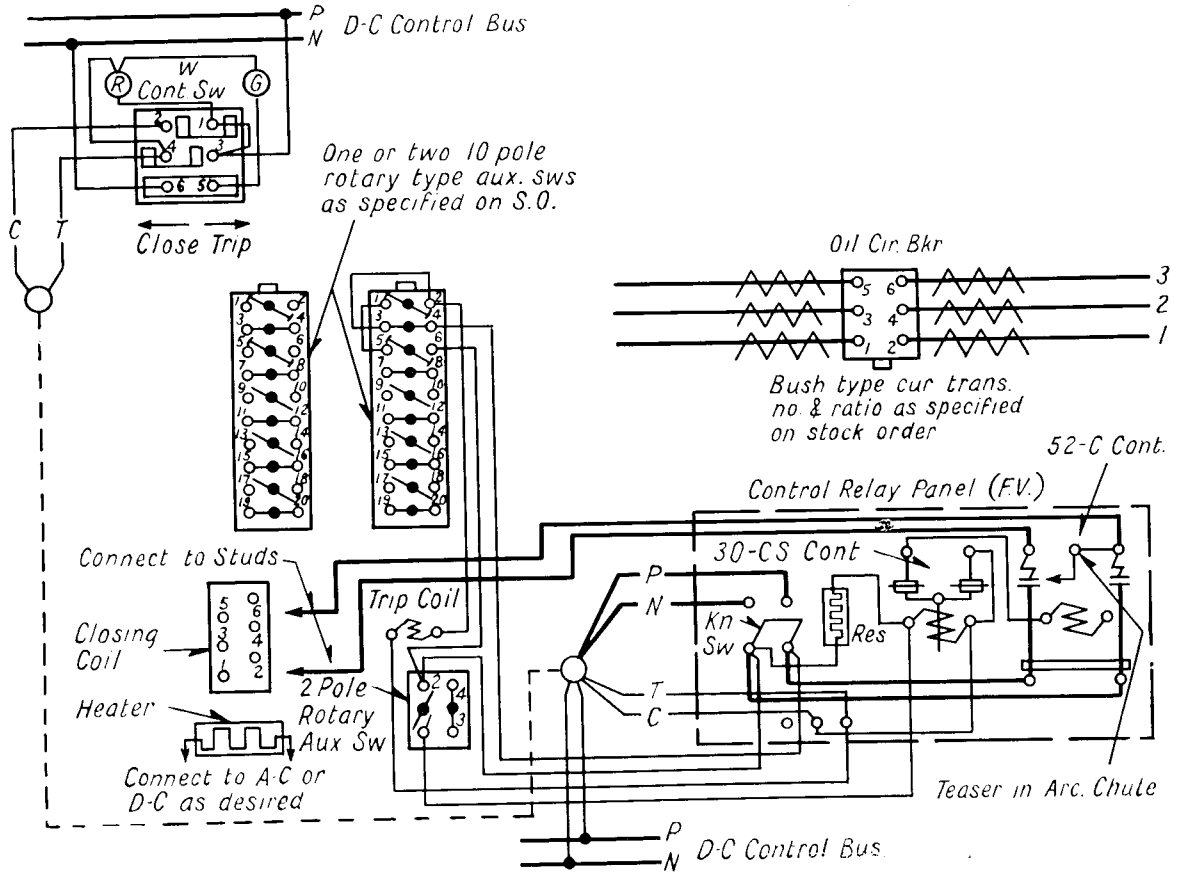


FIG. 35—CONTROL DIAGRAM FOR SOLENOID MECHANISM, TYPE SA-7

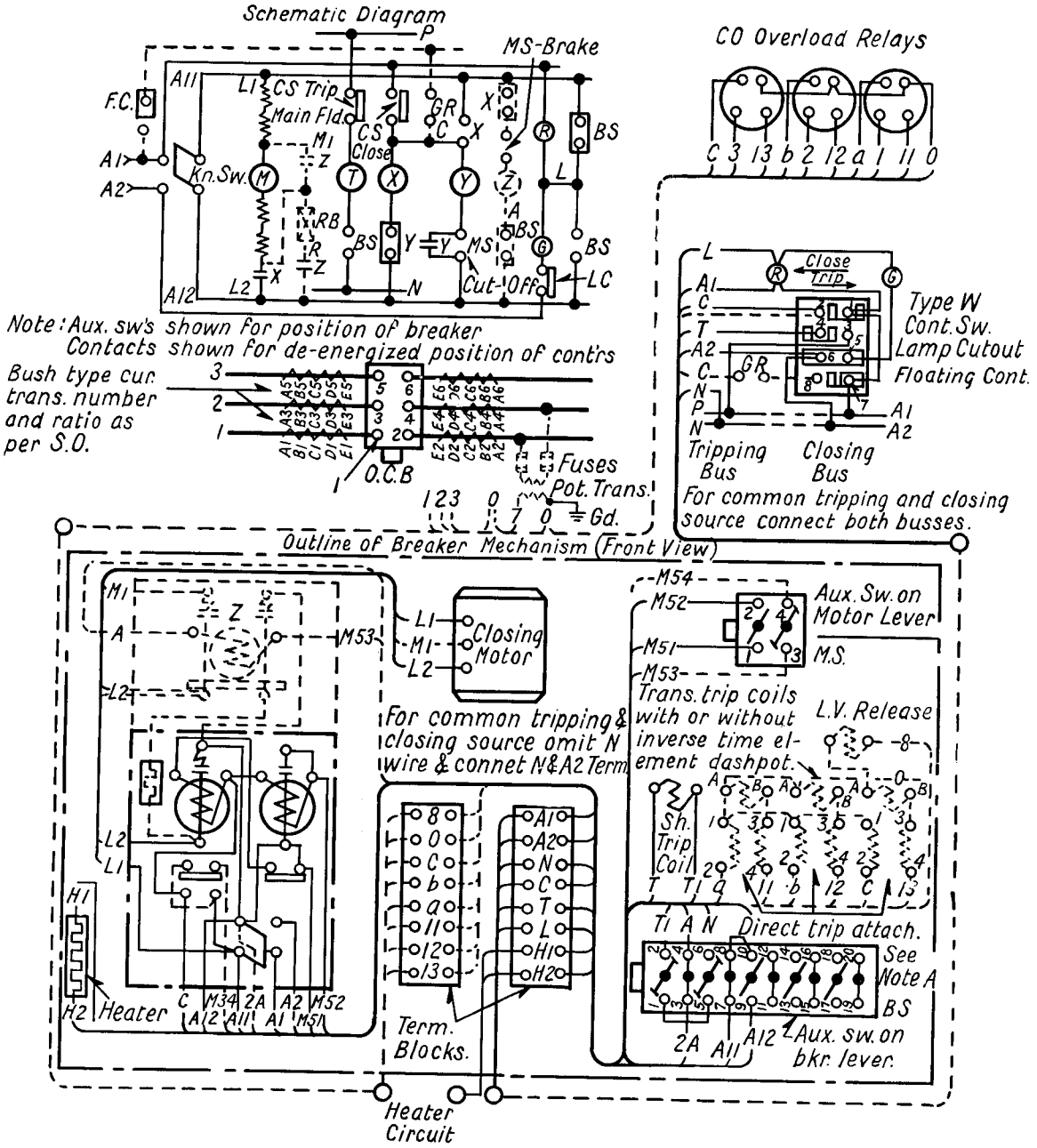


FIG. 36—CONTROL DIAGRAM FOR TYPE CF-1 MOTOR MECHANISM

RENEWAL PARTS DATA

Recommended Stock of Renewal Parts For "De-ion" Grid Oil Circuit-Breakers and Mechanism

The following is a list of the Renewal Parts and the quantities of each that we recommend should be stocked by the user of this apparatus to minimize interrupted operation caused by breakdowns. The parts recommended are those most subject to wear in normal operation or those subject to damage or breakage due to possible abnormal conditions. This list of Renewal Parts is given only as a guide. When continuous operation is a primary consideration, additional insurance against shut-downs is desirable. Under such conditions more renewal parts should be carried, the amount depending upon the severity of the service and the time required to secure replacements.

Circuit-Breakers in use up to and including		Three Pole 1	Three Pole 5
Name of Part	No. Per Breaker	Recommended for Stock	
Breaker Complete	1	0	0
Breaker Unit Complete	1	0	0
Moving Contact Complete	3	0	0
Lift Rod	3	0	1
Moving Contact	6	2	4
Stationary Contact Comp'ete	6	0	0
Condenser Bushing	6	1	2
Porcelain Arc Shield	6	0	0
Contact Foot	6	0	0
"De-ion" Grid Stack Assembly	6	0	0
Stationary Contact	6	2	4
Contact Shunt	6	2	4
Contact Spring	3	0	1
Tank Lining	1	0	0
Electrically Operated Mechanism	1	0	0
Holding Latch	1	0	0
Latch Spring	2	0	1
Retrieving Spring	1	0	0
Accelerating Spring	1	0	0
Trigger	1	0	0
Trigger Spring	1	0	0
Auxiliary Switch—2 Pole	2	0	1
Moving Contact	4	0	2
Contact Finger	1	0	0
Auxiliary Switch—10 Pole	10	1	5
Moving Contact	20	4	20
Contact Finger	1	0	0
Closing Coil	1	0	1
Trip Coil			

Parts indented are included in the part under which they are indented.

Ordering Instructions

When ordering Renewal Parts, always specify the name of the part wanted as shown on the illustrations in this Instruction Book, giving Shop Order Number, and the type of Mechanism as shown on the nameplate. For Example:
One Holding Latch, S# 859606, for Type SA-4 Operating Mechanism, S.O. 20F383 shown in Instruction Book 5502, Fig. 26.

To avoid delays and misunderstandings, note carefully the following points:

1. Send all correspondence and orders to the nearest Sales Office of the Company.

2. State whether shipment is to be made by freight, express or parcel post. In the absence of instruction, goods will be shipped at our discretion. Parcel post shipments will be insured only on request. All shipments are at purchaser's risk.

3. Small orders should be combined so as to amount to a value of at least $1.00 net. Where the total of the sale is less than this, the material will be invoiced at $1.00.

Westinghouse
"De-ion" Grid
Oil Circuit-Breakers
Outdoor Type

INSTRUCTION BOOK

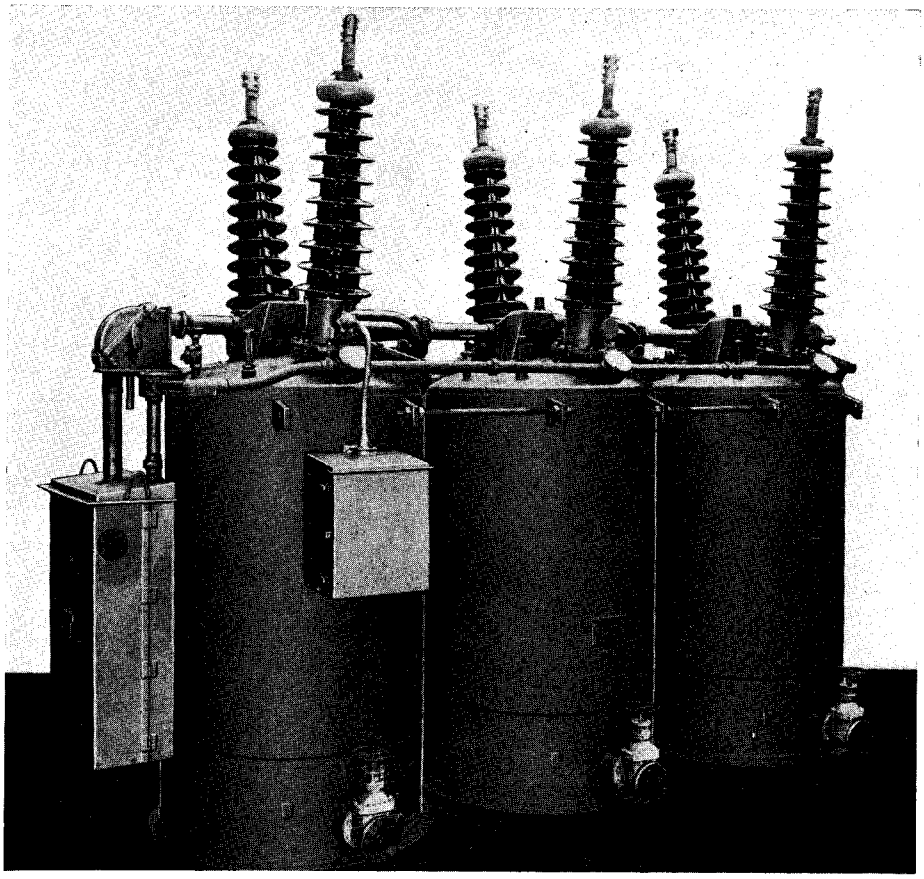


FIG. 1—138-KV., OIL CIRCUIT-BREAKER

Westinghouse Electric Corporation
East Pittsburgh, Pa.

Printed in U.S.A.
(Rep. 5-49)

I.B. 5502-E

Double Bell Crank Housing protects mechanism from gas and oil Housing is made in two separate compartments. Pull rod from mechanism enters one compartment and pull rod to pole units enters the other. Mechanical connection is made through heavy partition by double bell crank operating through a machine fitted bushing.

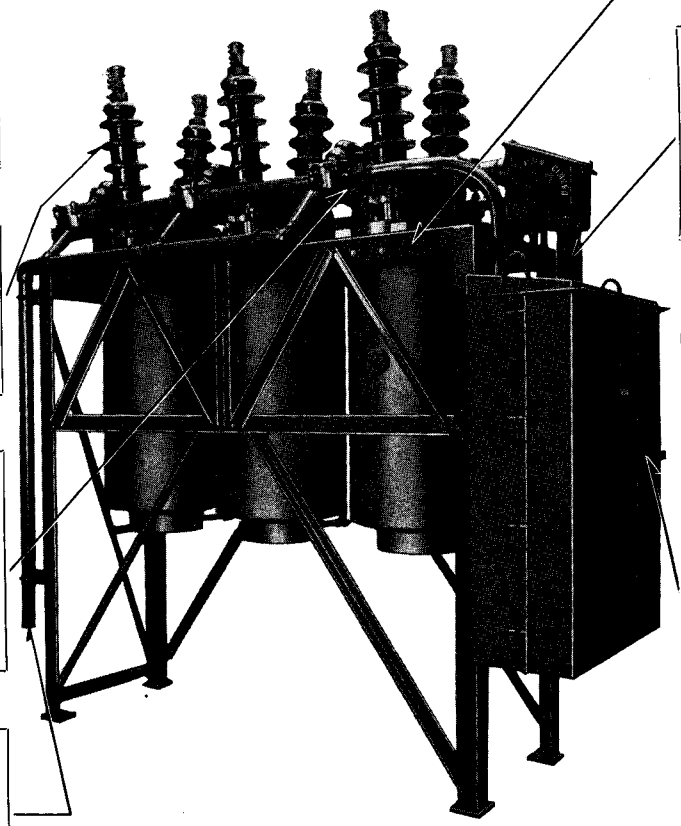
Hydraulic bumpers are provided on each pole unit. This device provides an oil cushion for the moving contacts at the end of the opening stroke, eliminating the rebound. The action of these bumpers in no way retards the opening because they do not operate until the opening stroke is almost completed.

Welded steel angle iron framework provides a rigid and substantial support for the pole units. Height gives easy access to the contacts for either adjustment or service when tanks are lowered. The lower braces are bolted permitting the removal of the tanks from either side.

Each pole unit is equipped with mufflers to prevent throwing oil.

Pull rods and toggle mechanism enclosed in weather-proof housing.

Condenser Bushings give greater strength in resisting the stresses caused by short circuits.



Shaft-operated toggle mechanism on each pole unit. Machined bushing, through which shaft operates, prevents transfer of gas and oil from one pole to another.

Solenoid mechanisms are mechanically trip-free in all positions. When breaker is tripped, the weight of the plunger and most of the toggle mechanism does not retard the contact opening. The mechanism is enclosed in a weather-proof sheet steel housing which provides easy access to the mechanism. The housing is mounted on brackets which lowers the installation costs by eliminating the necessity of an extra mounting base and raises it out of the reach of water and snow.

Header conducts explosive gases down and away from live parts of breaker.

FIG. 2—TYPE GO-2, 34.5-KV. 3-POLE SINGLE THROW OIL CIRCUIT BREAKER. THIS IS TYPICAL CONSTRUCTION OF THE OUTDOOR FRAME-MOUNTED BREAKER LINE.

The tanks are of formed welded boiler plate. The top edge of each tank is fitted with a Velumoid packing gasket which fits into a groove in the pole top providing an oil tight joint. The bottom of each tank is dome shaped with a base ring to provide stability when tanks are removed. A gate valve is attached to the bottom of each tank for draining.

Each pole unit can be equipped with bushing-type current transformers on each bushing if desired.

All pins used in this breaker are made of rust-resisting material.

Windlass Type Tank lifter on end opposite mechanism.

Positive indication of open or closed position of the contacts

Westinghouse

"De-ion" Grid Oil Circuit-Breakers—Outdoor Type

Part I

Installation

Introduction

The oil circuit-breaker is a very important unit in the modern transmission system, being depended upon for protection and 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. "De-ion" Grids for Oil Circuit-Breakers—W. E. Corp. Special Publication 1881.
2. Extinction of a Long A-C. Arc, by Dr. J. Slepian.—A.I.E.E. Trans., Vol. 49, 1930.
3. The Use of Oil in Arc Rupture, by B. P. Baker and H. M. Wilcox—A.I.E.E. Trans., Vol. 49, 1930.
4. Field Tests on "De-ion" Grid Breakers, by L. W. Dyer—Electrical World, April 19, 1930.
5. 220 Kv. Tests on "De-ion" Grid Breakers, by L. W. Dyer—Electrical World, April 26, 1930.

Shipment

All oil circuit-breakers are assembled and tested completely at the factory. They are shipped assembled in as complete units as handling and transportation facilities will permit. Each breaker is carefully inspected and packed 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 boxing should not be taken from the insulators until after the breaker has reached its permanent location and all over head work completed with oil in all tanks.

If the breaker cannot be installed in the final location immediately, and it is necessary to store the equipment, it should be kept in a clean, dry place. It must not be exposed to dirt, to the action of corrosive gases, or to possible mechanical injury.

Special care should be taken to protect machined parts of operating mechanism, etc., against rusting; and if the breaker is stored for any length of time, it should be inspected periodically to see that rusting has not started.

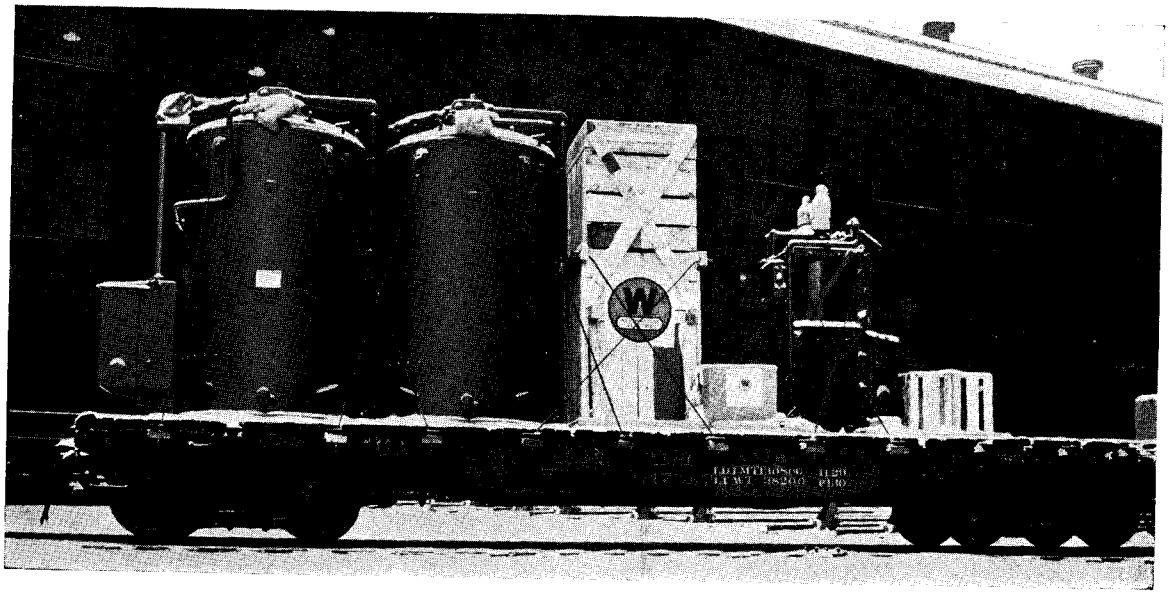


FIG. 3—OIL CIRCUIT-BREAKERS LOADED FOR SHIPMENT

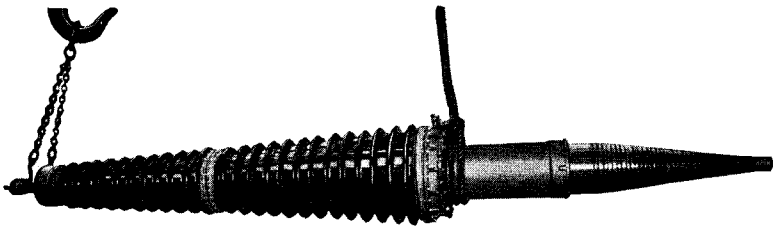


FIG. 4

Particular care should be taken to protect insulating parts, which might absorb moisture. It is desirable that these parts be stored in a dry room.

Precaution should be taken to make sure that the "De-ion" Grid stacks are kept dry at all times. If these parts are to be stored before assembled they must be kept in a dry place and should be stored in WEMCO-C Oil. When being put into the breaker they must not be allowed to come in contact with any moisture.

Handling

The total weight of the breaker without oil is given on the nameplate of the frame mounted breaker. For the floor mounted breakers, the weight of the pole unit without oil and the weight of the condenser bushing will be found on the name plate. This information should serve as a guide to the strength of cranes or other lifting means required for handling the breakers. The large hooks attached to the side of the tanks of the floor mounted breakers are of adequate strength for lifting the entire pole unit without oil. The frame mounted breakers may be lifted by hooking onto the supporting frame.

When using cable slings for supporting the apparatus, do not allow the slings to strike the bushing 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 terminals when transporting it. The skids on which the breaker is mounted should be left with the circuit-breaker and 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 some of these breakers is high, so when handling 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 device and tank lifter. The breaker should be supported sufficiently high so that flood conditions will not cause water to enter the operating mechanism.

Unpacking

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

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 pages 5 and 6.

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 Book and tags are kept with the circuit-breaker.

It is well to remember that details which have been removed from the breaker after test are identified by number markings which correspond to the serial number of the breaker and the terminal 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 parts in the closed position during shipment must be removed. Always look for a wire holding the mechanism triggers and latches from slipping during shipment. On breakers with pole units shipped in a horizontal position, the levers in the breaker top, and the dashpots may be found wired to prevent movement.

Mounting

All circuit-breakers must be set level in order that the moving parts within the breaker operate freely. Otherwise friction will develop, and undue strains will be imposed upon the lift rods and other moving contact details which will cause breakage or defective operation. The foundation bolts should be left loose to permit the frame or tank sides to be properly plumbed and leveled by inserting shims where necessary to insure the breaker to rest solid on the foundation. Care must be taken to see that the pole units of the floor mounted breakers are all on the same centerline and spaced the proper distance apart. The drilling plan for the individual breaker should be carefully followed. When properly lined up and leveled, the foundation bolts should be securely tightened.

The smaller frame mounted breakers are shipped with the bushings, contacts, and operating mechanisms all in place so that it should only be necessary to carefully remove the breaker from its skids onto the permanent foundation.

Larger frame mounted breakers are of the split frame type and require the assembly of lower frame extension to upper frame when placing breaker on its foundation.

The floor mounted breakers require assembly of the parts connecting the pole units together as well as the installation of bushings and contacts. See Fig. 5. The pole unit adjacent to the operating mechanism should be put into position first. Before moving the second, or middle pole unit into place, the horizontal pull rods connecting between these poles should be pushed into the pull rod housing because they cannot be put in after the units are in position without removal of the accelerating spring on #3 phase. When in place, the flanges on the pull rod housing can be bolted together.

The tie rod braces between pole units may be installed after the units have been put into alignment. The nut on one end may be run up to the end of

the thread and this end first put into place. After these rods are in place the nuts should be securely tightened on both sides of the lugs on the pole units.

The third pole unit will be set into position in the same manner. Final assembly and adjustment of the operating rods is to be made after the bushings and contacts have been installed.

Transformers

When shipped as details, should be assembled into the breaker before the terminal bushings are installed. The leads from the transformers are to be brought out through the conduit which has been provided. These leads must pass through the insulating bushing which closes the space within the conduit.

Terminal Bushing Assembly

See Instructions IL-3610.
See Instructions IC-3828

The condenser terminal bushings must be handled with great care to avoid breakage or the entrance of moisture in the insulation before and during installation. Unpacking should be carefully done so that the porcelain will not be broken in taking the bushing from the crate. The lifting of the bushing should be done entirely as instructed on tag attached to the bushing. Care must be taken not to strike the lower portion of the bushing as any bruises on the surface are liable to lead to a breakdown in service. In putting the bushing in the breaker, see that it does not strike the sides of the hole as it is being let down into place.

It is very important that the bushings be kept dry. The lower portion, designed to operate under oil, is not weatherproof and must be kept dry. The black gummed tape covering is put on at the factory to protect the exposed micarta during shipment and must be removed before the bushing is installed, but should not be removed until just before the bushing is put into the breaker. To remove the tape, (just below the clamping flange), take hold of the projecting end of rip cord and pull down to the lower end. And then unwind the tape from the bottom end of the bushing. Be sure that the steps are thoroughly clean before proceeding. **Do Not Cut the Tape with a Knife!** When working with the bushing in a horizontal position, be sure to support it on a clean well padded surface.

Remember to put the weatherproofing gasket in place between the bushing flange and the bushing seat.

When assembling a terminal in the circuit-breaker, care should be taken to prevent it from striking against the sides of the opening in the base of the breaker. Sliding over the edge of the bushing opening will damage the Micarta winding of the bushing, and may result in injury to the conducting layers which will later lead to failure of the terminal.

The bushing should be assembled with the tap for the potential device connection outward.

The lower end of the condenser bushings should be located in line with the lift rod and equally spaced each side of the lift rod as shown in Figs. 8 and 10. It is essential that this spacing be correct so that the moving contacts will freely enter the slot in the De-ion grid stacks. A little time spent in locating the lower end of the condenser bushing stud will save considerable time later when assembling the contact details.

The flange bolts should be tightened uniformly around the bushings with the gaskets in place so as to prevent moisture from entering the breaker tank.

Arc Shield Assembly

Arc shields must be thoroughly clean and dry, inside and out, before installing. Special precautions should be taken. In damp weather it may be necessary to use artificial heat to warm up the porcelain, thus prevent condensation on the surface. Cleaning of the unglazed surfaces is best done by scrubbing with gasoline. A rope sling should be used for handling the shields. The arc shield assembly is shown in Fig. 6.

Where arc shields are used, the condenser bushing has an extra long flange over the ground band. At the lower end of the flange is an internal thread into which an adjustable hood is screwed. The under side of the hood is machined to receive two gaskets, one of Velumoid and one of cork. The cork gasket is placed next to the porcelain and the Velumoid, when used, next to the machined surface of the hood. This facilitates turning of the hood to apply pressure to the gaskets at both ends of arc shield.

The static-shield holder, or arc shield support, below the porcelain also has a finished surface to fit a single cork gasket as shown. The under side has a pipe plug which may be removed for draining the oil from the arc shield. This arc shield support with the pipe plug in place, should be screwed tight against the insulation at the lower end of the bushing.

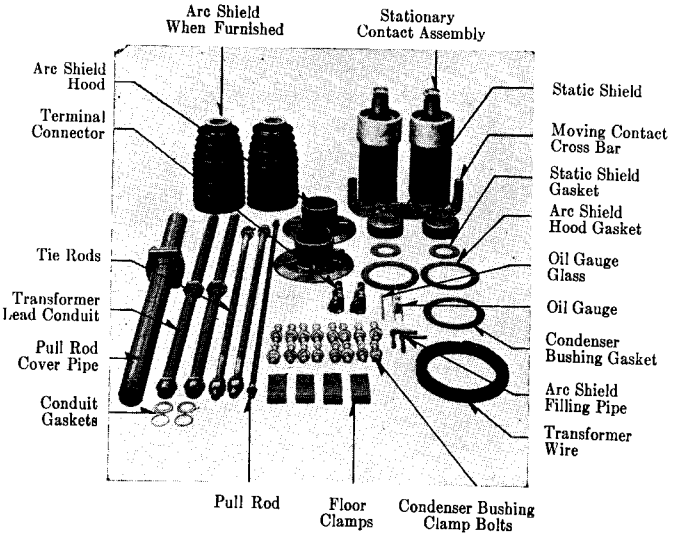


FIG. 5—PARTS FOR SINGLE POLE UNIT

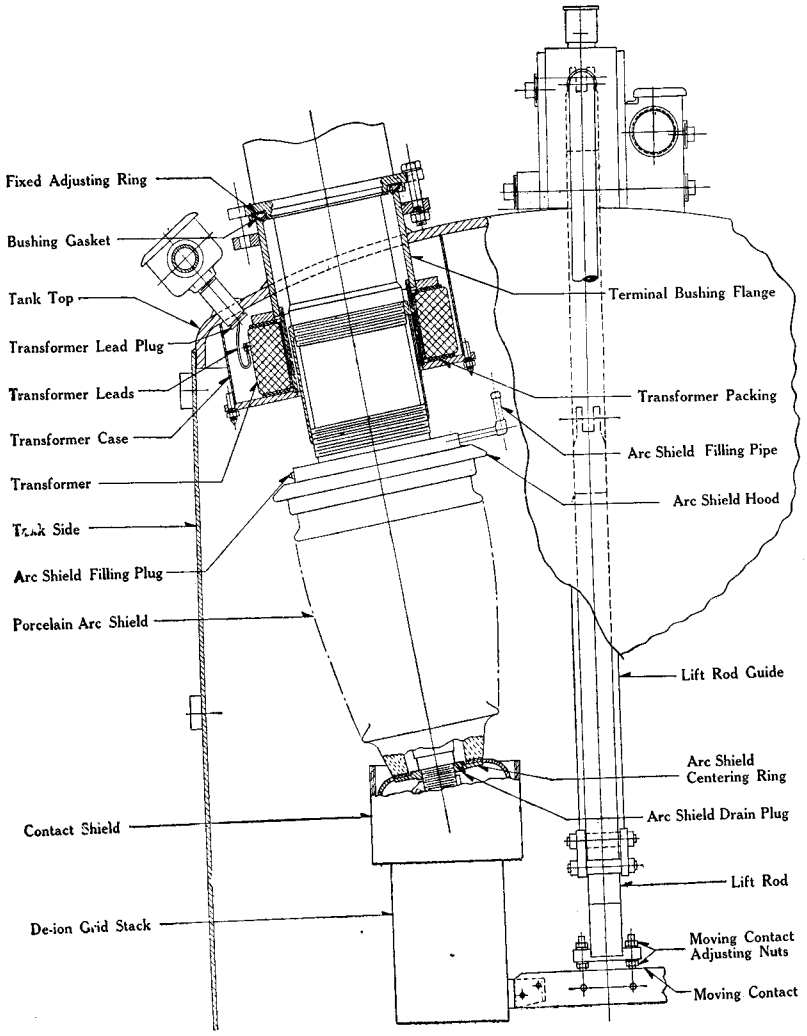


FIG. 6—ARC SHIELD AND TRANSFORMER ASSEMBLY

An insulating spacer is sometimes provided for centering the lower end of the arc shield. This spacer must be put in so as to permit oil to pass to the drain plug for draining the arc shield.

In all cases have the cork gaskets next to the porcelain. Cork gaskets should be inserted clean and dry and there is no necessity for covering them with a sealing compound. Seal the space within the shield by turning the adjustable arc shield hood in such a direction that the cork gaskets are compressed sufficiently to prevent leakage of oil. The hood may be turned by fitting a pipe threaded bar into the hole provided for the filling pipe or plug. When tight, fit the hole most convenient with the filling pipe. **Do Not Permit the Oil Filling Pipe to Touch the Transformer Case,** as this would place a short circuit turn around the transformer and affect its ratio.

Filling of the arc shield with oil may wait until just before filling the tank, **but it must not be forgotten,** and the instructions for placing oil in service given on Page 12 must be carefully followed.

Stationary Contact Assembly

The stationary contact supports as shown in Figs. 7, 8 and 10 should be clamped on the lower end of the condenser bushing in such a position that the full thread length of the clamp is on the stud.

The clamp should be put on so that the opening between the loose piece and the main casting is all on one side of the stud. The castings have been machined to fit the end of the bushing and then one side milled out to permit a tight clamping onto the bushing.

With this assembly there will be little adjustment required in aligning the contacts. When the contact supports have been clamped into place, the stack of "De-ion" Grids may be bolted on.

Although the stack of "De-ion" Grids is shipped assembled to the contact supports, it will usually be found more convenient to separate these two parts before attempting to assemble the contact supports on the end of the condenser bushing. Four bolts are used to hold the contact bracket to the contact support and these bolts may be removed in order to separate the stack of grids from the contact supports.

The stacks have been assembled under pressure and the large nuts on the 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 loosening the four smaller steel nuts at the upper end of the studs.

Final adjustment of the contacts can only be made after the moving contacts and operating rods have been assembled.

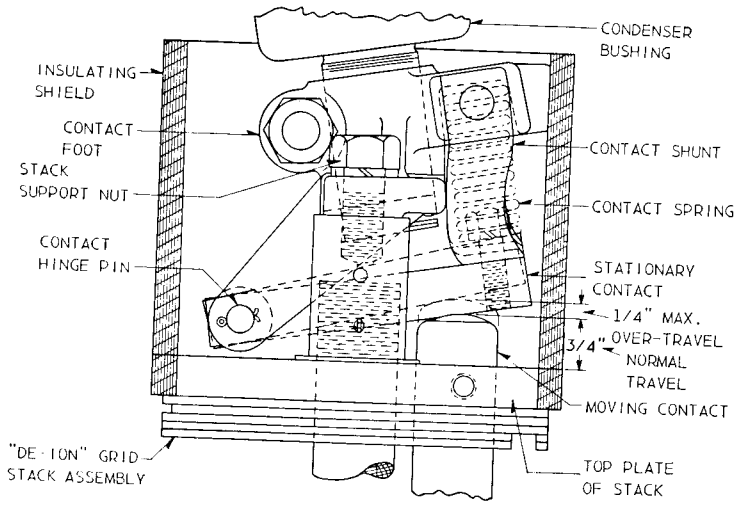
Moving Contact Assembly

The moving contacts for these breakers are shipped as complete units and can be assembled by inserting the hinge pin. No adjustment should be necessary inasmuch as all parts have been assembled and tested at the factory.

Alignment of moving and stationary contacts should be made by adjusting the stationary contacts to suit the closed position of the moving contacts at the same time the stops and toggle settings are being checked.

When the fibre nuts on the moving contact guide have been removed, Bakelite cement must be used to seal them on the studs when they are replaced.

Operating Rod Assembly and Adjustment—The operating rods of the frame mounted breakers have not been removed for shipment and it should only be necessary to see that the lever is about



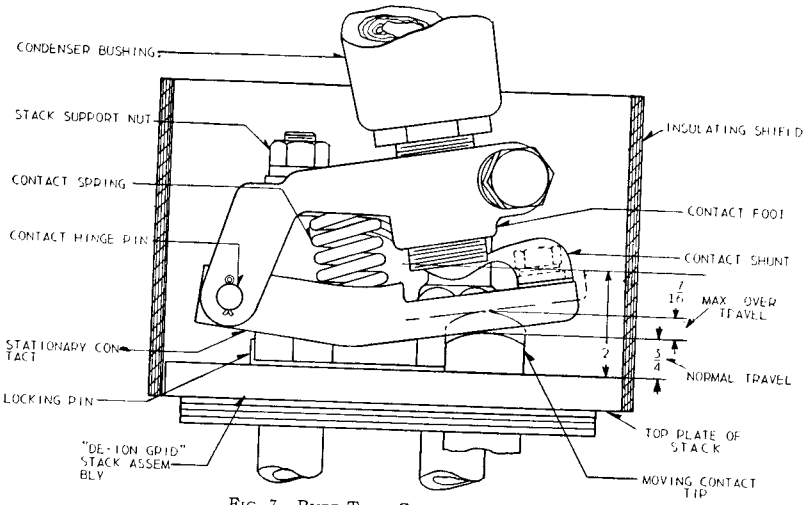


FIG. 7—BUTT TYPE CONTACT ASSEMBLY.

INSTRUCTIONS FOR ADJUSTING CONTACTS AND "DE-ION" GRIDS FOR 34.5-69 KV. BREAKERS

1. The breaker toggles should be checked for proper clearance on 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.

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 on the bushing stud. The insulating shield should then be slipped on over the contact support, and then the "De-ion Grid" stack should be 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 assembled ahead of the stack.

4. The setting of the condenser bushings controls the clearance on the moving contact member when same is passing through the slot in the grids. It is important that care be taken 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 shown.

6. After the contacts have been properly adjusted, the insulating shield should be raised above the contact support up along the condenser bushing to tighten the clamping bolt on the contact support. The insulating shield should 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 seal the fibre pins which hold the Micarta tubes in the lift rod guides.

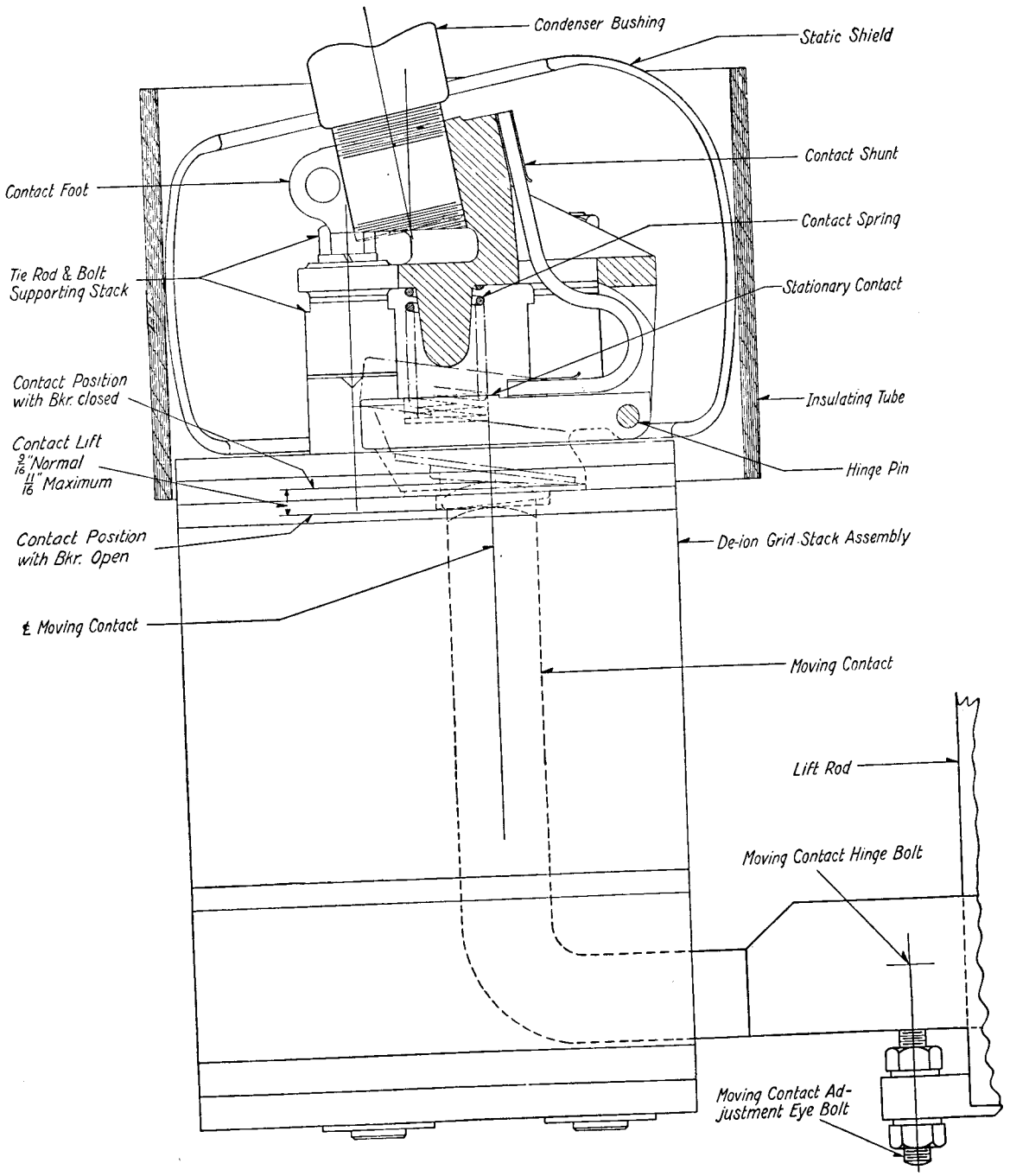


FIG. 8—MOVING AND STATIONARY CONTACT ASSEMBLY WITH BUTT TYPE CONTACT

INSTRUCTIONS FOR ADJUSTING CONTACTS AND "DE-ION" GRIDS, 115-161 Kv. Inc.

1. The breaker toggles should be checked for proper clearance on the toggle stops with the breaker in the closed position.
2. The proper contact pressure should be arrived at by raising or lowering the grid assembly on the condenser bushing. The reason for making the adjustment at this point is that the proper setting of the moving contact member has been made in the factory and should be worked to when the final set-up is made for service.
3. The setting of the condenser bushings controls the clearance on the moving contact member when same is passing through the slot in the grids. It is important that care be taken when the final setting of the bushings is made as it is necessary to have the contact member centered with the grid slots.
4. The proper contact pressure will be obtained when the stationary contact is in the closed position shown
5. The complete grid assembly can be raised or lowered on the condenser bushing stud by removing the insulated stud from the guide for the moving contact member. This will allow the lift rod to be swung to one side so that the grid can be raised or lowered on the bushings.

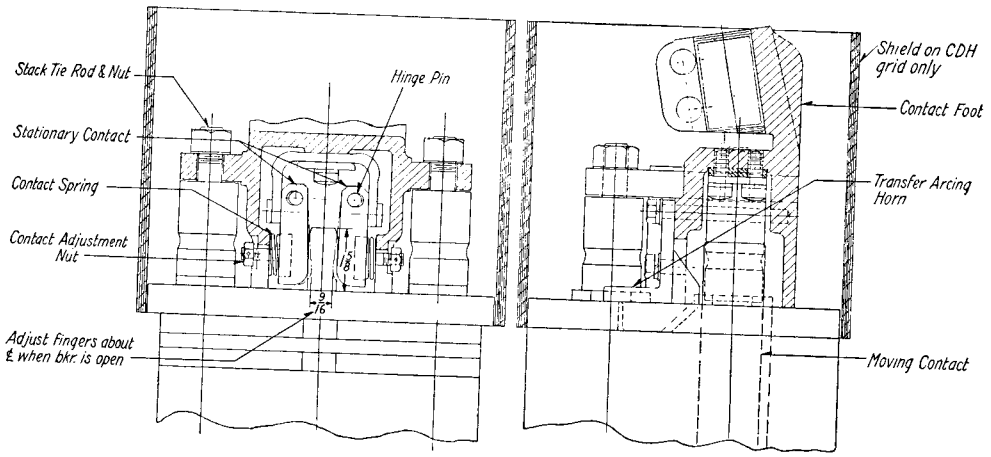


FIG. 9—"DE-ION" GRID, WITH FINGER TYPE STATIONARY CONTACT ASSEMBLY

INSTRUCTIONS FOR ADJUSTING THE FINGER TYPE "DE-ION" GRID CONTACTS, 15 TO 69 KV.

1. With the circuit breaker in the closed position, the toggle stops should be checked for clearance when the breaker is closed by hand. It will be found that the toggle stops will be solid when the breaker is closed electrically. This is due to the finger contacts holding the moving contact member. When closed manually, the clearance will be approximately $\frac{1}{16}$ inch.

2. The final setting of the grid will be determined by the required amount of travel of the moving contact member into the finger contacts as shown. This adjustment is made by raising or lowering the grids on the condenser bushings. It will be found necessary to remove the fibre stud through the guide member of the moving contact. This will allow the moving contact to be swung to one side for clearance on the grid.

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

4. To inspect contacts it is necessary to remove the transfer arcing horn at the rear of the stationary contact assembly.

5. The contact fingers are designed to give a high pressure at the lower end. When in proper contact a slight opening will be observed at the top end.

$\frac{1}{16}$ inch from the stop when the contacts are in the closed position (See Fig. 11). Ordinarily, it is not necessary to adjust the length of the pull rods between the poles; however, if adjustment is necessary, the pin at one end of the pull rod should be removed and the rod end given a turn or two. Be sure to tighten the lock nut on the rod after making this adjustment.

The pole units of the floor mounted breakers should be adjusted one at a time. Starting with the pole nearest the mechanism, this pole unit is connected to the mechanism through the pull rod, and the other poles disconnected. The length of the pull rod from the mechanism to the breaker unit can be adjusted by screwing the rod end up or down on the end of the pull rod. With the breaker mechanism latched, and the breaker unit in the closed position, check the clearance between the lever and the stop to see that the lever is approximately $\frac{1}{16}$ inch from the stop. The pole unit may then be opened and a check made to see that the moving parts strike against the bumper. With the unit having been checked in both the open and closed position, it may then be tripped by hand to make sure that the action is correct and that the shock of opening is taken up by the bumper.

The setting of the lift rod stop may be observed by removing the vent pipe at the top of the pole unit and looking into this opening.

The toggle stop setting may be observed by removing pipe plug from side of the mechanism box on top of the tanks.

For the purpose of releasing the breaker slowly by hand, the load of the breaker may first be taken up by the hand closing device and then the holding latch in the solenoid mechanism be pushed back to allow the mechanism to come to the open position slowly.

The pull rod to the second pole unit can be connected and the operation of this unit made to conform with that of the first pole unit. The adjustment of the horizontal pull rod between these units is made in the same manner as the vertical adjustment from the first unit to the operating mechanism. After the second unit has been checked and adjusted, the operation should be repeated with the third pole.

It will be found somewhat difficult to set up the last pole unit of the breakers because they have the accelerating spring on this unit. This work may be made easier by removing the cap at the rear end of the spring housing

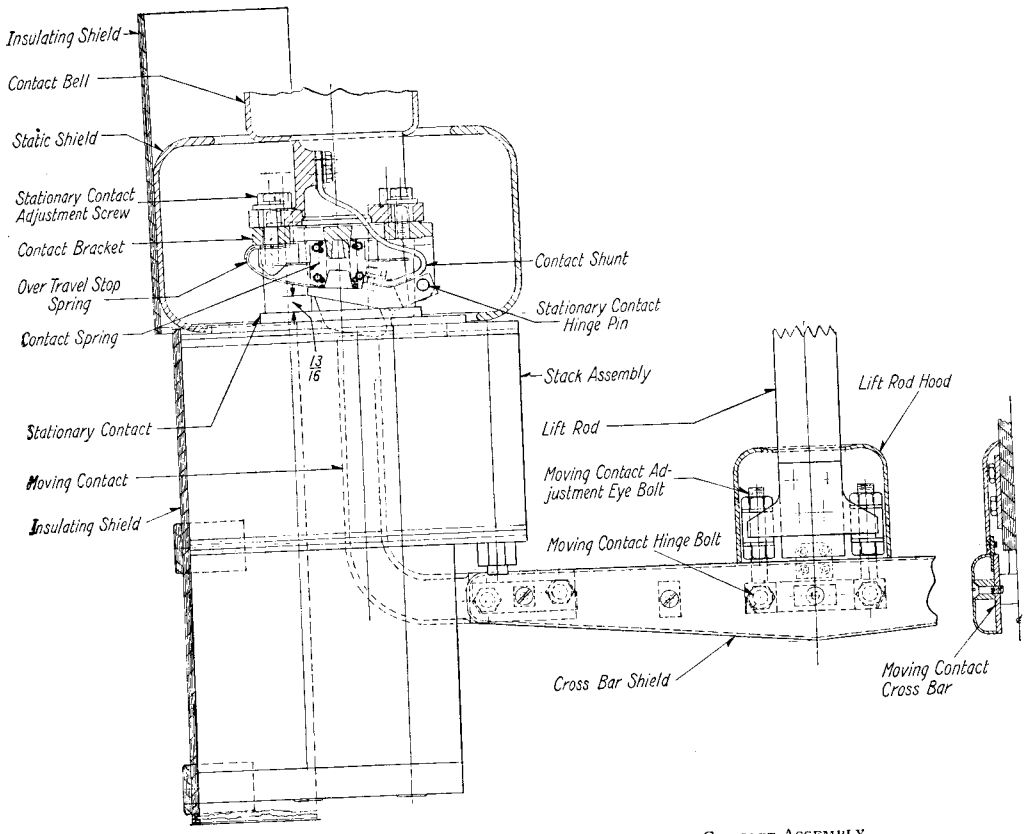


FIG. 10—"DE-ION" GRID 196/230 AND 230 KV. STATIONARY CONTACT ASSEMBLY

when the breaker is closed. This relieves a large portion of the pressure from the accelerating spring. After this pole unit has been connected to the others, it can be closed in the usual manner and, in the closed position, the cap can be easily assembled. When all of the poles have been adjusted in this way, a re-check should be made on the first and second, as some readjustments of the pull rods may be found necessary due to the added weight of the second and third poles. Each toggle position, stop and bumper should be re-checked before attempting to operate the breaker electrically. The breaker units should not be allowed to drop open freely more times than is absolutely necessary before the oil has been placed in the tanks. Without the cushioning effect of the oil, damage to the moving part is liable to occur.

Connections

Leads should be flexible and brought down from above the circuit breaker if possible. Ample room must be provided between these leads and parts of the station or overhead steel structure.

All terminals must be fastened securely to the leads and tightly clamped to the connection studs. Connections to the breaker are usually made by copper tube terminals fastened to the ends of the bushings. When tightening the terminal or clamp bolts, care must be taken not to place unnecessary strain on the top of the condenser bushing.

All joints must be clean, bright and free from dents or burrs.

All nuts on the current carrying parts must be securely tightened to obtain good contact. If the joints are not made correctly, dangerous heating of the breaker may result at these points.

Cables should be properly supported so that the bushings are not subjected to unnecessary strain. Any strain which at first has no apparent effect may eventually loosen the insulator cap and permit moisture to enter the bushings.

To avoid heating, the connection leads must be of a current carrying capacity at least equal to that of the current carrying part of the breaker.

Control Wiring

All control wires to the circuit breaker should be run in conduit when practicable. A diagram 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 transformer connections are illustrated on page 17.

The cover on the lower end of the transformer case must not touch bushing flange.

Grounded Connections

The frame of each breaker should be permanently grounded. The usual practice is to connect a heavy cable to the frame and to the station ground. A good permanent low resistance ground is essential for adequate protection. A poor ground may be worse than no ground at all, since it gives a false feeling of safety to those working around the equipment.

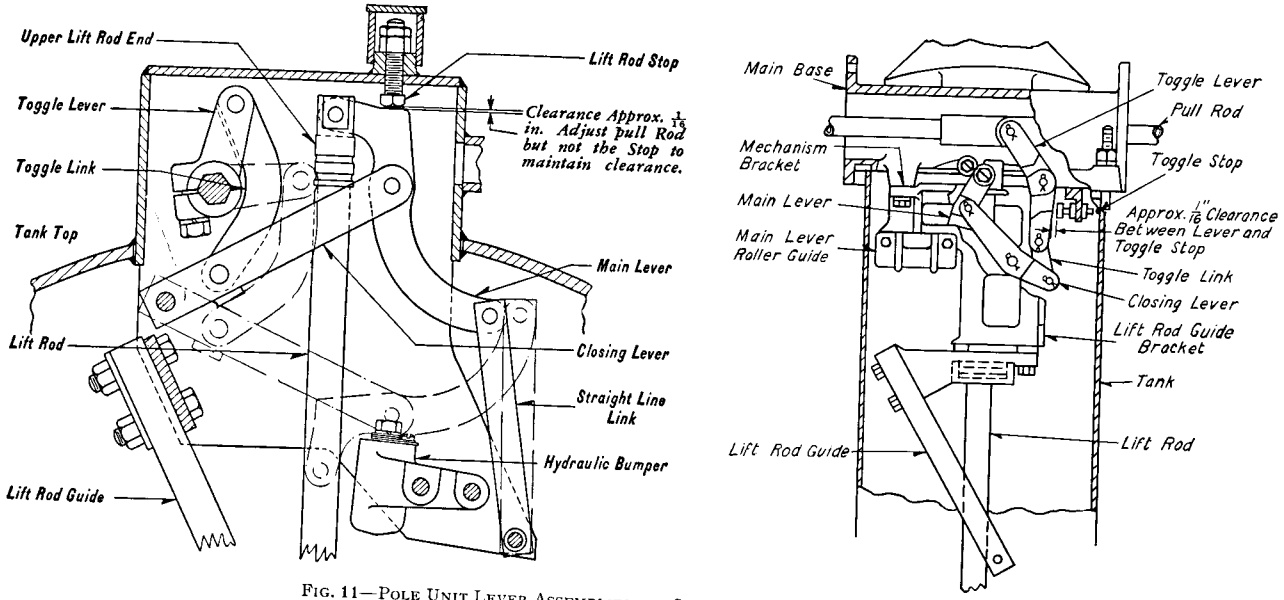


FIG. 11—POLE UNIT LEVER ASSEMBLIES FOR SMALL FRAME MOUNTED BREAKERS WITH FINGER OR BUTT TYPE STATIONARY CONTACTS

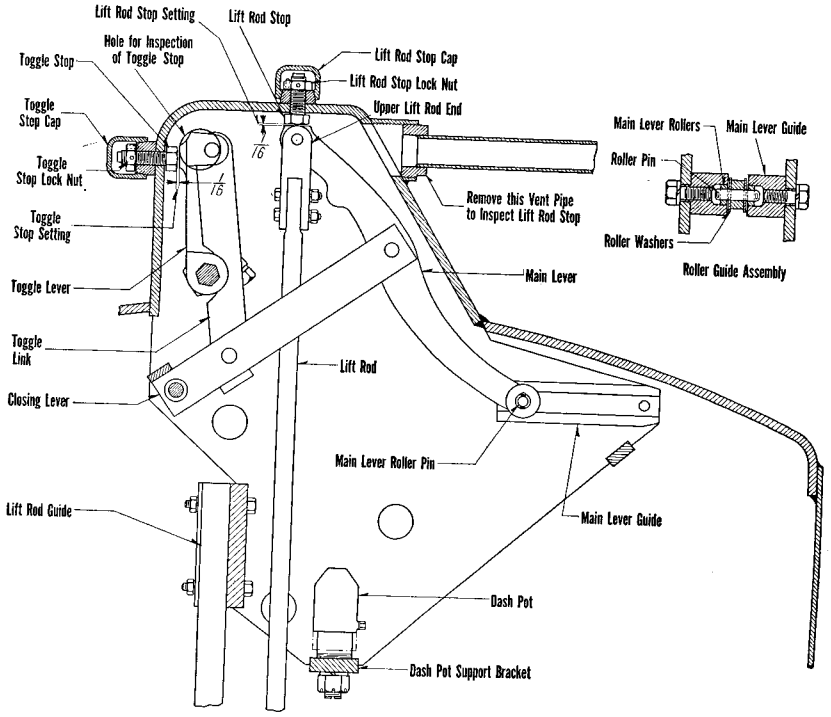


FIG. 12—POLE UNIT LEVER ASSEMBLY FOR FLOOR MOUNTED BREAKERS

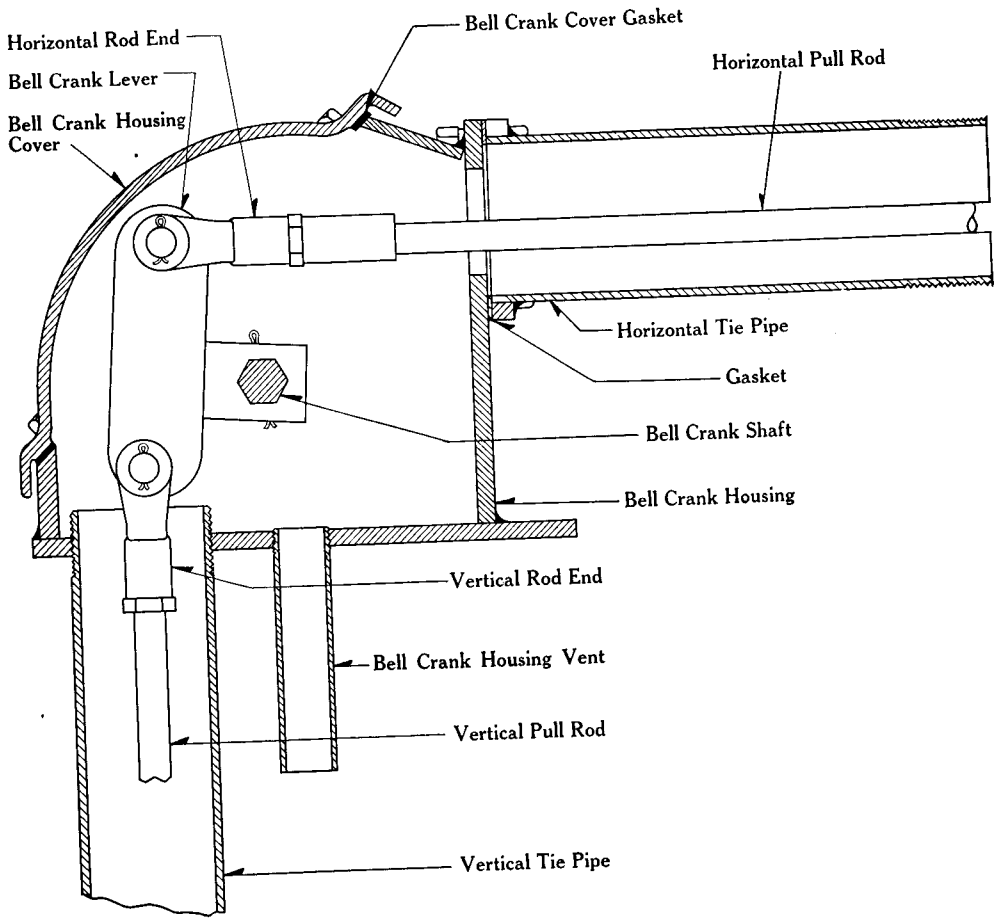


FIG. 13—BELL CRANK ASSEMBLY FOR FLOOR MOUNTED BREAKERS

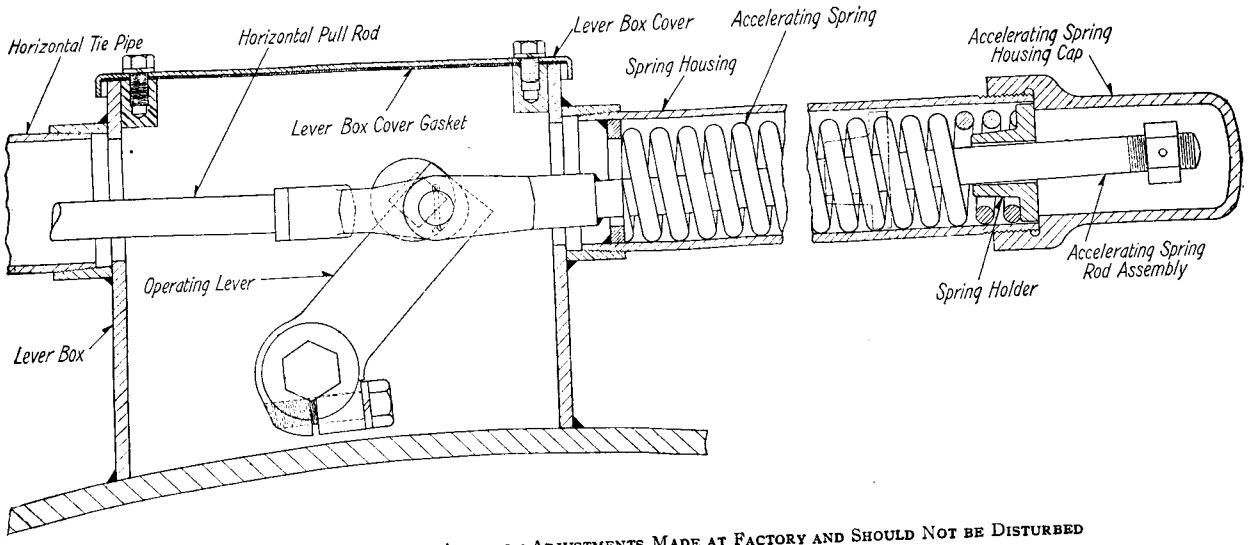


FIG. 14—ACCELERATING SPRING ASSEMBLY ADJUSTMENTS MADE AT FACTORY AND SHOULD NOT BE DISTURBED

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 test 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. When furnished, tank linings should be examined for possible mechanical damage.**
2. **See that the breaker is properly set up and leveled on its foundation.**
3. **See that all bearing surfaces of the operating mechanism have been lubricated.**
4. **Close the breaker slowly by hand, noting that the operating rod and contacts are properly adjusted for correct alignment and that good contact is made when the breaker is closed. The movement of the breaker on opening and closing should be free and without friction.**
5. **The muffler setting should be examined and, if it has not loosened during shipment, should be left alone. Otherwise, the setting should be made as explained on page 17.**
6. **All nuts must be tightened so that moisture cannot enter the circuit breaker. The bolts on the bushing, flanges, tanks and fittings must be kept tight.**
7. **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.**
8. **Inspect all insulated wiring to see that no damage has resulted during the process of installation.**
9. **Test the wiring for possible grounds or short circuits.**
10. **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.**
11. **The electrical operation may be checked a few times without oil in the tanks. Excessive operation without oil may damage the breaker and should be avoided.**

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 exposed and stored in open 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.

First fill the arc shield with oil known to be clean and dry, until the level of the oil has reached the level of the filling hole in the arc shield hood. Then plug this hole and fill to the top of the filling pipe; and cap the pipe.

Some oil may seep out along the threads on the arc shield fittings. This is not serious as long as this does not materially lower the level of the oil in the arc shield before the tank has been completely filled.

Fill the oil tanks to the proper level with Wemco "C" oil. Special precaution must be used in handling the oil in accordance with detailed instructions given on page 19 and Westinghouse Instruction Book 5336.

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. Don't 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 Operation

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 Mechanism

This mechanism, located in the upper part of each pole unit, operates the lift rod which carries the moving contact. It is somewhat hidden from view and reference to the illustrations on pages 11, 14, 15, and 16 should help in a better understanding of the operation of these mechanisms.

It should be remembered that the stops have been set and locked at the factory. Unless it is obvious that they have been disturbed, all adjustments should be made to give the approximate $\frac{1}{16}$ inch clearance at the stops without changing the position of the stop screws. This clearance should exist with the breaker in the normal latched closed position with full contact and spring load when breaker has been manually closed.

The toggle must not be permitted to pass over center as such a condition would prevent the breaker from tripping open.

There must be clearance at the stops in the normal closed position so that the closing mechanism will have time to latch and not put an undue strain on any of the parts.

With the toggle too far from center in the closed position the breaker will be hard to close.

Lifting Rod Stop

In the top of most of these breakers will be found the lifting rod stop or moving contact stop. This is to prevent overtravel of the lift rod and moving contacts. It will prevent the inertia of the moving contacts from taking up the clearance in the various links and pins. The clearance at this stop can be checked with a thickness gauge by removing the vent pipe and reaching into the mechanism compartment through the vent pipe opening.

Toggle Stop

Some of the smaller breakers do not require a toggle stop.

Other breakers have a toggle stop in addition to the lift rod stop. The setting at this stop should be approximately $\frac{1}{16}$", the same as for the lift rod stop.

The toggle stop in the large frame mounted breakers, as illustrated in Fig. 16, may be checked with a gauge by reaching up into the top when the tank is lowered.

In the floor mounted breakers, an inspection hole is available for use when checking the toggle stop. This hole is illustrated in Fig. 12. It must be closed tightly after the inspection is complete.

Bumpers

Most of these breakers are provided with the hydraulic type of bumper using the oil in the circuit-breaker tank to cushion the shock at the end of the opening stroke. The form of the dashpot varies with the size of the breaker but the principle of operation remains the same.

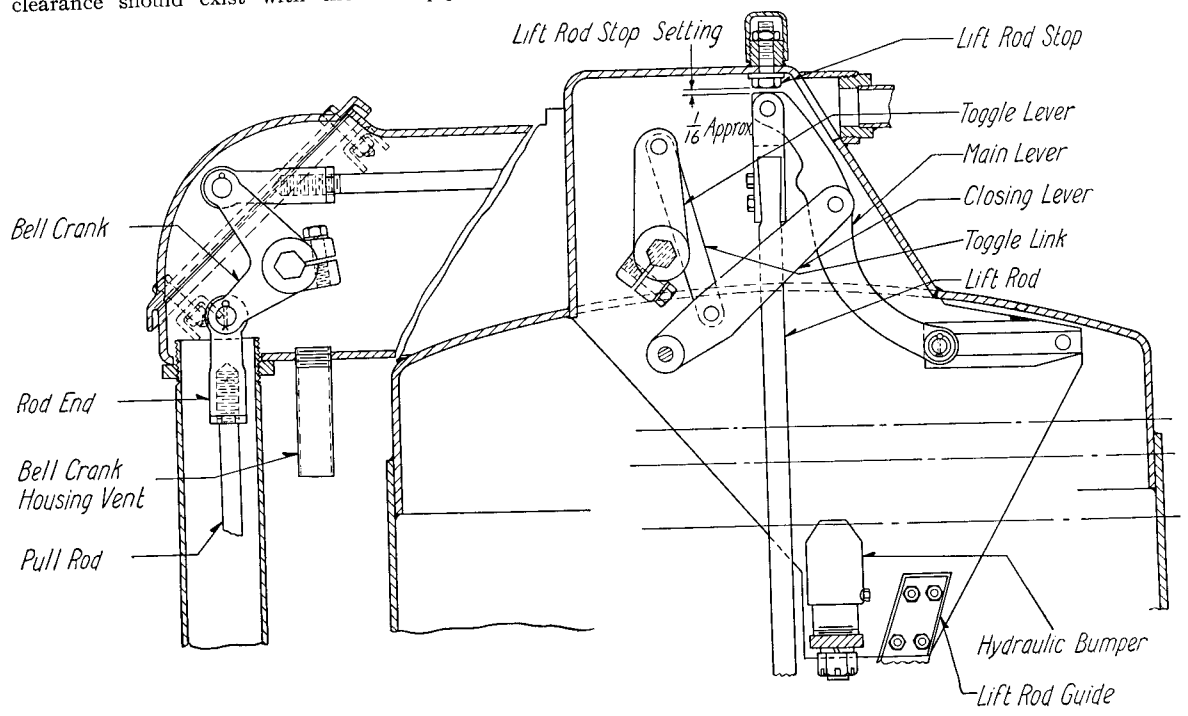


FIG. 15—TOGGLE MECHANISM FOR TYPE GO-1, 115,000 VOLT BREAKER

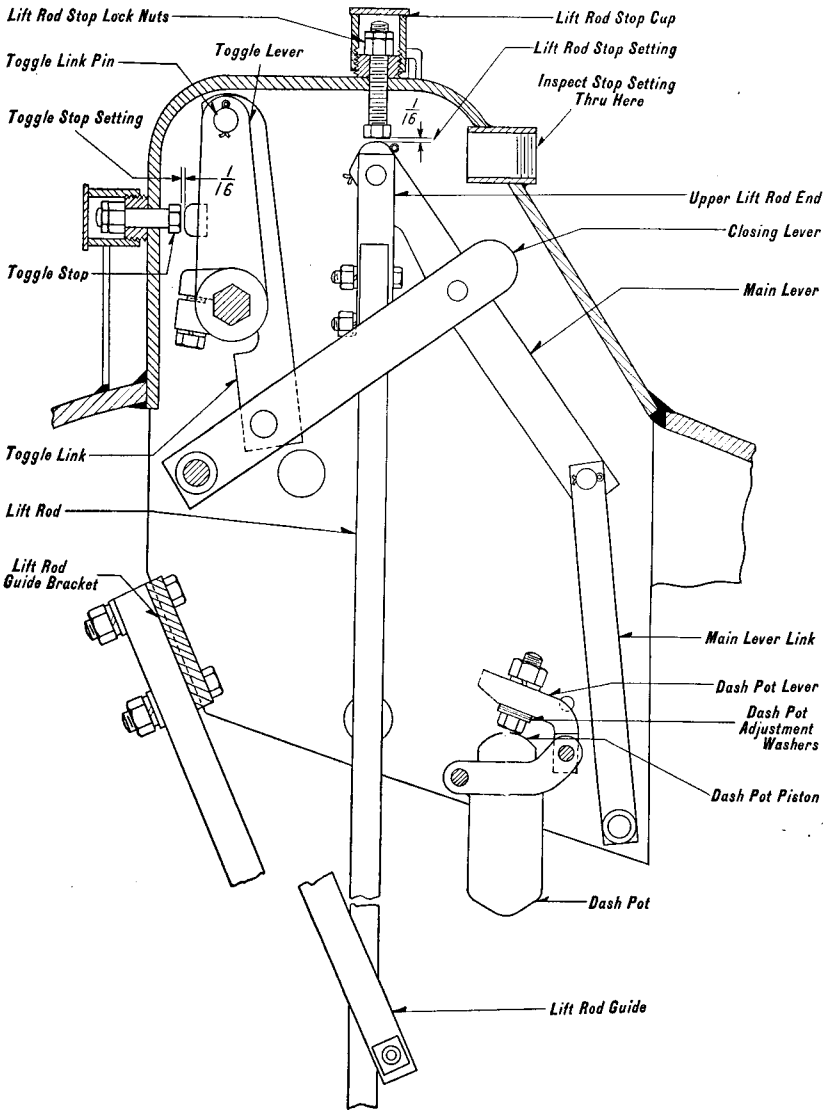


FIG. 16—TOGGLE MECHANISM FOR LARGE FRAME MOUNTED BREAKER

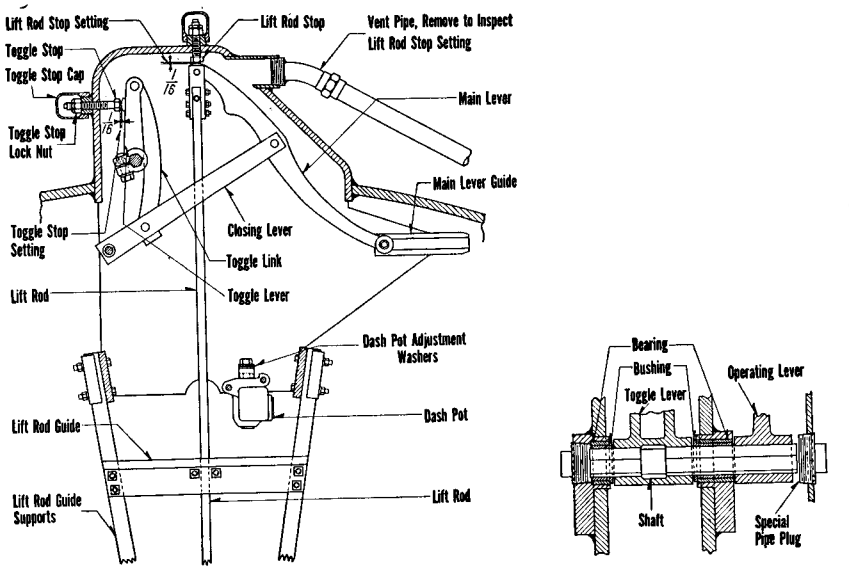


FIG. 17—TOGGLE MECHANISM FOR 230,000 VOLT BREAKERS

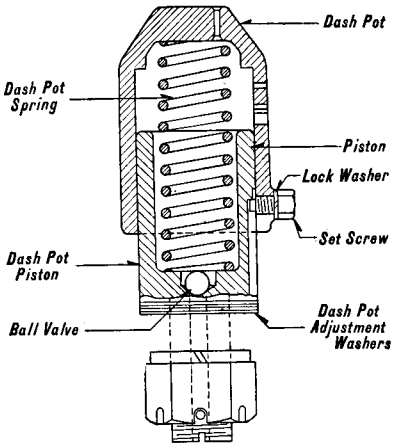


FIG. 18—HYDRAULIC BUMPER (DASH POT)

Fig. 18 illustrates one of these bumpers. When the tank is empty, the bumpers will also be empty. It is therefore desirable to avoid unnecessary tripping of breaker without having the tanks filled to the proper oil level.

In the open position, the levers of all three poles must rest on the bumpers which should be solid in the full open position. Care must be taken to see that no one bumper is taking all of the load, but that each is taking the load of its pole unit.

Current Transformers

Current transformers, supplied only when ordered, are mounted in the transformer cases in the top of the pole units. Transformers are usually of the multi-ratio type having five leads which provide a wide range of ratio as illustrated by the accompanying tables. All of the leads are brought out and numbered for external connections. When transformers are ordered with the breaker the leads are run through conduit to out 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. The diagram Fig. 21 shows 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, care must be taken to see that the end of the current transformer carrying the white mark is placed upward. The terminal foot or stationary contact and arc shields when used must be removed. After disconnecting the transformer, the support for it is removed and the transformer slid down over the bushings. In replacing the transformer, care must be taken that the packings at top, bottom and sides of transformer are in position. **The transformer case must not touch the ground banding on the terminal bushings, bushing flange or arc shield hood.**

Multi-Ratio Transformers

Multi-ratio transformers are shown schematically by Fig. 19. Ratio tables for standard transformers are:

600-AMPERE 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-AMPERE 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

2000-AMPERE MULTI-RATIO TABLE

Approximate *Ratio	Turn Ratio	Secondary Taps
800 to 5	160 to 1	C—D
1200 to 5	240 to 1	C—E
1400 to 5	280 to 1	B—D
1600 to 5	320 to 1	A—D
1800 to 5	360 to 1	B—E
2000 to 5	400 to 1	A—E

3000-AMPERE MULTI-RATIO TABLE

Approximate *Ratio	Turn Ratio	Secondary Taps
1000 to 5	200 to 1	A—C
1800 to 5	360 to 1	C—D
2000 to 5	400 to 1	C—E
2400 to 5	480 to 1	B—D
2600 to 5	520 to 1	B—E
3000 to 5	600 to 1	A—E

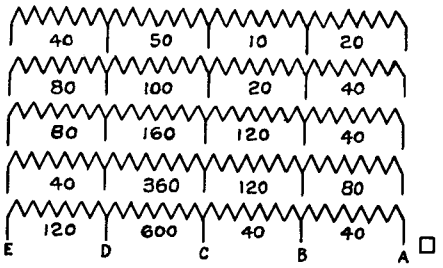
4000-AMPERE MULTI-RATIO TABLE

Approximate *Ratio	Turn Ratio	Secondary Taps
3000 to 5	600 to 1	C—D
3200 to 5	640 to 1	B—D
3400 to 5	680 to 1	A—D
3600 to 5	720 to 1	C—E
3800 to 5	760 to 1	B—E
4000 to 5	800 to 1	A—E

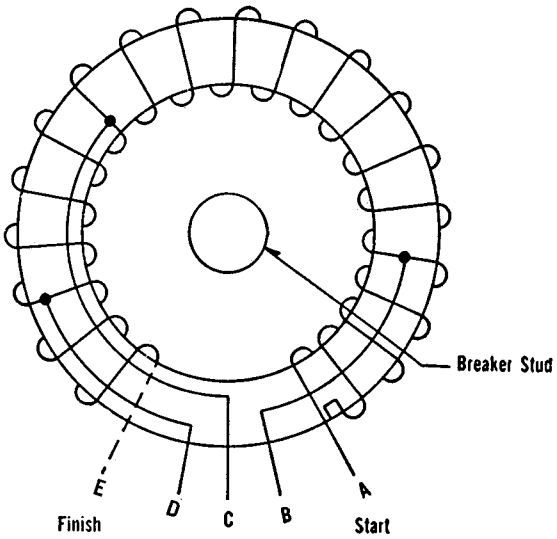
*Not compensated for secondary loading see ratio curves for various loadings.

These transformers are not compensated for any given loading.

Where accuracy of load ratio is required, ratio curves should be referred to. The curves for standard transformers may be obtained from the East Pittsburgh Works. A separate curve sheet is made for each ratio for each design of transformer. Ratio curves are not available for special transformers except where provision was made for these curves at the time the order entered. In requesting curves the normal ratio should be specified, together with the stock order number, breaker type, and rating, as given on the nameplate. A typical curve sheet showing available curves on standard burdens is illustrated by Fig. 20.



Development of winding giving number of turns between taps



Subtractive polarity indicated by white polarity mark. With any combination of taps. The tap nearest A has the same relative polarity as terminal A.

Bushing-Type current transformer

FIG. 19—MULTI-RATIO BUSHING TYPE CURRENT TRANSFORMERS

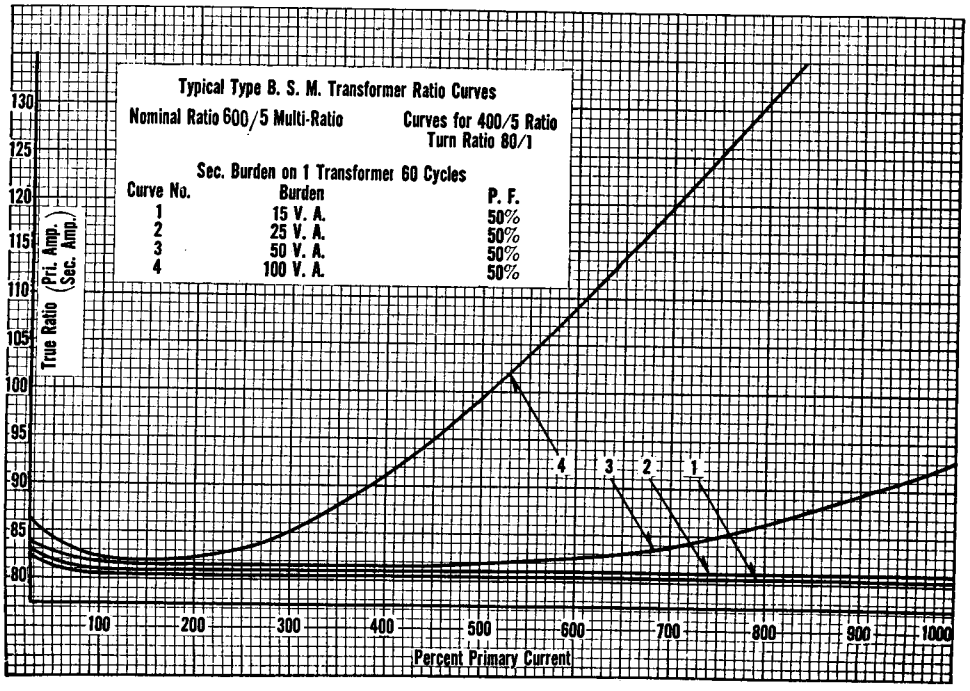


FIG. 20—TYPICAL TRANSFORMER RATIO CURVE

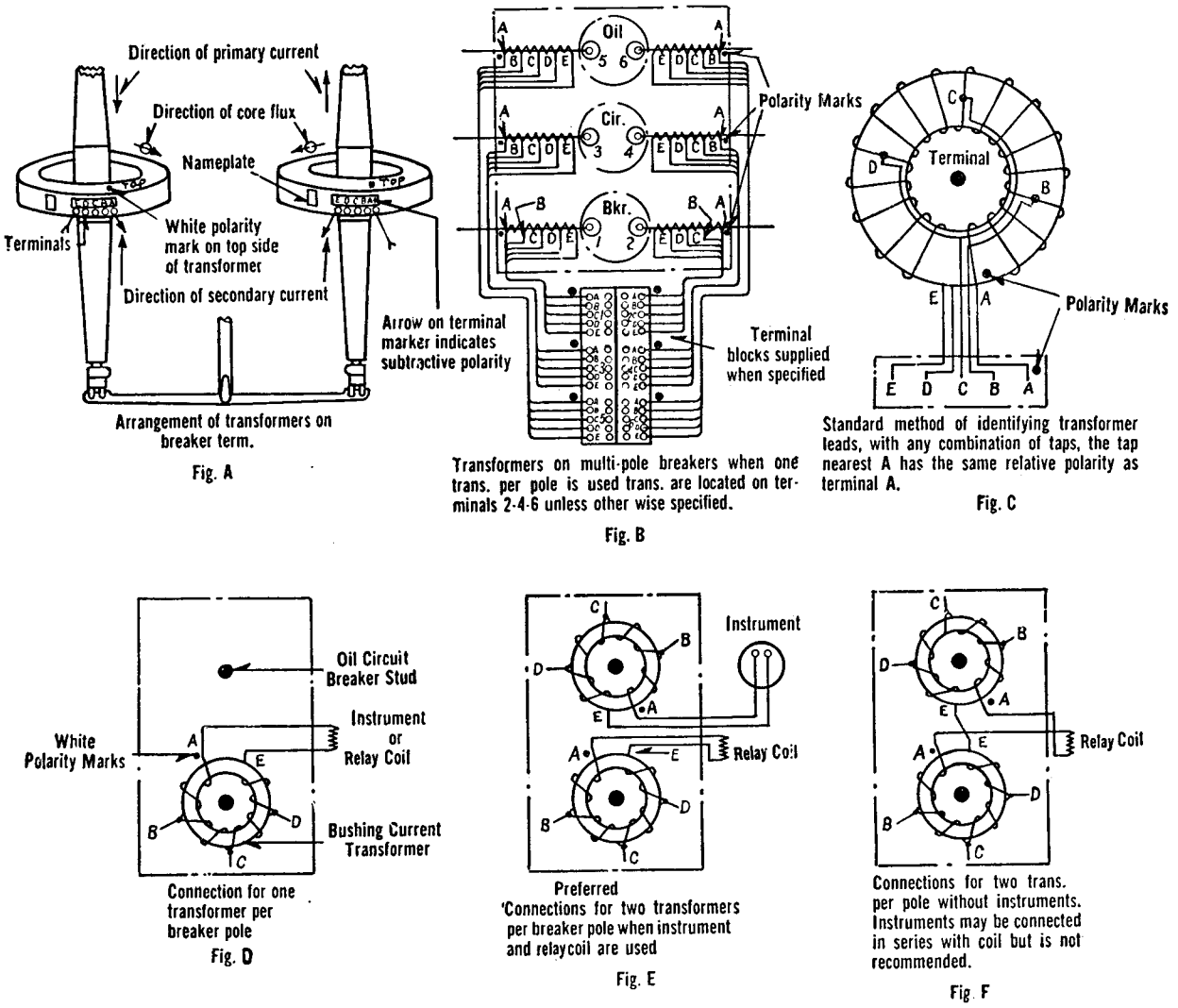


FIG. 21—TYPICAL BUSHING TYPE CURRENT TRANSFORMER CONNECTIONS

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 subtractive polarity and the direction of flux and current 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 higher ratios.

Hipernik Transformers

Hipernik transformers of special nickel steel are used for accurate metering and 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 silicon steel over the lower ranges of currents and burdens, there is little difference in performance over the higher ranges for the same size and ratio.

Condenser Terminals

General instructions for installing have been given under the subject of "Terminal Bushing Assembly" on page 5. However, certain precautions are necessary to insure satisfactory service.

Do not store these bushings under a *leaking roof*, or where water may drop on them, or in any extremely damp place.

When in service do not permit the grounding band on the bushing to touch the metal plate which holds the transformer in place.

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.

Venting

Frame mounted breakers when supplied with mufflers having fixed valves, and the setting should not be changed unless local conditions require. Then the change should only be made after it has been shown to be necessary. When shipped from the factory, the valve setting is one-half open. This adjustment should be satisfactory for all ordinary

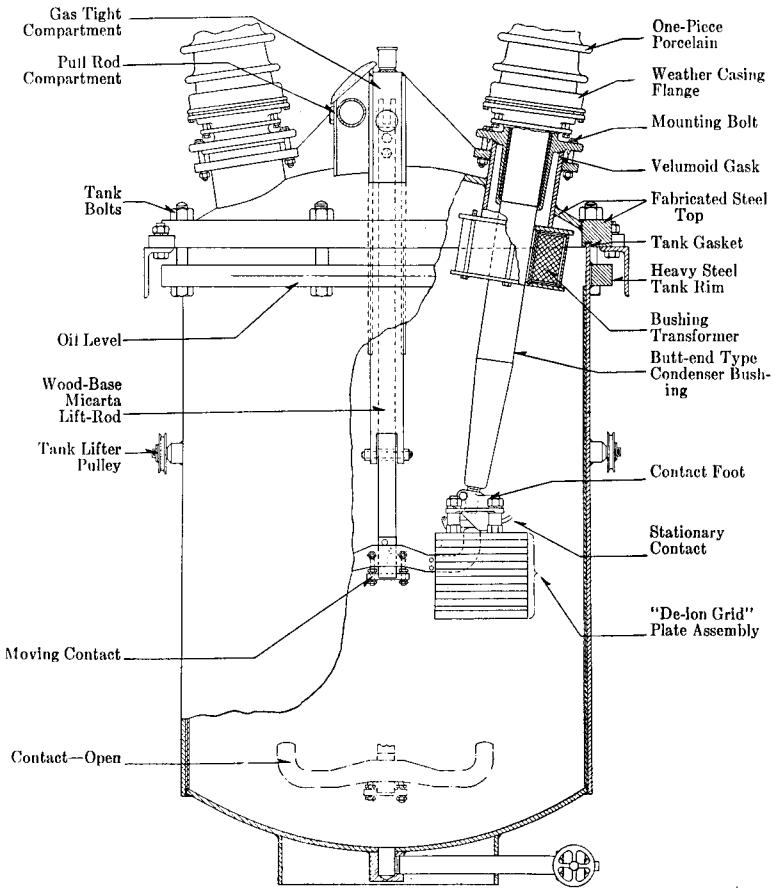


FIG. 22—POLE UNIT FOR 69,000 VOLT BREAKER

installations. The function of the muffler is to separate the oil from the arc gasses, which are discharged when the breaker interrupts the circuit. The circuit-breaker is shipped with the passage half closed with screw Style No. 555630. This is the normal condition. For light rupturing duty it is permissible to increase the opening by using screw Style No. 555631 without causing oil throw. On extreme or heavy duty the passage must be closed more by using screw Style No. 555629 to decrease the velocity of the gas entering the muffler and assist in the separation of the oil and the gas.

Gasket—Style Number 555632 is used with all screws.

Floor mounted breakers do not have mufflers, but are supplied with long vent pipes which extend down, outside the tank and require no adjustment.

Contacts

(a) Contacts once properly installed should not require further adjustment.

(b) When the arcing contacts become burned or pitted from subsequent operations, they should be hammered back into shape and filed slightly if necessary.

(c) At regular inspection periods it is desirable to clean the copper surfaces to remove any signs of oxidization which may have occurred.

(d) 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 start to break.

(e) Keep the contact travel as near as possible to the original setting.

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

Lift Rod and Guide

The only adjustment provided for the lift rod is in the floor mounted breakers where it passes through the guide. Insulated studs are used to prevent excessive side movement of the lift rod and moving contact. These studs may be moved to a new set of holes if necessary to take up clearance or make a closer adjustment on the lift rod. After changing the position of the studs, the nuts must be sealed on by the use of Bakelite cement.

Tanks

Frame mounted 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. If the wrench handle is not long enough, it is well to use a piece of pipe 3 or 4 feet long so as to obtain a good leverage.

The covers on the tops of the floor mounted breaker and the frame mounted breakers should be carefully tightened

Tanks should not be left off the breaker, nor the man-hole covers left off over night because this would permit

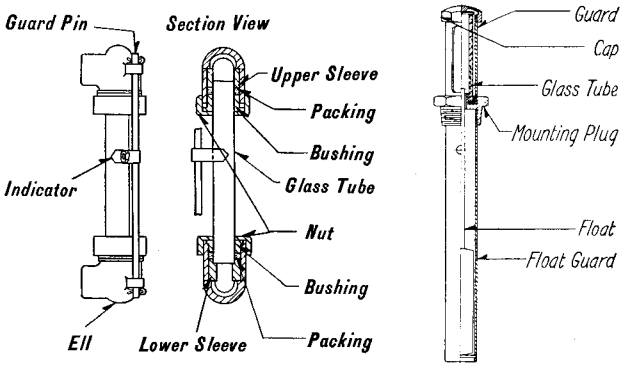


FIG. 23—OIL GAUGE ASSEMBLIES

entrance of moisture in the form of dew or as a result of a sudden storm. Tanks should not be lowered in wet weather without provision for keeping rain out of them and off of the internal parts of the breaker.

Oil Gauges

All tanks are provided with glass gauges for indication of the level of oil within the tank. 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° Centigrade.

Reference to the illustrations, Fig. 23, should be helpful in case it is necessary to replace a broken gauge glass or tighten the gaskets.

Return Type

For the return type oil gauge Fig. 23 Westinghouse packing P.D. Spec. 6057 should be used. Assemble fittings on tank with red plumber's cement, at the threaded joints. Line up fittings so that glass will be vertical. Make sure all threaded joints are tight. Place small counterbored sleeve in lower fitting and plain sleeve in upper fitting (Holding it in place). Place gland nuts and glands around glass and put in place, putting the top end in first.

Pack upper gland first, using black plastic packing which is supplied with gauges. Glands can be packed more easily, by hammering a piece of plastic packing out flat, approximately, ¼" thick, and then pushing it down around the glass with a small rod or screwdriver. Use only enough packing to fill space and still allow gland nuts to be started on. Start nut on, then pack lower gland in same way. Nuts should be screwed down by hand and guard pins put in place. Care should be taken in tightening nuts to avoid breaking the glass.

Float Type

For the float type oil gauge, Fig. 23, clean guard thoroughly, assemble gaskets at top and bottom of glass and tighten cap so glass is in a vertical position. Then fill bottom end of guard to lip of sight with Westinghouse cement P.D. Spec. #690-2.

In case any threaded parts are dismantled Westinghouse cement P.D. Spec. #672 should be used on threads when reassembling.

Oil

The Westinghouse Electric Corporation 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 which 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 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 18,000 volts when tested by one of the usual methods with electrodes 1" diameter 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 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 overloads. Oil dash pots may be uncovered and fail to provide proper cushioning effect. Attention is again called to Westinghouse Instruction Book 5336 which is a manual covering the care and maintenance of oil and which should be referred to before any attempt is made to test or purify the oil.

Electric Operating Mechanisms

The mechanisms should be opened slowly by hand except when attached to a breaker.

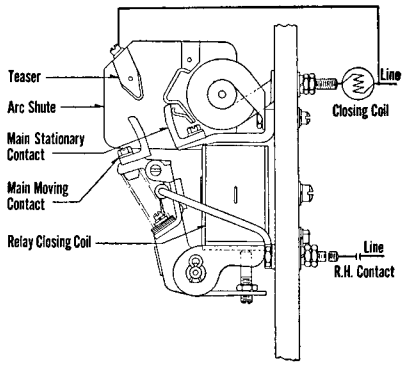


FIG. 24—TEASER CIRCUIT IN CONTROL RELAY

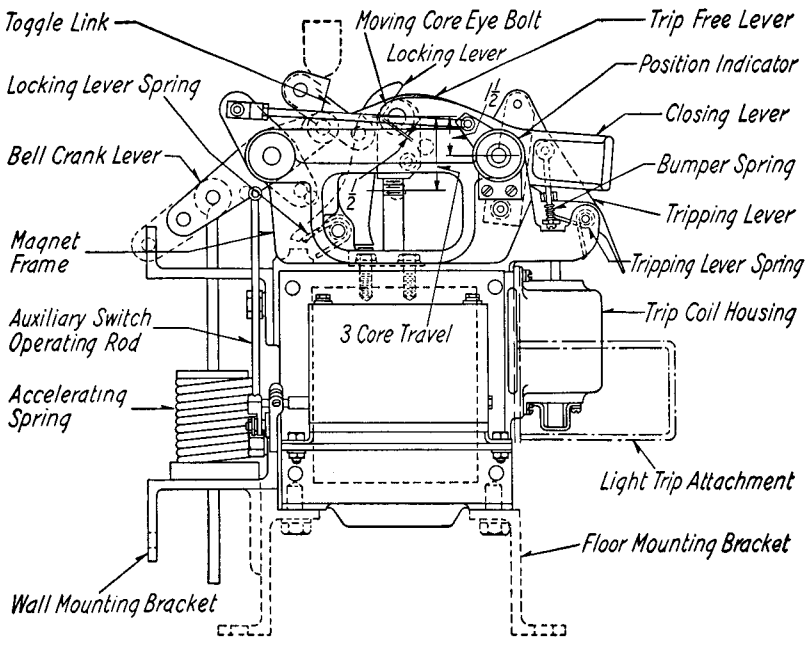


FIG. 25—TYPE "SA" 3-INCH SOLENOID MECHANISM DETAILS

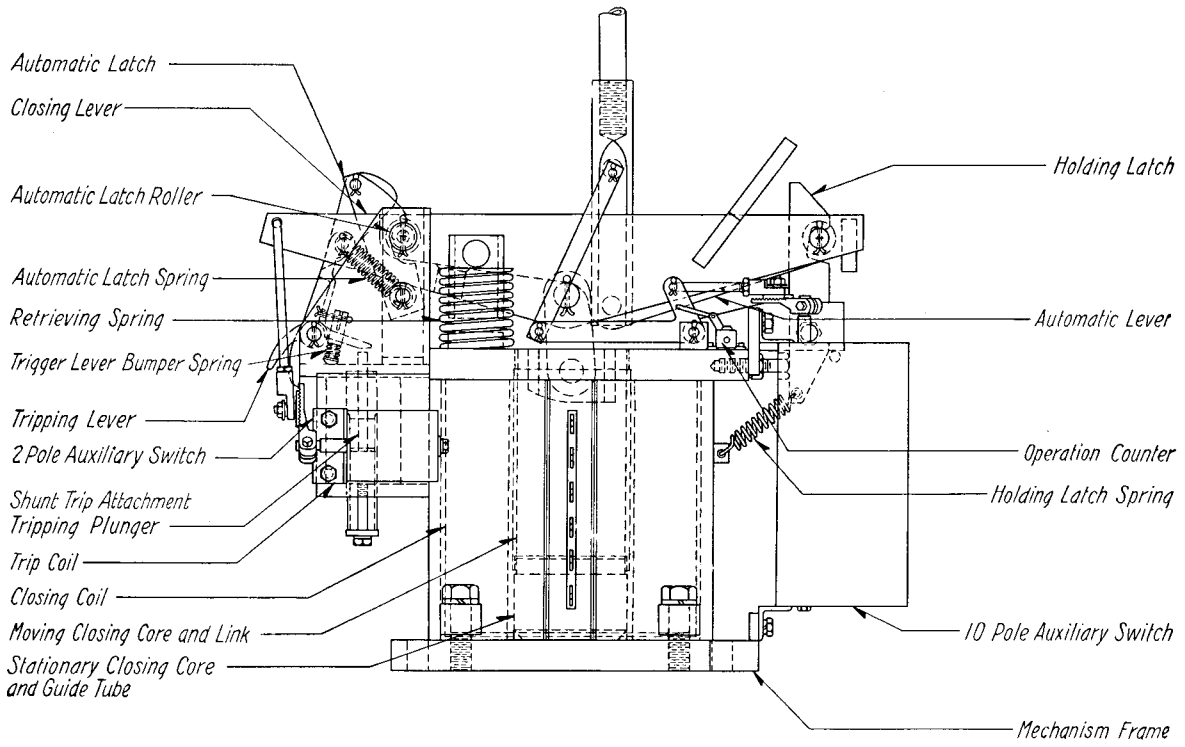


FIG. 25—SOLENOID MECHANISM, TYPE SAF-4 (CLOSED POSITION)

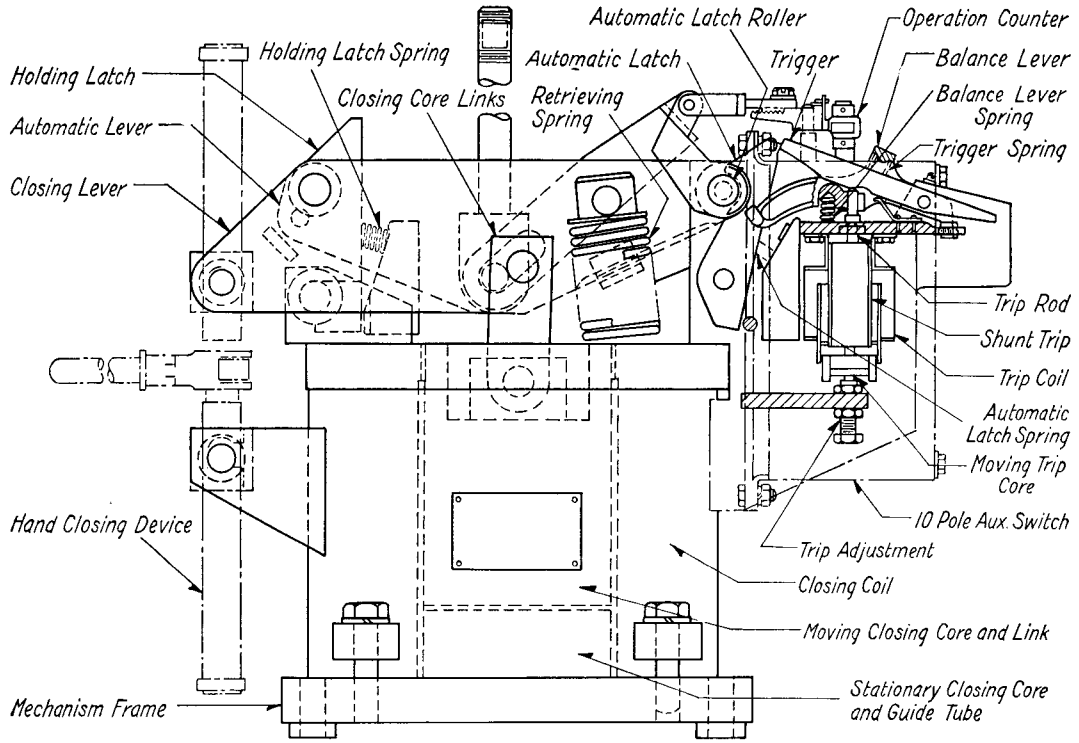


FIG. 26—SOLENOID MECHANISM, TYPE SAF-6 (CLOSED POSITION) WITH LEVER TYPE HAND CLOSING

Tripping Link Trigger "R" Trip Interlock Lever

Westinghouse "De-ion" Grid Oil Circuit-Breakers

The auxiliary switches should require an 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 very near the end of the stroke so that the mechanism will close completely. The length of the switch lever and the length of the operating rod are adjustable.

The latching surface of the trigger can be polished by fine emery if it becomes dirty or rusty. **Do not attempt to grind or change the angle of the latch.**

Control Panels

The panels for the several mechanisms are different because of amount of current handled and the space available within the mechanism housings. A diagram is shipped with each breaker and should be followed when connecting and checking the control circuits.

Rectox Operation

When Rectox rectifiers are furnished for operation with circuit-breakers, Instruction Card #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. A wiring diagram is shipped with each breaker and 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.

If at the end of approximately one-second from the time of energizing the control switch the breaker fails to close, the operator should release the control switch in order to prevent injury to the Rectox. This time is ample to permit ordinary closing, and since tests show that the Rectox will not burn out for many seconds, this one second rating gives a large factor of safety.

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, due to an inherent characteristic of the Rectox the internal resistance increases with age, thereby decreasing the d-c. voltage, and should be compensated for varying the adjustable resistor.

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

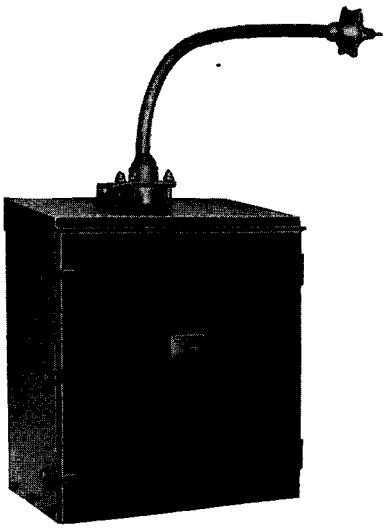


FIG. 29—POTENTIAL DEVICE

Potential Devices

This apparatus is described fully in Instruction Book 5441 which is sent with each shipment and must be referred to whenever installing or adjusting the device.

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 out and tested and the operation tried out.

Operation counters are mounted on the electric mechanisms to show the number of closing and tripping operations of 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 load interruptions place mechanical strains upon the breakers as well as reduce the dielectric strength of oil. After each case of severe duty the mechanical operation should be checked and the condition of the oil tested.

Use care to prevent the entrance of moisture at the several gaskets, conduits, and tank fittings.

Renewal Parts

When ordering renewal parts, specify the name of the part, giving the name shown in the illustration in this book. Give the breaker **Type, Amperes, Volts, and Stock Order Number** as found engraved in the nameplate. Fig. 30 illustrates the breaker nameplate and shows by heavy black lines the information which should be given in addition to the name of the part required.

At any time the breaker fails to operate properly and you are not able to remedy or locate the trouble, you should notify the nearest Westinghouse Sales Office or Service and Repair Shop which maintains a corps of experts for this purpose. A list of these offices and shops can be found in back of this book.

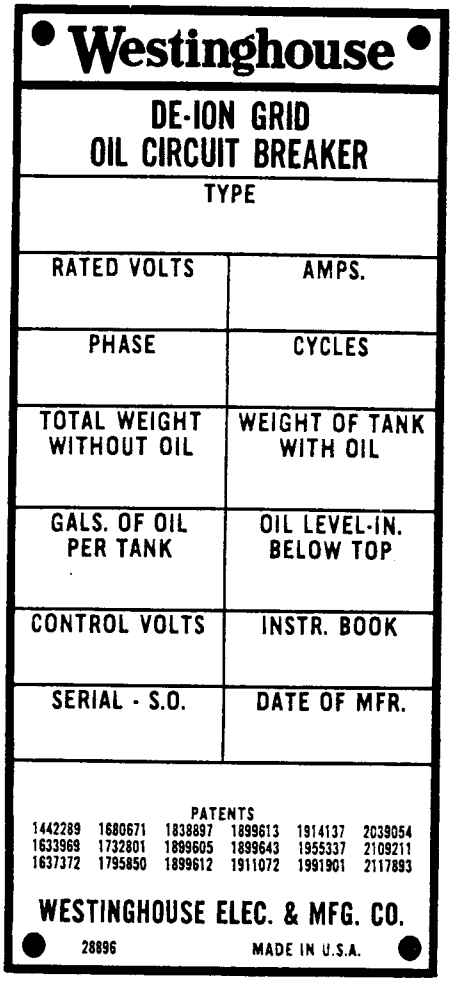


FIG. 30—CIRCUIT-BREAKER NAMEPLATE FOR FRAME MOUNTED BREAKERS

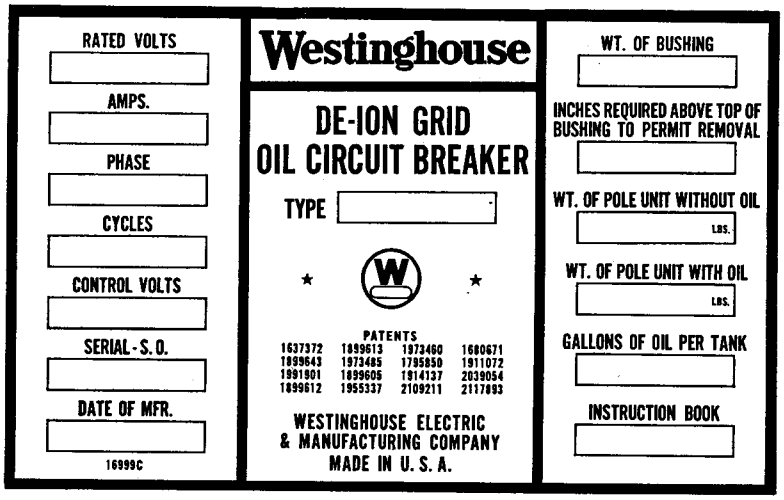


FIG. 31—CIRCUIT-BREAKER NAMEPLATE FOR FLOOR MOUNTED BREAKERS

See I.B. 5805 for Type SAF-6 Solenoid operated mechanism.
See I.B. 5818 for Type SAFR-6 Solenoid operated mechanism.
See I.B. 5664 for Type SAF-4 Solenoid operated mechanism.
See I.B. 5567 for Type SA-3 Solenoid operated mechanism.
See I.C. 3610 for condenser type bushings.
See I.C. 3610 for condenser type bushings.

RENEWAL PARTS DATA

Recommended Stock of Renewal Parts For

"DE-ION" GRID OIL CIRCUIT-BREAKERS

and Mechanism

The following is a list of the Renewal Parts and the quantities of each that we recommend should be stocked by the user of this apparatus to minimize interrupted operation caused by breakdowns. The parts recommended are those most subject to wear in normal operation or those subject to damage or breakage due to possible abnormal conditions. This list of Renewal Parts is given only as a guide. When continuous operation is a primary consideration, additional insurance against shut-downs is desirable. Under such conditions more renewal parts should be carried, the amount depending upon the severity of the service and the time required to secure replacements.

		Three Pole	
Breakers in use up to and including		1	5
Description of Part	No. Reg.	Recommended for Stock	
Breaker Complete	1	0	0
Breaker Pole Unit Complete	3	0	0
Moving Contact Complete	3	0	0
Lift Rod	3	0	1
Moving Contact	3	1	3
Condenser Bushing	6	1	2
Porcelain Arc Shield	6*	0	0
Stationary Contact Complete	6	0	0
Stationary Contact Foot	6	0	0
"De-ion" Grid Stack	6	0	0
Stationary Contact	6	2	4
Stationary Contact Shunt	6 or 12	2	4
Stationary Contact Spring	6 or 12	2	4
Tank Liner	3*	0	1
Solenoid Operated Mechanism	1	0	0
Closing Coil	1	0	0
Tripping Coil	1	0	1

Parts indented are included in the part under which they are indented.

*When Supplied.

Ordering Instructions

When ordering Renewal Parts, always specify the name of the part wanted as shown on the illustrations in this Instruction Book, giving Shop Order Number, and the type of Breaker as shown on the nameplate. For Example:
One Lift Rod, S# 1080030, for Type GO-3A Oil Circuit Breaker, SO 28Y910, shown in Instruction Book 5502, Fig. 9.

To avoid delays and misunderstandings, note carefully the following points:

1. Send all correspondence and orders to the nearest Sales Office of the Company.

2. State whether shipment is to be made by freight, express or parcel post. In the absence of instruction, goods will be shipped at our discretion. Parcel post shipments will be insured only on request. All shipments are at purchaser's risk.

3. Small orders should be combined so as to amount to a value of at least $1.00 net. Where the total of the sale is less than this, the material will be invoiced at $1.00.

Westinghouse

Type B-6
Oil Circuit-Breakers

INSTALLATION
OPERATION & MAINTENANCE

INSTRUCTION BOOK

Westinghouse Electric & Manufacturing Company
East Pittsburgh, Pa.

I. B. 5548
(Filing No. 33-000)

Printed in U.S.A. (Rep. 8-36)

Westinghouse Electric & Manufacturing Company

Remit to H-12354 2-25-28

CUSTOMER'S ORDER NO. & DATE: ME-2825
REQUISITION NO.: PG-20308-E
CONTRACT NO.:
OUR ORDER NO (Prefix) (Serial) (Code)

REFER TO INVOICE NO. & DATE

SHIPMENT NO. 958008

1 SOLD TO: THE EXCELSIOR ELECTRIC CO.
MR. A. C. JONES, PURCHASING AGENT,
YOUNGSTOWN, OHIO.

2 SHIPPED TO AND DESTINATION: THE EXCELSIOR ELECTRIC COMPANY
SHOALS PLANT
YOUNGSTOWN, OHIO.

DATE SHIPPED: 10-6-28 FROM COLL. (X) PREPAID ( )
CAR INITIALS & NO. HOW SHIPPED&ROUTE: PRR. (PRR-36267) PENNA.
GROSS WEIGHT: 29200 LBS. COMPLETE ( ) PARTIAL (X) FINAL ( ) FROM THIS POINT

	NAME	NO.
SALESMAN (4)	MOORE 30%	380-226
B/L ORIGINAL TO 1	70% CHGO.	CHGO.
INV. 1 TO 1—1 TO 0.0.0.F.	S/N to H. M. COULTER, G.P.D. I.C.A.	
S.N. 1 TO 2 IF DIFF. from 1	S/N to YGST. OFFICE (MARSHALL)	
S.N. TO S.P. CORR.		

PACKAGE NUMBERS	Item No.	Quantity (Show Unit)	IDENTIFICATION NO. AND DESCRIPTION
SKID 58140-D	1	1	TYPE "B-6" ELECTRICALLY-OPERATED, NON-AUTOMATIC, REMOTE CONTROL, ANGLE-FRAME MOUNTED, 3-POLE, SINGLE-THROW, 3000-AMPERE, 2500-VOLT, OIL CIRCUIT-BREAKER. S.O. - 38-M-692 SEC. R. P-4
CRT. 58141		1	WITH - TANK LIFTER S-490879
58140 X		1	CLOSING LEVER S-438624 S.O. - 38-M-692 P-4

Continued ( )

FRT., EXP., ETC.
S. D. OR C.O.D. (IF SO.)
O. O. CORRESP.
COLLECT ( ) PREPAID ( )
ROUTE IF CUSTOMER SPECIFIED
PARTIAL?
NEG. No.
P & S BY

F. O. B (as above) With Freight Allowed To (If Differer.t)

(3) If F. O. B. is Ordering Office with shipment from elsewhere show rate and class also.
(4) If not 100% show % and for the remainder(1) the office symbol with % for each and (2) the town of ultimate destination. (5) Include special marks for packages, if any.

FIG. 3—TYPICAL SHIPPING LIST

placed under the mechanism and the mechanism securely bolted down.

The tanks of the breaker unit should be dropped and the blocking removed around the contacts as well as from under the breaker mechanism on the outside of the breaker unit.

Tanks should not be left off the breaker except when the breaker is being worked on. If the tanks are left off and dirt or foreign matter gets on the contact surfaces, the closing of the breaker may result in damage to the contacts. This will require needless additional work in preparing the circuit-breaker for service.

ating mechanism. Observe the arcing contacts to see that they separate practically simultaneously. The breaker unit should be observed to see that, when the mechanism is completely open, each breaker unit is also completely open with the cross head resting on the top of the bumper spring.

When the circuit-breaker is being closed slowly by hand, check to see that all the arcing contacts touch approximately simultaneously; that the brushes touch simultaneously and that they are all in the same position with the mechanism latched.

When the circuit-breaker is closed electrically and latched, the contacts

contact assembly. No change should be necessary at this point in the breaker as received however. If all contacts are slightly open, correction can be made by changing the length of the pull rod which connects the operating mechanism to the bell-crank lever immediately above it.

The arcing contacts are not relied upon to carry any part of the load current and good contact between them is not essential. They should engage definitely until the main contacts are well cleared to insure adequate protection to the main contacts when opening their circuit. Time spent obtaining a good contact on the arcing contacts is prac-

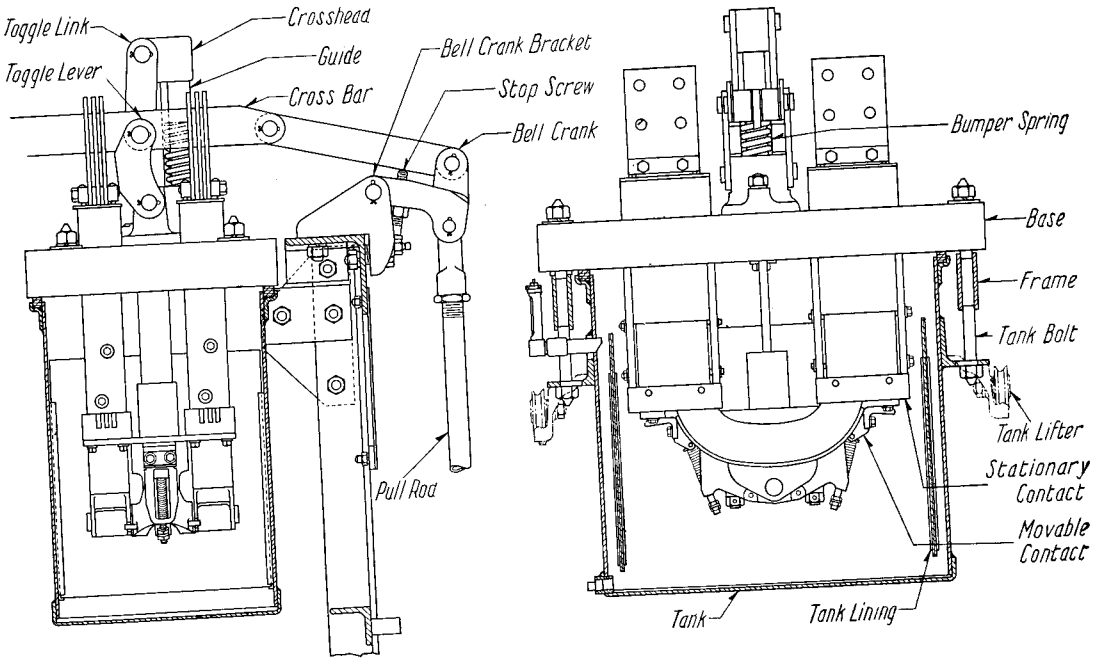


FIG. 4—BREAKER UNIT ASSEMBLY

The detail adjustment of the circuit-breaker is as follows:

Close the circuit-breaker slowly by hand observing the operation of the breaker unit to see that everything moves freely and easily. With the mechanism closed and latched, the set-screw stop on the bell crank lever, above the operating mechanism should be approximately ⅛ inch from the lever. The circuit-breaker should be opened slowly by hand using the hand closing lever to take the weight off the latch of the oper-

should be observed to be sure that they are making contact over their entire area. This can be checked by holding a light on the opposite side of the brush and looking along the lamination. It can also be checked by inserting a feeler gauge from 0.005 to 0.010 of an inch thick between the inner laminations of the brush and the center block. There should not be a greater gap than 0.010 of an inch at this point. Individual adjustments are obtained by shifting the nut on a brush-supporting bolt as shown in Fig. 5 on the

tically wasted because the first few openings of the circuit will roughen them.

Just previous to placing the circuit-breaker in service, the main contacts should be rubbed lightly with fine sand paper to remove the oxide film that will have formed during the shipment and installation period. The contact brushes should be rubbed in a direction parallel to the laminations. The contact foot should be rubbed in a direction at right angles to the brush laminations.

Oil should be placed in the tanks and put in place just previous to putting the circuit-breaker in service. A sample of the oil should be tested in the standard test cup to insure that it is up to standard in quality.

It is a good thing to operate the circuit-breaker 25 or 50 times after all adjustments are completed and then drop the tanks and look over the circuit-breaker to see that nothing has shifted and that everything is in perfect working order. The circuit-breaker then can be closed and turned over for service.

In replacing the tanks care should be taken to be sure that the nuts on the tank studs are drawn up tight.

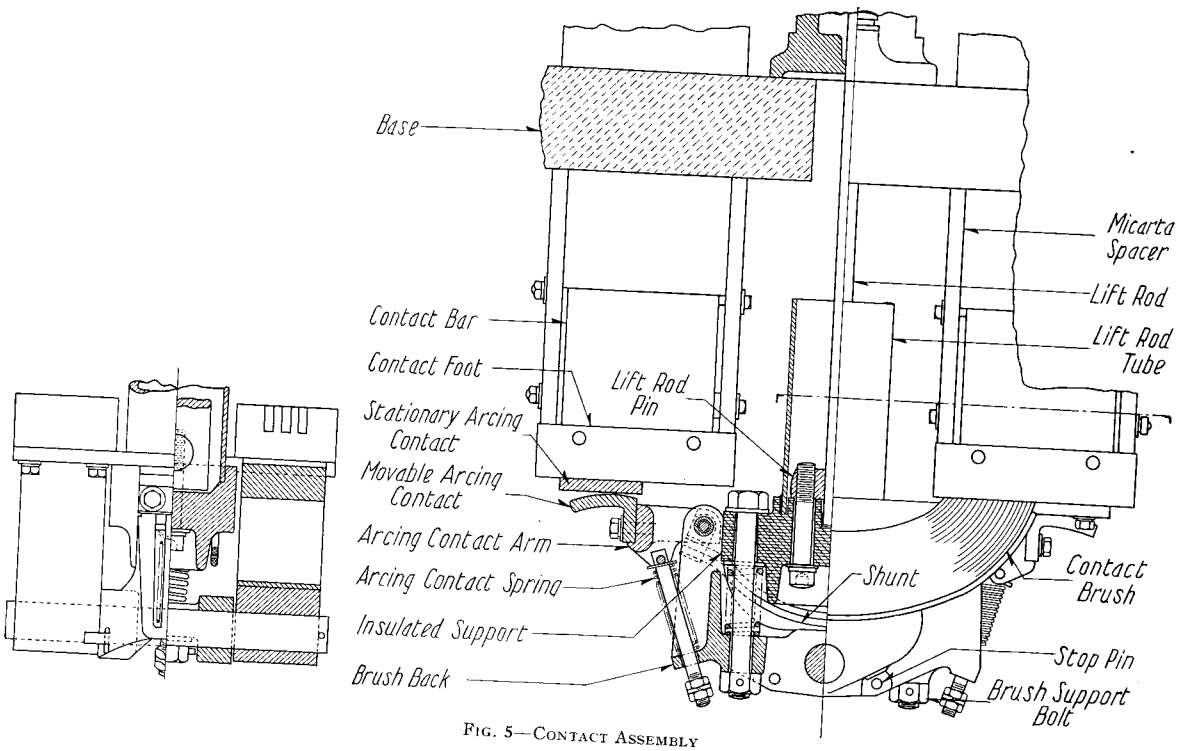


FIG. 5—CONTACT ASSEMBLY

Pole Unit

The pole-unit mechanism of the type B-6 breaker is very simple. Two long cross bars connect the toggle levers on each pole unit to the operating mechanism through a bell crank. The operating mechanism moves these cross bars in a horizontal direction straightening the toggle levers in a vertical position thus closing the contacts of the breaker as shown in Fig. 4.

The contacts are opened by gravity assisted by the accelerating spring of the operating mechanism. A bumper spring, on top of the pole unit, absorbs the shock of opening.

Pole-Unit Adjustment

No adjustments should be necessary on the pole unit of the type B-6 breaker. However, the breaker should be checked in accordance with the instructions on page 5.

OPERATION

The following adjustments are provided so that repairs, when necessary, can be easily made.

When replacing a stationary contact, check with a straight edge to see that the contact faces are in the same plane. If necessary, trim the Micarta spacer shown in Fig. 5.

To adjust the position of the moving contact, change the position of the nut on the end of the brush-support bolt. If necessary, redrill the brush-support bolt to match the new position of the nut. Always be sure that the nut is keyed to the brush-support bolt before putting the breaker back in service.

With full contact between the brushes and the stationary contacts, the toggle levers should be from $\frac{3}{16}$ to ¼ inch off center and the stop screw on the bell crank approximately ⅛ inch from the connecting link.

The arcing tips may be adjusted to make contact simultaneously by changing the position of the nuts on the arcing-tip studs.

Electric Closing Mechanism

The mechanism shown in Fig. 5 is furnished when it is desired to close the circuit-breaker electrically from a distant point. This mechanism consists essentially of a moving core operating on a main lever to close the circuit-breaker, the main lever being retained in the closed position by the latch until tripped free by the hand-trip device or the shunt-trip solenoid. The closing core is equipped with a dash pot which has an adjustable valve to diminish the shock to the circuit-breaker parts on closing. The mechanism is also equipped with an accelerating device to speed up the opening of the circuit-breaker, and this acceler-

ating device is also provided with a dashpot which retards the operation on the end of the opening stroke.

When the control switch at a distant point is thrown to the position for closing the circuit-breaker, current flows through the closing solenoid drawing down the moving closing core toward the stationary closing core. It is customary to use a control relay so that the current coming from the control switch to the electric mechanism will only be that necessary to operate the relay switch coil which in turn connects the solenoid coil to the control bus. (See description of control relay panels—Fig. 7, page 8).

The operation of the closing solenoid is as follows: When the moving closing core is drawn by the solenoid, air is entrapped in the space between the two cores giving a cushioning action on the end of the closing stroke.

The leather washer mounted on the end of the moving closing core, which slides down inside the metal sleeve, is kept pushed out against the metal sleeve by the metal expander. Should it become necessary to remove the moving closing core from the metal sleeve it can be replaced readily by first forcing a tube of the same inside diameter down over the leather and then lining up the two tubes so that the leather slides freely. The leather washers on the metal expander are held in the end of the moving closing core by means of the piston follower. A steel pin passes through the follower, the expander and the leather washer into the moving closing core, thus preventing the turning of these three items. The metal sleeve is fastened to the stationary closing core by means of screws and the joint between the two is packed to make it air tight.

An adjustable air valve is placed in the bottom of the stationary core so that the escapement of air from the closing core dashpot can be regulated. Turning the screw shown on the bottom of the stationary core to the left drops the ball into its seat and permits the more easy escape of air, thus reducing the cushioning effect and allowing more speedy closing. Rotation of the valve screw to the left drops the ball into its seat and limits the escapement of air from the dashpot, thus cushioning the closing action of the circuit-breaker.

This closing core dashpot should be adjusted for each particular circuit-breaker to give the best closing operation with the control voltage that will actually be used.

The moving closing core of the mechanism is connected to the operating lever by an eye bolt which is adjustable in the core to secure the proper position of the roller on the main lever with respect to the latch when the closing cores come together. The mechanism is adjusted at the factory to latch properly when the moving closing core draws the lever down so that there is a clearance between the roller and the latching surface at the trigger of ⅛ of an inch with the coil energized. This condition should be kept as closely as possible in actual operation. Owing to lost motion in the linkage, it will be possible to draw the lever down by hand to obtain a somewhat greater backlash than the ⅛ inch. Adjustment of this backlash, which is very important to successful operation of the circuit-breaker, is made by loosening the lock nut on the eye bolt and running the moving closing core up or down on the eye bolt until correct adjustment is obtained. Make sure that the lock nut on the eye bolt is drawn down securely after any adjustment.

The mechanism trigger consists of a piece of case hardened steel set in a casting. The angle of the latching surface has been carefully determined and has been produced by accurate workmanship in the factory. It has been tested completely, and no change should be attempted. If the latching surface has become rough

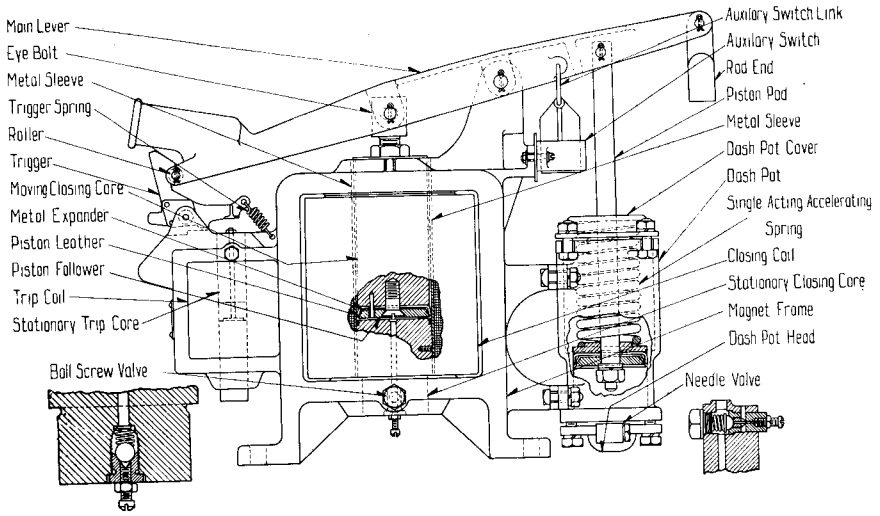


FIG. 6—DIRECT-CURRENT OPERATING SOLENOID

because of neglect and the breaker does not trip on minimum voltage, this surface and the roller may be polished with fine emery.

The mechanisms are equipped with accelerating devices shown in Fig. 5 to speed up the opening operation of the breaker. This accelerating device consists of a powerful spring mounted in a cylinder, the spring being under compression when the breaker is closed. This accelerating device is also equipped with an air dashpot consisting of a follower casting on the rod, a leather washer and a metal expander for holding the leather washer against the sides of the dash pot piston. The dash pot head is equipped with a ball valve which allows a regulated escapement of air from the dashpot on the end of the opening stroke of the circuit-breaker. Regulation of this valve is obtained by an adjusting screw, rotation of the screw to the right causing the ball to be lifted from its seat and facilitating the exit of air from the dashpot, and rotation of the screw to the left causing the ball to return to its seat, thus closing up the valve opening. Its dashpot and valve are similar to those described above in connection with the closing cores.

Installation of Electric Mechanism

The following should be carefully checked upon the installation of the mechanism:

(1) That all parts are free from dirt and grit, and operate freely.

(2) That the air dashpot between the moving closing core is in good condition.

(3) That the backlash is correct.

(4) That the trigger stop is set correctly.

(5) That the tripping core upon being raised disengages the trigger from the main lever.

(6) That the signal switch makes contact in both the open and closed positions of the magnet.

(7) That with the electric mechanism in either the open or closed position, the circuit-breaker to which it is attached is in the open or closed position.

MAINTENANCE

The following points should be checked from time to time to insure that the mechanism remains in the operating condition which is obtained when it is installed:

(1) That the backlash is correct.

(2) That the air dashpots are functioning properly. The leather washer should be kept oiled by a few drops of oil which will not coagulate or gum. It is essential that the leather be kept pliable, but that it not be flooded with oil because it will cause the softening of the leather. Arcticammonia, or a mixture obtained by warming vaseline and cylinder oil, is recommended for this purpose.

(3) The air valves should be kept clean and free from dirt.

(4) The bolts holding the stationary closing and tripping cores should be checked up to see that none of them have become loosened.

(5) The auxiliary switch should be examined to see that it is making contact properly and the contacts wiped with a small amount of vaseline. The connections to the auxiliary switches should be checked to see that none of them have become loosened.

CONTROL RELAY PANEL

General

Type B-6 circuit-breaker is provided with a control relay panel (Fig. 7) for operation in connection with the electric mechanism. This panel consists, essentially of a control relay, a knife switch for opening the main control circuit and terminals for complete circuit-breaker control wiring. The control relay operating coil is energized from a control switch on the switchboard when it is desired to close the circuit-breaker. The action of this coil closes the main control relay contacts, which allows current to flow through the main solenoid closing the circuit-breaker. When the circuit-breaker is nearly closed, the auxiliary switch on the circuit-breaker closes the circuit to the release coil of the control relay. Figure 8 shows a typical diagram of the circuit-breaker and control panel.

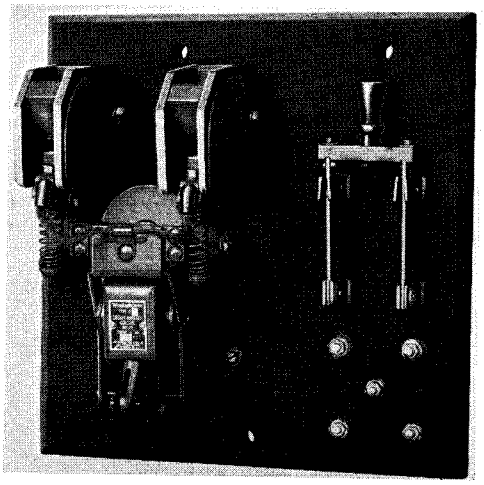


FIG. 7—CONTROL RELAY

Adjustment and Operations

To make sure that this control is in proper operating condition, the following points should be checked:

(1) The control relay should pick up and close the contacts on minimum closing voltage.

(2) The release coil must open the relay contacts when energized by minimum voltage. (Check with the relay in the closed position).

(3) The stop on the release coil housing shall be set so as to allow the relay lever to open just far enough to permit the latch to re-engage.

INSULATING OILS

The Westinghouse Electric & Manufacturing Company assumes the responsibility of oil circuit-breaker operations only when the insulating oil employed is in accordance with its recommendation.

Deterioration in Use

All insulating oils are subject to carbonization through arcing between conducting surfaces. This carbonization forms a deposit on the bottom of the tank on any part of the mechanism located in the oil. The contacts and the interior of the tanks should be cleaned whenever the amount of sediment makes it necessary to do so. Carbonization reduces the dielectric strength of the oil. It is necessary, therefore, that the tank be emptied and refilled with new oil from time to time. Deteriorated insulating oils can be filtered and dried by the use of a Westinghouse Oil Drying and Purifying Outfit.

Storage

All Westinghouse insulating oil for oil circuit-breaker use is shipped either in soldered tin cans, in sealed drums provided with screw bungs which are sealed before shipment, or in tank cars used exclusively for the purpose. All oil in drums which are not sealed, all oil in sealed drums which has been stored exposed to the weather, and all oil shipped in tank cars should be tested before using by taking a sample from each container. Drums stored out of doors should always be placed on their sides, never turned up on end, and when storing drums out of doors, protection against direct precipitation of rain or snow should be provided.

Handling

Extreme precautions are required to insure that all containers and any apparatus therein are absolutely dry when oil is transferred to it from a drum, soldered can, or tank car.

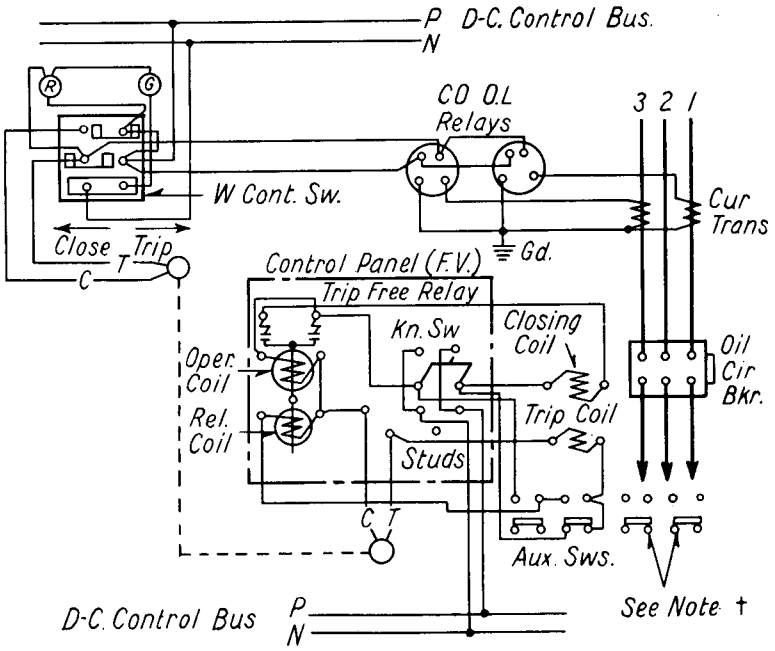


FIG. 8—TYPICAL WIRING DIAGRAM

†Second auxiliary switch supplied only when specified on stock order.

NOTE:—The tripfree relay, in energizing relay operating coil, closes the relay contacts. In energizing the relay release coil, it opens the relay contacts which remain open until the relay operating circuit is de-energized and energized again

Auxiliary switches are shown for the open position of the breaker.

Relay contacts are shown in the de-energized position of the relay.

RENEWAL PARTS DATA

Ordering Instructions

When ordering renewal parts, specify the name of the part wanted, give the type and stock order number of the circuit-breaker which will be found on the nameplate, for example: One closing lever link for type B-6 oil circuit-breaker, S. O. 43-B-675 as shown in instruction book No. 5548.

Recommended Stock of Renewal Parts

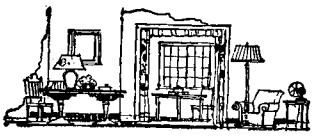
Below is a list of the renewal parts and the minimum quantities of each that should be carried in stock. These are the parts most subject to wear in ordinary operation, and to damage or breakage due to possible abnormal conditions. The maintenance of such stock will minimize service interruptions due to shutdowns.

Recommended Stock of Renewal Parts for Breaker and Mechanism

Type B-6—3000 Amperes, 2500 Volts, 3-Poles

Total Number of Circuit-Breakers up to and including		1	5
Name of Part	**No. Per Breaker**	**Recommended for Stock**	
Breaker Complete	1	0	0
Moving Brush	6	1	4
Arcing Contact	6	6	18
Spring (Short)	6	1	4
Spring (Long)	6	1	4
Shunt	12	2	8
Stationary Contact	6	0	2
Tank Liner	6	1	4
Electrically-Operated Mechanism	1	0	0
Piston Leather	1	0	0
Piston Leather Expander	1	0	0
Piston Leather—Dash Pot	1	0	0
Piston Leather Expander	1	0	0
Trigger	1	0	0
Trigger Spring	1	0	0
Signal Switch	1	0	1
Control Panel	1	0	0
Closing Coil	1	0	0
Trip Coil	1	0	0

Westinghouse Products



Homes—Farms

- Air Heaters
- Auto Engine Heaters
- Automatic Irons
- Automatic Percolators
- Automatic Ranges
- Cozy Glow Heaters
- Curling Irons
- Fans
- Hot Plates
- Light and Power Plants
- Lighting Equipment
- Mazda Lamps
- Motors for
  - Buffers and Grinders
  - Ice Cream Freezers
  - Ironers and Washers
  - Refrigerators
  - Sewing Machines
  - Vacuum Cleaners
- Newel Posts
- Panelboards
- Radio Equipment
- Rectigon Chargers for Automobiles and Radio Batteries
- Rectox Trickle Charger
- Refrigerators, Electrical
- Safety Switches
- Sollaire Luminaires
- Sol-Lux Luminaires
- Solar Glow Heaters
- Table Stoves
- Tumbler Water Heaters
- Turnover Toasters
- Vacuum Cleaners
- Wall-Type Heaters
- Waffle Irons
- Warming Pads
- Water Heaters



Buildings

- Arc Welding Equip.
- Circuit-Breakers
- Elevators and Control
- Glue and Solder Pots
- Instruments and Relays
- Kitchen Equipment
  - Bake Ovens
  - Hot Plates, Ranges
- Lighting Equipment
  - Brackets, Newels and Lanterns
  - Reflectors & Lamps
  - Sol-Lux Luminaires
- Lightning Arresters
- Micarta Trays
- Meters
- Meter Service Switches
- Motor Generators
- Motors and Control for:
  - Coal and Ash-Handling Equipment
  - Compressors
  - Elevators
  - Fans and Blowers
  - Laundry Equipment
  - Refrigerating Equip.
  - Vacuum Cleaners
  - Water & Sump Pumps
- Panelboards
- Radio Equipment
- Synchronous Converters
- Safety Switches
- Solar Glow Heaters
- Stokers
- Switchgear
- Transformers



City Improvements

- Airport Floodlights
- Automatic Substations
- Constant Current Regulators
- Control Apparatus
- Elec. Railway Equip.
- Lighting Units
- Mazda Lamps
- Ornamental Standards
- Parkway Cables
- Street Brackets
- Streethoods



Offices and Stores

- Air Heaters
- Bread-baking Oven
- Elevators and Control
- Fans, Desk and Exhaust
- Fuses
- Lighting Equipment
- Mazda Lamps
- Meters
- Micarta Desk Tops
- Motors for
  - Adding Machines
  - Addressing Machines
- Motors for
  - Coffee and Meat Grinders, etc.
  - Dictaphones
  - Envelope Sealers
  - Fans and Blowers
  - Pumps
  - Refrigerating Machines
- Panelboards
- Safety Switches
- Switches
- Tumbler Water Heaters



Aviation

- Approach, Boundary, Hangar, and Obstruction Lights
- Arc Welding Equip.
- Floodlight Projectors
- Motor-Generators
- Reflectors
- Transformers
- Mazda Lamps
- Micarta
  - Cabin-lining Plate
  - Fairleads
  - Hinge Bearings
  - Propellers
  - Pulleys
  - Tailwheels
- Radio Equipment



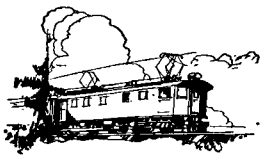
Ships

- Circuit-Breakers
- Condensing Equipment
- Deck Winch Motors
- Elec. Heating Appar.
- Eng. Foom Auxiliaries
- Fans and Blowers
- Fuses
- Generating Equipment
- Instruments
- Light and Power Plants
- Lighting Equipment
- Micarta Trays
- Motors and Controllers
- Ovens, Ranges and Galley Equipment
- Panelboards
- Propulsion Equipment
  - Diesel-Electric
  - Geared Turbine
  - Turbine Electric
- Radio Equipment
- Safety Switches
- Switchgear



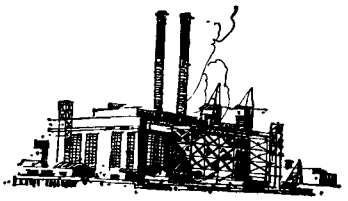
Electric Railways

- Arc Welding Equip.
- Automatic Substations
- Babbitt, Solder & Pots
- Baking Ovens
- Circuit-Breakers
- Elec. Trolley Coaches
- Fans
- Gas Electric Coaches
- Gears and Pinions
- Generators
- Insulating Material
- Insulators
- Lighting Fixtures
- Lightning Arresters
- Line Material
- Manual Substations
- Mazda Lamps
- Meters
- Motors and Control
- Panelboards
- Portable Substations
- Relays
- Signal Equipment
- Supervisory Control
- Switchgear
- Synchronous Convert's
- Transformers
- Trolley Poles



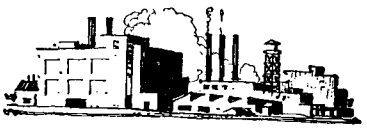
Railroads

- Arc Welding Equipment
- Automatic Substations
- Babbitt, Solder & Pots
- Baking Ovens
- Battery Charging Equip.
- Cars—Multiple-Unit. Gas-Elec., Oil-Elec.
- Circuit-Breakers
- Control Apparatus
- Elec. Heating Apparatus
- Fans
- Gears and Pinions
- Generators
- Headlight Equipment
- Instruments
- Insulating Materials
- Insulators
- Lighting Equipment
- Lightning Arresters
- Line Material
- Locomotives—Electric Gas-Elec., Oil-Elec.
- Manual Substations
- Mazda Lamps
- Micarta Gears
- Motors and Control
- Outdoor Substations
- Panelboards
- Power House Apparatus
- Radio Equipment
- Safety Switches
- Signal Equipment
- Stokers
- Supervisory Control
- Switchgear
- Transformers
- Yard Lighting Equip.



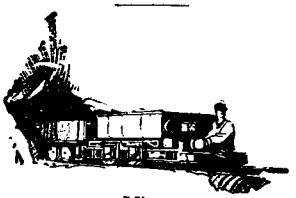
Electric Service Companies

- Automatic Switching Equipment
- Circuit-breakers
- Condensers
- Cutouts
- Fans
- Frequency-converters
- Fuses
- Generators
- Instruments & Meters
- Insulating Material
- Insulators
- Line Material
- Lighting Equipment
- Lightning Arresters
- Micarta
- Motors and Control
- Motor-Generators
- Network Protectors
- Network Transformers
- Oil Testing and Purifying Equipment
- Outdoor Substations
- Panelboards
- Porcelain Insulators
- Relays
- Safety Switches
- Steam Turbines
- Stokers
- Supervisory Control
- Switchgear
- Synchronous Conden'rs
- Synchronous Conv'ters
- Transformers
- Turbine Generators
- Voltage Regulators



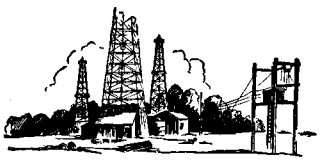
Mills and Factories

- Arc Welding Equip.
- Automatic Starters and Controllers
- Babbitt & Babbitt Pots
- Capacitors
- Circuit-Breakers
- Condensers
- Fans, Desk and Exhaust
- Furnaces and Ovens
- Fuses
- Generating Equipment
- Insulating Materials
- Knife Switches
- Larry Car Equipment
- Lighting Equipment
- Lightning Arresters
- Locomotives—Electric Gas-Elec., Oil Elec.
- Mazda Lamps
- Meters and Relays
- Micarta Gears
- Motors and Controllers
- Panelboards
- Pipe Fittings (Struct'al)
- Power House Apparatus
- Safety Switches
- Solder & Glue Pots
- Space Heaters
- Stokers
- Switchgear
- Transformers
- Turbines



Mines

- Arc Welding Equip.
- Auto. Feeder Equip.
- Automatic Starters and Controllers
- Automatic Substations
- Battery Charging Equip.
- Circuit-Breakers
- Clamps
- Elec. Heating Apparatus
- Fans
- Gears and Pinions
- Headlights
- Insulating Materials
- Insulators
- Larry Car Equipment
- Lightning Arresters
- Line Material
- Locomotives
- Manual Substations
- Mazda Lamps
- Meters & Instruments
- Micarta
- Motor Generators
- Motors for Hoists, Pumps, Tipples, and Breakers
- Panelboards
- Portable Substations
- Relays
- Safety Switches
- Switchgear
- Synchronous Conv'ters
- Transformers
- Ventilating Outfits



Oil Fields

- Arc Welding Equip.
- Change House Heaters
- Floodlight Projectors
- Gear Units
- Insulators
- Mazda Lamps
- Motors and Control
- Panelboards
- Reflectors
- Rig Lighters
- Safety Switches
- Small Light Plants
- Transformers
- Vapor Proof Fixtures

Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

Address nearest Sales Office or Agent-Jobber

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BEAUMONT, TEX., 2209 Caulder St.
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BLUEFIELD, W. VA., 208 Bluefield Ave.
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*BUFFALO, N. Y., 814 Ellicott Square
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*BUTTE, MONT., 52 E. Broadway
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*CHARLOTTE, N. C., 210 E. Sixth St.
CHATTANOOGA, TENN., 536 Market St.
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*DENVER, COLO., 910 Fifteenth St.
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*DETROIT, MICH., 5757 Trumbull Ave.
DULUTH, MINN., 10 East Superior Street
EASTPORT, ME., P. O. Box 764
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FORT WORTH, TEX., 501 Jones St.
GARY, IND., 701 Washington St.
GRAND RAPIDS, MICH., 507 Monroe Ave. N.W.
GREENVILLE, S. C., West Earle St.
HAMMOND, IND., 235—167th St.
*HOUSTON, TEX., 608 Fannin St.
*HUNTINGTON, W. VA., 209 Ninth St.
INDIANAPOLIS, IND., 539 Madison Ave.
ISHPEMING, MICH., 433 High St.
JACKSON, MICH., 212 W. Michigan Ave.
JOHNSTOWN, PA., 47 Messenger St.
KANSAS CITY, MO., 2124 Wyandotte St.
KNOXVILLE, TENN., Gay and Clinch Sts.
LITTLE ROCK, ARK., 1115 West Twenty-fourth St.
*LOS ANGELES, CALIF., 420 S. San Pedro St.
LOUISVILLE, KY., 332 W. Broadway
MADISON, WIS., 508 Edgewood Ave.
MARSHALL, TEX., 202 W. Merritt St.
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NASHVILLE, TENN., 219 N. Second Ave.
*NEWARK, N. J., 1180 Raymond Blvd.
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*NEW ORLEANS, LA., 333 St. Charles St.
NEW YORK, N. Y., 150 Broadway
NIAGARA FALLS, N. Y., 205 Falls St.
NORFOLK, VA., 254 Tazewell St.
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OMAHA, NEB., 409 S. Seventeenth St.
PEORIA, ILL., 104 E. State St.
*PHILADELPHIA, PA., 3001 Walnut St.
PHOENIX, ARIZ., 11 W. Jefferson St.
*PITTSBURGH, PA., 435 Seventh Ave.
PORTLAND, ME., 27 Deerfield Rd.
*PORTLAND, ORE., 309 Southwest Sixth Ave.
PROVIDENCE, R. I., 16 Elbow St.
RALEIGH, N. C., 803 N. Person St.
RICHMOND, VA., Fifth and Byrd Sts.
ROCHESTER, N. Y., 410 Atlantic Ave.
ROCKFORD, ILL., 130 S. Second St.
SACRAMENTO, CALIF., 719 "K" St.
*SALT LAKE CITY, UTAH, 10 W. First South St.
SAN ANTONIO, TEX., 212 East Houston St.
SAN FRANCISCO, CALIF., 1 Montgomery St.
*SEATTLE, WASH., 603 Stewart St.
SIOUX CITY, IOWA, 2311 George St.
SOUTH BEND, IND., 216 E. Wayne St.
SPOKANE, WASH., 158 Monroe St.
SPRINGFIELD, ILL., 130 S. Sixth St.
SPRINGFIELD, MASS., 395 Liberty St.
*ST. LOUIS, MO., 411 N. Seventh St.
SYRACUSE, N. Y., 420 N. Geddes St.
TACOMA, WASH., 1023 "A" Street
TAMPA, FLA., 417 Ellamae Ave.
TOLEDO, OHIO, 245 Summit St.
TULSA, OKLA., 303 E. Brady St.
UTICA, N. Y., 113 N. Genesee St.
WASHINGTON, D. C., 1434 New York Ave. N.W.
WATERLOO, IOWA, 328 Jefferson St.
WICHITA, KAN., 400 South Emporia St.
WILKES-BARRE, PA., 267 N. Pennsylvania Ave.
WORCESTER, MASS., 32 Southbridge St.
YORK, PA., 143 S. George St.
YOUNGSTOWN, OHIO, 25 E. Boardman St.
The HAWAIIAN ELECTRIC CO., Ltd., Honolulu, T. H.—Agent

*Warehouses located in these cities.

WESTINGHOUSE AGENT-JOBBERS

ABILENE, KAN., Union Electric Co.
AKRON, OHIO, The Moock Elec. Supply Co.
ALBANY, N. Y., Westinghouse Elec. Supply Co., Inc
ALLENTOWN, PA., Westinghouse Elec. Sup. Co.
ATLANTA, GA., Westinghouse Elec. Supply Co.
AUGUSTA, ME., Wetmore-Savage Elec. Supply Co.
BALTIMORE, MD., Westinghouse Electric Supply Co.
BANGOR, ME., Wetmore-Savage Elec. Sup. Co.
BINGHAMTON, N. Y., Westinghouse Electric Supply Co., Inc.
BIRMINGHAM, ALA., Moore-Handley Hdwe. Co.
BLUEFIELD, W. VA., Superior-Sterling Co.
BOSTON, MASS., Wetmore-Savage Elec. Sup. Co.
BUFFALO, N. Y., McCarthy Bros. & Ford
BURLINGTON, VT., Wetmore-Savage Elec. Sup. Co.
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CANADIAN WESTINGHOUSE CO., Limited
HAMILTON, ONTARIO

Westinghouse

Type SA-3 Solenoid-Operated Mechanism for Oil Circuit-Breakers

INSTRUCTION BOOK

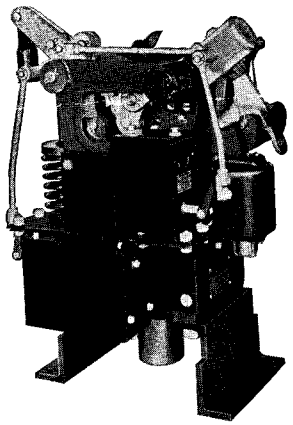


FIG. 1—TYPE SA-3 SOLENOID-OPERATING MECHANISM

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Westinghouse

Type SA-3 Solenoid-Operated Mechanism for Oil Circuit-Breakers

Introduction

This mechanism is the direct-current solenoid type. It operates on standard direct-current control voltages or, when equipped with a Rectox unit, on alternating-current. It is a mechanically full automatic mechanism, trip free in all positions.

Application may be made to indoor or outdoor breakers within the limits of power of the mechanism. For indoor service, it is mounted on the foundation or on the breaker structure. For outdoor service it is placed in a weather-proof metal box with enclosed connections to the breaker.

A control relay is supplied with the mechanism to handle the closing coil current. The necessary tripping devices form a part of the mechanism. A cut-off switch and the desired auxiliary contacts are mounted on the mechanism and mechanically connected to the linkage. A Veeder counter is supplied to record the number of operations. A position indicator connected to the breaker lever is also supplied.

Shipment and Storage

Whether the mechanism is shipped as a part of the breaker or separately, it is carefully inspected, tested and packed at the factory and should be received in good condition. It should be inspected for damage caused in shipment when received.

If the mechanism is to be stored for any length of time, it should be kept in a clean dry place, protected from dirt and moisture. The insulation particularly should be kept dry and reasonable care should be exerted to prevent it being damaged.

Unpacking should be done carefully so as to avoid damage. Care should be taken to remove all parts from the packing material. An instruction book and identification tags should accompany each mechanism.

Operation

Fig. 7 indicates the various parts of the mechanism as referred to. Referring to Figs. 7, 8, and 9, the breaker is connected to the bell crank lever by the pull rod end which is as shown in Fig. 7 for down pull. It can also be connected for vertical or horizontal pull The bell crank lever is linked to the trip free lever which is inside the closing lever. The closing lever is connected direct to the moving core. In closing, as the core rises the closing lever and trip free lever, acting together, rotate clockwise about their fulcrum, pushing up on the toggle link and thus rotating the bell crank lever counter-clockwise about its fulcrum. In the closed position the locking lever slips under the pin in the moving core eye bolt and holds the mechanism closed. The right hand end of the trip free lever has a roller which is held down by the trigger. Behind the trigger, to hold it in place, is a toggle formed of a link and the tripping lever. In tripping, the trip rod rises, strikes the trip lever rotating it clockwise. This releases the roller on the trip free lever from the trigger. The trip free lever then rotates counter-clockwise about the pin in the eye bolt. This allows the toggle link to move down, and the bell crank lever to rotate clockwise opening the breaker. The mechanism is then in the position shown in Fig. 8. The trip free lever in rotating, kicks the locking lever out from under the core pin and the linkage drops back to the position shown in Fig. 9, the roller re-engaging with the trigger. The mechanism is then ready for the next operation. Should the trip be energized at any point in the closing stroke, the breaker would be released as previously explained.

It will be noted that no dash pots are used on this mechanism.

An accelerating spring is provided on the rear of the mechanism to increase the speed of opening of the breaker. This spring acts on the bell crank lever. Ordinarily the standard spring is used but in certain applications a special spring is supplied to meet the particular requirements of the breaker.

Fig. 6 shows a typical wiring scheme for d-c. operation. This scheme includes a Type S-1 trip free control relay. Moving the control switch to the "close" position energizes the operating coil on the relay which closes, energizing the closing coil, and closing the breaker. When the closed position is reached, the release coil is energized through the cut-off contacts of the 2-pole switch which is operated by the closing lever. This releases the latch on the relay and allows it to open, even though the operat-

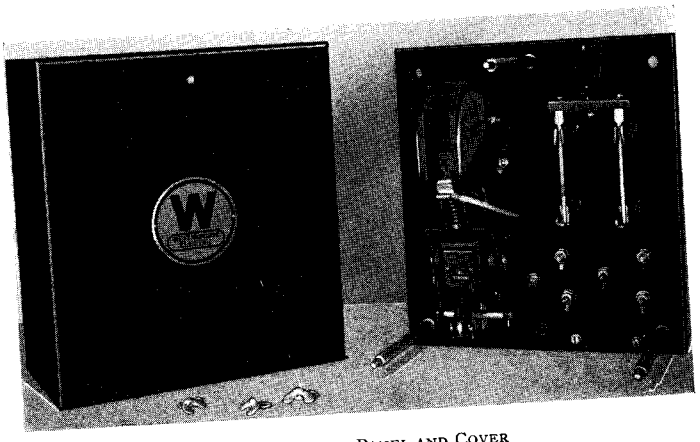


FIG. 2—CONTROL PANEL AND COVER

ing coil is still energized. The relay cannot be closed to energize the breaker closing coil again until the control switch is turned to the neutral position. To trip, the control switch is turned to the trip position energizing the trip coil through the auxiliary switch which is operated by the bell crank lever. As the breaker opens, the trip coil is de-energized by this switch. The 2-pole knife switch is arranged to isolate the breaker from the control circuit.

Hand closing is provided by means of a removable lever which is inserted in a socket of the closing lever. The breaker may be tripped free of the hand closing lever the same as it is from the closing core.

The auxiliary switches are Type W rotary switches. The 2-pole switch is connected to the closing lever and thus moves with the core. It serves to cut-off the closing coil when the cores come together in closing and also provides an extra contact. The 6 or 10-pole switch is connected to the bell crank lever and moves with the breaker. Two sets of contacts, connected in series, are used to de-energize the trip coil and to allow is to be energized when the breaker is closed.

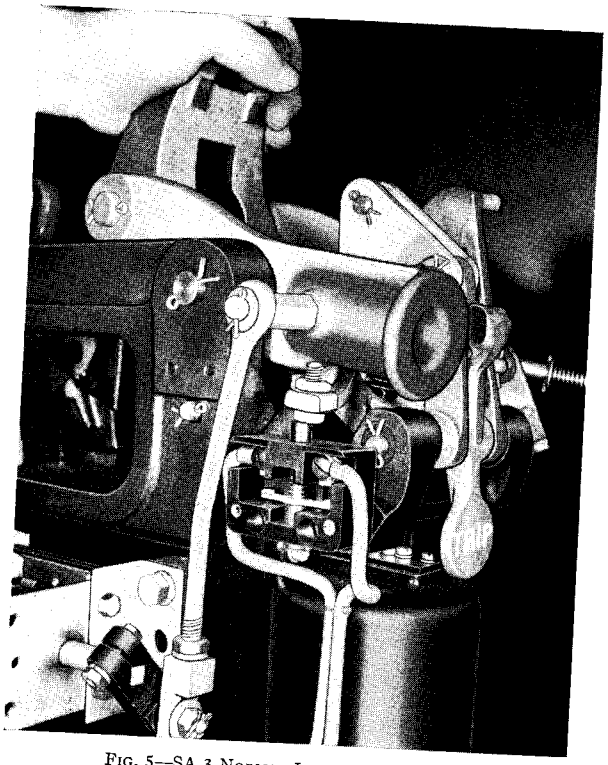


FIG. 5—SA-3 NORMAL LATCHING POSITION

Latch Checking Switch

The latch checking switch is intended primarily for use on circuits where automatic reclosures are desired. It is designed so that the reclosing circuit is not completed until the solenoid mechanism levers have reached the retrieved positions.

When the mechanism has been tripped out, the trip lever is locked out by means of a locking lever until the trip free lever has returned to the retrieved position, at which point the latching lever is disengaged, allowing the switch operating lever to retrieve and close the contacts of the plunger type switch.

Adjustments

Fig. 3 shows the switch contacts in the closed position with a clearance of $\frac{1}{16}$ to $\frac{3}{16}$ inch between the top of the plunger and the head of the adjusting screw. This clearance is important

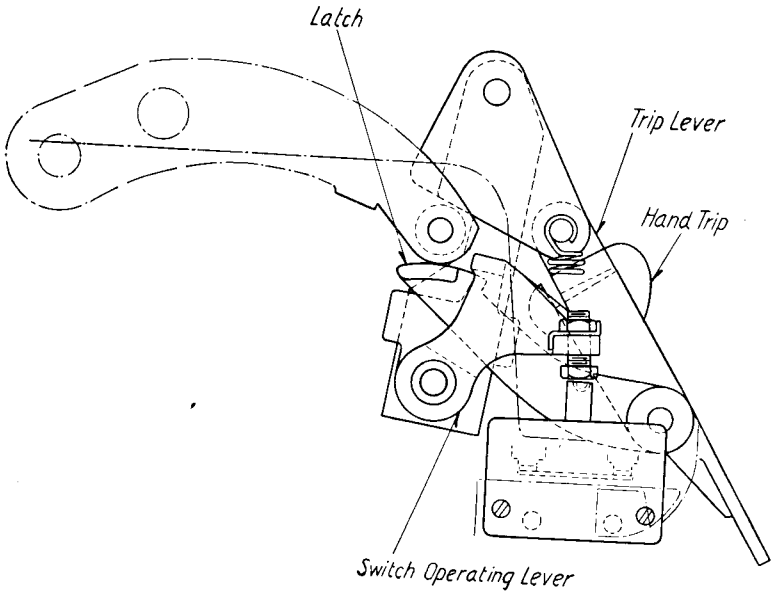


FIG. 3

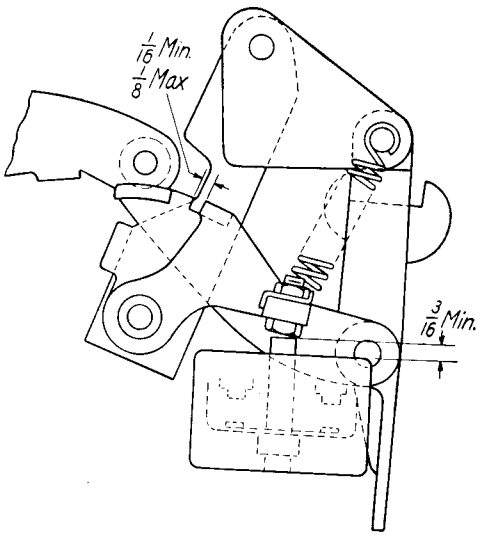


FIG. 4

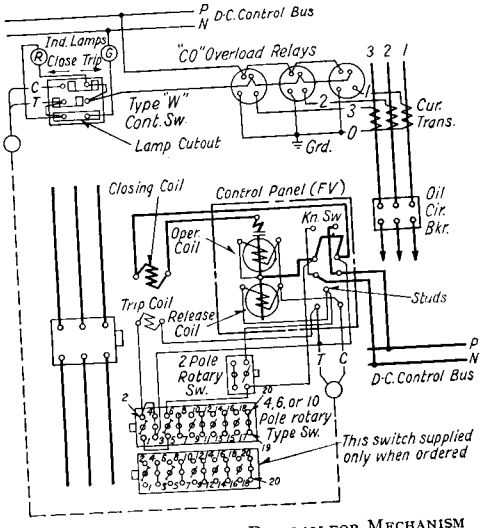


FIG. 6—TYPICAL WIRING DIAGRAM FOR MECHANISM

and must be maintained in order to insure good contact. The adjusting screw may be turned in or out as required to secure the clearance specified. After final adjustments have been made be sure that the lock-nut is securely locked in place.

Fig. 4 shows the switch operating lever in the maximum open position with the contacts of the switch open. In this position there should be a clearance of $\frac{1}{16}$ to $\frac{1}{8}$ inch between the latch and the switch operating lever. The top of the plunger should also be extending approximately $\frac{3}{16}$ inch minimum above the top of the switch. This dimension should not be less as the plunger will go solid and damage the switch beyond repair.

Fig. 5 shows the normal latching position. Failure to latch out may be due to incorrect angle on latch, insufficient clearance at latching point, or a combination of both.

Tripping Devices

The tripping latch consists of a trigger, which has been hardened and ground, engaging a roller on the trip free lever. This is a slip-off trigger, that is, the surface of the trigger which engages the roller is ground at such an angle that it tends to slip off. It is held engaged by a toggle formed by a pair of links and the tripping lever. This toggle is held slightly over center, against a stop, by the tripping lever spring. When the trip rod strikes the trip lever it breaks this toggle and allows the trigger to slip off. When the mechanism retrieves, the toggle is broken by the roller striking the links on each side of the trigger. A bumper spring is provided on the tripping lever so the toggle will not be disturbed by the closing operation.

Shunt Trip—The standard shunt trip consists of a magnetic circuit, coil, and a stationary and moving core, the upper end of which extends out through the top. A bracket on the bottom retains the moving core and limits its travel to about one inch. A thin brass washer prevents the cores from coming tight together.

4-Coil Trip Attachment—This tripping device, illustrated in Fig. 10, is to be used when transformer trips coils, capacitor trip, or undervoltage release is required. Space is provided for a total of four trip coils, including shunt trip, overload trip, with or without inverse time attachment or direct trip, and undervoltage trip. Only three direct trips and one under-voltage trip can be used. Otherwise, any combination up to four may be obtained.

The trip attachment is bolted to the mechanism in the place of the standard shunt trip. It is flexibly mounted so that the shock of operation will not jar the tripping devices. Referring to Fig. 10, the trip rod is located under the trigger. The trip rod is held down by a toggle linkage which engages it in the notched portion. This linkage consists of links and a U lever which are normally down over center. When the linkage is struck in the center from below, the toggle is broken, the latch pin moves to the right and the trip rod is forced upward by the trip rod spring.

This toggle linkage is located right over the four tripping devices. An "H" shaped bar rests on the four bushings through which the trip rods slide. The

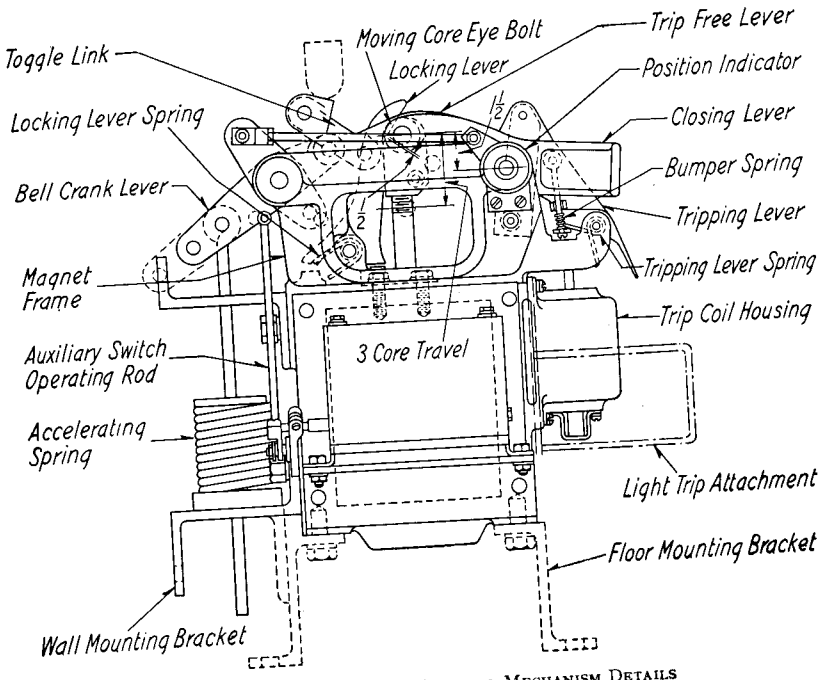


FIG. 7—TYPE "SA" 3-INCH SOLENOID MECHANISM DETAILS

operation of any one of the trips tilts up that corner of the "H" bar and raises the center enough to push the toggle up over center. In case one or more of the trips is omitted, a dummy bushing is used and the operation of the others is not affected.

As already explained, the force to trip the breaker comes from the trip spring. After tripping, and before another operation can take place, the trip rod must be reset. This is accomplished by the reset rod which is connected to the mechanism closing lever. The reset rod operates a reversing lever at the bottom, which in turn acts on the lower end of the trip rod, through a tube when the breaker is tripped, the reset rod rises and the trip rod which has just hit the trigger lever is moved downward and engaged with the latching pin. Then, on closing, the reset rod moves down and the lower end of the trip spring moves upward. Thus it stays until the breaker is tripped again.

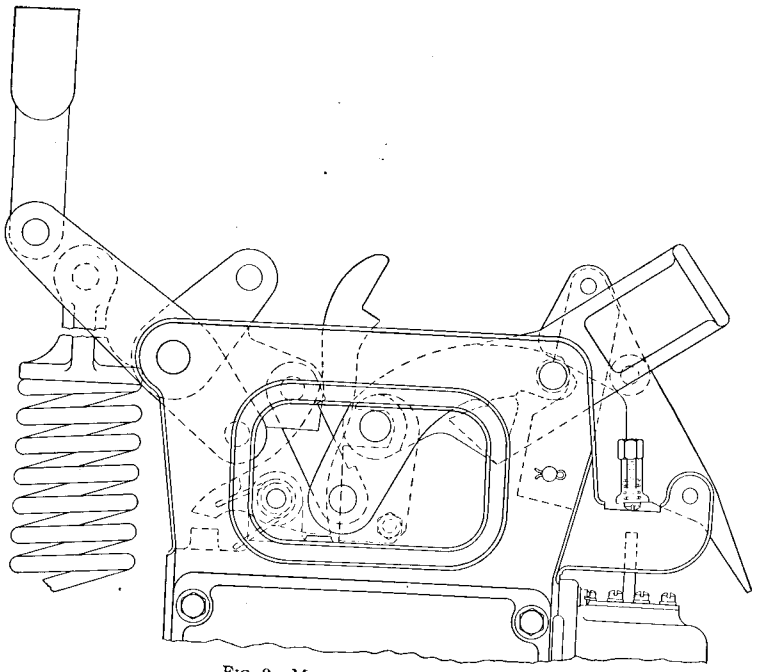


FIG. 9—MECHANISM—OPEN

Undervoltage Trip—The undervoltage device is mounted in the left hand rear space. A separate magnetic circuit surrounds the coil so that positive action of this part of the device is obtained. When the coil is energized the upper core is held down against the stationary core against the pull of the spring which is bias across the diamond shaped toggle device just below the mounting bracket. When the voltage across the undervoltage coil falls to a value of from 60 to 40 percent of normal, the undervoltage coil is no longer able to retain the upper core against the force of the spring. The spring then causes the core to rise and drives the trip against the trip bar.

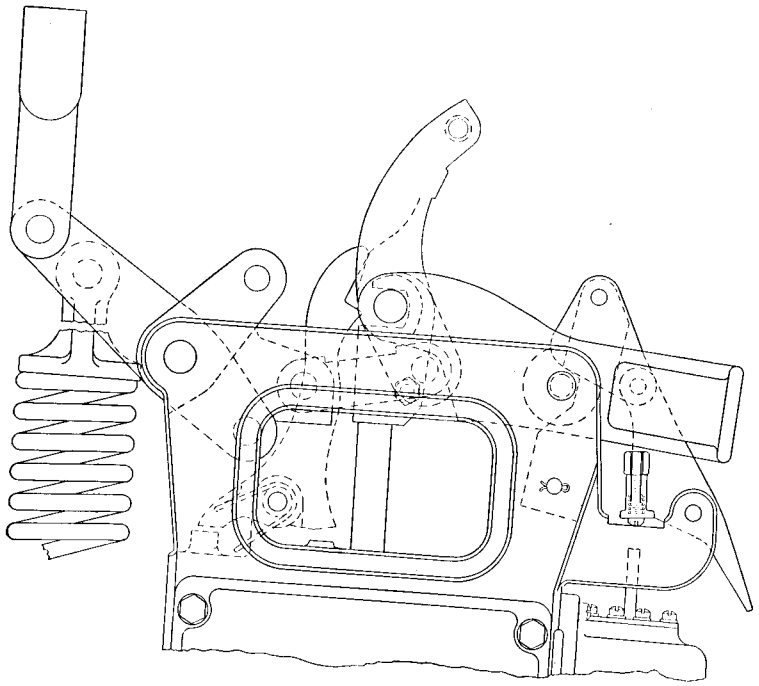


FIG. 8—MECHANISM—TRIPPED FREE

As the breaker returns to the open position the movement of the resetting rod and the reversing lever draws the diamond shaped toggle downward, bringing the undervoltage coils together. At the end of the stroke a small latch engages the inner end of the diamond shaped toggle to prevent the undervoltage release from tripping the breaker until the closing position of the breaker is reached. This latch is released by the rising of the reversing lever during the closing stroke of the breaker as it compresses the tripping spring.

5-Ampere Transformer Trip on Overload Trip—This is shown by Fig. 11 and is a duplicate of the shunt trip except for the coil. It is calibrated for tripping current of from 5 to 9 amperes. It is set to pick up and trip at 5 amperes. The setting is changed by raising or lowering the moving core, by means of the screw which extends from the lower end of the tube cap. The screw is secured by a locking nut which should be loosened before adjusting and retightened after setting is correct. Lowering the plunger gives higher pick up and current values and raising the plunger gives lower values.

Inverse Time Element Trip—Fig. 12 shows an attachment which can be adapted to a 5-ampere overload where tripping is not desired unless overload

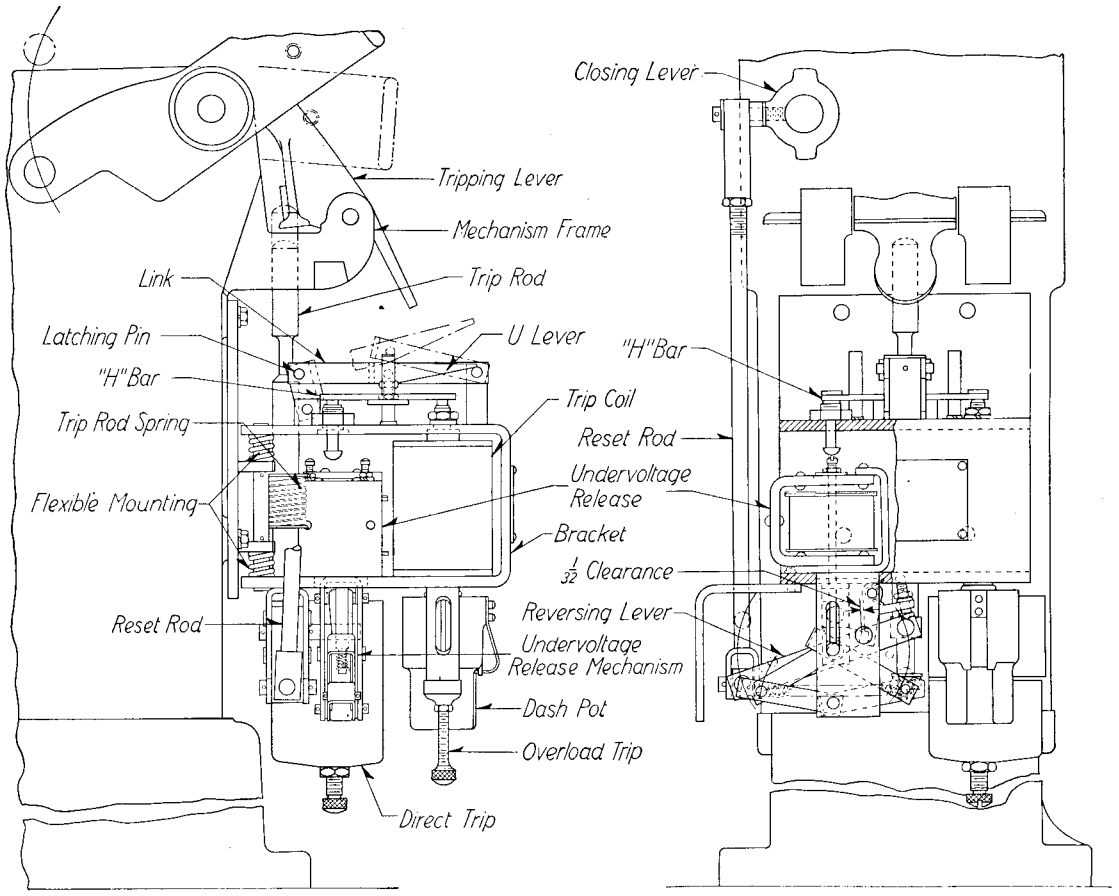


FIG. 10—FOUR COIL TRIPPING ATTACHMENT

continues for a predetermined length of time. The calibration is inscribed on the dashpot and is varied by screwing the pot into the cover.

The time is varied by changing the number of holes in the bottom of the piston uncovered by the diaphragm. Instantaneous resetting is possible because the check valve action of the washer at the time of tripping varies inversely with the amount of overload and directly with the variation in the viscosity of the oil. Fig. 13 shows variations of the time with the variations of the overload and the effect of changed temperature on the standard dashpot oil as supplied with the dashpot.

THE INVERSE TIME LIMIT ATTACHMENT should not be used when temperature is below 15°C. unless special oil is provided for dashpot.

Direct Trip Attachment—For low temperature which makes the dashpot unreliable, or where a definite time delay in tripping is desired, the trip with the attachment shown in Fig. 15 is available. This is used with a 5 ampere transformer trip and is connedted as shown schematically for one phase in Fig. 14.

The device consists essentially of two concentric coils wound to oppose each other with a suitable magnetic circuit and a flat plate armature fastened to the lower end of the trip core. The outer or holding coil, with leads marked 3 and 4, is connected in series with the transformer trip coil and the CO relay operating coil. The current flowing in this coil serves to hold and seal the flat plate.

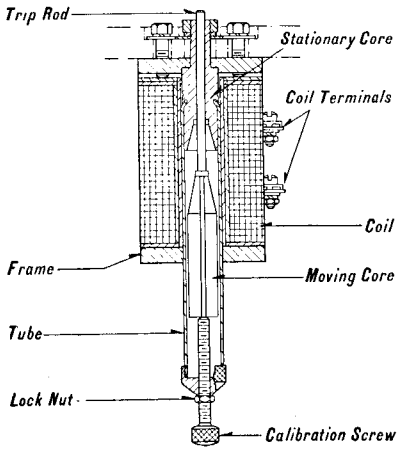


FIG. 11—SHUNT TRIP AND 5-AMP. TRANSFORMER TRIP

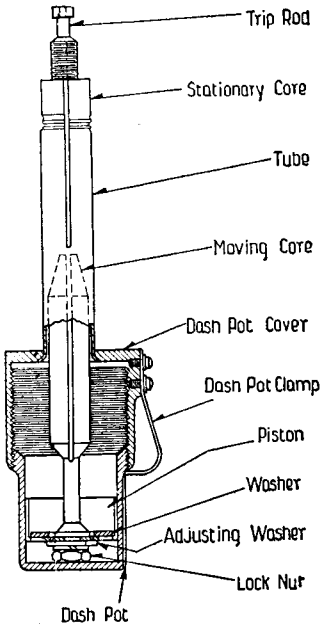


FIG. 12—INVERSE TIME ELEMENT TRIP

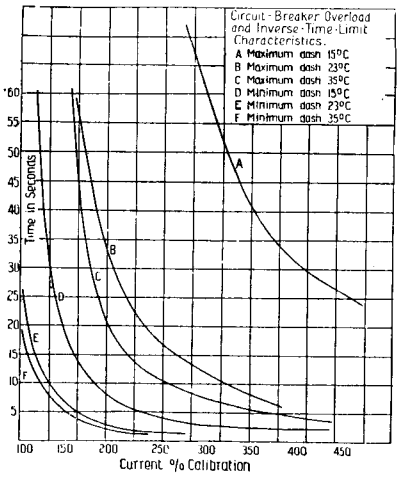


FIG. 13—CURVES FOR INVERSE TIME ELEMENT

armature to the pole pieces. The inner or secondary coil, with red leads, marked 1 and 2, is connected to the CO relay contacts and is short circuited by the action of this relay. When short circuited by the relay, the current induced in this circuit serves to set up a flux opposed to that holding the armature which is released allowing the transformer trip to function. An adjusting screw, balance spring and adjusting pin are provided to balance weight of the moving parts so that the armature will just touch the pole pieces when no current is flowing.

The armature and pole pieces must be kept clean and free from foreign matter as the breaker would be tripped out without functioning of relays if armature is not properly seated. Care must be observed in cleaning that the non-magnetic plating which covers the flat plate armature is not removed or injured. The pole pieces and the armature are accurately flat and care should be taken that the armature is not bent by mishandling, if it is removed for any reason. Variation in time delay with this device is obtained by adjusting the CO relays, The transformer trip and coils are the same as for the 5 ampere transformer trip.

Adjustment

When the mechanism is shipped from the factory attached to the breaker, it has been thoroughly inspected, adjusted and tested and no changes should be necessary. If it is to be assembled in the field certain relations must be obtained.

When setting up and connecting the breaker and mechanism, be sure the leverages and travel relations indicated on the assembly drawings are maintained. In the closed position the connecting rods should be adjusted to allow clearance at the breaker stops. The core should have approximately $\frac{1}{16}''$ overtravel, after latching, with the breaker stops still clear. In the open position the breaker should rest on its bumpers with clearance at the mechanism stop. After setting up, check the complete operation. Operate electrically and be sure that there is not an excessive amount of slamming.

The auxiliary switches are adjustable both in stroke and position. These switches are adjusted and set at the factory and should be correct. Certain conditions may necessitate a change in the cut-off switch adjustment as it is rather particular. However it is not always the cause of the mechanism failing to latch should this occur.

Should it be necessary to change contacts on the auxiliary switch from closed to open or vice versa in a given position, remove the switch and take the rotor out and remove the bolt in the end of the shaft opposite the lever. Take off the parts and rotate to the new position. Be sure to replace all parts in the proper relation and tighten up. Then check the operation of the switch when connected.

The control relay is adjusted and tested at the factory. The contacts should be kept clean by using sandpaper occasionally. **Never use emery cloth.** Coils can be identified by the style number stamped on them.

The shunt trip should require no adjustment. It should be kept tight and its mounting bolts should not be allowed to loosen as there is a definite relation to maintain between the trip rod and the tripping lever.

The 4 coil tripping attachment when used is mounted in place of the shunt trip. If shipped with the mechanism, it is tested and adjusted at the factory. If it is shipped separately to replace the shunt trip in the field, the shunt trip is removed and it is bolted on. The shoulder screw is put in the closing lever and the resetting rod put on.

With the mechanism trigger held in the open position the hand closing lever of the breaker should be moved slowly to the closed position. Before reaching the closing position, the latch of the mechanism can be released and the toggle latch disengaged. See that with the solenoid mechanism latch out of the way, the trip rod rises $\frac{7}{8}''$. With the mechanism in the closed position the distance from the cross head of the under side of the bracket should be $\frac{13}{16}''$ as indicated in Fig. 10. The resetting rod should be adjusted to obtain this dimension.

Raise any one of the tripping cores slowly by hand. The clearance between the screw in the "H" bar and the pin in the center of the toggle latch should not be over $\frac{1}{32}''$.

In the open position of the breaker check to see that the undervoltage release is drawn downward so that the

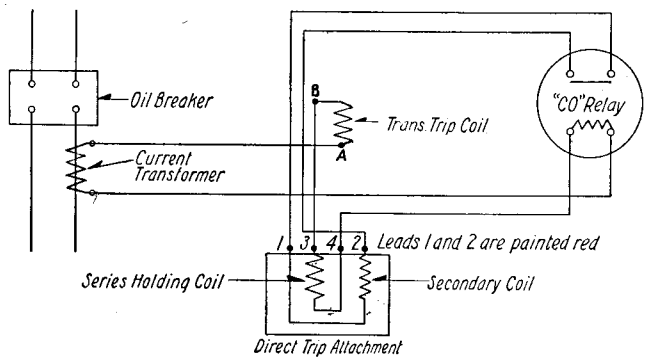


FIG. 14—SCHEMATIC DIAGRAM OF CONNECTIONS FOR DIRECT-TRIP ATTACHMENT

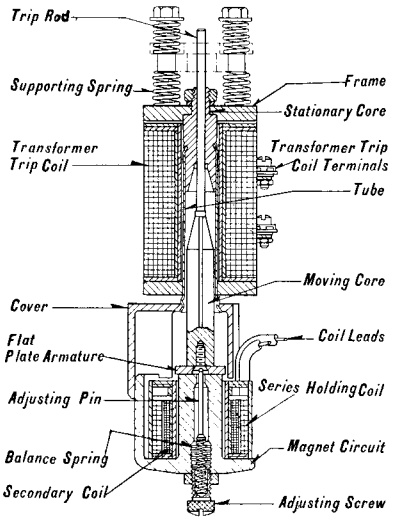


FIG. 15—OVERLOAD WITH DIRECT TRIP ATTACHMENT

lockout trigger engages positively. The screw on the inner end of this trigger should be adjusted so that with the mechanism in the closed position the latching surface of the trigger clears the end of the diamond shaped toggle by $\frac{1}{32}$" as shown in Fig. 10.

The adjustment of the tripping devices on the 4 coil attachment is explained under the heading of Operation.

Inspection

The electric solenoid closing mechanism contains a number of moving joints and operating parts all of which are subject to wear or sticking, if not kept in the proper condition. It is desirable to inspect the mechanism at regular intervals and be assured of its good condition by making a number of operations, regular adjustments and repair. It is desirable to apply a light lubricating oil to the various pins but it should not be done to the extent of causing the joints to become gummed or sticky. It is necessary to keep the moving parts, particularly the trigger and switches, clean and free from foreign matter.

In case there is any trouble in operation, the mechanism should be taken out of service at once and put into the proper condition. The circuit-breaker is highly dependent on the proper functioning of the mechanism and therefore it should always be kept in good condition.

Rectox Rectifiers

General—This rectifier is designed to deliver direct-current at the amperage and voltage stamped on the name plate at any commercial frequency. The normal value of a-c. voltage at which the rated d-c. output may be obtained appears on the name plate.

The complete unit consists of a full wave rectifying element, adjustable series resistor in the a-c. line, a fuse in each a-c. line and suitable mounting plate or enclosing tank.

The rectifier units should not be immersed in oil.

See Fig. 1 for schematic diagram of the complete rectifier.

Operation—This rectifier is designed for intermittent operation only and must not be used to supply other loads than the breaker solenoid.

Unless otherwise indicated on the name plate the a-c. voltage must not be applied to the rectifier for longer than one second nor more than 10 operations within a five-minute period.

The rectifier rating must not be exceeded, as for instance by the operation of two solenoids at once.

Maintenance and Adjustment

Fuses—Use fuses having rating of approximately $\frac{3}{8}$ of the maximum d-c. load current drawn by the breaker solenoid. Fuses of this rating are used in order to protect the rectifying unit in case load should remain connected to the outfit for longer than the permissible time.

Resistor—The resistor is included as a means of compensating for variables such as line voltage, lead resistance, rectifier resistance, temperature, breaker mechanism variation, etc.

When the rectox is shipped from the factory it is set to give proper breaker operating speed at rated a-c. line voltage. When installing, the breaker closing time should be checked to see that correct operation is obtained, since line voltage conditions may be different from those at the factory. This should be done by means of a cycle counter after all mechanical and dashpot adjustments have been checked.

If closing time is incorrect, the series resistor in the rectox assembly must be adjusted.

To obtain quicker breaker operation, reduce the series resistance.

To obtain slower breaker operation, increase the series resistance.

Note—No further adjustment of the series resistor should be necessary except as may be required by the normal aging of the rectifier unit. Approximately 30 days after the unit has been installed, the breaker closing time should again be checked under the same conditions of supply voltage as existed during installation. Adjustment to take care of any change during the first 30 days, is again made by means of the series resistor. Following this adjustment, no further attention should be necessary except at normal periods of breaker maintenance, say every 6 months.

Current and Voltage Measurements—Measurements of rectifier output voltage and current can be made only by means of an Osiso, oscillograph, or coded meter, as the time required to use ordinary indicating instruments may damage the rectifier. Measurement of the closing time of the breaker, with a cycle counter, is usually sufficient indication of the rectifier output.

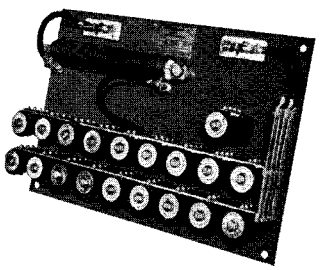


FIG. 16—PLATE-MOUNTED RECTOX FOR A-C. OPERATION

5567-C

INSTRUCTIONS FOR INSTALLING TYPE PC-1 CAPACITOR POTENTIAL DEVICE

The type PC-1 capacitor potential device consists of a stack or string of coupling capacitors in combination with a resonant potential network. The capacitor stacks are so designed that they can be used to energize one potential device on each phase or in a 3-phase combination to energize one potential device.

The installation and adjustment of the capacitor potential device is quite similar to the bushing potential device described in the attached Instruction Book #5441-D. The condenser bushing is replaced by the capacitor stack and the circuit breaker tank is replaced by the potential network supporting housing. The determination of reference potential and adjusting burden are made in the same manner as described in Instruction Book 5441-D. The capacitor stack and potential device should be installed as shown on the outline drawing and connected according to the wiring diagram.

Each capacitor stack consists of one or more individual coupling capacitor units. The upper units in each stack are identical. The bottom unit is a multiple capacitor containing a connection to the potentiometer tap. The bottom unit is also arranged so that it can be used in conjunction with the remainder of the capacitor stack for the purpose of carrier current coupling. When using the capacitor potential device for zero sequence potential, the units comprising the capacitor stack should be selected and assembled such that the total electrostatic capacity of each stack in a 3-phase grouping is approximately the same. In connecting the the capacitor stack to the line or bus (high voltage) proper care should be taken to prevent any undue strain due to expansion and contraction of high voltage circuits, from being imposed on the capacitors.

To adjust the potential device, the capacitor stack is to be energized at normal line voltage and frequency, the secondary terminals S-1 and S-2 are to be connected to an equivalent burden including a voltmeter and phase meter as described in Instruction Book 5441-D. If the device is equipped with a ground switch an inspection should be made to see that this switch is in the open position. The normal operating position of this switch is the open position. When it is necessary to ground the primary and secondary of the potential network, the ground switch should be thrown to the ground position. The actual procedure of adjusting this device is the same as with the bushing potential device with the exception that care should be taken to check the potential transformer voltage. This is determined by measuring the voltage across the mid-points of dials #4 and #5 with a high resistance voltmeter when the secondary burden is connected to S-1 - S2. This voltage multiplied

Westinghouse

Condenser Bushing Potential Device

Installation

Operation Maintenance

INSTRUCTION BOOK

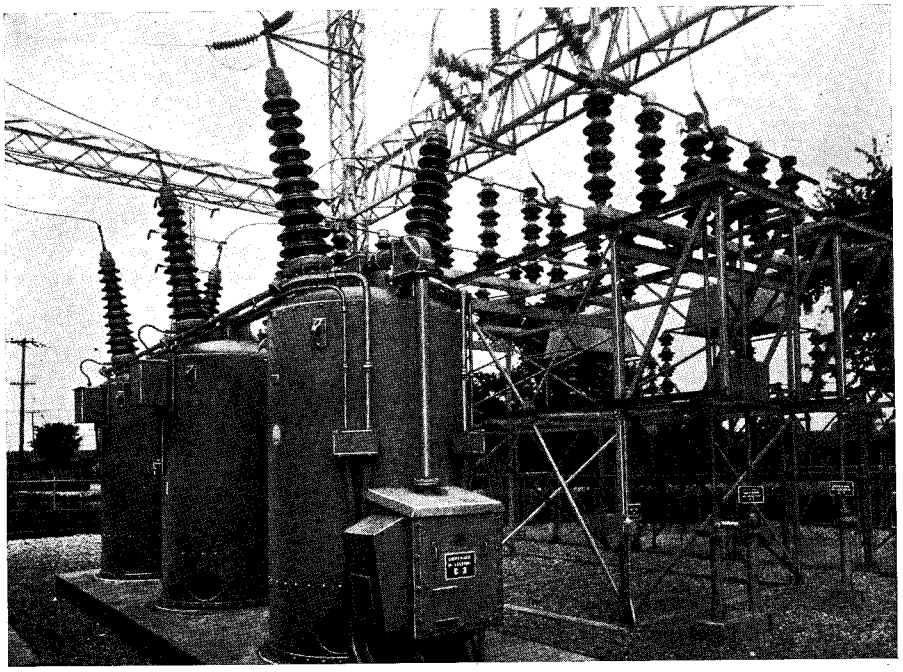
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CONDENSER BUSHING POTENTIAL DEVICES MOUNTED ON A 154 KV. BREAKER FOR SYNCHRONIZING UNGROUNDED SYSTEMS

Westinghouse

Condenser Bushing Potential Device

DESCRIPTION AND THEORY

The Condenser Bushing Potential Device provides a means of obtaining a low voltage suitable for instrument and relay use, without using a high voltage potential transformer. The component parts of the device are mounted in a sheet steel protective housing and arrangement is provided for connecting to a tap near the ground band of a condenser bushing which may be the terminal of a circuit-breaker or of a power transformer, or may be mounted in a separate tank. The connection between the tap and housing is short and consists of a varnished cambric insulated lead covered cable. Fittings are provided on each end to afford easy installation.

The potential device makes use of the inherent potentiometer characteristics of the condenser bushing on high tension circuit-breakers and transformers. The condenser bushing itself consists of a conductor surrounded by alternate layers of insulating and conducting material. The conducting material may be considered as the plates of a condenser and the insulating material is, of course, the insulation between the various plates. The various conducting layers are accurately proportioned so that the voltage stresses are practically equal across each insulating layer. The bushing has a sufficient number of layers so that a comparatively low evenly distributed potential is obtained across each layer and from the voltage tap to ground. The condenser bushings with the voltage tap have been so designed that their well known advantages of mechanical ruggedness, great dielectric strength, high flashover value and long life are all retained.

This tap voltage is stepped down by a small potential transformer within the potential device and having suitable reactance and capacity in its secondary circuit to give a voltage of proper magnitude, usually 63.5 or 110 volts as desired, and of correct phase relation for the operation of switchboard instruments and relays.

The equipment within the housing consists of a low voltage potential transformer, an enclosed spark gap, a reactor and condensers. A ground switch is provided in the Type PB-2 device only. The normal position of the switch is open. When closed the tap connection to the bushing is grounded within the potential device housing.

The spark gap is a protective feature that functions when an overload has been placed on the secondary terminals of the device, thereby protecting the bushing. Likewise, the gap functions upon abnormal line conditions such as would be caused by lightning, switching, etc., thus protecting the instruments connected to the secondary of the device. The operation of the protective gap due to impulse surges caused by lightning, switching, etc., or excessive load is in no way detrimental to the long life of the bushing.

The transformer, reactor and condenser are all equipped with taps for the purpose of making accurate adjustment of the device. The ground connection of the primary of the transformer is made through the protective housing. All secondary leads from the transformer as well as leads from the reactor and condenser are brought to an adjusting panel mounted at the front and right hand side of the device. The potential transformer and reactor leads terminate on dial switches and the condenser leads on small knife switches so that adjustments may be quickly and easily made for any frequency or load within the range of the equipment. Three connections are provided at the bottom of the adjusting panel and an opening is provided in the bottom of the housing for leads to the instrument or relays which are to be actuated by the device. These leads may be handled and insulated in the same manner as the leads from the secondary of any standard potential transformer.

APPLICATION

There are essentially two bushing potential devices; namely the Type PB-1 and the Type PB-2. The distinguishing characteristics are the maximum permissible burden which may be imposed on the device and accuracy performance. The Type PB-1 device has the lower rating and accuracy. Whereas the PB-2 device operating at a higher tap voltage delivers greater output and is more accurate. These devices are not interchangeable physically and are designed to operate with bushings of different design.

The condenser bushing potential device is applicable for voltage indication, frequency indication, synchronizing and relay operation. The device may be applied to the standard bushings with voltage tap on circuit-breakers, power transformers or in separate tanks with the limitations in burden depending on primary voltage as given in Table I.

For larger volt-ampere burdens it is often the case that the power factor is relatively low, as in the average relay and in certain types of indicating instruments. In this case the effective volt ampere burden on the device may be reduced by paralleling a suitable condenser capacity installed within the device to improve the burden power factor. A discussion of the use and effect of this additional condenser is given under "Adjustments".

In case greater secondary burdens than those above are to be used, two potential devices per pole unit can be used in parallel per phase. When using this arrangement it is possible to carry a burden of double rating per phase. This will apply mostly to relay applications where it will be possible to open the paralleled secondaries when the breaker is in the open position. This arrangement is necessary because the Potential Device on the line side of the breaker would otherwise feed back into the device on the bus side.

One desirable application of this device is for synchronizing across a circuit-breaker using a potential device on both the line and bus sides of the breaker. On

TABLE 1

Bushing Class	Operating Voltage	BURDEN (63.5-110 VOLTS) PB-1	PB-2
92 kv.	88— 92 kv.	8 watts**	15 watts*
115 kv.	110—115 kv.	15 watts	30 watts
138 kv.	132—138 kv.	20 watts	40 watts
161 kv.	154—161 kv.	27 watts	55 watts
196 kv.	187—196 kv.	50 watts	100 watts
230 kv.	220—230 kv.	60 watts	100 watts

*20 watts at 63.5 volts (only).

**12 watts at 63.5 volts (only).

systems not solidly grounded and where there is possibility of neutral shift, phase to phase synchronizing should be used. This may be accomplished by connecting two devices in series (reversed open delta) on adjacent phases to indicate phase to phase voltage instead of the usual phase to ground voltage.

The potential device is adaptable to most relay protection schemes requiring a voltage source. It is inherently adapted to those schemes depending upon a voltage indication from phase to ground since the secondary voltage of the device is proportional to "phase to ground" voltage. The secondaries of three devices (three-phase installation) can be connected in star or delta to obtain potential for directional phase or ground relays. The potential device is energized continuously and a potential is always available for relay operation whenever a fault occurs.

INSPECTION

Upon receipt of the Condenser Bushing Potential Device, the first step is to make a thorough inspection to see that no parts appear to have been broken, bent or otherwise damaged during shipment. Particular attention should be paid to the condenser bushing voltage tap and to the plug connection. Any damage which has occurred should be taken care of by restoring the parts to the original condition or by obtaining replacement parts from the manufacturer. Claims for damage during shipment should be taken up at once with the transportation company.

The interior of the device should be inspected as to condition of wiring. In case there is any indication of the presence of moisture, the equipment should be thoroughly dried before putting into service with the condenser bushing.

INSTALLATION

The Condenser Bushing Potential Device is composed of two main parts, namely the condenser bushing and the potential device network contained within the protective housing. The condenser bushing is usually a part of the circuit-breaker or other high voltage apparatus and should be installed in accordance with instructions pertaining to the particular apparatus. The voltage tap on the bushing must extend outwards towards the potential device housing as shown in Figure 1, to permit proper assembly of the "lead-in" cable which is furnished with each housing. In case the bushing is mounted in a separate tank, it is only necessary to install the bushing in accordance with instruction Card No. (E.P.)I.C. 182 and I.T. 994 and fill the tank with Wemco "C" oil to the proper level as indicated by the gauge. Care must be taken to insure that all joints are made tight to prevent the entrance of moisture.

The potential device housing is equipped with two entrances for the primary and secondary circuits and with lugs for mounting on the circuit-breaker or transformer tank. When installing the housing (device contained within) as shown in Figures 2 and 3, care should be taken to insure that paint and other foreign material is cleaned from the lug surfaces which come into contact. These surfaces should then be given a coat of conducting paint to prevent rusting. Since the apparatus within the housing is grounded to the housing it is necessary that the device be grounded through the lug connection to the tank and the tank provided with a good ground.

The primary circuit as made by installation of the lead-in cable assembly shown in Figures 4a and 4b. The lead-in cable assembly consists of a high voltage varnished cambric insulated lead covered cable with suitable couplings, gaskets, and a porcelain plug. It is used to provide an electrical connection between the bushing voltage tap and the potential device. The lead-in cable assembly as shipped, is tested electrically and mechanically. Special pressure tests insure against the possible entrance of moisture in the completely assembled cable.

When the cable is first received, a careful inspection should be made to determine if the cable is in first class condition, undamaged in transit, and that no moisture is in evidence. If moisture is found, the cable assembly should be carefully dried in an oven of temperature not to exceed 85°C., before any attempt is made to place the cable in service.

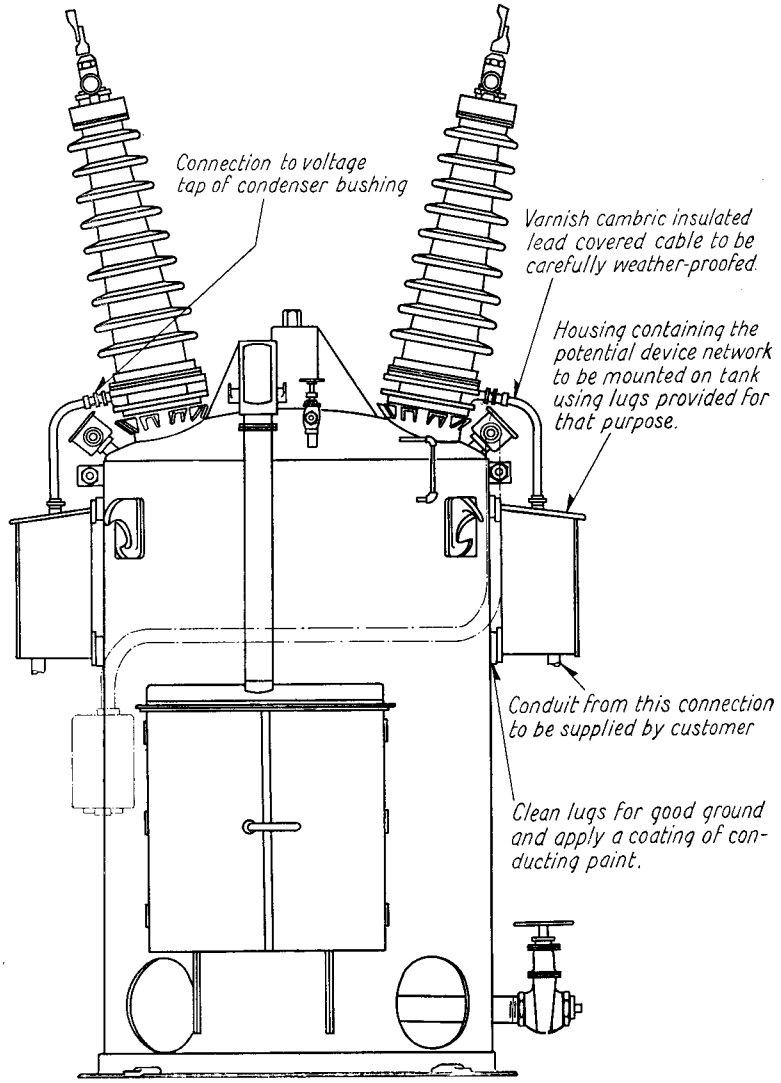


FIG. 1—CONDENSER BUSHING POTENTIAL DEVICE MOUNTED ON BREAKER TANK

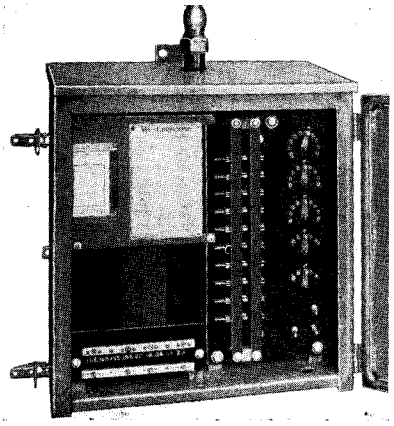


FIG. 2—TYPE PB-1

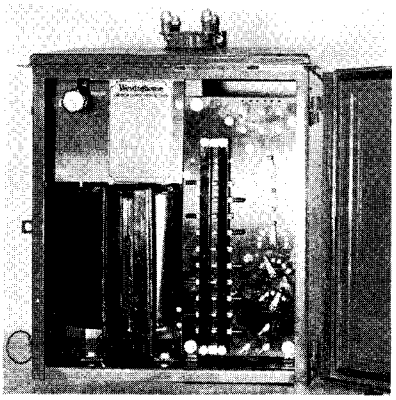


FIG. 3—TYPE PB-2

The voltage taps of all bushings should be filled with petrolatum (commercial vaseline) before being placed in service. Bushings equipped with a tap for the PB-1 device should have petrolatum forced into the chamber before installing the lead-in-cable. The petrolatum should be packed in the chamber in a manner that will prevent the possibility of any air pockets after assembly of the cable. Bushings equipped with a tap for the PB-2 device are provided with a filling plug, permitting the tap chamber to be filled with heated petrolatum in the liquid condition after the lead-in-cable is assembled in place. Sufficient time should be allowed in filling the chamber to prevent the formation of air pockets.

The installation of the lead-in-cable should be carried out in the following manner. The gasket supplied by the manufacturer for each coupling should be coated on both sides with a weather proofing shellac or varnish Apply a similar coating to all flanged surfaces and threads through which moisture may tend to pass. The housing end of the cable assembly should be assembled first and carefully tightened with a suitable wrench to insure a good tight weatherproof joint. The cable should then be carefully bent so that the bushing end of the cable may be inserted in the voltage tap of the bushing without interference. This coupling should then be tightened to insure a good tight weatherproof joint. The tap chamber of the bushing used with the PB-2 device should be filled with petrolatum as described above.

The entire cable assembly should be given a coat of weather-proof paint as a further protection against weather. The housing end of the cable should be connected to the transformer primary and the lightning arrester forming the T connection as indicated on the wiring diagram. The connection from the primary of the transformer and of the lightning arrester to their respective points of grounding should be inspected to insure that same have not worked loose during transportation and field assembly.

ADJUSTMENT

Determination of Reference Potential—In making the proper adjustment of the condenser bushing potential device it is essential that a reference potential and a secondary burden be available. Due to the fact that both the magnitude and phase angle of the secondary voltage of the device is affected by the choice of settings, it is necessary to use a known reference as a basis. This reference should be a voltage in phase with the voltage across the condenser bushing to ground and of proportionate magnitude. ** It is usually most convenient to obtain this reference from potential transformers installed in a low voltage bus. Quite frequently the determination of the correct reference is complicated by the power apparatus between the high voltage system and the low voltage bus. For a particular example refer to Figure 5 where a 110 kv. system has been selected

**Suggest use of Reactive Component Compensator Style 423778 for obtaining voltage of correct magnitude and phase angle from the available bus potential transformers where necessary.

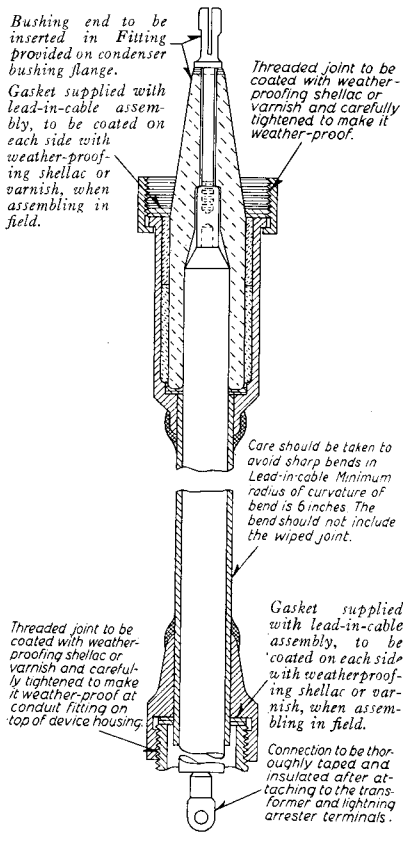


FIG. 4a—LEAD IN CABLE ASSEMBLY (PB-1)

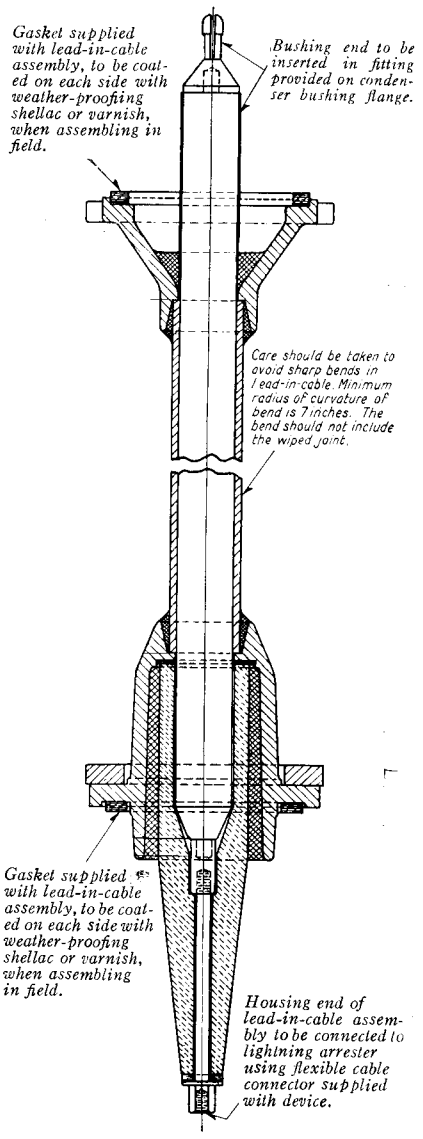


FIG. 4b—LEAD IN CABLE ASSEMBLY (PB-2)

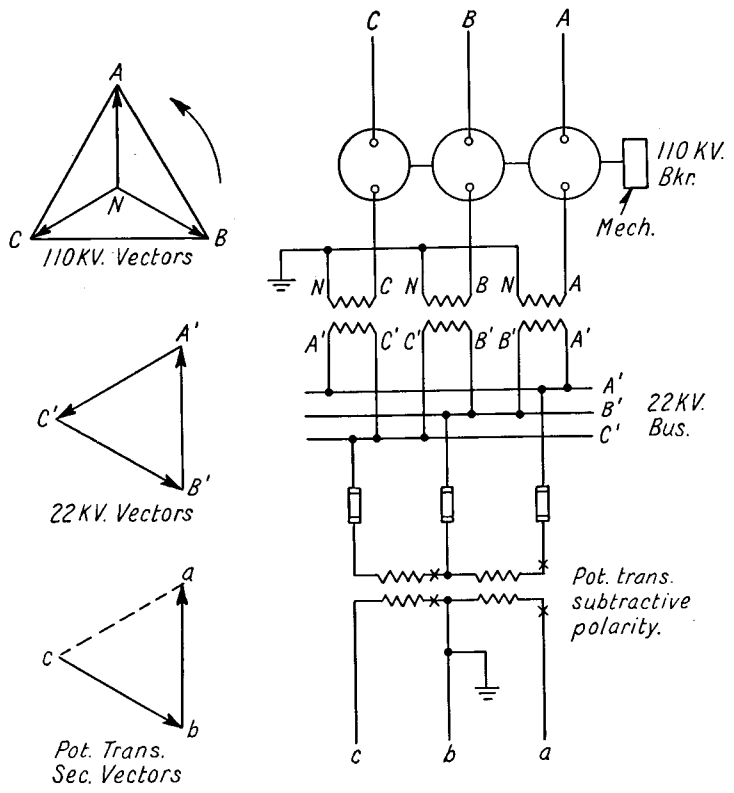


FIG. 5—VECTOR ANALYSIS FOR OBTAINING CORRECT REFERENCE POTENTIALS. PHASE ROTATION A, B, C.

with two potential transformers connected in open delta in the 22 kv., bus An inspection of this diagram indicates that the voltages will have the following relation and the proper reference to be selected.

110 Kv. Voltage	Potential Transf. Sec. (Reference)
A to N	a to b*
B to N	b to c
C to N	c to a

*By removing ground from tie point of pot. trans. secondary.

In making a similar analysis for a given installation, care must be exercised in the determination of the phase rotation of the system and of the relative polarity of the transforming apparatus.

To determine the magnitude of the potential device secondary voltage (across terminals S_1 S_2) a high resistance voltmeter (low burden) of not less than 20000 ohms at 110 volts should be used, to prevent the burden of the voltmeter affecting the secondary voltage. (Suggest Westinghouse Voltmeter Style No 703872.) When it is impossible to obtain a voltmeter of low burden it will be necessary to include the burden of the meter in the dummy burden.

To determine the phase angle of the potential device secondary voltage relative to the "phase to ground" voltage of the system, it is recommended that a Westinghouse Phase Meter Style No. 408136A or a low burden two voltage element phase meter be used. The choice of instruments will depend on the particular application of the devices in question. If the devices are to be used for synchronizing it will probably be more convenient to use the synchronoscope as installed on the switchboard for determining phase angle. The phase meter is probably better adapted to adjusting the devices used for relaying on account of its accuracy and portability.

Regardless of the instrument used for phase indication, it will be necessary to energize one element from the known correct reference. When using the synchronoscope, potential transformer voltage can be applied to one side of the synchronoscope and the potential device voltage to the other. (Assuming of course that the primaries of each type of voltage apparatus are energized from same phase of the high voltage system and in synchronism.) This voltage must have approximately the same magnitude as the potential device secondary voltage. When the device is properly adjusted, the synchronoscope should indicate practically zero. When using the phase meter the current element should be energized from the potential transformer by connecting in series with sufficient resistance (or lamps) to limit the current to approximately two and one-half amperes in the secondary of the potential transformer and meter. In using this scheme care must be taken in avoiding overburden of the bus potential transformer. It is advisable to use the same reference phase for adjustment of devices on all three-phases and make allowance for angle between phases of the system (120°) when adjusting devices on the other two-phases. (Do not use voltage across open delta of the bus potential transformers to energize the current coil of the phase meter.) If a two voltage element phase meter is used, energize the lowest burden element from the potential device and the other from the potential transformer.

Determination of Adjusting Burden—It is often impossible to adjust the condenser bushing potential device with its associated meters and relays. This is due to the effect of the burdens of the measuring instruments used for adjusting and also to the distribution of secondary burden, when the devices are connected in star or delta, to supply potential to various relay and synchronizing schemes. If a device is to be adjusted to supply potential (phase to ground) to an individual instrument, for example, a synchronoscope or voltmeter, it will be more convenient to connect the secondary of the device to the instrument installed on the switchboard for use with the device. The device can be adjusted as later explained by using a high resistance voltmeter to obtain correct secondary voltage. If a voltmeter and synchronoscope are to be used interchangeably with one potential device it is advisable to adjust the device so that it supplies a voltage of correct magnitude when the voltmeter is connected and of correct phase angle when the synchronoscope is connected. (Should a "hot-line" indication be required, a neon lamp, ½ watt, 110 volt, can be connected to the secondary of the potential device continuously.)

A dummy burden is required to adjust the individual potential device when two or more devices are to be used in combination for a common burden. In most cases this burden should include the measuring instruments, particularly the phase meter. Several examples will be taken to illustrate the method of determining the dummy burden:

Example No. 1—Suppose it is assumed that three devices are to be installed on a three-phase 110 kv. breaker using system set-up as in Figure 5 to furnish potential for three directional CR relays using "90 degree" connection

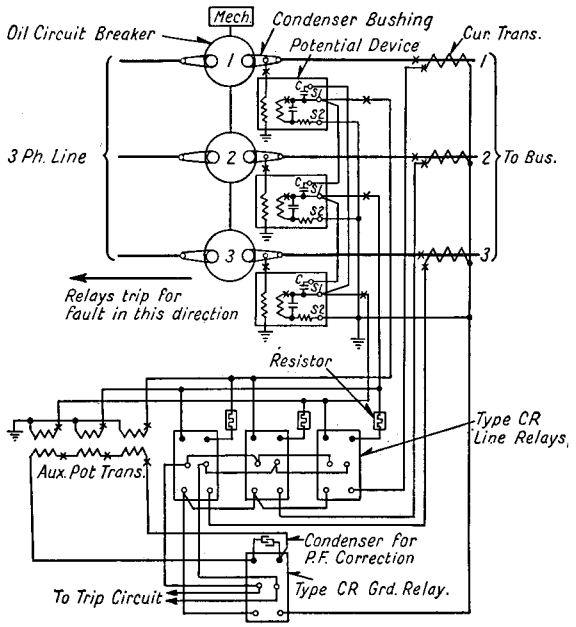
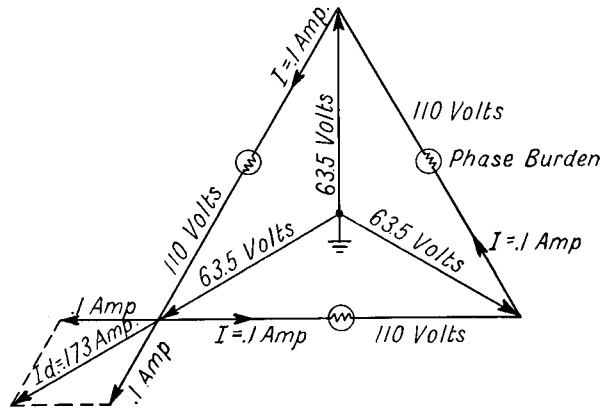


FIG. 6—CONDENSER BUSHING POTENTIAL DEVICE CONNECTIONS FOR GROUND AND LINE RELAYS, TYPE CR 90° CONNECTIONS



Assume A Phase Load Across Each Phase = 11 Volt-Amps., 100% P. F. At 110 Volts.

I (At 110 Volts) $= \frac{11}{110} = .1$ Amp.

From Left Hand Vectors of Current:

Id (Per Device) = 1.73 x I per phase = 1.73 x .1 = .173 Amp.

From Main Vector Diagram of Voltage:

$$\text{e Per Device} = \frac{\text{E Per Phase}}{1.73} = 63.5 \text{ Volts}$$

Burden Per Device = (e x Id) Per Device = 63.5 x .173 = 11 Volt-Amps., 100% P. F. at 63.5 Volts

Thus, Burden Per Device, Provided Phase Loading Is Equally Distributed, is the same Volt-Ampere Burden at 63.5 Volts as the Phase Burden is at 110 Volts.

FIG. 7—VECTOR DIAGRAM FOR DETERMINING DEVICE BURDEN FOR ANY GIVEN PHASE BURDEN

and equipped with external resistors. The devices will be connected in star on their secondaries as shown in Figure 6 and the relays connected in delta. The burden of the potential element of these relays is approximately 15.2 volt-amperes at 78 percent power factor on 110 volt circuit. Using the method shown in Figure 7 the burden per device is 15.2 volt-amperes at 78 percent power factor on basis of 63.5 volts. In order to obtain a better performance of each device it is desirable to compensate for the effect of the reactive component of the relay burden. A separate condenser installed within the device is for the purpose of correcting for reactive component of the secondary burden primarily to permit the use of larger burdens having a high reactive component. As indicated elsewhere in this publication the maximum burden of the PB-1 device for 110 kv. line voltage is 15 volt-amperes at 100% power factor on 110 volt basis. Thus to reduce the effective burden of the relays on each device in this example the calculation in Table II will determine the capacity of condenser to use in each device. This capacity may also be determined from the curve, Fig. 8.

This value of capacity should be obtained by combining the proper taps on the balance condenser in each potential device. These balance condensers are quite similar to the network condensers having the units connected in series with a tap brought out from each unit. The capacity of each unit is marked on the end of the case and on the panel. The proper capacity (2.08 in this example) should be obtained by parallel and series combinations on each condenser and finally connected across phases on the secondary of the potential device as shown in Figure 10. The effective burden on each device is 11.8 volt-amperes at 100% power factor. Each device should be adjusted for this burden which is made up as shown in Table III.

The adjusting burden is made up of the potential element of the phase meter, a condenser of 2.23 m.f. capacity and a resistor of 563 ohms resistance, all connected in parallel. The current element of the phase meter should be energized from the correct reference potential as described above and the device adjusted as later explained.

TABLE II

*Relay burden in volt-amperes (110 volts) (15.2 volt-amps. —78% P. F.)	11.8 + j 9.45
Minimum possible effective burden of relay in volt-amps. (Watt component)	11.8 + j 0
Reactive component in volt-amps. to be balanced by condenser (V. A.)	0 + j 9.45

$$\text{Balance Capacity} = \frac{\text{V.A.} \times 10^6}{\text{E} \times 2\pi\text{f}} = \frac{9.45 \times 10^6}{110^2 \times 377} = 2.08 \text{ micro-farads.}$$

*See Fig. 9.

TABLE III (Based on 63.5 Volts)

†Phase Meter burden in volt-amp. (5.75 volt-amp.—80.8% P.F.)**	4.65 + j 3.39
Paralleled condenser in volt-amps.	0 — j 3.39
Paralleled resistor in volt-amps.	7.15 + j 0
Adjusting burden in volt-amps.	11.80 + j 0

$$\text{Paralleled resistance} = \frac{\text{E}^2}{\text{V.A.}} = \frac{63.5^2}{7.15} = 563 \text{ ohms.}$$

$$\text{Paralleled condenser} = \frac{\text{V. A.} \times 10^6}{\text{E}^2 \times 2\pi\text{f}} = \frac{3.39 \times 10^6}{63.5^2 \times 377} = 2.23 \text{ m. f.}$$

† Burden of potential coil of Phase Meter to be used should be measured accurately as the burden of different instruments vary somewhat.

** Phase meter burden can be eliminated if a low burden (less than one volt-amp.) phase meter is used.

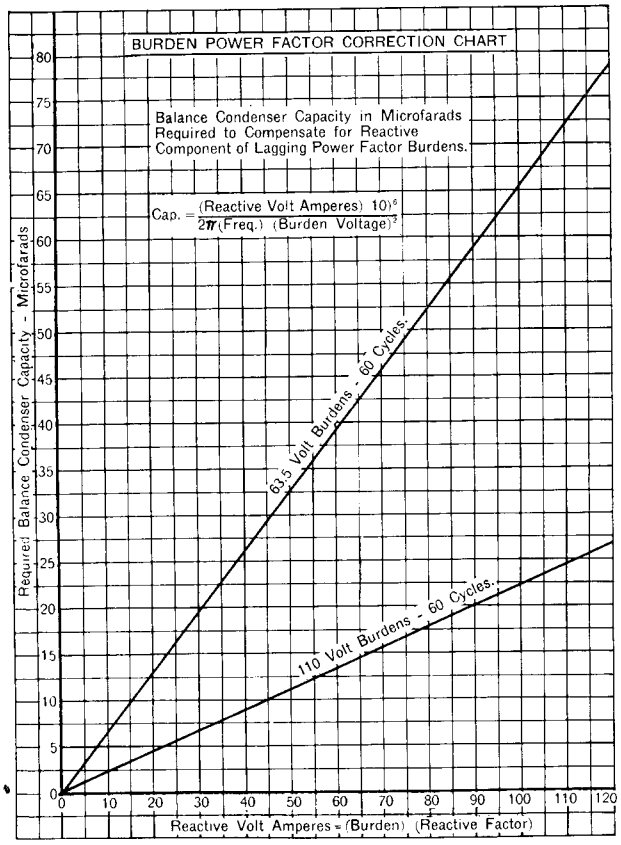


FIG. 8—BURDEN POWER FACTOR CORRECTION CHART

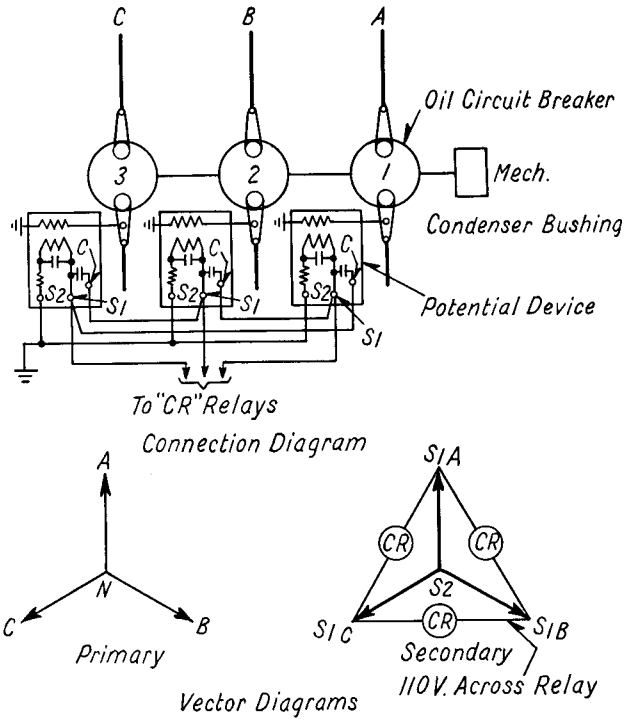
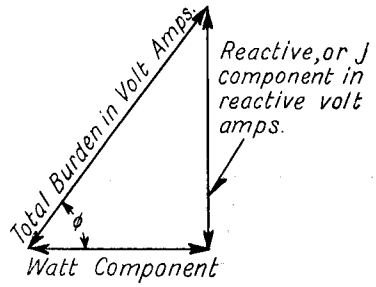


FIG. 10—THREE CONDENSER BUSHING POTENTIAL DEVICES CONNECTED IN STAR TO SUPPLY POTENTIAL FOR DIRECTIONAL PHASE PROTECTION

Example No. 2—Should it be required to adjust three devices to supply potential for CR relays using 30 degree connection (See Fig. 11) (without external resistor) a procedure similar to example number one is followed except the effective burden can be considerably reduced. See Table IV.

This does not indicate that it is necessary to balance with this amount of capacity to obtain proper functioning of the devices with the relays. It is an example however that apparently heavy burdens (low power factor) can be carried on the devices if the effective burden per device is reduced by power factor correction. The amount of condenser to use is governed by the permissible maximum burden of the device. In correcting the effective burden to 100% power factor it is necessary to use an adjusting burden of 100% power factor which is usually much easier to make up than a burden at any other power factor.

If it is desirable to use a directional type CR ground relay with either of the above phase relay schemes, a residual delta voltage can be obtained by using an auxiliary star-delta three-phase transformer (Westinghouse Style No. 699869 all contained in one case). The CR ground relay should have four one microfarad condensers connected across the potential element to insure correct operation with the potential device.



∅ = Angle Depending on Power Factor of Burden.
Power Factor = Cosine ∅
Reactive Factor = Sine ∅
Watt Component = Power Factor x Total Burden.
Reactive Component = Reactive Factor x Total Burden.
For Relay Burden of 15.2 Volt-Amps. at 78% P.F.
Watt Component = .78 x 15.2 = 11.8 Watts.
Reactive Component—.62 x 15.2 = 9.45 Reactive Volt-Amps., Or Volt-Ampere Burden = 11.8 + j9.45.

FIG. 9—METHOD OF SEPARATING A BURDEN INTO ITS COMPONENTS

TABLE IV

Relay burden in volt-amps. (110 volts) (23.7 volt-amps.—15% P. F.)	3.56 + j 23.4
Minimum possible effective burden of relay in volt-amps. (watt component)	3.56 + j 0
Reactive component in volt-amps. to be balanced—by condenser (V. A.)	0 + j 23.4

Balance capacity $= \frac{23.4 \times 10^6}{110^2 \times 377} = 5.12$ m.f.

TABLE V

Burden imposed on each device $= 11.44 \times \frac{63.5}{110} = 6.62$ volt-amps. at 90% P. F.

Burden imposed on each device vectorally = 5.95 + j 2.88

Phase meter burden in volt-amps.	4.65 + j 3.39
Paralleled condenser in volt-amps.	0 — j 0.51
Paralleled resistance in volt-amps.	1.30 + j 0
Adjusting burden in volt-amps.	5.95 + j 2.88

Paralleled resistance $= \frac{63.5^2}{1.30} = 3100$ ohms.

Paralleled condenser $= \frac{.51 \times 10^6}{63.5^2 \times 377} = .335$ m.f.

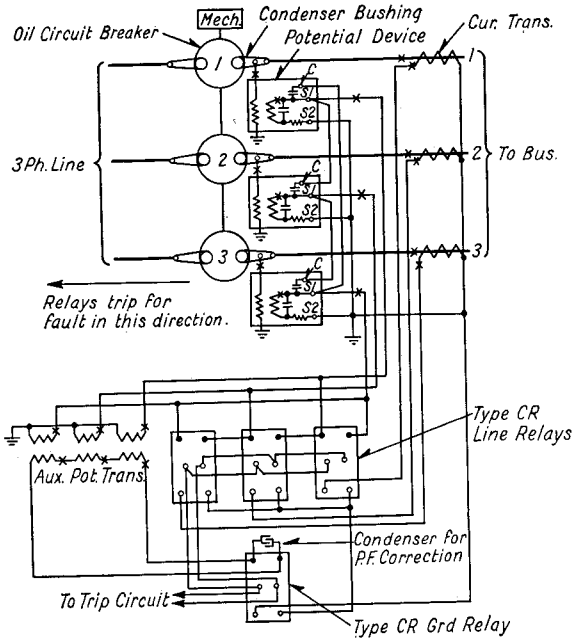


FIG. 11—CONDENSER BUSHING POTENTIAL DEVICE CONNECTIONS FOR GROUND AND LINE RELAYS TYPE CR 30° CONN.

The burden of this ground relay need not be considered in the adjustment of the devices.

It is sometimes desirable when using directional relay protection to check the angle between the voltage and current in the potential and current elements respectively. This check is described in detail in the instruction books covering the particular relay. One modification is necessary when using the potential device, however, in that the potential connections must be removed from one particular relay and the potential element of the phase meter inserted instead. In addition, the burden of the phase meter must be modified with condensers where possible to have the same burden as the potential element of the relay. For cases where the burden of the relay is less than the burden of the phase meter, the relays should be connected as used in service and the voltage across each potential element of the relay checked against a known reference voltage using the "null method" or using a low burden phase motor.

Example No. 3—Suppose it is assumed that two devices are to be installed on a three-phase 110 kv. breaker using a system set-up as in Figure 5 to furnish potential for a Type SI synchronoscope. The devices will be connected in series (reversed open delta) supplying a phase to phase voltage as shown in Figure 13. The standard Type SI synchronoscope has two elements, having burdens of 10.6 volt-amps. at 100% power factor and 11.44 volt-amps. at 90% power factor on the split phase element both on a 110 volt circuit. To adjust the two devices for the synchronoscope burden it is advisable to make an approximate adjustment on the individual device and make the final adjustment with the devices connected is reversed open delta to the synchronoscope. The adjusting burden is made up as shown in Table V.

The adjusting burden is made up of the potential element of the phase meter, a condenser of .335 m.f. capacity and a resistor of 3100 ohms resistance all connected in parallel. The current element of the phase meter should be energized from the correct reference potential and the devices adjusted to approximately zero angle and 63.5 volts.

Connect the devices in reversed open delta to the synchronoscope mounted on the station switchboard. Energize the other side of the synchronoscope from the reference potential (correct phase and

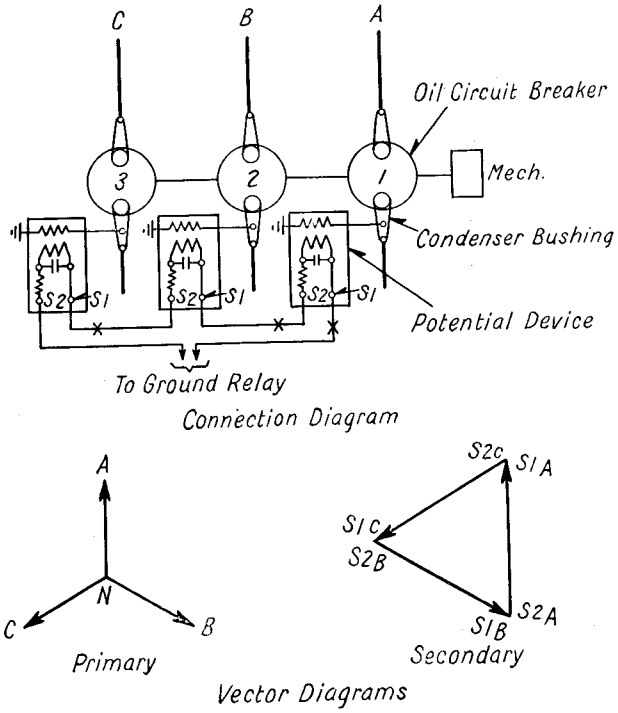


FIG. 12—THREE CONDENSER BUSHING POTENTIAL DEVICES CONNECTED IN DELTA TO SUPPLY RESIDUAL VOLTAGE FOR DIRECTIONAL GROUND POTENTIAL

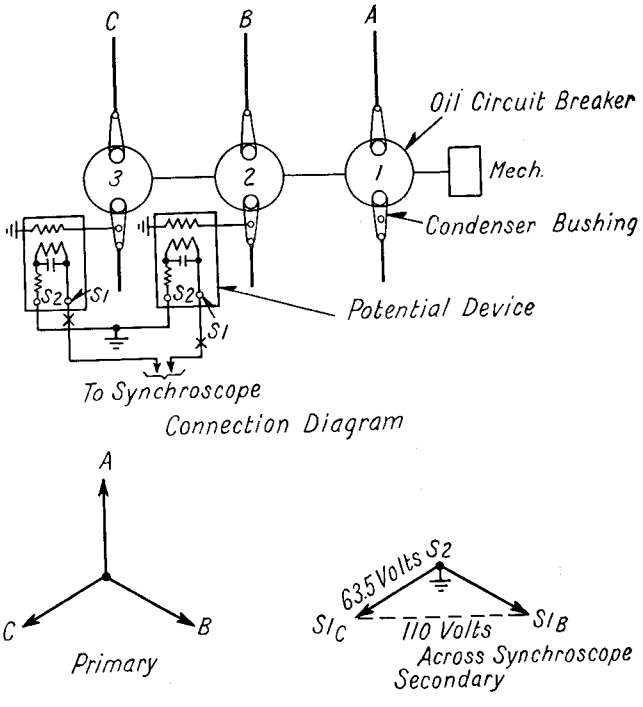


FIG. 13—TWO CONDENSER BUSHING POTENTIAL DEVICES CONNECTED TO SUPPLY POTENTIAL FOR PHASE TO PHASE SYNCHRONIZING

magnitude) and make any slight adjustment as may be required at the devices to bring the synchronoscope needle to zero. Both devices should be adjusted together. For a given shift in angle or voltage a portion of each should be corrected by making necessary adjustment on each device, and, not all on one device. This method of adjustment is suggested to prevent incorrect series operation of the devices. The regulation of a device is changed by changing its adjustment and it is quite easy to obtain settings whereby one device would tend to take all of the burden. This is prevented by making the initial approximate adjustment individually.

In general, regardless of the scheme used and total combined burden, it is necessary to determine the burden to which each device will be subjected at its desired normal operating voltage. When six devices are used per breaker to supply a common burden such as relays when the breaker is closed and some other burden such as a synchronoscope when the breaker is open, the same procedure is followed as in the above examples.

DEVICE ADJUSTMENTS

To facilitate the actual adjustment of the device, a complete understanding should be had of the connections and effect of variations of the network reactor, transformer and condenser.

The main reactor taps are connected to dial No. 1, so that rotating the movable selector switch from left to right increases the amount of reactance added to the circuit. This compensates for the phase shift caused by the capacity of the condenser bushing and the burden impedance. The vernier reactor is a small coil on the main reactor which may be connected additive or subtractive with respect to the main reactor by varying the selector switches on dials No. 2 and No. 3. When the numerical setting of dial switch No. 2 is larger than that of dial No. 3, the vernier is added to the main coil, and vice versa. The smaller vernier steps are between V_1 and V_5 while the relatively larger steps are between V_5 and V_9. This point should be kept in mind while making the final adjustments.

The transformer taps are connected to dials No. 4 and No. 5 in the following manner: (See diagram of device).

X_4-X_5-Lowest transformer voltage.
X_3-X_5-Intermediate
X_2-X_5-Intermediate
X_1-X_5-Normal transformer voltage
X_1-X_6-Intermediate
X_1-X_7-Intermediate
X_1-X_8-Highest transformer voltage.

The first contacts on dials No. 4 and No. 5 are marked "off" and provide a means of opening the secondary circuit when connections are being made to terminals "S_1" and "S_2" of the device. It is unnecessary to open the secondary circuit or to remove the voltage from the device while making adjustments as all the adjusting switches may be readily moved from one position to another while the device is energized. However, the selector switches on dials No. 1 to No. 5 should not bridge two adjacent contacts for any great length of time as this will give an unsatisfactory adjustment and may cause damage to the device.

The condensers are controlled by single pole double throw knife switches in such a way that the individual condenser units may be connected in series, parallel or series parallel as desired. From the wiring diagram it is evident that alternate switches thrown to the left and right place the various condenser units in parallel across the transformer secondary. A switch to the right and another to the left, with one or more open in between, places the units in series. The top switches control the larger units and the bottom switches control the smaller units of network condenser capacity.

It must be remembered that while the reactor predominately affects the phase error of the device, and the transformer and condenser affects the voltage, that the adjustment or variation of any one of the component parts must necessarily affect the magnitude and direction of the voltage and phase angle together. Assuming that the device is correctly mounted and connected to the bushing tap and that normal line-to-ground voltage is available for energizing the bushing, the following procedure should be noted.

1. Set the reactor selector switch dial No. 1 to R_5.
2. Set the vernier selectors, switches dial No. 2 and dial No 3 to V_1.
3. Set the transformer selector switch No. 4 to X_1.
4. Set the transformer selector switch dial No. 5 to X_5.
5. Close condenser knife switch B to left and switch C to the right.
6. Connect adjusting burden including phase meter or synchronoscope to S_1 S_2 on the panel of the device.
7. Connect a voltmeter having resistance not less than 20000 ohms on 150 volt scale to S_1 S_2.
8. Energize condenser bushing from high voltage system by closing breaker or line disconnects.
9. Energize current coil of phase meter or one element of synchronscope from the reference potential.
10. Connect reference potential to a voltmeter to determine its value at all times during the adjustment.
11. Note the voltage and phase angle errors as indicated by the meters using the initial dial and switch settings given in the preceding paragraphs. Both readings will probably be in error to start with. Vary the main reactor switch (Dial No. 1) left or right until the phase angle error is approximately zero as indicated by the phase indicator. Adjust the voltage by varying the condenser knife switches, remembering that the larger values of capacity are at the top and the smaller values at the bottom of the panel. Alternate switches to the right and left places the condenser units in parallel across the transformer secondary. Additional voltage and phase angle variation may be obtained by varying the transformer taps as previously indicated.

    When the voltage and phase angle readings are of approximately the desired values, the vernier reactor and smaller condenser units should be used to make the final close adjustments. Taps V1 to V5 of Dials No. 2 and No. 3 control the smaller steps of the vernier reactor while taps V5 to V9 control the larger steps.
12. In case the phase angle error is very great and difficulty is experienced in adjusting same, a re-check should be made to see that the voltage used for reference is approximately equal to the voltage desired from the potential device, is from the proper phase, and that the phase indicator polarity is correct. If the protective arrester functions, add additional condenser capacity to the circuit by means of the knife switches, or use a high voltage setting of the transformer. If satisfactory results cannot be obtained in this way, re-check the total volt-ampere burden on the device to make sure the rating of the device has not been exceeded.
13. When a desirable setting has been obtained measure the voltage across the mid point of dial No. 4

and 5 with a voltmeter having not less than 40000 ohms on the 300 volt scale. This voltage which is affected by various adjustments is the network condenser voltage and should not exceed 270 volts.

It is usually desirable to determine the tap voltage of the device as finally adjusted, and connected to the burden. This voltage can be calculated by multiplying the transformer secondary voltage with the transformer ratio. This ratio can be obtained from the transformer diagram furnished with each device. This voltage under normal operating conditions should not exceed 4300 volts with the PB-1 device and 8000 volts with the PB-2 device.

14. The PB-2 device can be adjusted to obtained modified performance. For instance the device can be adjusted to lower phase angle errors than shown on accompanying curves but at the sacrifice of ratio accuracy and vice versa. The best average performance for devices normally operating at rated line voltage is obtained with transformer ratios between 27/1 and 32/1.

15. When the devices are used in a three phase combination of any nature, care should be taken in adjusting the devices such that the same transformer taps are used on each device of a given 3 phase group. This precaution will tend to hold the internal impedance of each device at the same value.

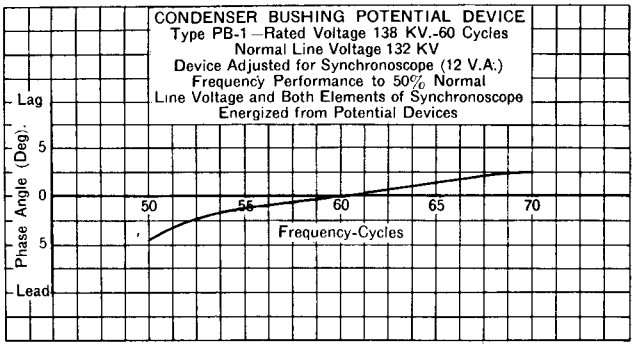


FIG. 14—APPROXIMATE PHASE ANGLE—FREQUENCY PERFORMANCE

16. If the above procedure is carefully observed the secondary voltage may be adjusted to approximately one and one-half percent of the desired value and phase angle to within 2 degrees for any burden within the normal rating of the device. After the adjustment is completed the locking bar should be fastened in place on the condenser knife switches and the final dial and switch settings recorded. The door of the housing should be closed and padlocked and no further attention need be given to the device.

PERFORMANCE

The performance of the condenser bushing potential device is dependent on the line frequency, line voltage and to some extent the amount of secondary burden. On referring to the performance curve (Figure 14) it is noted that the phase angle variation with frequency is quite small when using potential devices to energize both sides of the synchronoscope.

The typical performance characteristics may be noted from the curves shown in Figs. 15 to 18 on page 12. If the device should be loaded beyond its capacity the secondary voltage is decreased and the voltage across the last layer of the bushing is increased. Under a condition of sufficient over-burden the spark gap arrester will function and prevent the increased voltage from causing damage to the bushing.

RENEWAL PARTS

Since there are no parts in this device subject to wear there is practically no occasion to carry spare parts. However, in case the device is damaged and replacement parts are needed, it is necessary to give the name of the part and complete name plate marking which is located on the door of the device. It is advisable to carry several sets of spare lead-in cable gaskets, as these should be replaced whenever the connection to the bushing is opened.

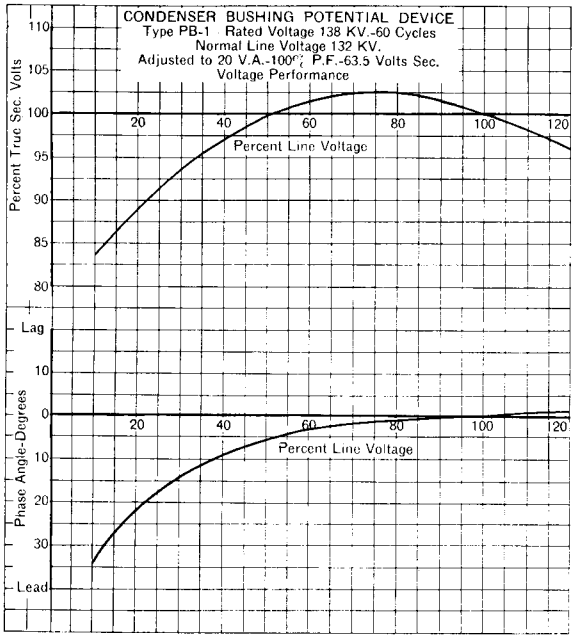


FIG. 15—TYPE PB-1 TYPICAL VOLTAGE CHARACTERISTICS

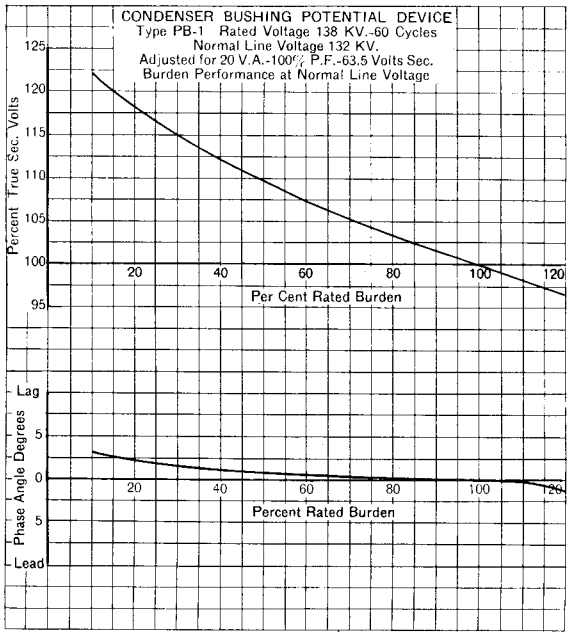


FIG. 16—TYPE PB-1 TYPICAL BURDEN CHARACTERISTICS

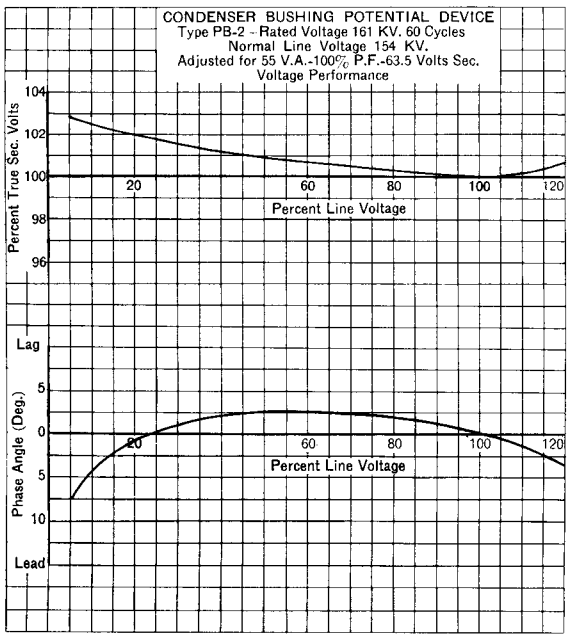


FIG. 17—TYPE PB-2 TYPICAL VOLTAGE CHARACTERISTICS

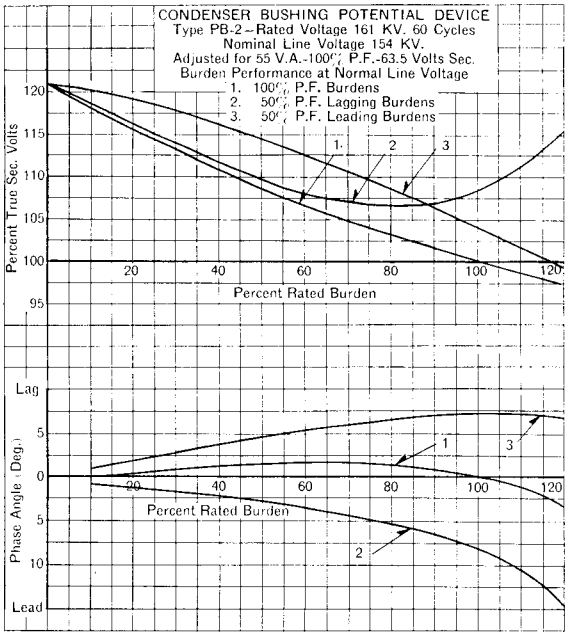


FIG. 18—TYPE PB-2 TYPICAL BURDEN CHARACTERISTICS

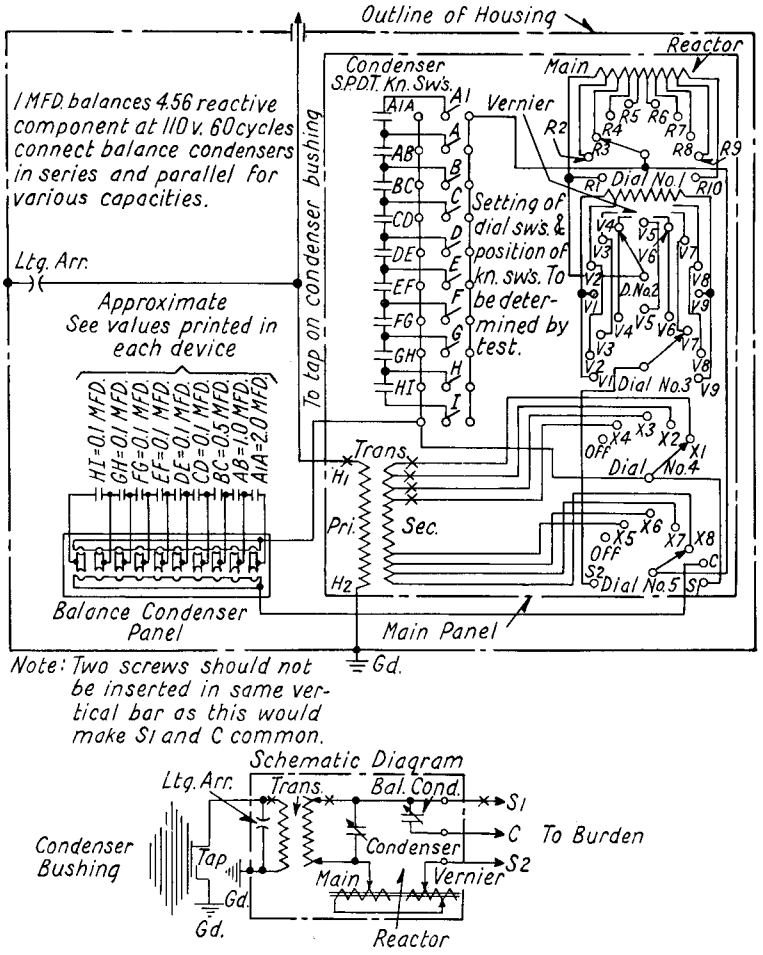


FIG. 19—SCHEMATIC AND WIRING DIAGRAM OF TYPE PB-1 BUSHING POTENTIAL DEVICE

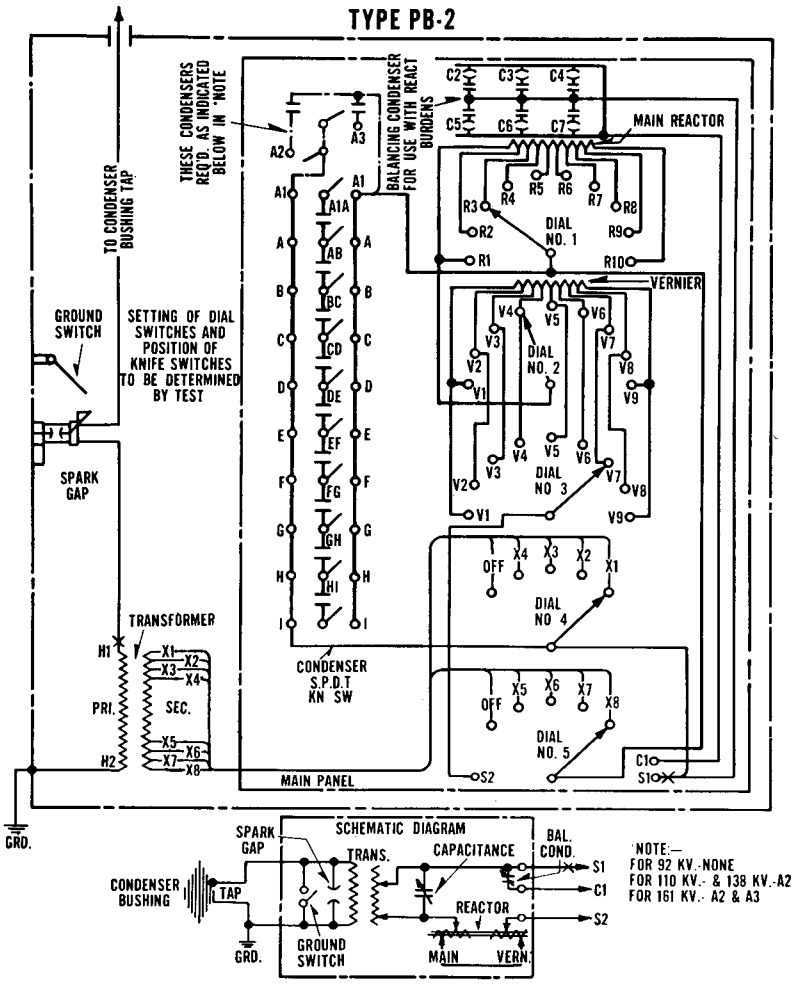


FIG. 20—SCHEMATIC AND WIRING DIAGRAM OF THE TYPE PB-2 BUSHING POTENTIAL DEVICE.

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*LOUISVILLE, KY., 322 West Broadway
*MADISON, WISC., 508 Edgewood Ave.
xMANSFIELD, OHIO, 200 East Fifth St.
*MARSHALL, TEXAS, 202 W. Merritt St.,
*MEMPHIS, TENN., 130 Madison Ave.
*MIAMI, FLA., 1036 N. Miami Ave.
*MILWAUKEE, WISC., 546 North Broadway
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#NEW ORLEANS, LA., 527 Poydras St.
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#PORTLAND, OREGON, 720 N. Thompson St.
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YOUNGSTOWN, OHIO, Moock Elec. Sup. Co.

①Changed or added since previous issue.

January, 1937

Westinghouse

Type SAF-2 Operating Mechanism

for

Type F-122, 400, 600 & 800 Amp. 2 & 3 P. S. T.
and
Type F-124 600 & 1200 Amp. 2 & 3 P. S. T.
Oil Circuit Breakers

INSTRUCTION BOOK

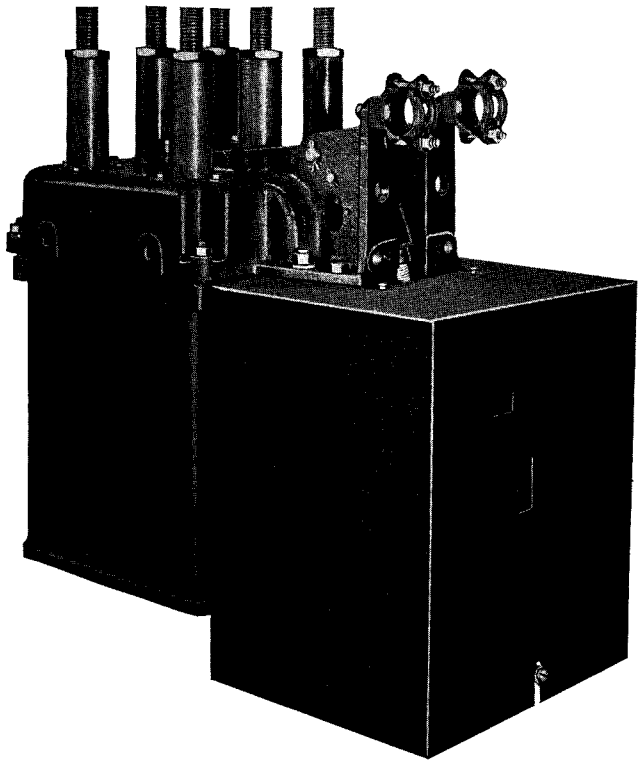


FIG. 1--TYPE F-122, SOLENOID-OPERATED BREAKER

Westinghouse Electric & Manufacturing Company
East Pittsburgh, Pa.

Westinghouse Press
Printed in U.S.A. (Rep. 4-45)
★Supersedes I. B. 5790-A

I. B. 33-216★
(Filing No. 33-000)

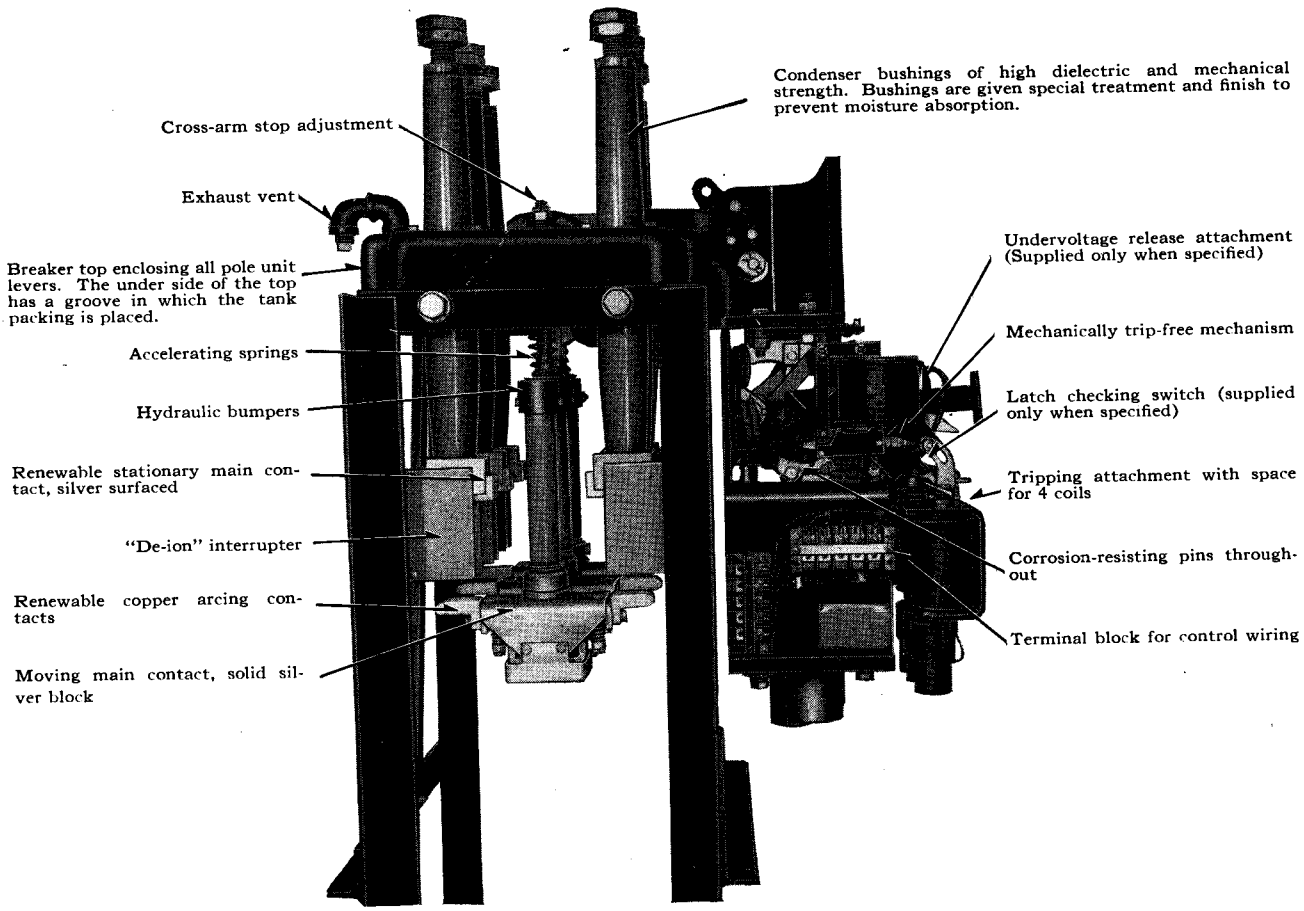


FIG. 2—TYPE F-124-A, 600 OR 1200-AMPERE, SOLENOID-OPERATED BEEAKER WITH TANK REMOVED FROM THE BREAKER AND COVER REMOVED FROM THE TYPE SAF-2 SOLENOID

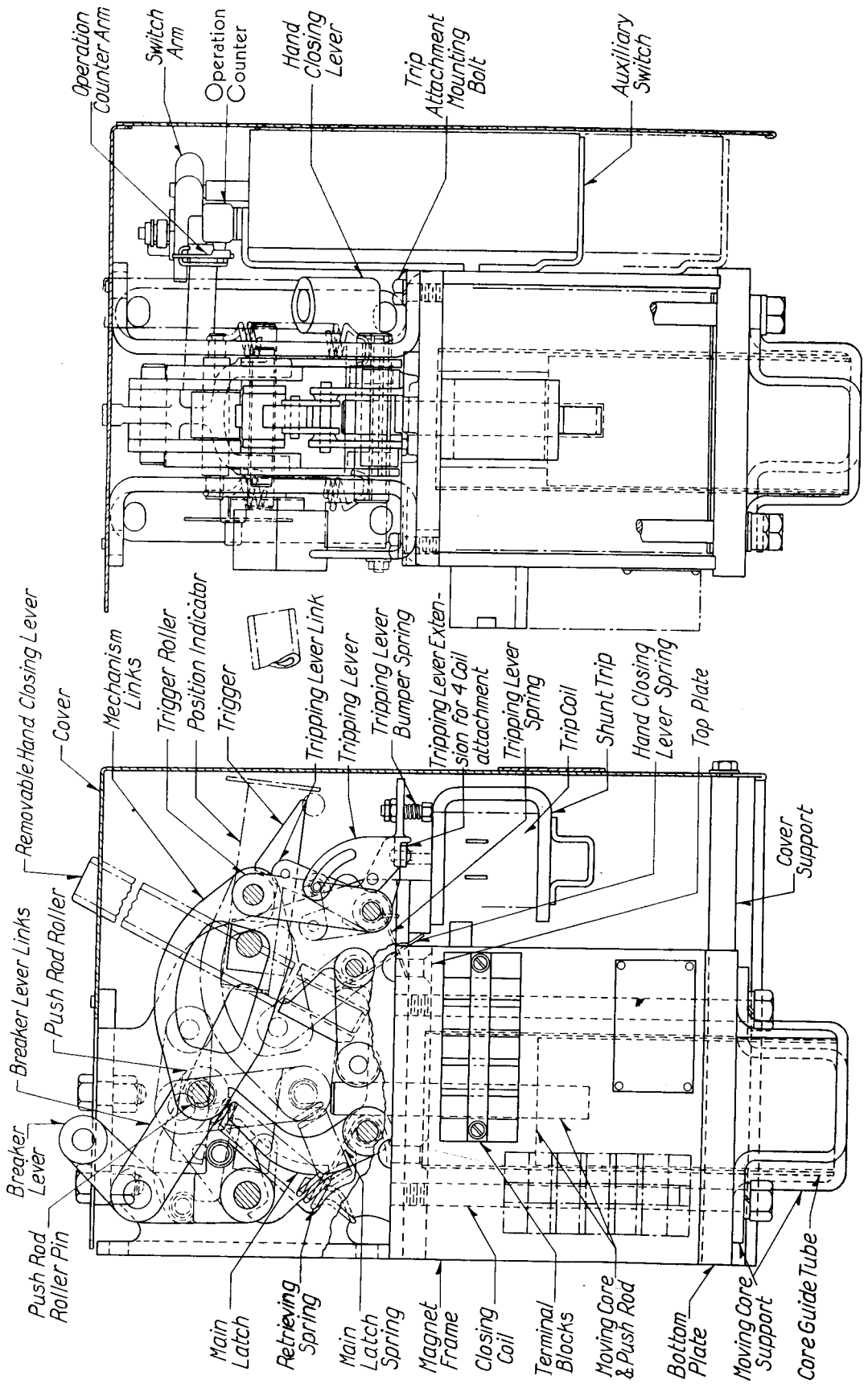


FIG. 3—CIRCUIT BREAKER—OIL-TYPE "SAF-2" MECHANISM ASSEMBLY

Westinghouse

Type SAF-2 Operating Mechanism

INTRODUCTION

This mechanism is the direct-current solenoid type. It operates on standard direct-current control voltages or when equipped with a rectox unit, on alternating-current. It is a mechanically full automatic mechanism, trip free in all positions.

This mechanism is used principally to electrically operate the 400, 600 and 800 ampere type F122 and the 600 and 1200 ampere type F124 oil circuit breakers. This instruction book applies to the mechanism only. Instructions on adjustments and maintenance of the type F122 and F124 breakers can be found in Instruction Books 5746 and 5767 respectively.

The standard mechanism is supplied with a single shunt trip coil, a 6 pole auxiliary switch, cover, position indicator and control relay. The mechanism can be equipped with additional attachments, such as, operation counter, latch checking switch, four coil tripping attachments (in place of single shunt trip coil), a 10 pole auxiliary switch instead of a 6 pole, an undervoltage tripping attachment and a single pole cut off switch.

SHIPMENT

Ordinarily the mechanism will be mounted on the breaker unit, with all adjustments complete, ready for installation as described in I.B. 5746 or 5767. Occasionally, however, the mechanism will be shipped separately, fastened in the closed position.

HANDLING

Do not attempt to lift the mechanism by its attachments or levers; or to move the attachments by the coil leads. Always grasp the frame, which is designed to withstand handling.

INSTALLATION

1. When the mechanism is mounted on the breaker before shipment, it is only necessary to follow the installation procedure outlined in the breaker Instruction Books and operations 8 to 12 of this book.

2. When the mechanism is shipped separately, however, it is necessary to first mount the breaker unit as described in the above Instruction Books and then mount the mechanism to the breaker as shown in Fig. **4**, or the outline supplied with the breaker.

3. Bolt the mechanism to the breaker frame, floor or wall with four bolts. If the mechanism is for wall or floor mounting, structural steel members should be inserted between the mechanism and wall or floor to prevent disintegration of the wall by the closing shock.

4. Remove the rod end from breaker lever of the mechanism; remove the fulcrum pin from the toggle lever of the breaker, and the pin from the operation rod end of the breaker.

5. Screw the operating rod into the operation rod end, with the lock nut and lock washer in place as shown.

6. Replace the rod end assembly and pins, and check the operation of the mechanism.

7. Operations #4, 5 and 6 should be repeated until the length of the operating rod assembly is such, that, with the mechanism in the closed position, the breaker toggle lever links will be $\frac{1}{32}$" away from the breaker stop pin.

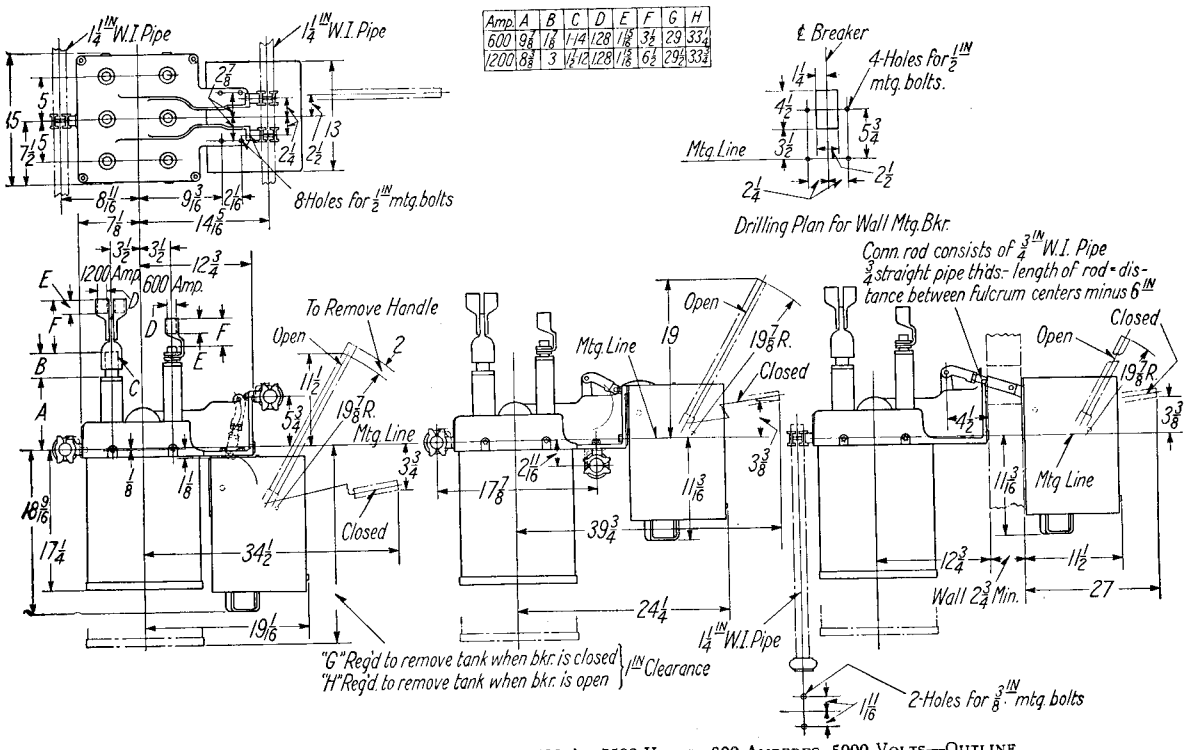


FIG. 4—STANDARD TYPE F-122, 400 AND 600-A—7500 VOLTS., 800 AMPERES, 5000 VOLTS—OUTLINE

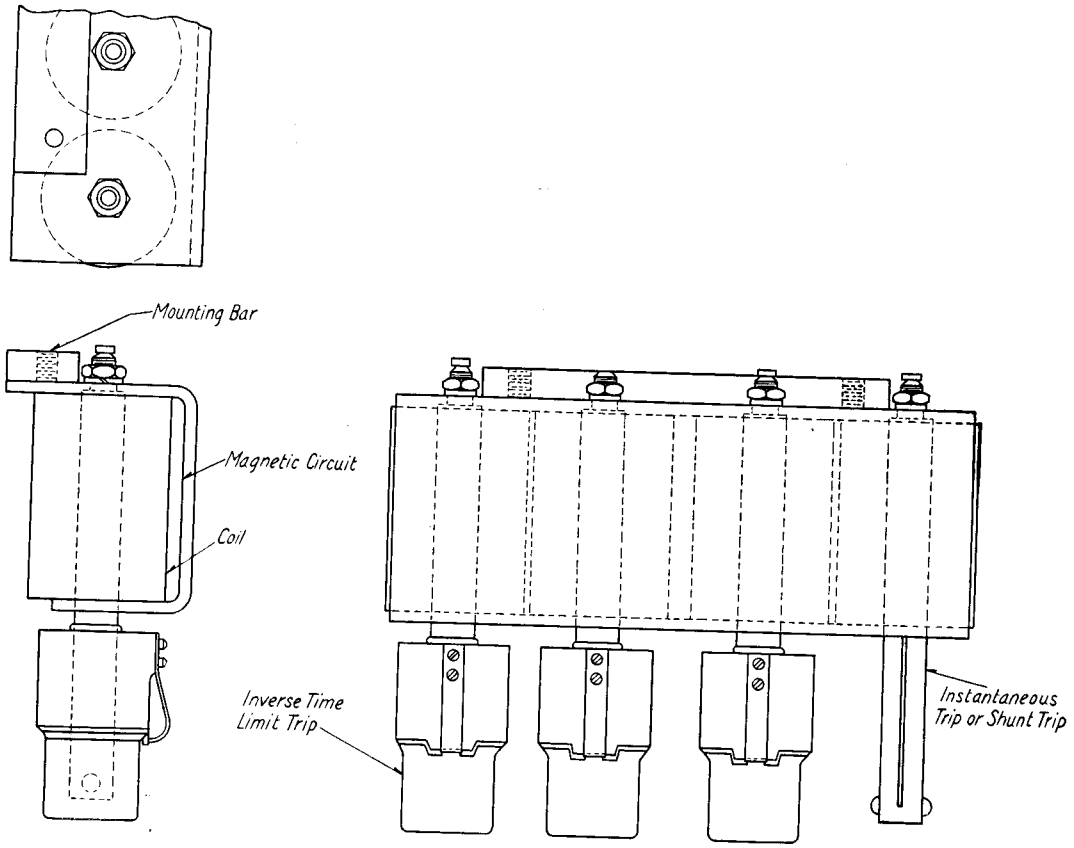


FIG. 5—INVERSE TIME LIMIT ASSEMBLY

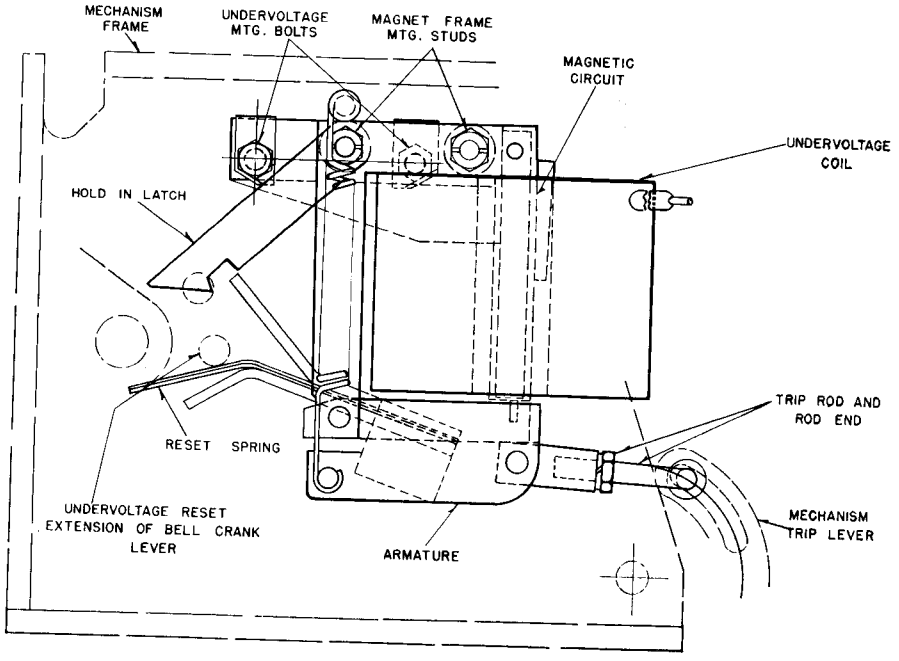


FIG. 6—UNDERVOLTAGE OPERATING ASSEMBLY

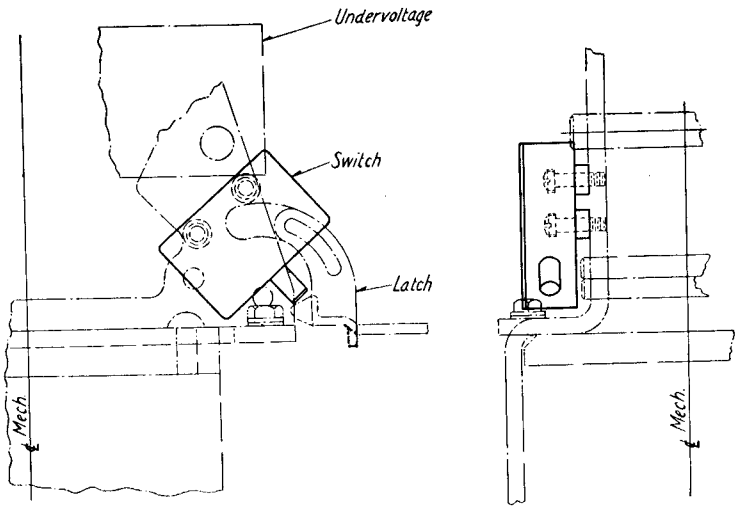


FIG. 7—LATCH CHECKING SWITCH ASSEMBLY

8. With operation #7 completed, the main moving contact of the breaker should be ¼" below the lift rod end as described in I.B. 5746 or 5767.

9. Mount the control panel in a convenient location.

10. Wire the control panel to the mechanism in accordance with one of the typical diagrams Figs. **8** and **9**, or in accordance with the diagram covering the complete installation. (The control panel is not wired at the factory; all wiring must be done at the time of installation.)

11, Operate the attachments to make sure they are functioning properly, as described under adjustments.

12. Apply voltage to the closing coil and check the electrical operation of the solenoid. The mechanism should operate satisfactorily with 72% of normal voltage applied, measured at the coil.

ADJUSTMENTS

Mechanism Operation:

Ref. Fig. **2.**

Energizing the closing coil forces the moving core and push rod upwards against the push rod roller (located at the junction of the breaker lever links and the mechanism links). This upward force straightens the toggle formed by the breaker lever links and the mechanism links which in turn rotates the breaker lever counter-clockwise, as the trigger roller (which is fastened to the mechanism links) is held stationary by the trigger. Just before the moving core strikes the top plate, the main latch is forced under the push rod roller by the main latch spring, thus locking the mechanism in the closed position. The toggle formed by the breaker lever links and the mechanism links is prevented from going over center by the push rod roller pin striking the top of the frame.

Energizing the trip coil rotates the tripping lever counter-clockwise to break the tripping toggle, and pull the trigger out of engagement with the trigger roller. This permits the entire linkage (mechanism links, breaker lever links and breaker lever) to slide horizontally off the main latch, thus permitting the mechanism to open. As the push

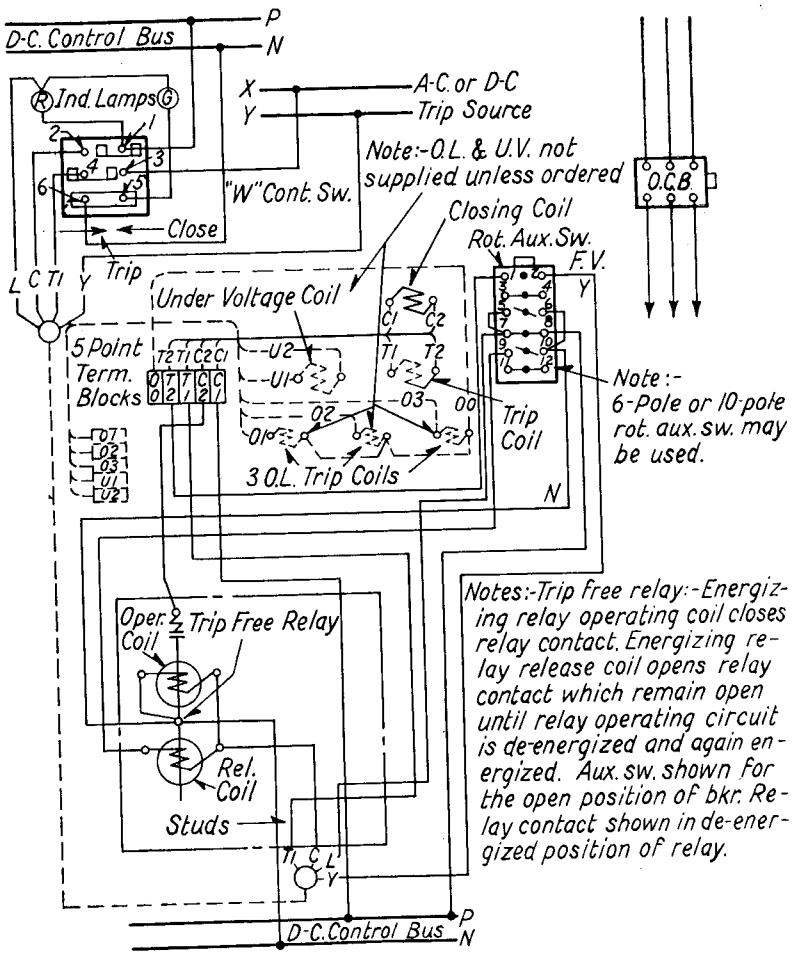


FIG. 8—DIAGRAM OF CONTROL PANEL CONNECTIONS

rod roller slides off the main latch, the retrieving springs pull the push rod roller downwards to reset the mechanism.

The mechanism tripping toggle should be set either on toggle or slightly over toggle to prevent trigger failure when closing on maximum voltage.

Four Coil Attachment

Ref. Fig. **5** and Fig. **2**

The four coil attachment bolts to the mechanism frame, in place of the single coil shunt trip attachment. In bolting the attachment in place it is only necessary to observe that the coil plungers push the tripping lever upwards sufficiently to trip the mechanism. A tripping lever with suitable extensions must be used with the four coil attachment.

Overload Release

See I.C. 1488.

AUXILIARY SWITCH

Ref. Fig. **3.**

The adjustable linkage between the mechanism breaker lever and the switch arm should be adjusted so that the switch arm travels equally on either side of a line thru the switch arm shaft.

The length of the switch arm should be adjusted so that the contact segments make good contact with the contact fingers in both the opened and closed position of the mechanism. Make certain the operating arm of the auxiliary switch is not in dead center, otherwise damaged parts will result.

UNDERVOLTAGE RELEASE

Ref. Fig. **6, 2** and **11.**

The undervoltage mounts on the left hand side of the mechanism frame

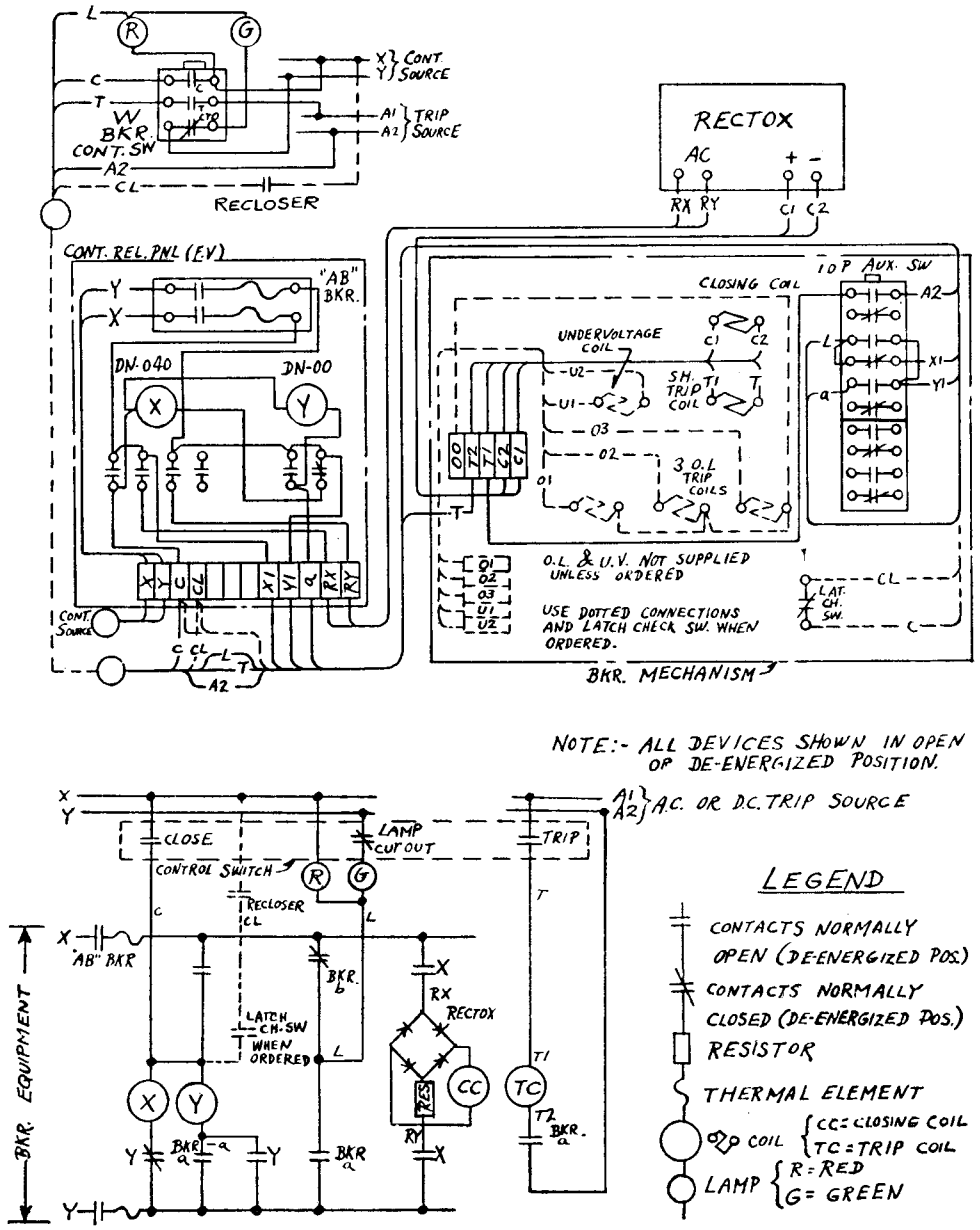


FIG. 9—RECTOX CLOSING SCHEME FOR SAF-2 MECHANISM

with the two mounting screws shown. The undervoltage reset extension of the breaker lever should operate between the undervoltage reset spring and the undervoltage hold in latch.

LATCH CHECKING SWITCH

Ref. Fig. **7.**

The latch checking switch block mounts on the two screws shown. The push button and permit the switch to make contact.

OPERATION COUNTER

Westinghouse

Oil Circuit-Breakers

Type GO-B—15,000 Volts—600 Amperes—50,000 KVA.
Type GO-1-B—15,000 Volts—600 Amperes—100,000 KVA.
Type GO-2-B—15,000 Volts—600 Amperes—250,000 KVA.
Type GO-2-B—15,000 Volts—1200 Amperes—250,000 KVA.
Type GO-1-B—23,000 Volts—600 Amperes—250,000 KVA.

INSTRUCTION BOOK

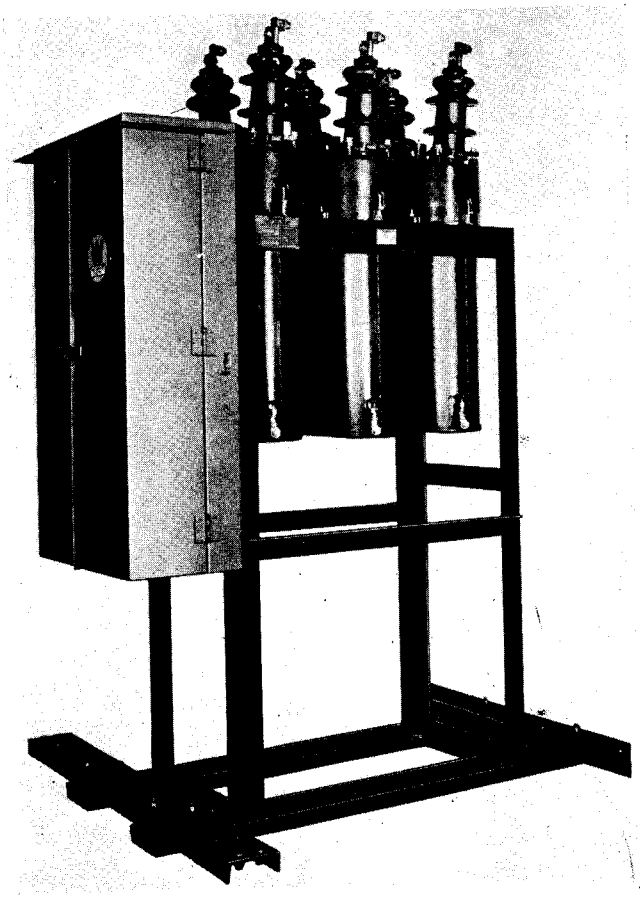


FIG. 1—TYPE GO-1-B, 15000 VOLT, 600-AMPERE, SOLENOID- AND MANUALLY-OPERATED BREAKER.

Westinghouse Electric Corporation
East Pittsburgh, Pa.

I. B. 5816
(Filing No. 33-000)

Printed in U.S.A. (Rep. 7-50)

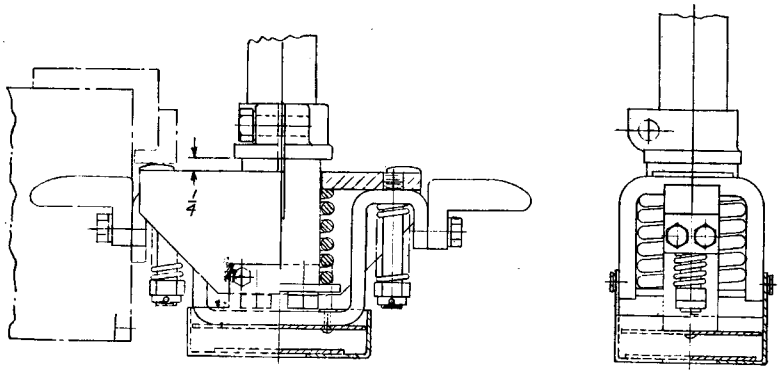


FIG. 5—DE-ION INTERRUPTER ASSEMBLY FOR GO-B CIRCUIT BREAKER

anism trigger and allow the breaker to open slowly.

4. Remove the tanks and examine the inside for evidence of moisture or foreign matter. Flush with benzine. Tanks should not be lowered in wet weather without provision for keeping moisture out of them. The internal parts of the breaker should be protected as well.
5. Examine the contacts to see that they are clean and in alignment. For adjustments, see section covering "Adjustments".
6. Operate the breaker by hand several times, watching each pole and the operating mechanism to be sure that all parts move freely.
7. Install connections to the breaker studs. All contact surfaces should be cleaned and should be free of burrs. The terminal studs are not designed to carry undue cable or bus bar loads. An excessive strain, which at first may have no apparent effect, will eventually loosen the porcelain weather casing and permit moisture to enter the breaker.
8. With the tanks removed, fill them with oil in accordance with name plate instructions or if more desirable, the oil can be added through a filling plug located in the breaker top after the tank has been bolted in place. Be sure to replace the filling plug and to see that tank is drawn up even and tight all around. See that the oil level is at the proper height on the oil gauge.
9. Connect the breaker frame to ground through the grounding pad provided on the breaker frame. The National Electric Code requires grounding cable to have one-fifth the main circuit capacity, except that it must never be smaller than No. 8 and need not be larger than No. 0, B & S gauge.
10. Remove the undrilled conduit entrance plate from the bottom of the mechanism housing and drill for the conduit entrance as desired.
11. Connect the control and transs former circuits to the proper point on the terminal blocks, as shown on the diagram supplied (Ref. Fig. 6).

When the breaker is located a considerable distance from the battery or transformer, allowance should be made for the voltage drop between the battery, or transformer, and the terminals of the operating coil to secure proper operation at minimum control voltage. The bushing type current transformer name plate should be used as an indication of the proper taps to use, although the proper taps will be determined by the loading. It is always necessary to determine the proper taps by test. The following tables indicate the primary current necessary to trip the breaker for several standard attachments. Always be sure the transformer secondary connections are completed before impressing primary current on the breaker.

12. Check the operation of the breaker by operating it electrically, if for electrical operation.

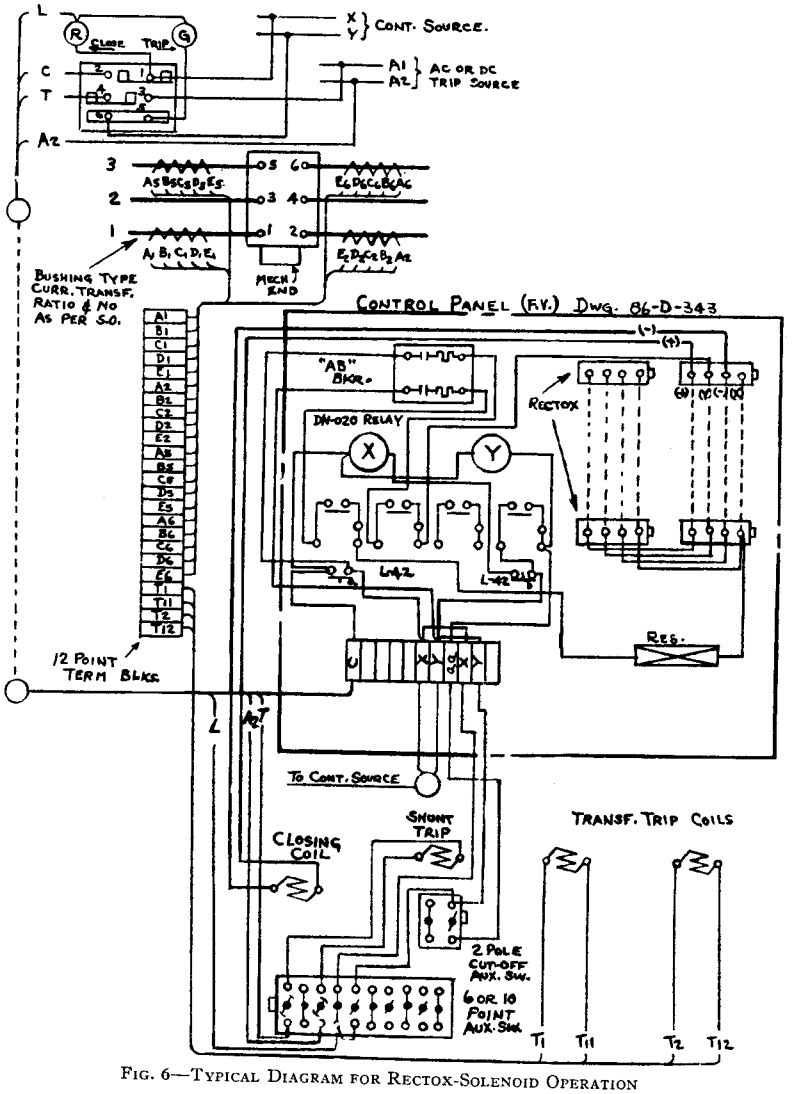


FIG. 6—TYPICAL DIAGRAM FOR RECTOX-SOLENOID OPERATION

Adjustments

These breakers used the wedge and finger type "De-ion" grid or interrupter contact shown in Figs. 3, 4 and 5. They are designed with sufficient pressure to carry rated current without the temperature rise exceeding A.I.E.E. limts.

GO-1-B to GO-2-B, 600 Amperes—The contacts are non-adjustable and are set properly at the factory. The distance between the top of the "De-ion" grid top plate and the top of the moving contact should be 1⅝ inches with the breaker closed. This dimension is only for new parts. Some allowance must of course be made when the contacts burn. The moving contacts are tipped with a special arc-resisting tungsten alloy to insure long life. This can only be replaced at the factory.

When fitting new stationary contact fingers the adjustment should be so made that the distance between the fingers is $\frac{5}{16}$ inch. See Fig. 3. The fingers should also be adjusted symmetrically with respect to the slot in the grids.

GO-2-B, 1200 Amperes—The auxiliary contacts (Fig. 4) are adjustable by turning the bracket up or down on the lift rod. With the breaker in the closed position the distance between the contact cross bar and cross bar bracket should be $\frac{5}{32}$ inch. It is important that this dimension be maintained.

These contacts make silver to silver contact and it is unnecessary to use an abrasive to keep them bright. In fitting new contacts it is unnecessary that perfect line contact be obtained. With the soft material (silver) good contact is obtained after a few operations. If it is necessary to renew the silver surfaces, use solder of at least 300°C. melting point. Use only "pure silver." Coin silver is unsatisfactory.

The moving contacts are tipped with a special arc-resisting tungsten alloy to ensure long life. This can only be replaced at the factory.

The adjustment of the stationary contact arcing fingers is the same as the 600 ampere breakers.

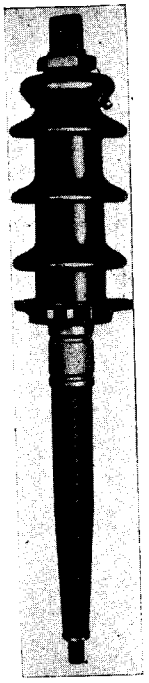


FIG. 7—GO-1-B CONDENSER BUSHING, 23,000 VOLTS

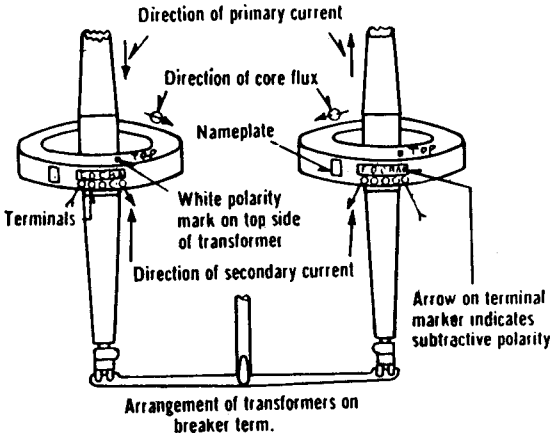


FIG. A

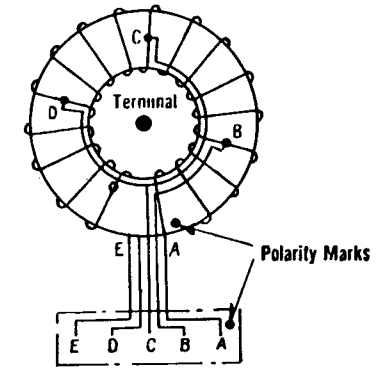


FIG. B

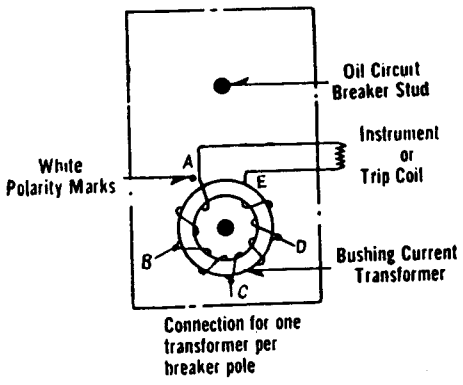


FIG. C

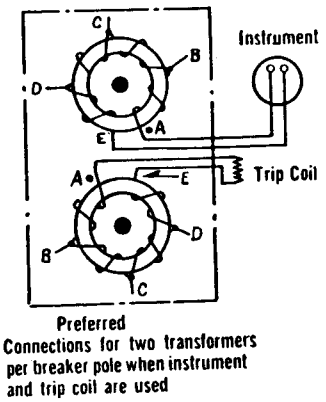


FIG. D

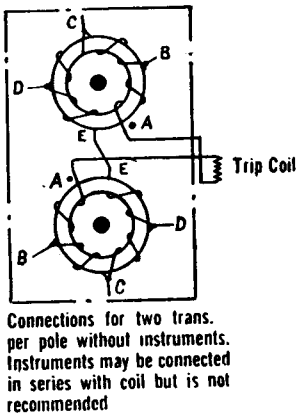


FIG. E

FIG. 8—TYPICAL BUSHING TYPE CURRENT TRANSFORMER CONNECTIONS

GO-B—The contact arrangement is shown in Fig. 5. The main and arcing contacts are both of the butt type, the ¼-inch lead of the arcing contacts being maintained by the thickness of the copper on the arcing tips. The contact pressure on the main contacts is obtained by a compression spring. With the breaker closed the top of the main moving contact should be ¼-inch below the shoulder on the lift rod end. If necessary to adjust, loosen the lift rod end and screw the assembly up or down as necessary.

It is important that the ¼-inch dimension be maintained as this determines the main contact pressure.

The main contacts make silver to silver contact and it is therefore unnecessary to use an abrasive to keep them clean. The oxide of silver does not increase the contact drop. In fitting new contacts it is unnecessary to secure perfect line contact; with the comparatively soft material (silver) good contact is secured after a few operations, as the silver flows slightly under pressure.

If the silver contacts on the moving contacts are replaced, use solder of at least 300°C. melting point. **Use only "pure silver", coin silver is unsatisfactory.**

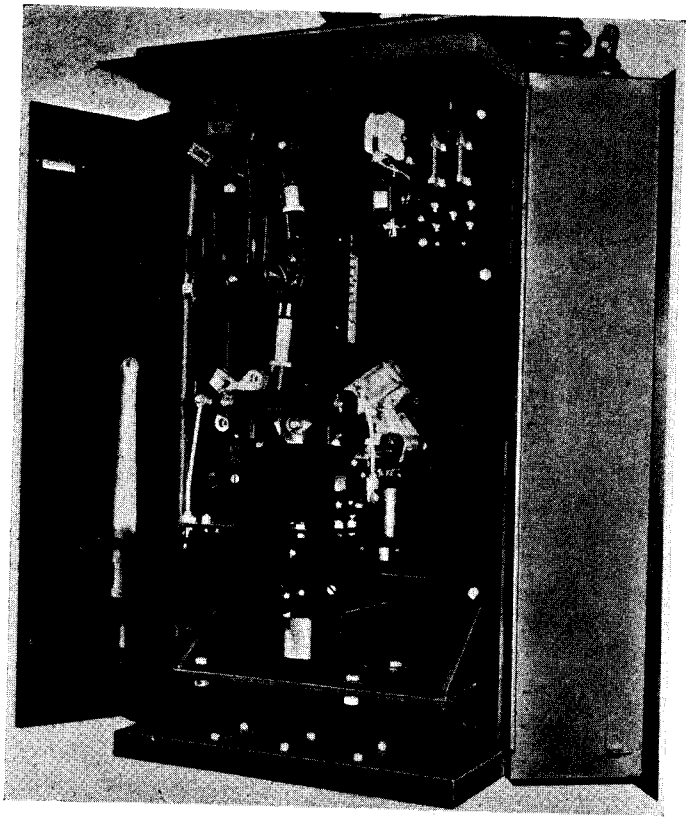


FIG. 9—TYPE SA-3 MECHANICALLY TRIP-FREE SOLENOID AND HOUSING

General:

Vertical and rotational adjustment of the contacts is secured by loosening the clamping bolt of the stationary contact foot and rotating the foot into alignment. If necessary to rotate the contact foot a complete turn, it will be necessary to remove the stationary contact bracket (with "De-ion" grid attached). Before rotating the foot a wedge should be driven into the saw cut to spread the foot. Never attempt to force the contact foot as the copper may "gall".

A limited amount of horizontal adjustment can be secured by adjusting the three clamp flange bolts on the top of the pole unit. This is done by loosening one or two bolts and tightening the remaining bolts. The bolts loosened should be checked for tightness after adjustment.

Before completing any adjustments, make sure that the contact support is turned so as to secure the minimum amount of friction or rubbing, between the moving contact and the stack or interrupter.

When removing the copper oxide from the contacts use sandpaper or a fine file. Do not use emery cloth; the particles of emery are electrical conductors and any particles remaining ower the insulating value of the oil.

Caution—Remember do not use an abrasive on silver contacts.

"De-ion" Grid Stacks—It is important that the arrangement of the plates in the "De-ion" grids be correct. Should it be necessary to renew parts of the stacks, it is recommended that they be returned to the factory for repair or completely new assembled stacks supplied.

"De-ion Interrupters"—The "De-ion Interrupters" control the arc and quickly extinguish it by de-ionization. These devices need little attention other than an occasional inspection. They must be kept securely tightened and properly aligned so that the moving contacts move freely and do not rub causing excessive friction. The fibre insulation is affected very little by the arc action but should be inspected occasionally and replaced if excessive deterioration is found.

Terminal Bushing—The surface of the bushing insulation should be smooth and well varnished. If the varnished surface is damaged or questionable, it should be smoothed off with fine sand paper and revarnished with three coats of good quality, clear, air-drying Spar varnish. Each coat should be allowed to dry for 24 hours.

Mechanical—Do not try to adjust the contacts by changing the toggle adjustment. The toggle of the breaker is set at the factory and should not be disturbed. The correct setting is ⅞-inch off center for the standard breaker. Refer to Fig. 10. Excessive overtravel of the contacts is prevented by the set screw stop in the top of the main casting. This stop should be set to secure $\frac{1}{16}$-inch clearance between the top of the pole unit main lever and the bottom of the set screw. This clearance can be approximated by screwing the set screw down until it touches the main lever, and then backing off one turn.

Maintenance

Points to be Observed in Maintenance—

1. Before making any adjustments, make sure that all lines are electrically dead.
2. Be sure the breaker frame is grounded.
3. Do not operate the breaker excessively with the operating mechanism when the tanks are removed.

4. Examine all contacts frequently especially after short-circuit. See that the contacts are properly aligned.
5. After making any adjustments, operate the apparatus carefully by hand to make sure that it operates smoothly and correctly.
6. Inspect the oil after severe faults. If it shows signs of moisture, carbonization or dirt, filter and retest it.
7. Remove all oil and thoroughly clean the tanks, tank liners, lift rods, terminal bushings, etc., at least once a year.
8. Occasionally inspect and tighten clamping nuts around bushings on top of breaker.
9. Any pitting of the contacts should be smoothed, or, if badly burned, the contacts should be replaced.
10. Keep the bearing surfaces of the mechanism and breaker units adequately oiled.
11. **Operating Mechanism**—For instructions covering the Type SA-3 solenoid mechanism, see Instruction Book 5567.

Insulating Oil

Dielectric tests of the oil should be made every three months, to show if it is reasonably good for circuit-breaker work. Samples should not be taken until the oil has remained undisturbed for at least four hours. In testing for indication of water, take the sample from the bottom of the tank. If for indication of carbon, and after a heavy short-circuit, take the sample from the surface of the oil.

The care of the insulating oil in circuit-breakers is of the utmost importance in their successful operation. Contamination by dirt, moisture, metallic particles, lint, etc., all reduce the dielectric strength, upon which the operation and current-interrupting ability largely depend. Consequently, the most careful attention should be given to keeping the oil clean, not only in filling the tanks originally but in later maintenance or other work on the breakers which might involve opening the tanks.

Only the highest grade, such as Wemco "C" or other approved oil, should be used in the breakers. The oil should be new or at least thoroughly reconditioned by means of a filter press or centrifuge. In any case, before using, it should be given a dielectric test which should show a minimum of 22,000 volts (preferably 25,000 to 30,000) measured between 1-inch diameter discs spaced .1 inch apart.

Before filling, the tanks should be thoroughly cleaned, and flushed out with insulating oil. The same treatment should be given the inside of the top of the breaker and the operating linkage and contact system. In doing this, rags which will leave lint should not be used as lint absorbs and holds moisture.

The same care should be used during inspection or maintenance work on the breaker, which should preferably be done only under favorable weather conditions. If the oil is to be reconditioned following operation of the breaker under short-circuit, the tank and entire inside of the breaker should be cleaned before the oil is returned to the tank. If the work merely involves lowering or removal of the tank, care should be taken to keep the tank covered until it is replaced so that dirt, dust, metallic particles, etc., cannot fall into the oil.

The above precautions may appear academic to those familiar with the maintenance and operation of oil circuit-breakers, but a little more than ordinary care in oil-handling will be well repaid in reliable and dependable operation for which the breaker is designed and built.

For instructions as to the care and testing of insulating oil, see Instruction Book 5336.

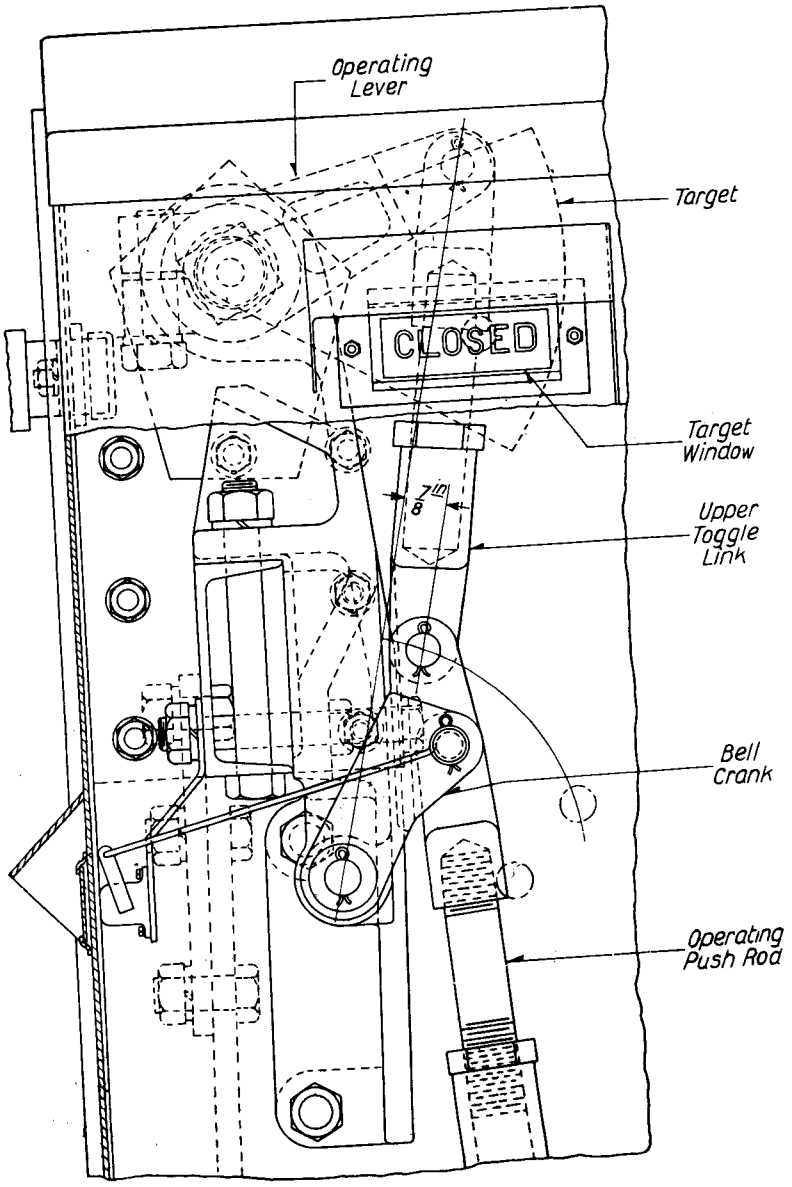


FIG. 10—TOGGLE MECHANISM

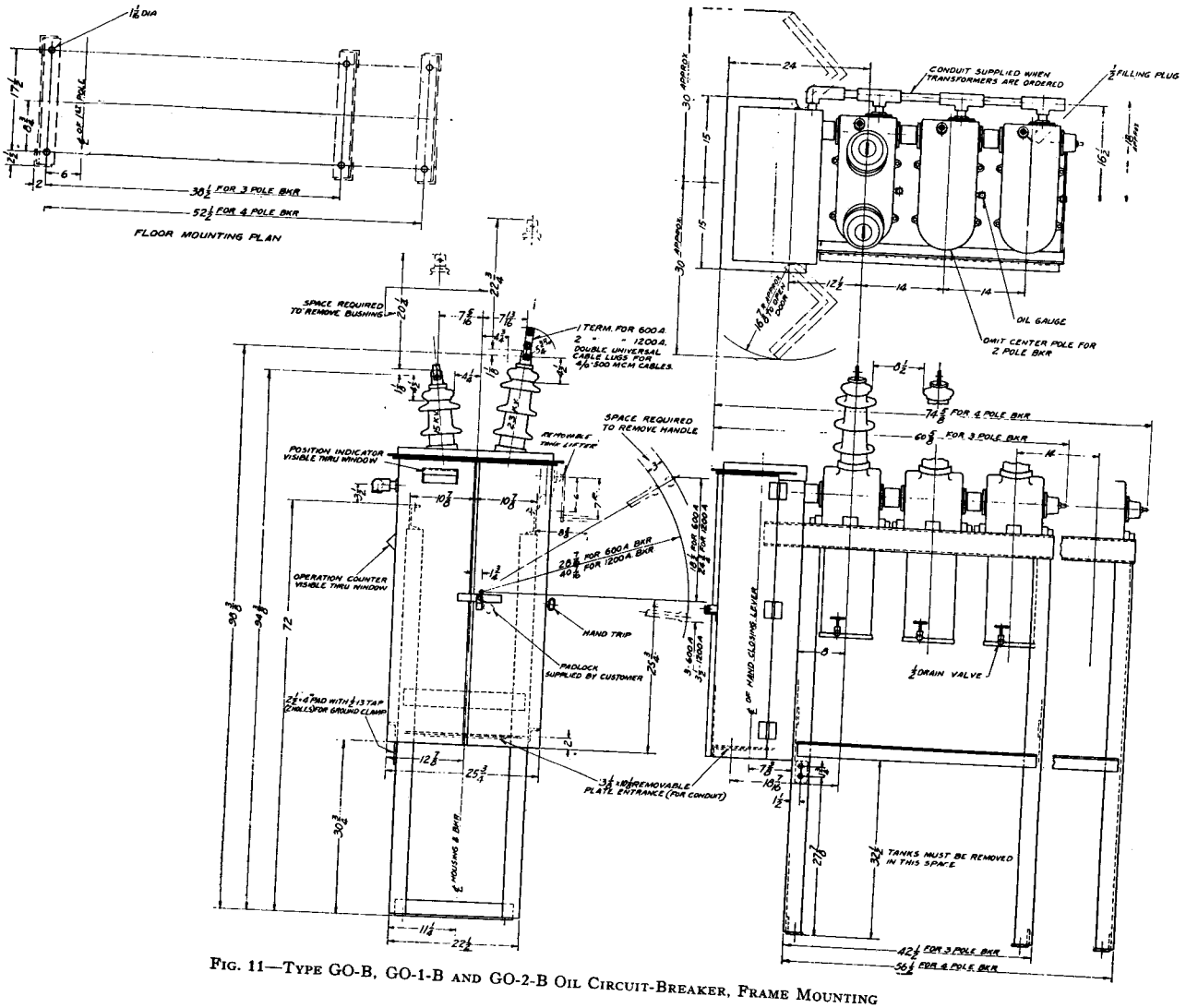


FIG. 11—TYPE GO-B, GO-1-B AND GO-2-B OIL CIRCUIT-BREAKER, FRAME MOUNTING

Type GO-B, GO-1-B and GO-2-B Breakers

DATA APPLYING TO 600–5 AND 1200–5 TRANSFORMERS
ACTUAL PRIMARY CURRENTS NECESSARY TO PRODUCE
5 AMPERES IN SECONDARY FOR ATTACHMENTS INDICATED
60 CYCLES

GO-B	15000 Volts	600 Amperes	50000 Kv-a.
GO-1-B	15000 Volts	600 Amperes	100000 Kv-a.
GO-2-B	15000 Volts	600 and 1200 Amps.	250000 Kv-a.
GO-1-B	23000 Volts	600 Amperes	250000 Kv-a.

Minimum Primary Tripping Currents for Bushing Type Current Transformers.

Ratio	TAPS				
	Without Relays Inst and I.T.L. Trip 5 Amps.	With Circuit Closing Relays and Shunt Trip 4 Amps. Tap	With Circuit Opening Relay and Inst. Trip 4 Amps. Tap	With Circuit Closing Relay and Direct Trip 5 Amps. Tap	With Circuit Closing Relay and Tripping Trans. 5 Amps. Tap
600/5 M. R.					
50/5 BC	90	49	82	70*	85*
100/5 AB	120	84	98	110*	115*
150/5 AC	165	122	135	175	185
200/5 DE	210	165	175	215	220
250/5 CD	260	202	215	265	270
300/5 BD	305	245	245	310	315
400/5 AD	407	324	330	410	415
450/5 CE	455	362	370	457	460
500/5 BE	505	405	420	508	510
600/5 AE	605	483	490	605	610
1200/5 M. R.					
100/5 BC	125	85	110	115*	120*
200/5 AB	220	185	175	220	225
300/5 AC	315	248	250	315	320
400/5 DE	415	326	335	415	420
500/5 CD	510	406	420	510	515
600/5 BD	610	486	495	610	615
700/5 AD	805	645	650	808	808
900/5 CE	905	723	730	905	905
1000/5 BE	1005	803	810	1005	1005
1200/5 AE	1205	963	965	1205	1205

Note—Minimum trip values based on one transformer per phase unless otherwise indicated.

* Two transformers in series.

ORDERING INSTRUCTIONS

When ordering Renewal Parts, always specify the name of the part wanted as shown on the illustrations in this Instruction Book, giving Shop Order Number and the type of Oil Circuit-Breaker, as shown on the name plate. For example:

One Moving or Stationary Contact Complete, 600 Amperes, for Type GO-B Oil Circuit-Breaker, S. O. 30-F-171, shown in Instruction Book 5816, Figure 2.

To avoid delays and misunderstandings, note carefully the following points:

1. Send all correspondence and orders to the nearest Sales Office of the Company.

2. State whether shipment is to be made by freight, express or parcel post. In the absence of instructions, goods will be shipped at our discretion. Parcel post shipments will be insured only on request. All shipments are at purchaser's risk.

3. Small orders should be combined so as to amount to a value of at least $1.00 net. Where the total of the sale is less than this, the material will be invoiced at $1.00.

RENEWAL PARTS DATA

Recommended Stock of Renewal Parts for TYPES GO-B, GO-1-B AND GO-2-B OIL CIRCUIT-BREAKERS

Outdoor Service

Manually or Solenoid Operated—Frame Mounting

600 or 1200 Amperes—15 or 23 KV.—3 Pole-Single Throw

FOR ILLUSTRATION OF PARTS SEE FIGURES 2, 3, 4, 5, 6 AND 9

The following is a list of the Renewal Parts and the quantities of each that we recommend should be stocked by the user of this apparatus to minimize interrupted operation caused by breakdowns. The parts recommended are those most subject to wear in normal operation or those subject to damage or breakage due to possible abnormal conditions. This list of Renewal Parts is given only as a guide. When continuous operation is a primary consideration, additional insurance against shut-downs is desirable. Under such conditions more renewal parts should be carried, the amount depending upon the severity of the service and the time required to secure replacement.

TYPE GO-B OIL CIRCUIT BREAKER

Breakers in use up to and including		1	5
Name of Part	**No. Per 3-Pole Breaker**	**Recommended For Stock**	
Breaker Complete	1	0	0
Breaker Pole Unit Complete	3	0	0
Bumper Spring	3	0	1
Moving Contact Complete	3	0	0
Lift Rod	3	0	1
Main Moving Contact	3	0	1
*Main Moving Contact Spring	3	0	1
Moving Arcing Contact Breaker	3	0	0
Moving Arcing Contact	6	6	12
Moving Arcing Contact Spring	6	2	6
Stationary Contact Complete	6	0	0
Condenser Bushing	6	0	2
Main Stationary Contact	6	0	2
Stationary Arcing Contact	6	6	12
Stationary Arc Shield	6	0	2
Oil Tank Complete	3	0	0
Oil Tank	3	0	1
*Oil Gauge Glass	3	0	1
Tank Liner	3	0	1
*Type SA-3 Solenoid Operated Mechanism	1	0	0
*†Closing Coil	1	0	1
*†Trip Coil	1	0	1
*†Rectox Rectifier	1	0	0

* Not illustrated.
† When ordering, specify identification number stamped on part.
Parts indented are included in the part under which they are indented.

TYPE GO-1-B AND GO-2-B OIL CIRCUIT BREARERS

Breakers in use up to and including		1	5
Name of Part	**No. Per Breaker**	**Recommended For Stock**	
Breaker Complete	1	0	0
Breaker Pole Unit Complete	3	0	0
Bumper Spring	3	0	1
Moving Contact Complete	3	0	0
Lift Rod	3	0	1
Moving Contact	3	0	1
Stationary Contact Complete	6	0	0
Condenser Bushing	6	0	2
Stationary Contact	6	0	0
De-ion Grid Stack	6	0	0
Stationary Contact Finger	12	12	24
Stationary Contact Finger Spring	12	4	12
Stationary Arcing Horn	6	6	12
Oil Tank Complete	3	0	0
Oil Tank	3	0	0
*Oil Gauge Glass	3	0	1
Tank Liner	3	0	1
*Type SA-3 Solenoid Operated Mechanism	1	0	0
*†Closing Coil	1	0	1
*†Trip Coil	1	0	1
*†Rectox Rectifier	1	0	0
Current Transformer 600/5	1	0	1
Current Transformer 1200/5	1	0	1
	.	.	.
	.	.	.

* Not listed on illustration.
† When ordering, specify identification number stamped on part.
Parts indented are included in the part under which they are indented.

Ordering Instructions on Page 9

MEMORANDUM

5816

Westinghouse

Type GO-A Oil Circuit-Breaker

15,000 Volts — 600 Amperes

2, 3 or 4 Poles

INSTRUCTION BOOK

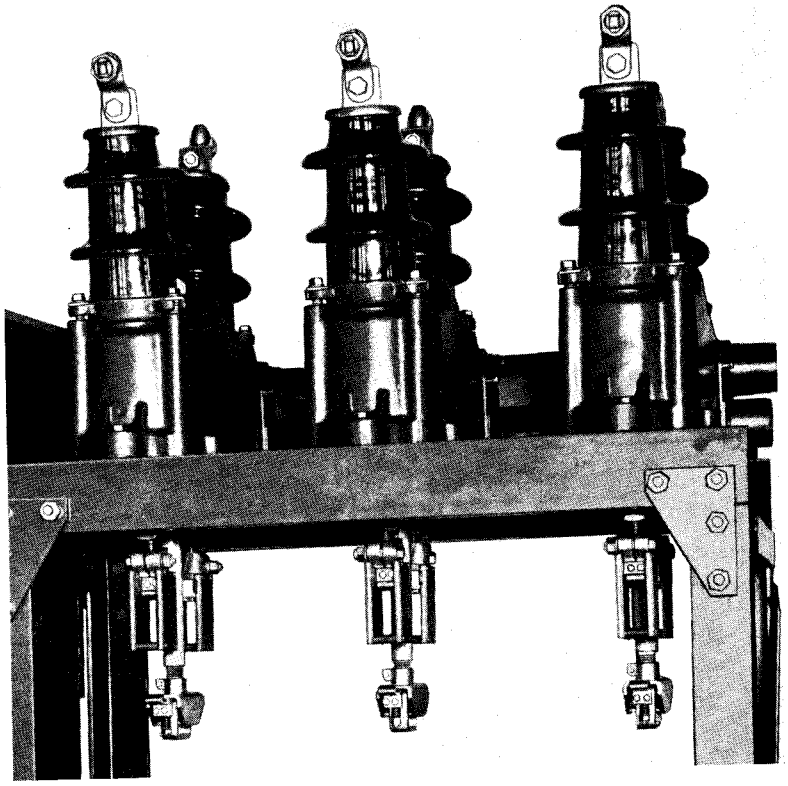


FIG. 1—TYPE GO-A OIL CIRCUIT-BREAKER, 600 AMPERES, 15000 VOLTS, WITH TANKS REMOVED, SHOWING "DE-ION" INTERRUPTORS

Westinghouse Electric & Manufacturing Company

East Pittsburgh Works — **East Pittsburgh, Pa.**

I. B. 5770

(Filing No. 33-000)

Printed in U.S.A. (2-37)

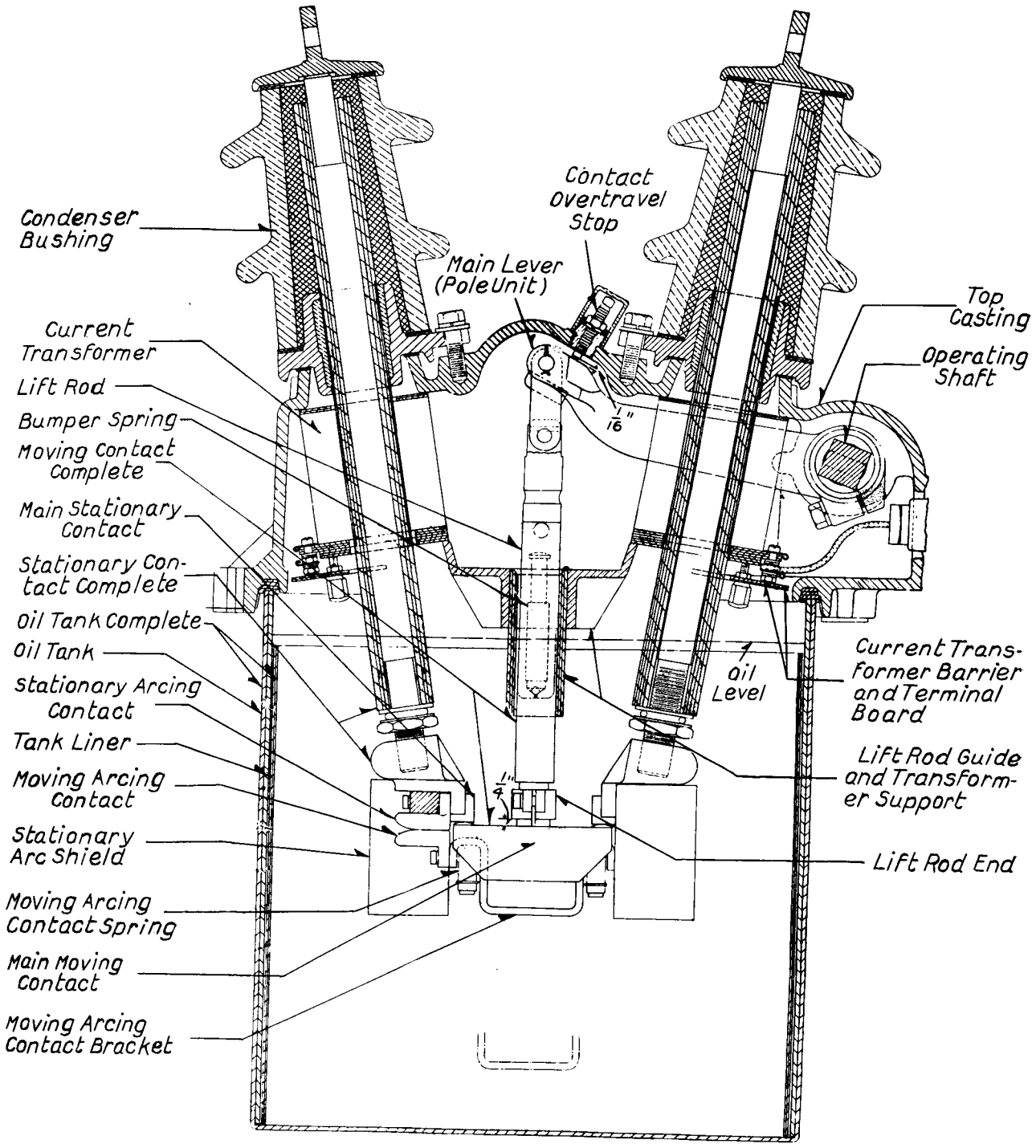


FIG 2—TYPE GO-A POLE UNIT (CROSS SECTION)

Westinghouse

Type GO-A Oil Circuit-Breaker

15,000 Volts—600 Amperes

2, 3 or 4-Poles

Manually or Electrically Operated

General Description

The Type GO-A Oil Circuit-Breaker is a 2-, 3- or 4-pole, single throw breaker of non-oil throwing design for outdoor service.

The breaker is frame-mounted with manual or solenoid operation, or pole-mounted with manual operation.

Electrical operation is by solenoid when direct-current is available, or by solenoid and Rectox when alternating-current is available.

The breaker is equipped with "Deion Interruptors" which assure speedy and positive arc interruption with a minimum of disturbance.

Shipment

The breaker will be shipped completely assembled, with all attachments and auxiliaries mounted in place. Do not remove the crating until the breaker reaches its permanent location.

Installation

1. Remove the crating and frame skids.
2. Mount the breaker on its foundation. The four foundation bolts should be left loose until the frame is properly leveled by inserting shims under the feet. The breaker must be perfectly level.

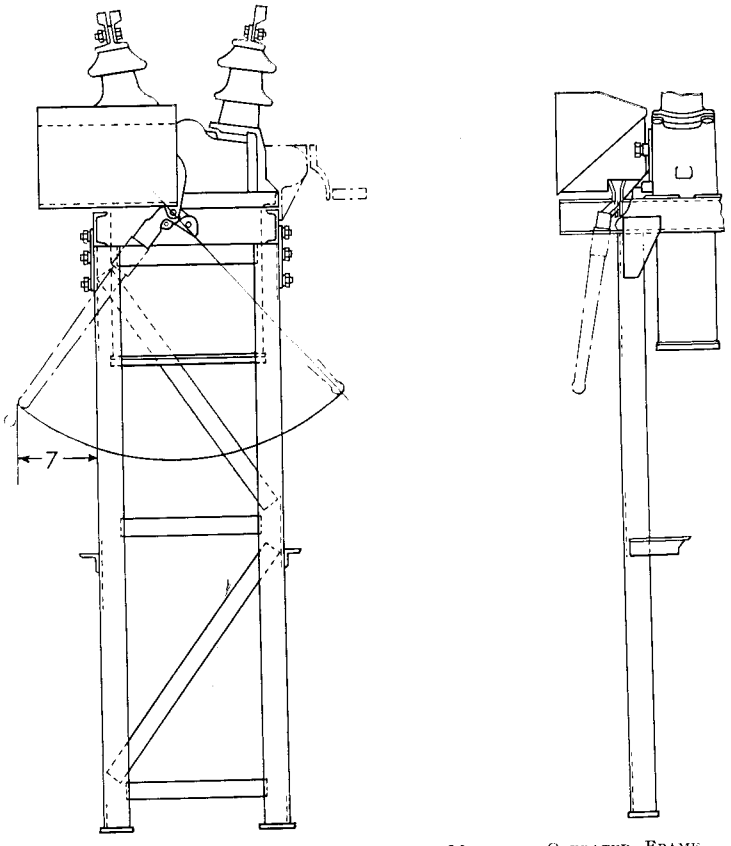


FIG. 3—TYPE GO-A OIL CIRCUIT-BREAKER, MANUALLY OPERATED, FRAME MOUNTING, 15,000 VOLTS

3. Remove the tie wire from the mechanism trigger and allow the breaker to open slowly.
4. Remove the tanks and examine the inside for evidence of moisture or foreign matter. Flush with benzine. Tanks should not be lowered in wet weather without provision for keeping moisture out of them. The internal parts of the breaker should be protected as well.
5. Examine the contacts and note that they are clean and in alignment. For adjustments, see section covering adjustments.
6. Operate the breaker by hand several times, watching each pole and the operating mechanism to be sure that all parts move freely.
7. Install connections to the breaker studs. All contact surfaces should be clean and should be free from burrs. The terminal studs are not designed to carry undue cable or bus bar loads. An excessive strain, which at first may have no apparent effect, will eventually loosen the porcelain weather casing and permit moisture to enter the breaker.
8. With the tanks removed, fill with oil in accordance with name plate instructions. When bolting in place, be sure the tank is drawn up evenly and tightly all around.
9. Connect the breaker frame to ground through one of the mounting bolts. The National Electric Code requires grounding cable to have one-fifth the main circuit capacity, except that it must never be smaller than No. 8 and need not be larger than No. 0, B and S gauge.
10. Remove the undrilled conduit entrance plate from the bottom of the mechanism housing (when supplied) and drill for the conduit entrance as desired. Unit and

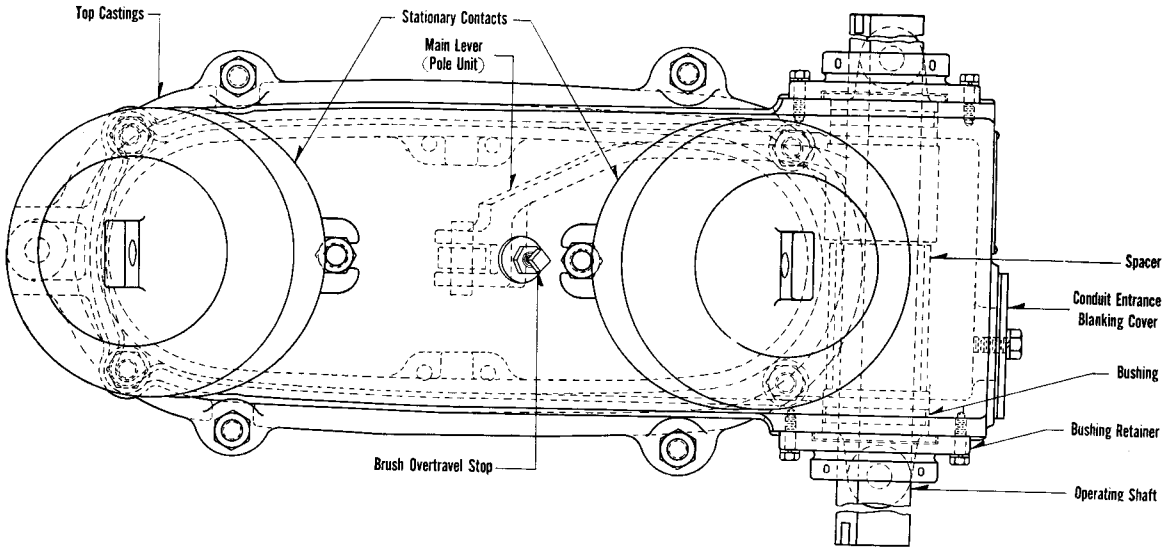


FIG. 4—TYPE GO-A POLE UNIT (TOP VIEW)

manual mechanisms have definitely located conduit entrances as shown on the outline drawing.

11. Connect the control and transformer circuits to the proper points on the terminal blocks as shown on the diagram supplied. When the breaker is located a considerable distance from the battery or transformer, allowance should be made for the voltage drop between the battery, or transformer, and the terminals of the operating coil to secure proper operation at minimum control voltage. The bushing type current transformer name plate should be used as an indication of the proper taps to use, although the proper taps will be determined by the loading. It is always necessary to determine the proper taps by test. The following tables indicate the primary current necessary to trip the breaker for several standard burdens. Always be sure the transformer secondary connections are completed before impressing primary current on the breaker.
12. Check the operation of the breaker by operating it electrically, if for electrical operation.

Adjustments

Contacts—The contact arrangement is shown in Fig. 2. The main and arcing contacts are both of the butt type, the ¼-inch lead of the arcing contacts being maintained by the thickness of the copper on the arcing tips. The contact pressure on the main contacts is obtained by a compression spring. With the breaker closed the top of the main moving contact should be ¼-inch below the shoulder on the lift rod end. If necessary to adjust, loosen the lift rod end and screw the assembly up or down as necessary.

It is important that the ¼-inch dimension be maintained as this determines the main contact pressure. Vertical and rotational adjustment of the stationary arc shields is secured by loosening the clamping bolts of the stationary contact foot and rotating the foot into alignment. Before rotating the foot, it will probably be necessary to spread the foot by driving a wedge or screw driver into the saw cut. Never attempt to force the contact foot as the copper may "gall".

A limited amount of horizontal alignment of the stationary arc shield can be secured by adjusting the three clamp flange bolts on the top of the pole unit. This is done by loosening one or two bolts and tightening the remaining bolts. The bolts loosened should be checked for tightness after adjustment. The main contacts make silver to silver contact and it is therefore unnecessary to use an abrasive to keep them clean. The oxide of silver does not increase the contact drop. In fitting new contacts it is unnecessary to secure perfect line contact; with the comparatively soft material (silver) good contact is secured after a few operations, as the silver flows slightly under pressure.

If the silver contacts on the moving contacts are replaced, use solder of at least 300°C. melting point. **Use only "pure silver", coin silver is unsatisfactory.**

"De-ion Interruptors"—The "De-ion Interruptors" control the arc and quickly extinguish it by de-ionization. These devices need little attention other than an occasional inspection. They must be kept securely tightened and properly aligned so that the moving contacts move freely and do not rub causing excessive friction. The fibre insulation is affected very little by the arc action but should be inspected occasionally and replaced if excessive deterioration is found.

Terminal Bushings—The surface of the bushing insulation should be smooth and well varnished. If the varnished surface is damaged it should be smoothed off with fine sandpaper and re-varnished with three coats of good quality, clear, air-drying spar varnish. Each coat should be allowed to dry for 24 hours.

Mechanical—Do not try to adjust the contacts by changing the toggle adjustment. The toggle of the breaker is set at the factory and should not be disturbed. The correct setting is ⅛-inch off center for the standard electrically operated breaker. Refer to Fig. 7. Excessive overtravel of the contacts is prevented by the set screw

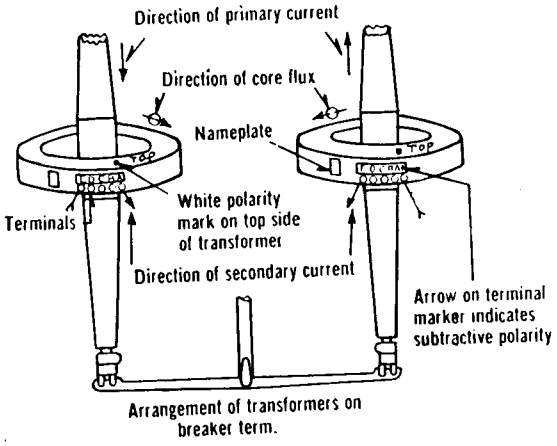
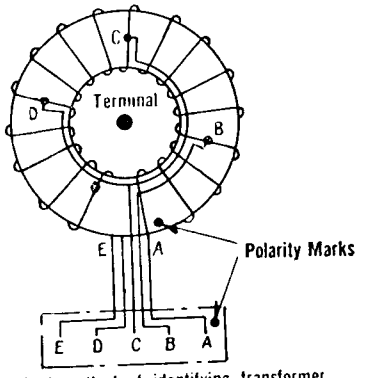


FIG. A



Standard method of identifying transformer leads, with any combination of taps, the tap nearest A has the same relative polarity as terminal A.

FIG. B

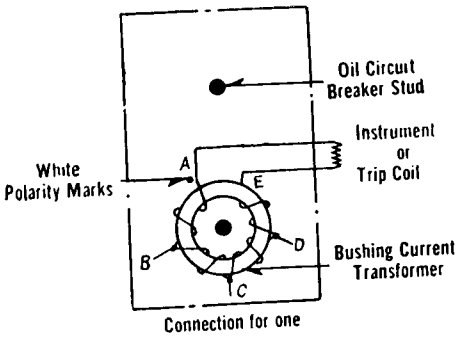


FIG. C

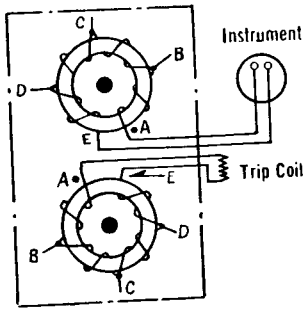


FIG. D

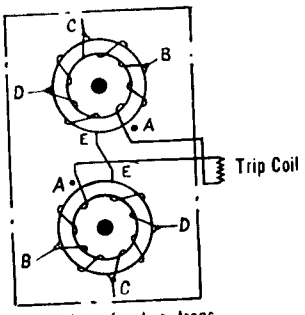


FIG. E

FIG. 5—TYPICAL BUSHING TYPE CURRENT TRANSFORMER CONNECTIONS

Type GO-A 600-Ampere 15,000-Volt Breaker

DATA APPLYING TO 400/5 AND 600/5 TRANSFORMERS. ACTUAL PRIMARY CURRENTS NECESSARY TO PRODUCE 5 AMPERES IN SECONDARY FOR ATTACHMENTS INDICATED 60 CYCLES

400/5 Transformers

Nominal Ratio	Turn Ratio	Tap	INSTANTANEOUS OR INVERSE TIME LIMIT TRIP Hand Operated L*	Hand Operated R*	Solenoid Operated L*	Solenoid Operated R*	DIRECT TRIP Hand Operated L*	Hand Operated R*	Solenoid Operated L*	Solenoid Operated R*	CO RELAY †Standard L*	†Standard R*	†Low Energy L*	†Low Energy R*
30	6	AB	O.L.	O.L.	O.L.	O.L.	O.L.	O.L.	O.L.	O.L.	O.L.	O.L.	50	40
50	10	BC	O.L.	O.L.	O.L.	O.L.	O.L.	O.L.	O.L.	O.L.	O.L.	60	55	50
80	16	AC	O.L.	O.L.	O.L.	130	O.L.	O.L.	O.L.	O.L.	80	75	70	65
125	25	CD	O.L.	180	O.L.	140	O.L.	O.L.	O.L.	190	110	105	105	100
175	35	BD	240	230	200	190	O.L.	O.L.	210	195	155	150	145	140
205	41	AD	255	245	230	220	O.L.	O.L.	230	220	170	165	170	165
300	60	CE	335	325	325	315	O.L.	335	320	310	250	245	245	240
350	70	BE	375	365	370	360	O.L.	370	365	360	285	280	280	275
380	76	AE	400	395	395	390	410	395	395	390	310	305	305	300

600/5 Transformers

50	10	BC	O.L.	O.L.	O.L.	O.L.	O.L.	O.L.	O.L.	O.L.	O.L.	80	75	50
100	20	AB	O.L.	O.L.	O.L.	O.L.	O.L.	O.L.	O.L.	O.L.	140	90	90	85
150	30	AC	O.L.	O.L.	O.L.	165	O.L.	O.L.	O.L.	205	135	130	125	120
200	40	DE	O.L.	250	O.L.	215	O.L.	O.L.	O.L.	215	170	170	165	165
250	50	CD	295	280	285	260	O.L.	O.L.	280	255	210	210	205	200
300	60	BD	340	330	330	315	O.L.	O.L.	315	295	250	250	245	240
400	80	AD	435	425	425	415	O.L.	460	390	375	330	330	325	325
450	90	CE	480	475	475	470	510	485	425	415	365	365	360	360
500	100	BE	525	520	525	520	530	525	480	470	410	410	405	405
600	120	AE	620	620	615	610	625	625	580	570	485	485	480	480

*L = Left hand transformer.
*R = Right hand transformer.
O.L. = Transformer overloaded—Do not use.
† Relay set on 4-ampere tap.

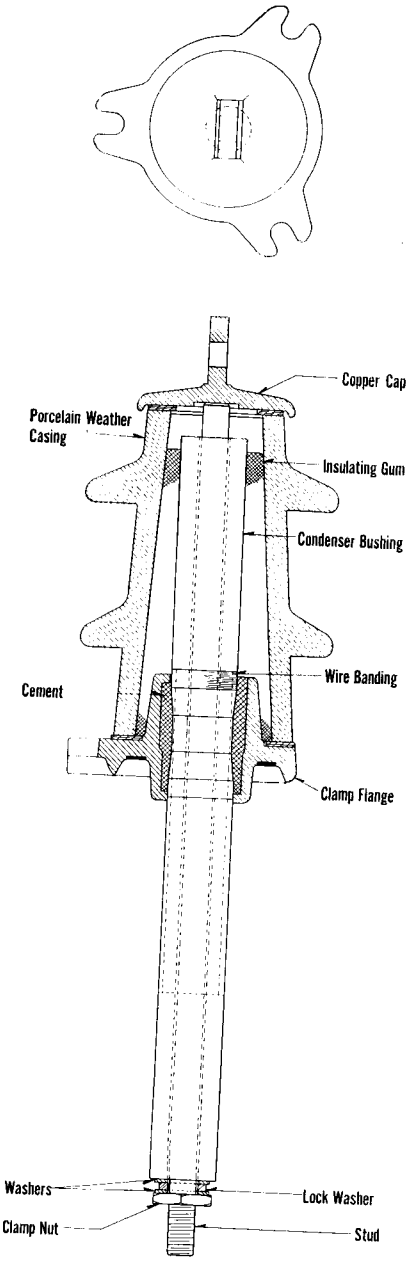


FIG. 6—GO-A STATIONARY CONTACT, 600 AMPERES, 15,000 VOLTS.

stop in the top of the main casting This stop should be set to secure $\frac{1}{16}$ inch clearance between the top of the pole unit main lever and the bottom of the set screw. This clearance can be approximated by screwing the set screw down until it touches the main lever, and then backed off one turn.

Manual Mechanism

Refer Fig. 8.

The manual mechanism adjusting link has four holes with unequal spacing so that four adjustment steps are possible. Increasing or decreasing the length of this link increases or decreases the travel of the breaker. It is necessary to make sure, however, that the trigger on the trigger lever engages with the roller on the roller lever, and that the roller lever does not hit the side of the mechanism housing.

The tripping bar set screw should be so adjusted that the moving core, of the overload attachment, is within $\frac{1}{32}$ inch of the stationary core at the time the breaker trips. This is necessary insofar as the attachment develops its greatest power just before the cores come together.

If it is found necessary to adjust this set screw, it will also be found necessary to adjust the lock nuts on the upper end of the tripping link to agree. They should be so adjusted that all play is removed from the linkage.

The tripping link should further be adjusted so that the small lever of the trigger toggle rests firmly against the trigger toggle stop.

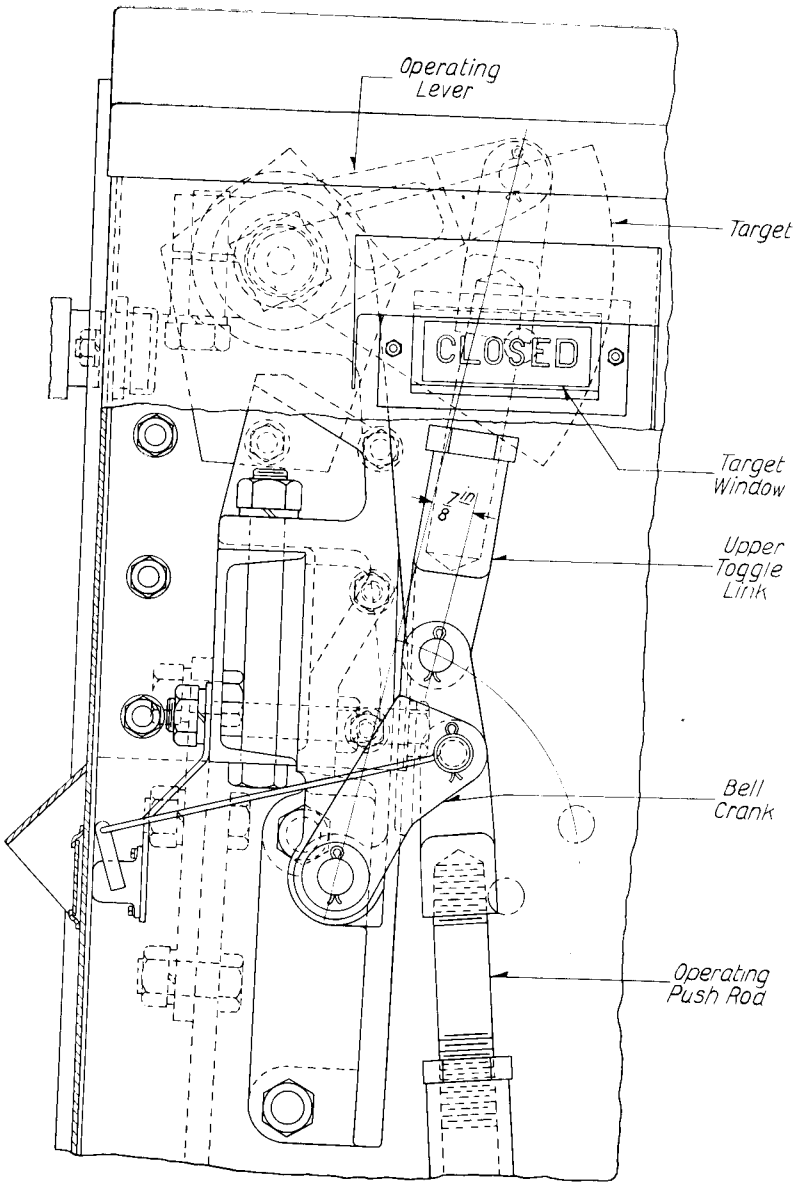


FIG. 7 – TOGGLE MECHANISM

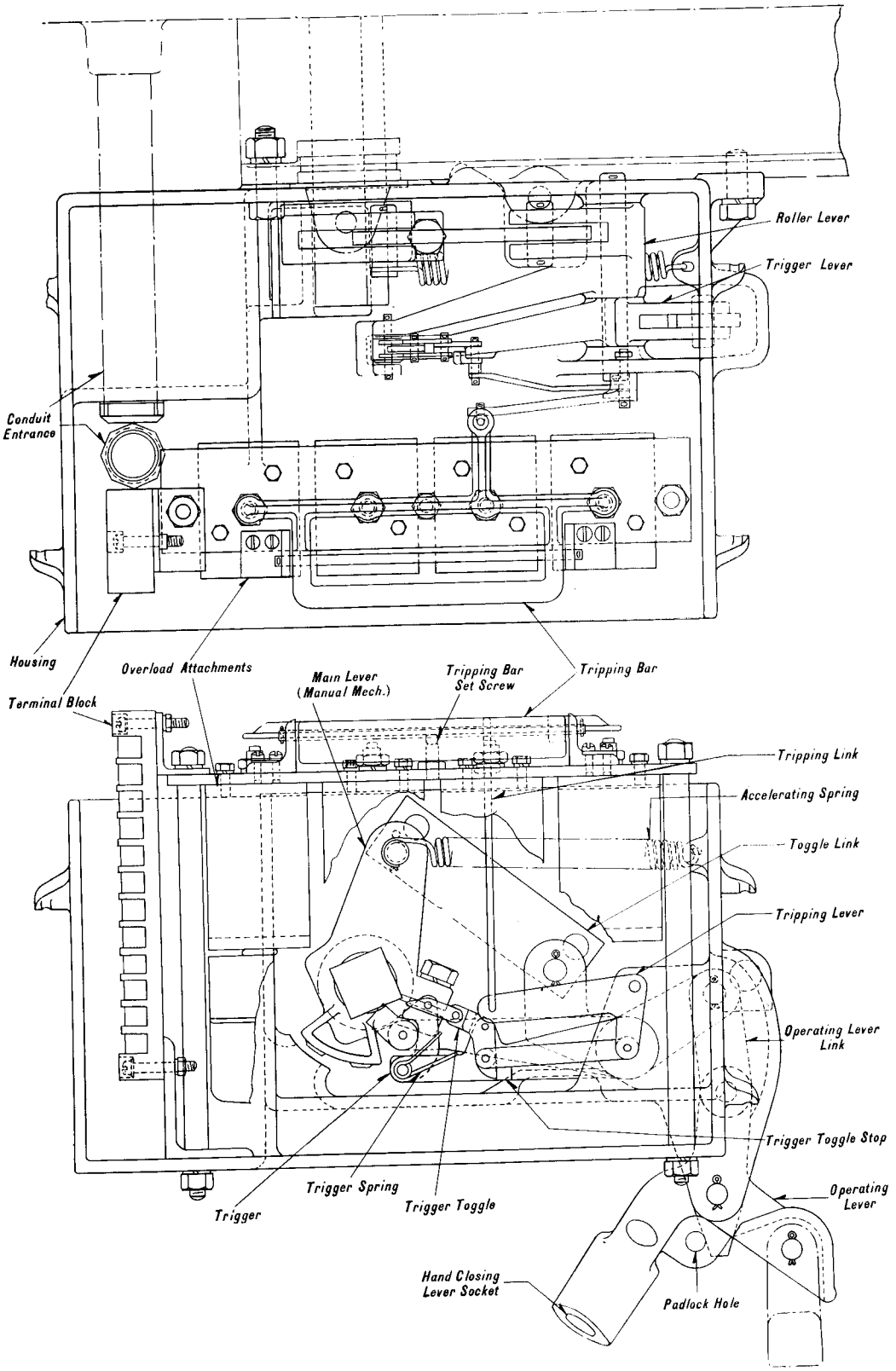


FIG. 8 MANUAL MECHANISM

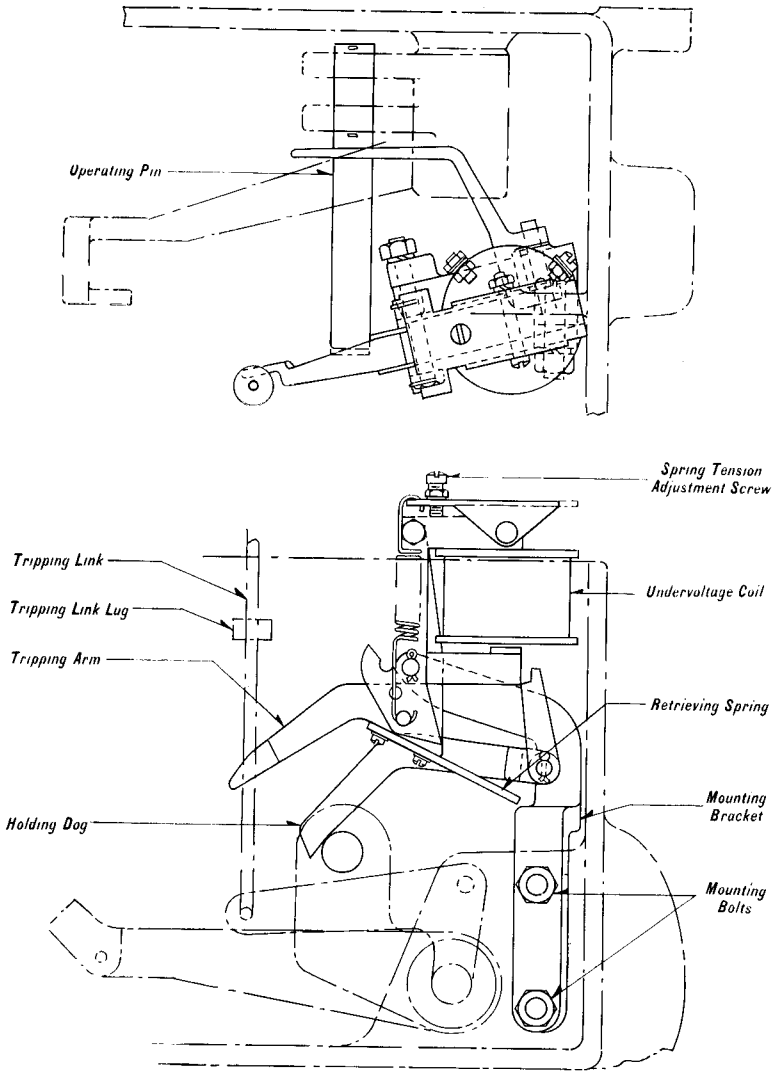


FIG. 9—UNDERVOLTAGE RELEASE ATTACHMENT FOR MANUAL MECHANISM

Undervoltage Release Attachment for Manual Mechanism

Refer to Fig. 9.

The attachment is mounted in place by means of the two mounting bolts indicated. Operation is secured by means of the special operating pin included as part of the attachment style number. The standard pin should be removed from the roller lever casting and the special operating pin substituted at the point indicated. Be sure that the set-up is rigid and agrees with the illustration.

Connect leads from the external circuit through the terminal block to the terminals on the undervoltage coil. The undervoltage coil should be connected directly across-the-line, but should be protected by fuses. The undervoltage coils should be connected to the line side of the breaker. Check the control voltage stamped on the name plate to make sure that it agrees with that on which the attachment is to be used.

Do not run the coil circuit through an auxiliary switch as this will result in "pumping".

Make sure that the tripping arm strikes the tripping link lug with sufficient force to trip the breaker as soon as the holding dog releases the armature.

Make sure that the retrieving spring retrieves the armature to within $\frac{1}{16}$-inch of the stationary core with the breaker in the open position. The low voltage coil is not a pickup coil and consequently is not capable of picking up the low voltage release armature when the distance exceeds this amount. If normal voltage is applied after this dimension is exceeded, the coil will burn out.

If noise develops, the faces of the armature and stationary core should be examined to see that a good clean seat is obtained when they are together. If necessary to clean these faces, be sure to leave them bearing over their entire area.

The attachment should be inspected periodically to make sure that all parts are rigidly assembled and functioning properly.

Auxiliary Switches for Manual Mechanism

Refer Fig. 10.

Mount the auxiliary switch in accordance with the illustration. Drill two $\frac{5}{16}$-inch holes in the bottom of the housing in accordance with the dimensions given (the drilling is the same for either one or two switches) and clamp the switches securely in place.

Insert the special operating pin supplied. Insert and adjust the adjustable opening links so that the switches make contact by the same amount in both the open and closed positions. Be sure that all electrical connections are tight.

Maintenance

Points to be observed in maintenance—

1. Before making any adjustments, make sure that all lines are electrically dead.
2. Be sure the breaker frame is grounded.
3. Do not operate the breaker excessively by the operating mechanism when the oil tanks are removed.
4. Examine all contacts frequently, especially after short-circuit. See that the contacts are properly aligned.
5. After making any adjustments, operate the apparatus carefully by hand to make sure that it operates smoothly and correctly.
6. Inspect the oil after severe short-circuits. If it shows signs of moisture, carbonization, or dirt, filter and retest it. Dielectric tests of the oil should be made every three months, to show if it is reasonably good for circuit-

breaker work. Samples should not be taken until the oil has remained undisturbed for at least four hours. In testing for indication of water, take the sample from the bottom of the tank. If for indication of carbon, and after a heavy short-circuit, take the sample from the surface of the oil.

7. Remove all oil and thoroughly clean the tanks, tank liners, lift rods, terminal bushings, etc., at least once a year.
8. Occasionally inspect and tighten clamping nuts around bushings on top of breaker.
9. Any pitting of the contacts should be cleaned off, or, if badly burned, they should be replaced.
10. Keep the bearing surfaces of the mechanism and breaker units adequately oiled.
11. Operating Mechanism—For instructions covering the SA-3 solenoid mechanism, see Instruction Book 5567. For Rectox Unit, refer to Instruction Leaflet 1782.

Care of Circuit-Breaker Oil

The care of the insulating oil in circuit-breakers is of the utmost importance in their successful operation. Contamination by dirt, moisture, metallic particles, lint, etc., all reduce the dielectric strength, upon which the operation and current interrupting ability largely depend. Consequently, the most careful attention should be given to keeping the oil clean, not only in filling the tanks originally, but in later maintenance or other work on the breakers which might involve opening the tanks.

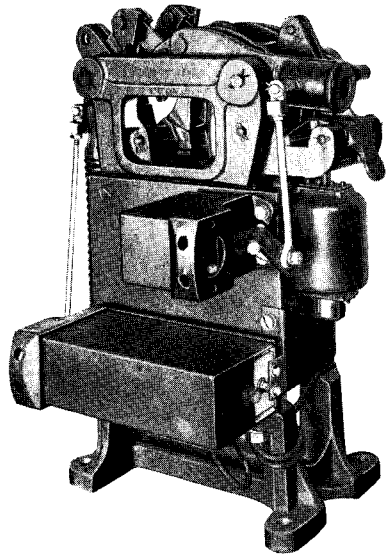


FIG. 11—TYPE SA-3 MECHANICALLY TRIP FREE SOLENOID

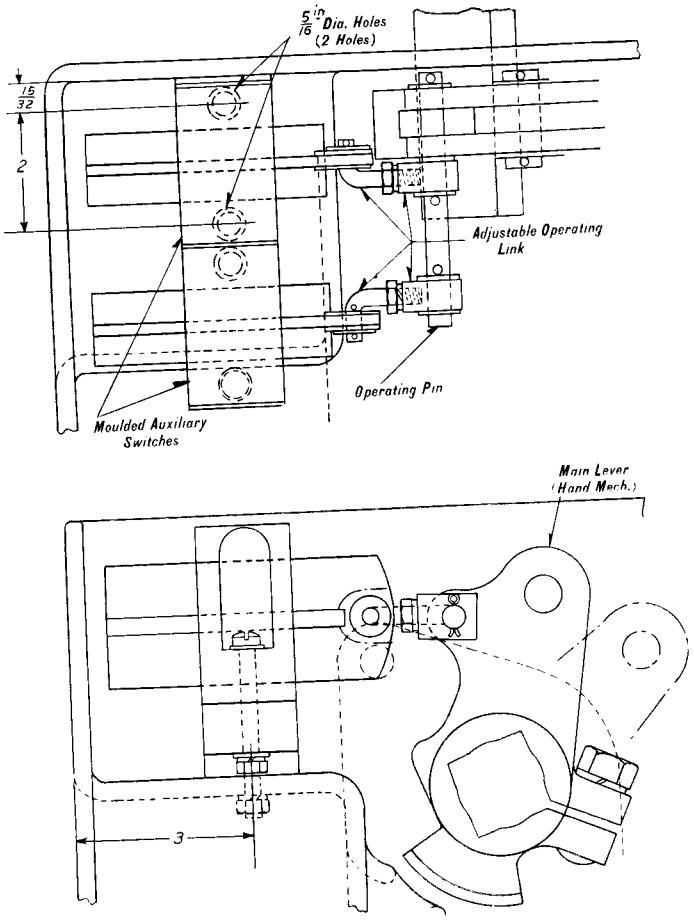


FIG. 10—AUXILIARY SWITCH FOR MANUAL MECHANISM

Only the highest grade, such as Wemco "C" or other approved oil should be used in the breakers. The oil should be new or at least thoroughly reconditioned by means of a filter press or centrifuge. In any case, before using, it should be given a dielectric test which should show a minimum of 22,000 volts (preferably 25,000 to 30,000) measured between 1-inch diameter discs spaced .1 inch apart.

Before filling, the tanks should be thoroughly cleaned and flushed out with insulating oil. The same treatment should be given the inside of the top of the breaker and the operating linkage and contact system. In doing this, rags which will leave lint should not be used as this absorbs and holds moisture.

The same care should be used during inspection or maintenance work on the breaker, which should preferably be done only under favorable weather conditions. If the oil is to be reconditioned following operation of the breaker under short-circuit, the tank, and entire inside of the breaker should be cleaned before the oil is returned to the tank. If the work merely involves lowering or removal of the tank, care should be taken to keep the tank covered until it is replaced so that dirt, dust, metallic particles, etc., cannot fall into the oil.

The above precautions may appear academic to those familiar with the maintenance and operation of oil circuit-breakers, but a little more than ordinary care in oil-handling will be well repaid in reliable and dependable operation for which the breaker is designed and built.

For instructions as to the care and testing of insulating oil, see Instruction Book 5336.

RENEWAL PARTS DATA

Recommended Stock of Renewal Parts for

TYPE GO-A OIL CIRCUIT-BREAKER

Outdoor Service

Manually or Solenoid Operated—Frame Mounting

600 Amperes; 15,000 Volts; 2, 3 or 4 Pole; Single Throw

FOR ILLUSTRATION OF PARTS SEE FIGURE 2

The following is a list of the Renewal Parts and the quantities of each that we recommend should be stocked by the use of this apparatus to minimize interrupted operation caused by breakdowns. The parts recommended are those most subject to wear in normal operation or those subject to damage or breakage due to possible abnormal conditions. This list of Renewal Parts is given only as a guide. When continuous operation is a primary consideration, additional insurance against shut-downs is desirable. Under such conditions more renewal parts should be carried, the amount depending upon the severity of the service and of the time required to secure replacement.

Breakers in use up to and including		1	5	
Name of Part	No. Per 3-Pole Breaker	Recommended For Stock		Style No. of Part
Breaker Complete	1	0	0	... ...
Breaker Pole Unit Complete	3	0	0	... ...
Bumper Spring	3	0	1	1 014 241
Moving Contact Complete	3	0	0	... ...
Lift Rod	3	0	1	949 458
Main Moving Contact	3	0	1	998 181
*Main Moving Contact Spring	3	0	1	969 910
Moving Arcing Contact Bracket	3	0	0	997 975
Moving Arcing Contact	6	6	12	947 450
Moving Arcing Contact Spring	6	2	6	969 731
Stationary Contact Complete	6	0	0	... ...
Condenser Bushing	6	0	2	666 241
Main Stationary Contact	6	0	2	947 451
Stationary Arcing Contact	6	6	12	947 450
Stationary Arc Shield	6	0	2	947 454
Oil Tank Complete	3	0	0	... ...
Oil Tank	3	0	1	841 763
*Oil Gauge Glass	3	0	1	255 850
Tank Liner	3	0	1	665 738
*Type SA-3 Solenoid Operated Mechanism	1	0	0	See I.B.5567
*†Closing Coil	1	0	1	†
*†Trip Coil	1	0	1	†
*†Rectox Rectifier	1	0	0	See I.L. 1782

* Not illustrated.
† When ordering, specify identification number stamped on part.
Parts indented are included in the part under which they are indented.

ORDERING INSTRUCTIONS

When ordering Renewal Parts, always specify the name of the part wanted as shown on the illustrations in this Instruction Book, giving Shop Order Number and the type of Oil Circuit-Breaker, as shown on the name plate. For example:

One Moving or Stationary Contact Complete, 600 Amperes, for Type GO-A Oil Circuit-Breaker, S. O. 30-F-171, shown in Instruction Book 5770, Figure 2.

To avoid delays and misunderstandings, note carefully the following points:

1. Send all correspondence and orders to the nearest Sales Office of the Company.

2. State whether shipment is to be made by freight, express or parcel post. In the absence of instructions, goods will be shipped at our discretion. Parcel post shipments will be insured only on request. All shipments are at purchaser's risk.

3. Small orders should be combined so as to amount to a value of at least $1.00 net. Where the total of the sale is less than this, the material will be invoiced at $1.00.

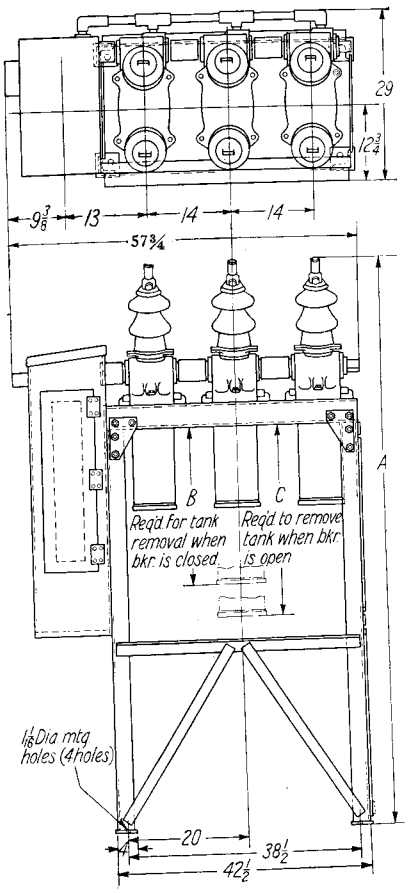


FIG. 12—TYPE GO-A OIL CIRCUIT-BREAKER, FRAME MOUNTING, 15,000 VOOTS

OUTLINE DIMENSIONS IN INCHES—3-POLE

Type	Amp.	Volts	Gallons Oil	Shipping Wt., Lb. Without Oil	Dimension A	Dimension B	Dimension C
GO-A	600	15000	22.5	1500	96	26½	32

MEMORANDUM

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY

Business Addresses

PARENT COMPANY

Headquarters, East Pittsburgh, Pa.

*AKRON, OHIO, 106 South Main St.
*ALBANY, N. Y., 360 Broadway
§ALEXANDRIA, VA., 121 Frazier Ave.
*ALLENTOWN, PA., 522 Maple St.
*APPLETON, WISC., #1 Bellaire Court
†APPLETON, WISC., 1029 So. Outagamie St.
*†#ATLANTA, GA., 426 Marietta St., N. W.
xATTICA, N. Y.
*BAKERSFIELD, CALIF., 2224 San Emedio St.
*BALTIMORE MD., 118 E. Lombard St.
†BALTIMORE, MD., 501 East Preston Road
§BALTIMORE, MD., 40 S. Calvert St.
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†#BOSTON, MASS., 12 Farnsworth St.
*†BRIDGEPORT, CONN., Bruce Ave. & Seymour St.
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†#BUFFALO, N. Y., 1132 Seneca St.
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*BURLINGTON, VER., 208 Park Ave.
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†#CHICAGO, ILL., 2211 W. Pershing Road
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*†x#CLEVELAND, OHIO, 1216 West Fifty-Eighth St.
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*COLUMBUS, OHIO, Gay & Third Sts.
*DALLAS, TEXAS, 209 Browder St.
#DALLAS, TEXAS, 1712 Carter St.
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*DAYTON, OHIO, 30 North Main St.
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#DENVER, COLORADO, 1700 Sixteenth St
†DENVER, COLORADO, 2644 Walnut St.
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*HAMMOND, IND., 235 167th St.
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x†HOMEWOOD WORKS, Pittsburgh, Pa., 543 N. Lang Ave.
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#HOUSTON, TEXAS, 2313 Commerce Ave.
†HOUSTON, TEXAS, 2315 Commerce Ave.
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†INDIANAPOLIS, IND., 551 West Merrill St.
*ISHPEMING, MICH., 433 High St.
*JACKSON, MICH., 212 West Michigan Ave.
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xLIMA, OHIO
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§LITTLE ROCK, ARK., % Fones Bros. Hdwe., 2nd & Rock Sts.
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*LOUISVILLE, KY., 322 West Broadway
*MADISON, WISC., 508 Edgewood Ave.
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†MILWAUKEE, WISC., 1669 N. Water St.
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*NASHVILLE, TENN., 219 N. Second Ave.
*NEWARK, N. J., 1180 Raymond Blvd.
†#NEWARK, N. J., Haynes Ave. & Lincoln Highway
xNEWARK, N. J., Plane & Orange St.
*NEW HAVEN, CONN., 42 Church St.
†*NEW ORLEANS, LA., 333 St. Charles St.
#NEW ORLEANS, LA., 527 Poydras St.
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†NEW YORK, N. Y., 460 West Thirty-Fourth St.
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#OKLAHOMA CITY, OKLA., Third & Alie Sts.
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§OMAHA, NEB., 117 N. 13th St.
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*PITTSBURGH, PA., 435 Seventh Ave.
①#xz†PITTSBURGH, PA., 543 N. Lang Ave.
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*PORTLAND, OREGON, 309 S. W. Sixth Ave.
†PORTLAND, OREGON, 2138 N. Interstate Ave.
#PORTLAND, OREGON, 720 N. Thompson St.
*†PROVIDENCE, R. I., 16 Elbow St
*RALEIGH, N. C., 803 North Person St.
§RALEIGH, N. C., 322 S. Harrington St
§READING, PA., 619 Spruce St.
*RICHMOND, VA., Fifth & Byrd
*§ROANOKE, VA., 726 First St., S. E.
*†ROCHESTER, N. Y., 410 Atlantic Ave.
*ROCKFORD, ILL., 130 South Second St.
*SACRAMENTO, CALIF., 20th and "R" Sts.
*SALT LAKE CITY, UTAH, 10 West First South St.
†#SALT LAKE CITY, UTAH, 346 A Pierpont Ave.
§SALT LAKE CITY, UTAH, 235 W. S. Temple
*SAN ANTONIO, TEXAS, 212 East Houston St.
*SAN FRANCISCO, CALIF., 1 Montgomery St.
*SEATTLE, WASH., 603 Stewart St.
†#SEATTLE, WASH., 3451 East Marginal Way
xSHARON, PA., 469 Sharpsville Ave.
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*SOUTH BEND, IND., 216 East Wayne St.
§SOUTH BEND, IND., 107 E. Jefferson St.
xSOUTH PHILA. WKS., Essington, Pa.
*SOUTH PHILA. WKS., P. O. Box 7348, Philadelphia, Pa.
*SPOKANE, WASH., So. 158 Monroe St.
*SPRINGFIELD, ILL., 130 So. Sixth St.
*†SPRINGFIELD, MASS., 395 Liberty St.
xSPRINGFIELD, MASS., 653 Page Boulevard
*ST. LOUIS, MO., 411 North Seventh St
†#ST. LOUIS, MO., 717 South Twelfth St.
xST. LOUIS, MO., 3850 Bingham Ave.
*SYRACUSE, N. Y., 420 N. Geddes St
*TACOMA, WASH., 1023 "A" St.
*TAMPA, FLA., 417 Ellamae Ave.
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*TULSA, OKLA., 303 East Brady St.
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*†WILKES-BARRE, PA., 267 N. Pennsylvania Ave.
*†WORCESTER, MASS., 32 Southbridge St.
*YORK, PA., 143 So. George St.
*YOUNGSTOWN, OHIO, 25 E. Boardman St.

*Sales Office †Service Office x Works # Warehouse °First Class Mail Only §Merchandising Only z Headquarters.

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AKRON, OHIO, The Moock Electric Sup. Co.
ALBANY, N. Y., 360 Broadway
ALLENTOWN, PA., 522 Maple St.
ATLANTA, GA., 96 Poplar St., N. W.
AUGUSTA, MAINE, 90 Water St.
BALTIMORE, MD., 40 South Calvert St.
BANGOR, MAINE, 175 Broad St.
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CHICAGO, ILL., 113 North May St.
CHICAGO, ILL., Hyland Electrical Sup. Co.
CINCINNATI, OHIO, The Johnson Electric Sup. Co.
CLEVELAND, OHIO, 3950 Prospect Ave.
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COLUMBUS, OHIO, Pixley Electric Sup. Co.
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FORT WORTH, TEXAS, 501 Jones St.
GRAND RAPIDS, MICH., 507 Monroe Ave., N. W.
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HOUSTON, TEXAS, 1903 Ruiz St.
HUNTINGTON, W. VA., Banks-Miller Sup. Co.
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KANSAS CITY, MO., Columbian Electrical Co.
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NASHVILLE, TENN., Tafel Electric Co.
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NEW HAVEN, CONN., 240 Cedar St.
NEW ORLEANS, LA., Electrical Sup. Co.
NEW YORK, N. Y., 150 Varick St.
NEW YORK, N. Y., Times Appliance Co., Inc.
NORFOLK, VA., 254 Tazewell St.
OAKLAND, CALIF., Tenth & Alice Sts.
OKLAHOMA CITY, OKLA., 10 E. California St.
OMAHA, NEB., 117 North Thirteenth St.
PEORIA, ILL., 104 East State St.
PHILADELPHIA, PA., 1101 Race St.
PHOENIX, ARIZONA, 315 West Jackson St.
PITTSBURGH, PA., Iron City Electric Co.
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PROVIDENCE, R. I., 66 Ship St.
RALEIGH, N. C., 322 S. Harrington St.
READING, PA., 619 Spruce St.
RICHMOND, VA., 301 South Fifth St.
ROANOKE, VA., 726 First St., S. E.
ROCHESTER, N. Y., 240 St. Paul St.
①ST. LOUIS, MO., 1011 Spruce St.
ST. PAUL, MINN., 145 East Fifth St.
SACRAMENTO, CALIF., 20th and "R" Sts
SALT LAKE CITY, UTAH, 235 West South Temple St.
SAN ANTONIO, TEXAS, 1201 E. Houston St.
SAN DIEGO, CALIF., The Electric Supplies Dist. Co.
SAN FRANCISCO, CALIF., 260 Fifth St.
SCRANTON, PA., Penna. Elect'l Engineering Co.
SEATTLE, WASH., 558 First Ave., South
SIOUX CITY, IOWA, 1005 Dace St.
SPOKANE, WASH., 152 So. Monroe St.
SPRINGFIELD, MASS., 46 Hampden St.
SYRACUSE, N. Y., 961 W. Genesee St.
TAMPA, FLA., 417 Ellamae St.
TOLEDO, OHIO, 812 Lafayette St.
TRENTON, N. J., 245 N. Broad St.
TULSA, OKLA., 303 East Brady St
UTICA, N. Y., 113 N. Genesee St.
WASHINGTON, D. C., 1216 "K" St., N. W
WATERLOO, IOWA, 328 Jefferson St.
①WICHITA, KANSAS, 233 So. St. Francis Ave.
WILMINGTON, DEL., 216 E. Second St.
WORCESTER, MASS., 24 Southbridge St.
YORK, PA., 143 S. George St.
YOUNGSTOWN, OHIO, Moock Elec. Sup. Co

①Changed or added since previous issue.

5-770

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WESTINGHOUSE ELECTRIC & MFG. CO.
1132 SENECA ST.,
BUFFALO, N. Y.

Westinghouse

Type GO-A Oil Circuit-Breaker

15,000 Volts — 600 Amperes

2, 3 or 4 Poles

INSTRUCTION BOOK

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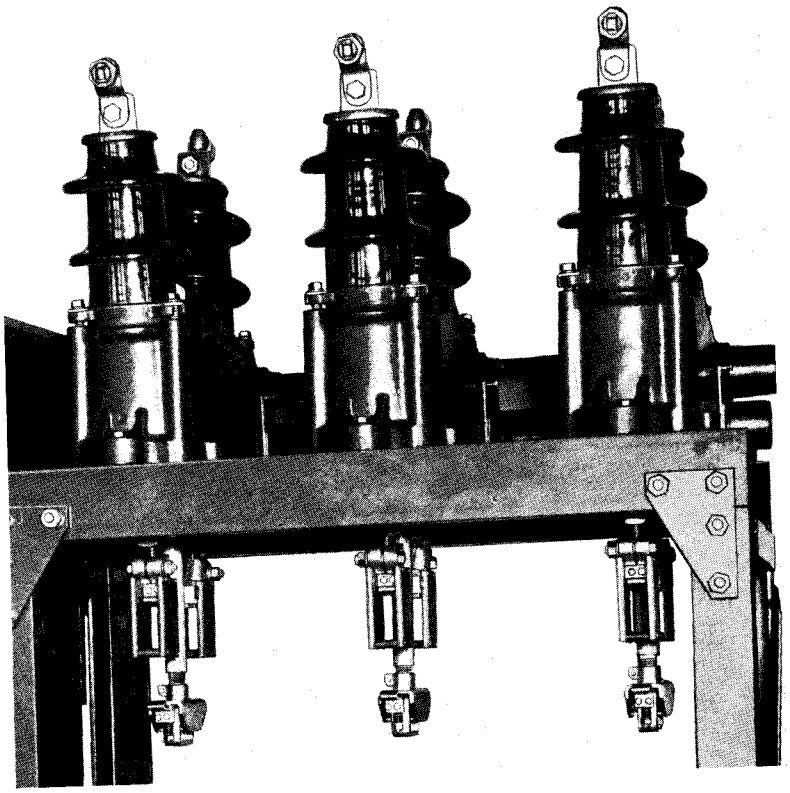


FIG. 1—TYPE GO-A OIL CIRCUIT-BREAKER, 600 AMPERES, 15000 VOLTS, WITH TANKS REMOVED, SHOWING "DE-ION" INTERRUPTORS

Westinghouse Electric & Manufacturing Company

East Pittsburgh Works — **East Pittsburgh, Pa.**

I. B. 5770

(Filing No. 33-000)

Printed in U.S.A. (2-37)

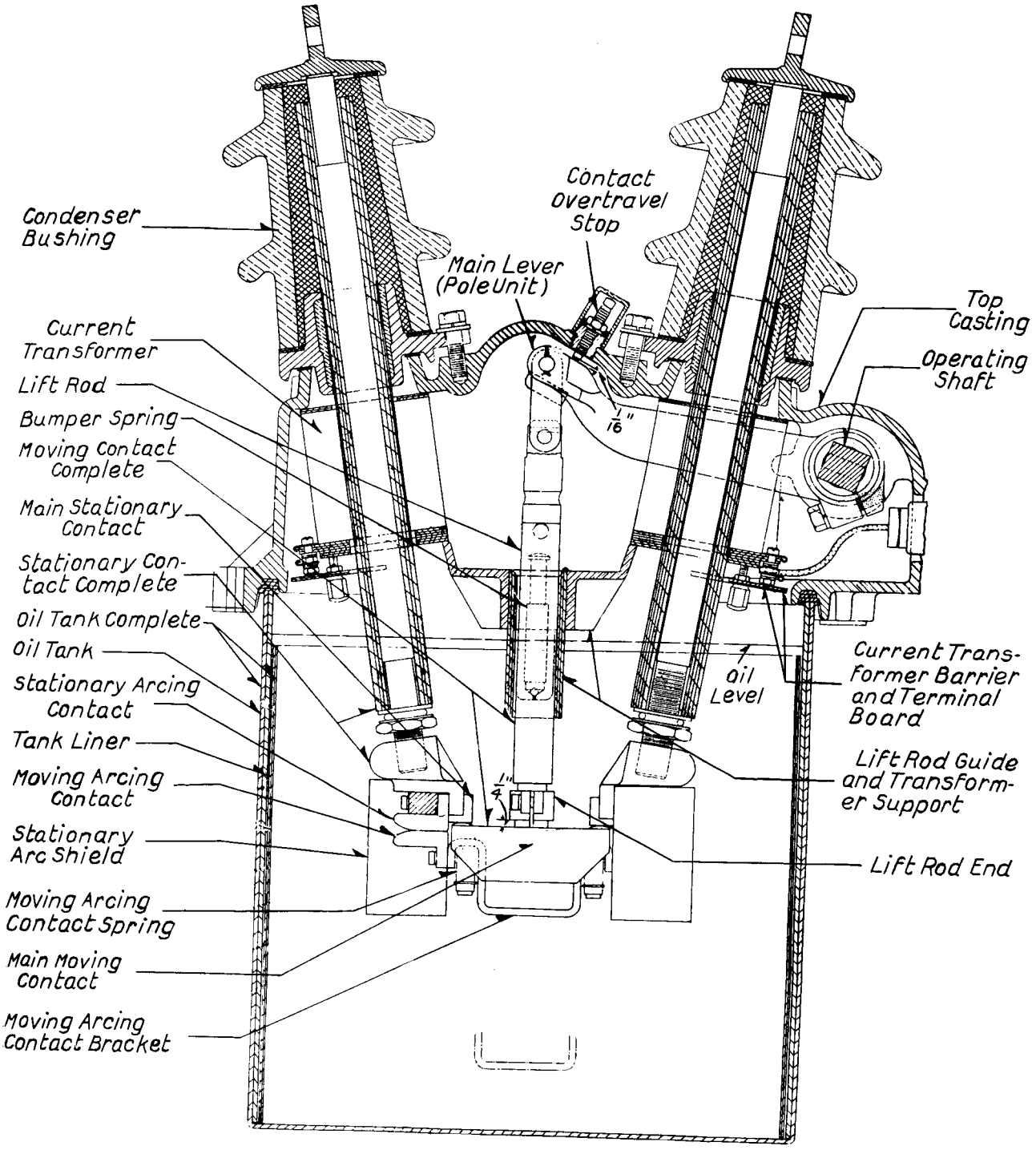


FIG 2—TYPE GO-A POLE UNIT (CROSS SECTION)

Westinghouse

Type GO-A Oil Circuit-Breaker

15,000 Volts—600 Amperes

2, 3 or 4-Poles

Manually or Electrically Operated

General Description

The Type GO-A Oil Circuit-Breaker is a 2-, 3- or 4-pole, single throw breaker of non-oil throwing design for outdoor service.

The breaker is frame-mounted with manual or solenoid operation, or pole-mounted with manual operation.

Electrical operation is by solenoid when direct-current is available, or by solenoid and Rectox when alternating-current is available.

The breaker is equipped with "Deion Interruptors" which assure speedy and positive arc interruption with a minimum of disturbance.

Shipment

The breaker will be shipped completely assembled, with all attachments and auxiliaries mounted in place. Do not remove the crating until the breaker reaches its permanent location.

Installation

1. Remove the crating and frame skids.
2. Mount the breaker on its foundation. The four foundation bolts should be left loose until the frame is properly leveled by inserting shims under the feet. The breaker must be perfectly level.
3. Remove the tie wire from the mechanism trigger and allow the breaker to open slowly.
4. Remove the tanks and examine the inside for evidence of moisture or foreign matter. Flush with benzine. Tanks should not be lowered in wet weather without provision for keeping moisture out of them. The internal parts of the breaker should be protected as well.
5. Examine the contacts and note that they are clean and in alignment. For adjustments, see section covering adjustments.
6. Operate the breaker by hand several times, watching each pole and the operating mechanism to be sure that all parts move freely.
7. Install connections to the breaker studs. All contact surfaces should be clean and should be free from burrs. The terminal studs are not designed to carry undue cable or bus bar loads. An excessive strain, which at first may have no apparent effect, will eventually loosen the porcelain weather casing and permit moisture to enter the breaker.
8. With the tanks removed, fill with oil in accordance with name plate instructions. When bolting in place, be sure the tank is drawn up evenly and tightly all around.
9. Connect the breaker frame to ground through one of the mounting bolts. The National Electric Code requires grounding cable to have one-fifth the main circuit capacity, except that it must never be smaller than No. 8 and need not be larger than No. 0, B and S gauge.
10. Remove the undrilled conduit entrance plate from the bottom of the mechanism housing (when supplied) and drill for the conduit entrance as desired. Unit and

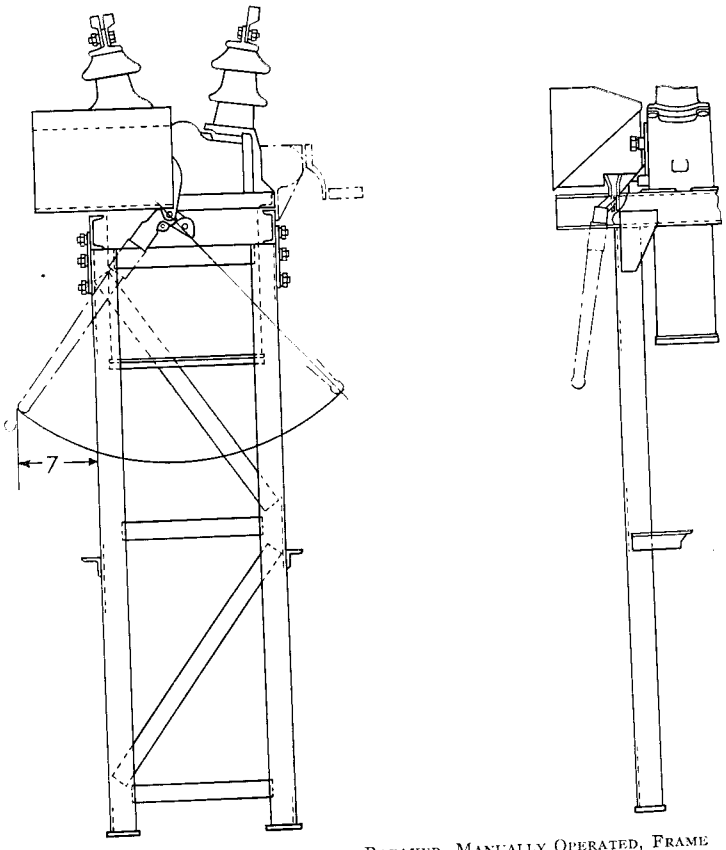


FIG. 3—TYPE GO-A OIL CIRCUIT-BREAKER, MANUALLY OPERATED, FRAME MOUNTING, 15,000 VOLTS

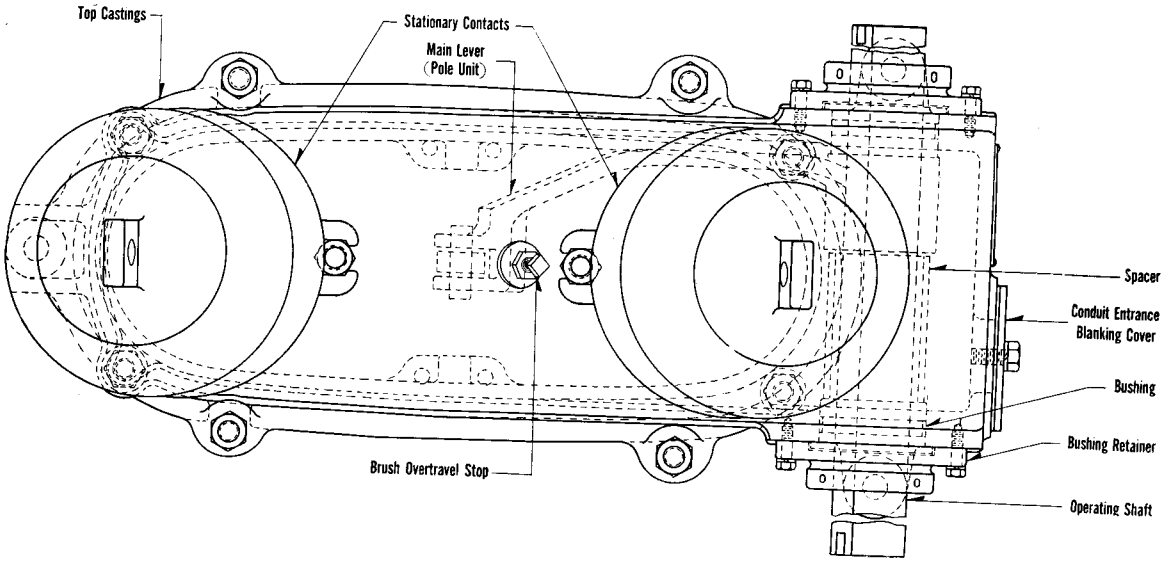


FIG. 4—TYPE GO-A POLE UNIT (TOP VIEW)

manual mechanisms have definitely located conduit entrances as shown on the outline drawing.

11. Connect the control and transformer circuits to the proper points on the terminal blocks as shown on the diagram supplied. When the breaker is located a considerable distance from the battery or transformer, allowance should be made for the voltage drop between the battery, or transformer, and the terminals of the operating coil to secure proper operation at minimum control voltage. The bushing type current transformer name plate should be used as an indication of the proper taps to use, although the proper taps will be determined by the loading. It is always necessary to determine the proper taps by test. The following tables indicate the primary current necessary to trip the breaker for several standard burdens. Always be sure the transformer secondary connections are completed before impressing primary current on the breaker.
12. Check the operation of the breaker by operating it electrically, if for electrical operation.

Adjustments

Contacts—The contact arrangement is shown in Fig. 2. The main and arcing contacts are both of the butt type, the ¼-inch lead of the arcing contacts being maintained by the thickness of the copper on the arcing tips. The contact pressure on the main contacts is obtained by a compression spring. With the breaker closed the top of the main moving contact should be ¼-inch below the shoulder on the lift rod end. If necessary to adjust, loosen the lift rod end and screw the assembly up or down as necessary.

It is important that the ¼-inch dimension be maintained as this determines the main contact pressure. Vertical and rotational adjustment of the stationary arc shields is secured by loosening the clamping bolts of the stationary contact foot and rotating the foot into alignment. Before rotating the foot, it will probably be necessary to spread the foot by driving a wedge or screw driver into the saw cut. Never attempt to force the contact foot as the copper may "gall".

A limited amount of horizontal alignment of the stationary arc shield can be secured by adjusting the three clamp flange bolts on the top of the pole unit. This is done by loosening one or two bolts and tightening the remaining bolts. The bolts loosened should be checked for tightness after adjustment. The main contacts make silver to silver contact and it is therefore unnecessary to use an abrasive to keep them clean. The oxide of silver does not increase the contact drop. In fitting new contacts it is unnecessary to secure perfect line contact; with the comparatively soft material (silver) good contact is secured after a few operations, as the silver flows slightly under pressure.

If the silver contacts on the moving contacts are replaced, use solder of at least 300°C. melting point. **Use only "pure silver", coin silver is unsatisfactory.**

"De-ion Interruptors"—The "De-ion Interruptors" control the arc and quickly extinguish it by de-ionization. These devices need little attention other than an occasional inspection. They must be kept securely tightened and properly aligned so that the moving contacts move freely and do not rub causing excessive friction. The fibre insulation is affected very little by the arc action but should be inspected occasionally and replaced if excessive deterioration is found.

Terminal Bushings—The surface of the bushing insulation should be smooth and well varnished. If the varnished surface is damaged it should be smoothed off with fine sandpaper and re-varnished with three coats of good quality, clear, air-drying spar varnish. Each coat should be allowed to dry for 24 hours.

Mechanical—Do not try to adjust the contacts by changing the toggle adjustment. The toggle of the breaker is set at the factory and should not be disturbed. The correct setting is 7/8-inch off center for the standard electrically operated breaker. Refer to Fig. 7. Excessive overtravel of the contacts is prevented by the set screw

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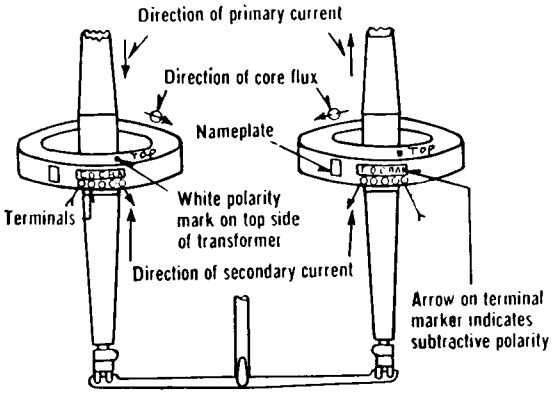
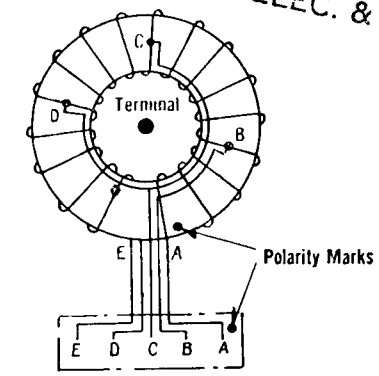


FIG. A



Standard method of identifying transformer leads, with any combination of taps, the tap nearest A has the same relative polarity as terminal A.

FIG. B

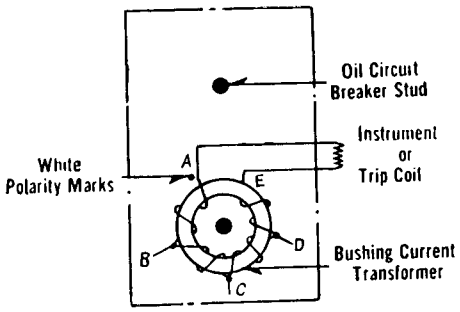


FIG. C

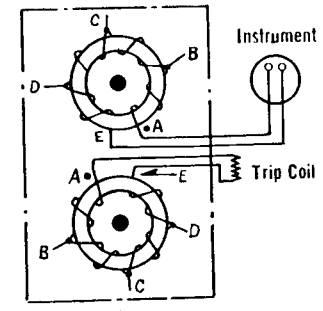


FIG. D

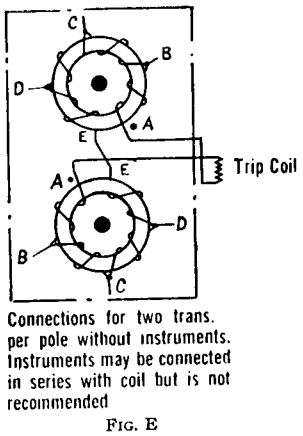


FIG. E

FIG. 5—TYPICAL BUSHING TYPE CURRENT TRANSFORMER CONNECTIONS

Type GO-A 600-Ampere 15,000-Volt Breaker

DATA APPLYING TO 400/5 AND 600/5 TRANSFORMERS. ACTUAL PRIMARY CURRENTS NECESSARY TO PRODUCE 5 AMPERES IN SECONDARY FOR ATTACHMENTS INDICATED 60 CYCLES

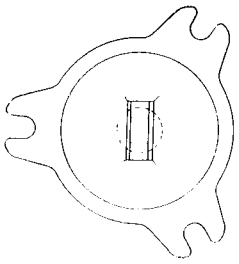
400/5 Transformers

Nominal Ratio	Turn Ratio	Tap	INSTANTANEOUS OR INVERSE TIME LIMIT TRIP Hand Operated L*	Hand Operated R*	Solenoid Operated L*	Solenoid Operated R*	DIRECT TRIP Hand Operated L*	Hand Operated R*	Solenoid Operated L*	Solenoid Operated R*	†CO RELAY Standard L*	Standard R*	†Low Energy L*	†Low Energy R*
30	6	AB	O.L.	O.L.	O.L.	O.L.	O.L.	O.L.	O.L.	O.L.	O.L.	O.L.	50	40
50	10	BC	O.L.	O.L.	O.L.	O.L.	O.L.	O.L.	O.L.	O.L.	O.L.	60	55	50
80	16	AC	O.L.	O.L.	O.L.	130	O.L.	O.L.	O.L.	O.L.	80	75	70	65
125	25	CD	O.L.	180	O.L.	140	O.L.	O.L.	O.L.	190	110	105	105	100
175	35	BD	240	230	200	190	O.L.	O.L.	210	195	155	150	145	140
205	41	AD	255	245	230	220	O.L.	O.L.	230	220	170	165	170	165
300	60	CE	335	325	325	315	O.L.	335	320	310	250	245	245	240
350	70	BE	375	365	370	360	O.L.	370	365	360	285	280	280	275
380	76	AE	400	395	395	390	410	395	395	390	310	305	305	300

600/5 Transformers

50	10	BC	O.L.	O.L.	O.L.	O.L.	O.L.	O.L.	O.L.	O.L.	O.L.	80	75	50
100	20	AB	O.L.	O.L.	O.L.	O.L.	O.L.	O.L.	O.L.	O.L.	140	90	90	85
150	30	AC	O.L.	O.L.	O.L.	165	O.L.	O.L.	O.L.	205	135	130	125	120
200	40	DE	O.L.	250	O.L.	215	O.L.	O.L.	O.L.	215	170	170	165	165
250	50	CD	295	280	285	260	O.L.	O.L.	280	255	210	210	205	200
300	60	BD	340	330	330	315	O.L.	O.L.	315	295	250	250	245	240
400	80	AD	435	425	425	415	O.L.	460	390	375	330	330	325	325
450	90	CE	480	475	475	470	510	485	425	415	365	365	360	360
500	100	BE	525	520	525	520	530	525	480	470	410	410	405	405
600	120	AE	620	620	615	610	625	625	580	570	485	485	480	480

*L = Left hand transformer.
*R = Right hand transformer.
O.L. = Transformer overloaded—Do not use.
† Relay set on 4-ampere tap.



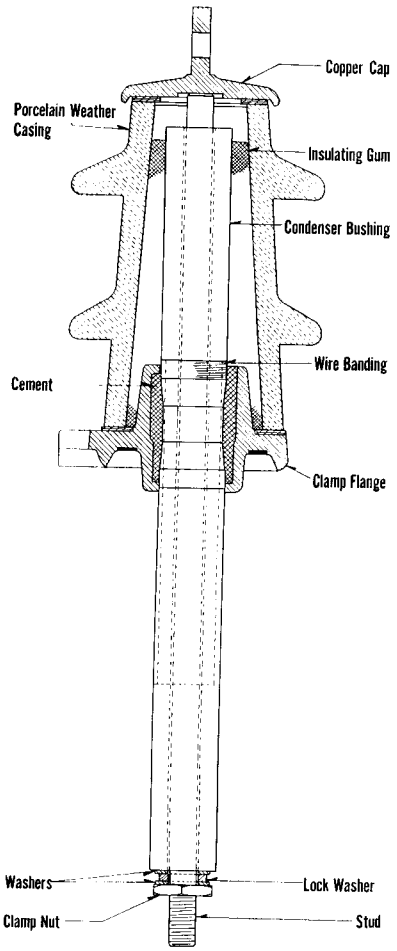


FIG. 6—GO-A STATIONARY CONTACT, 600 AMPERES, 15,000 VOLTS.

stop in the top of the main casting This stop should be set to secure $\frac{1}{16}$ inch clearance between the top of the pole unit main lever and the bottom of the set screw. This clearance can be approximated by screwing the set screw down until it touches the main lever, and then backed off one turn.

Manual Mechanism

Refer Fig. 8.

The manual mechanism adjusting link has four holes with unequal spacing so that four adjustment steps are possible. Increasing or decreasing the length of this link increases or decreases the travel of the breaker. It is necessary to make sure, however, that the trigger on the trigger lever engages with the roller on the roller lever, and that the roller lever does not hit the side of the mechanism housing.

The tripping bar set screw should be so adjusted that the moving core, of the overload attachment, is within $\frac{1}{32}$ inch of the stationary core at the time the breaker trips. This is necessary insofar as the attachment develops its greatest power just before the cores come together.

If it is found necessary to adjust this set screw, it will also be found necessary to adjust the lock nuts on the upper end of the tripping link to agree. They should be so adjusted that all play is removed from the linkage.

The tripping link should further be adjusted so that the small lever of the trigger toggle rests firmly against the trigger toggle stop.

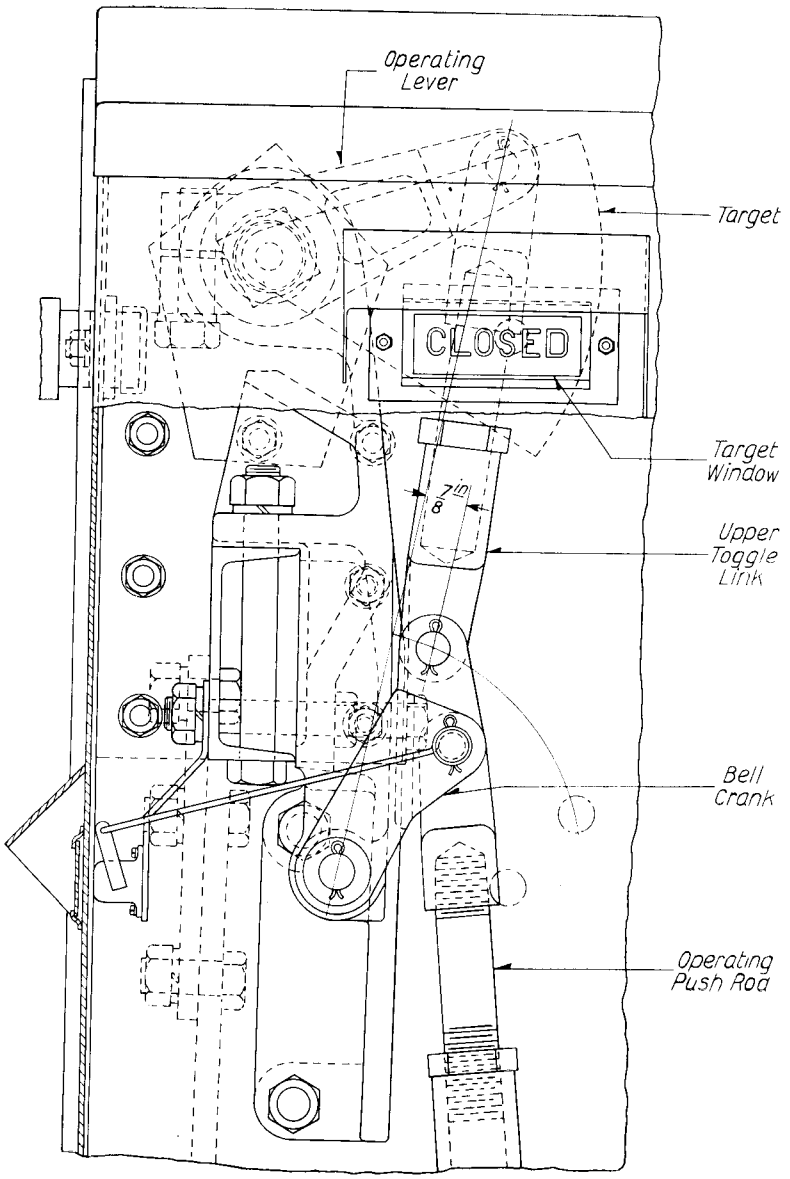


FIG. 7— TOGGLE MECHANISM

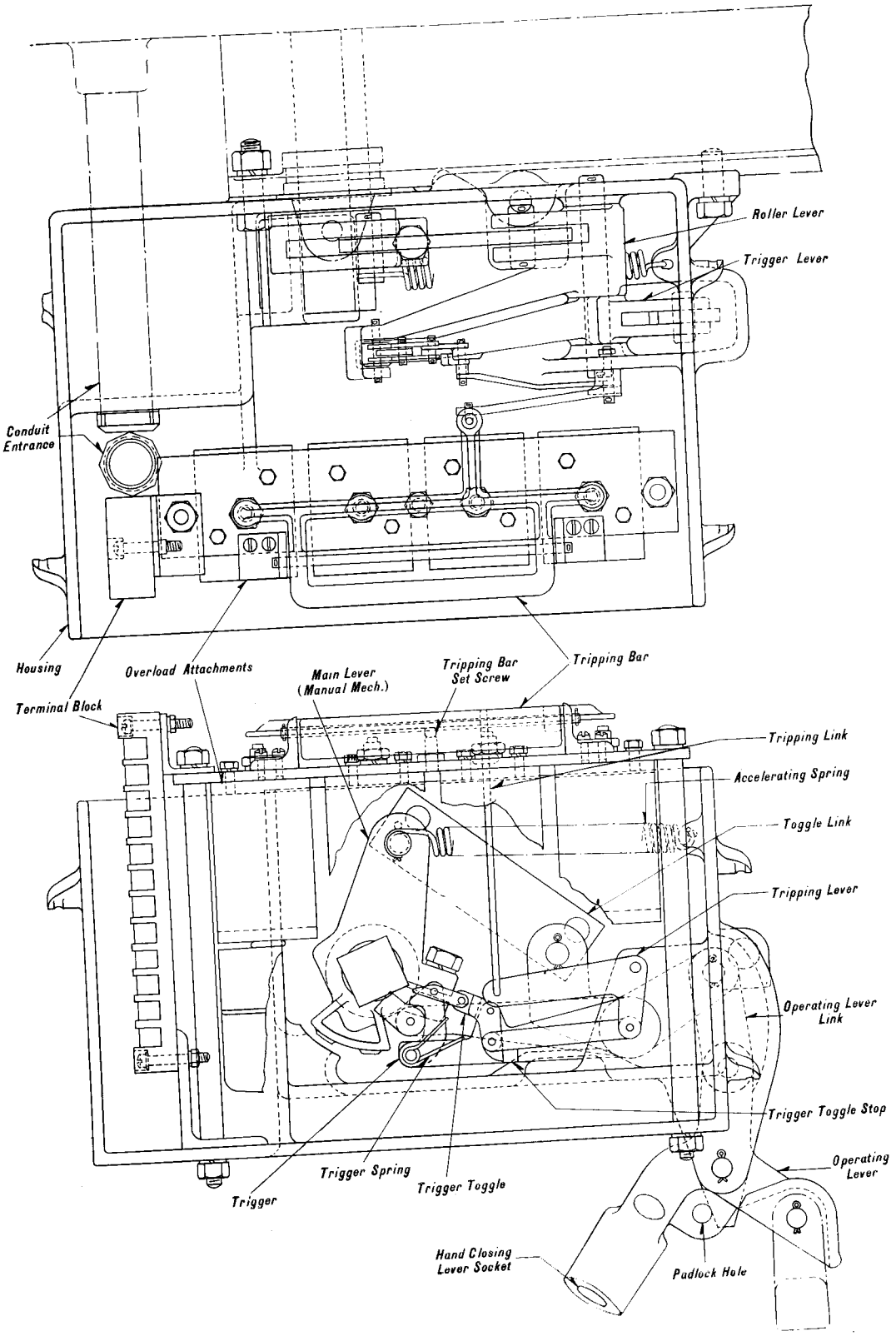


FIG. 8 - MANUAL MECHANISM

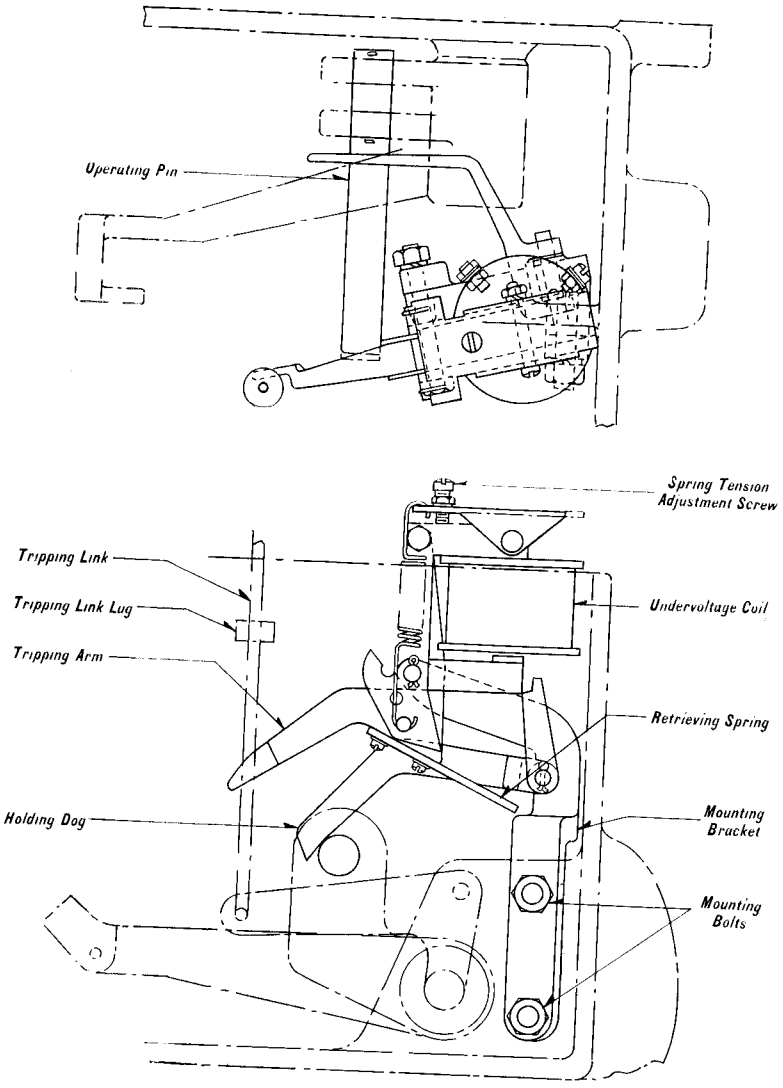


FIG. 9—UNDERVOLTAGE RELEASE ATTACHMENT FOR MANUAL MECHANISM

Undervoltage Release Attachment for Manual Mechanism

Refer to Fig. 9.

The attachment is mounted in place by means of the two mounting bolts indicated. Operation is secured by means of the special operating pin included as part of the attachment style number. The standard pin should be removed from the roller lever casting and the special operating pin substituted at the point indicated. Be sure that the set-up is rigid and agrees with the illustration.

Connect leads from the external circuit through the terminal block to the terminals on the undervoltage coil. The undervoltage coil should be connected directly across-the-line, but should be protected by fuses. The undervoltage coils should be connected to the line side of the breaker. Check the control voltage stamped on the name plate to make sure that it agrees with that on which the attachment is to be used.

Do not run the coil circuit through an auxiliary switch as this will result in "pumping".

Make sure that the tripping arm strikes the tripping link lug with sufficient force to trip the breaker as soon as the holding dog releases the armature.

Make sure that the retrieving spring retrieves the armature to within $\frac{1}{16}$-inch of the stationary core with the breaker in the open position. The low voltage coil is not a pickup coil and consequently is not capable of picking up the low voltage release armature when the distance exceeds this amount. If normal voltage is applied after this dimension is exceeded, the coil will burn out.

If noise develops, the faces of the armature and stationary core should be examined to see that a good clean seat is obtained when they are together. If necessary to clean these faces, be sure to leave them bearing over their entire area.

The attachment should be inspected periodically to make sure that all parts are rigidly assembled and functioning properly.

Auxiliary Switches for Manual Mechanism

Refer Fig. 10.

Mount the auxiliary switch in accordance with the illustration. Drill two $\frac{5}{16}$-inch holes in the bottom of the housing in accordance with the dimensions given (the drilling is the same for either one or two switches) and clamp the switches securely in place.

Insert the special operating pin supplied. Insert and adjust the adjustable opening links so that the switches make contact by the same amount in both the open and closed positions. Be sure that all electrical connections are tight.

Maintenance

Points to be observed in maintenance —

1. Before making any adjustments, make sure that all lines are electrically dead.
2. Be sure the breaker frame is grounded.
3. Do not operate the breaker excessively by the operating mechanism when the oil tanks are removed.
4. Examine all contacts frequently, especially after short-circuit. See that the contacts are properly aligned.
5. After making any adjustments, operate the apparatus carefully by hand to make sure that it operates smoothly and correctly.
6. Inspect the oil after severe short-circuits. If it shows signs of moisture, carbonization, or dirt, filter and retest it. Dielectric tests of the oil should be made every three months, to show if it is reasonably good for circuit-

breaker work. Samples should not be taken until the oil has remained undisturbed for at least four hours. In testing for indication of water, take the sample from the bottom of the tank. If for indication of carbon, and after a heavy short-circuit, take the sample from the surface of the oil.

7. Remove all oil and thoroughly clean the tanks, tank liners, lift rods, terminal bushings, etc., at least once a year.
8. Occasionally inspect and tighten clamping nuts around bushings on top of breaker.
9. Any pitting of the contacts should be cleaned off, or, if badly burned, they should be replaced.
10. Keep the bearing surfaces of the mechanism and breaker units adequately oiled.
11. Operating Mechanism—For instructions covering the SA-3 solenoid mechanism, see Instruction Book 5567. For Rectox Unit, refer to Instruction Leaflet 1782.

Care of Circuit-Breaker Oil

The care of the insulating oil in circuit-breakers is of the utmost importance in their successful operation. Contamination by dirt, moisture, metallic particles, lint, etc., all reduce the dielectric strength, upon which the operation and current interrupting ability largely depend. Consequently, the most careful attention should be given to keeping the oil clean, not only in filling the tanks originally, but in later maintenance or other work on the breakers which might involve opening the tanks.

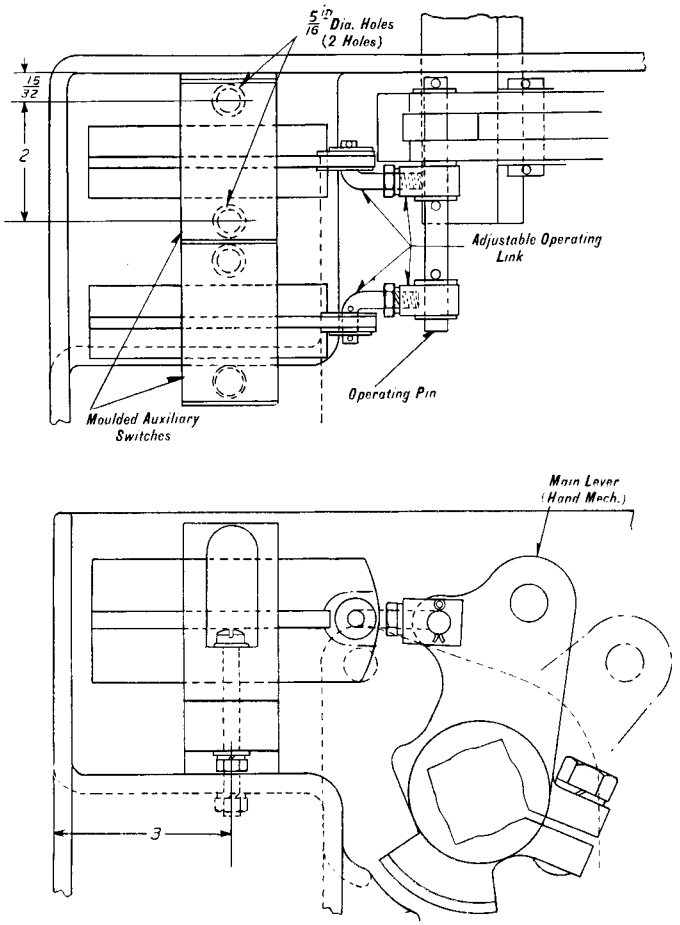


FIG. 10—AUXILIARY SWITCH FOR MANUAL MECHANISM

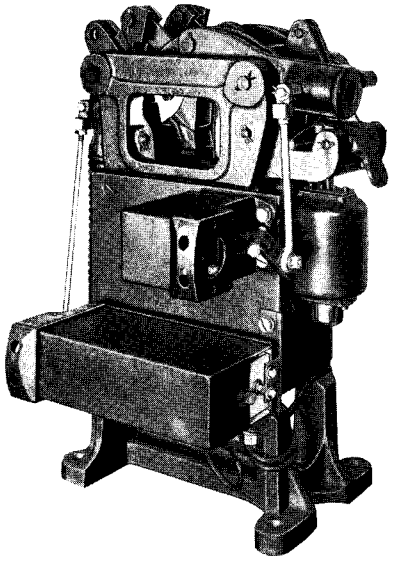


FIG. 11—TYPE SA-3 MECHANICALLY TRIP FREE SOLENOID

Only the highest grade, such as Wemco "C" or other approved oil should be used in the breakers. The oil should be new or at least thoroughly reconditioned by means of a filter press or centrifuge. In any case, before using, it should be given a dielectric test which should show a minimum of 22,000 volts (preferably 25,000 to 30,000) measured between 1-inch diameter discs spaced .1 inch apart.

Before filling, the tanks should be thoroughly cleaned and flushed out with insulating oil. The same treatment should be given the inside of the top of the breaker and the operating linkage and contact system. In doing this, rags which will leave lint should not be used as this absorbs and holds moisture.

The same care should be used during inspection or maintenance work on the breaker, which should preferably be done only under favorable weather conditions. If the oil is to be reconditioned following operation of the breaker under short-circuit, the tank, and entire inside of the breaker should be cleaned before the oil is returned to the tank. If the work merely involves lowering or removal of the tank, care should be taken to keep the tank covered until it is replaced so that dirt, dust, metallic particles, etc., cannot fall into the oil.

The above precautions may appear academic to those familiar with the maintenance and operation of oil circuit-breakers, but a little more than ordinary care in oil-handling will be well repaid in reliable and dependable operation for which the breaker is designed and built.

For instructions as to the care and testing of insulating oil, see Instruction Book 5336.

RENEWAL PARTS DATA

Recommended Stock of Renewal Parts for

TYPE GO-A OIL CIRCUIT-BREAKER

Outdoor Service

Manually or Solenoid Operated—Frame Mounting

600 Amperes; 15,000 Volts; 2, 3 or 4 Pole; Single Throw

FOR ILLUSTRATION OF PARTS SEE FIGURE 2

The following is a list of the Renewal Parts and the quantities of each that we recommend should be stocked by the use of this apparatus to minimize interrupted operation caused by breakdowns. The parts recommended are those most subject to wear in normal operation or those subject to damage or breakage due to possible abnormal conditions. This list of Renewal Parts is given only as a guide. When continuous operation is a primary consideration, additional insurance against shut-downs is desirable. Under such conditions more renewal parts should be carried, the amount depending upon the severity of the service and of the time required to secure replacement.

Breakers in use up to and including		1	5	
Name of Part	**No. Per 3-Pole Breaker**	**Recommended For Stock**		**Style No. of Part**
Breaker Complete	1	0	0	... ...
Breaker Pole Unit Complete	3	0	0	... ...
Bumper Spring	3	0	1	1 014 241
Moving Contact Complete	3	0	0	... ...
Lift Rod	3	0	1	949 458
Main Moving Contact	3	0	1	998 181
*Main Moving Contact Spring	3	0	1	969 910
Moving Arcing Contact Bracket	3	0	0	997 975
Moving Arcing Contact	6	6	12	947 450
Moving Arcing Contact Spring	6	2	6	969 731
Stationary Contact Complete	6	0	0	... ...
Condenser Bushing	6	0	2	666 241
Main Stationary Contact	6	0	2	947 451
Stationary Arcing Contact	6	6	12	947 450
Stationary Arc Shield	6	0	2	947 454
Oil Tank Complete	3	0	0	... ...
Oil Tank	3	0	1	841 763
*Oil Gauge Glass	3	0	1	255 850
Tank Liner	3	0	1	665 738
*Type SA-3 Solenoid Operated Mechanism	1	0	0	See I.B.5567
*†Closing Coil	1	0	1	†
*†Trip Coil	1	0	1	†
*†Rectox Rectifier	1	0	0	See I.L. 1782

* Not illustrated.
† When ordering, specify identification number stamped on part.
Parts indented are included in the part under which they are indented.

ORDERING INSTRUCTIONS

When ordering Renewal Parts, always specify the name of the part wanted as shown on the illustrations in this Instruction Book, giving Shop Order Number and the type of Oil Circuit-Breaker, as shown on the name plate. For example:

One Moving or Stationary Contact Complete, 600 Amperes, for Type GO-A Oil Circuit-Breaker, S. O. 30-F-171, shown in Instruction Book 5770, Figure 2.

To avoid delays and misunderstandings, note carefully the following points:

1. Send all correspondence and orders to the nearest Sales Office of the Company.

2. State whether shipment is to be made by freight, express or parcel post. In the absence of instructions, goods will be shipped at our discretion. Parcel post shipments will be insured only on request. All shipments are at purchaser's risk.

3. Small orders should be combined so as to amount to a value of at least $1.00 net. Where the total of the sale is less than this, the material will be invoiced at $1.00.

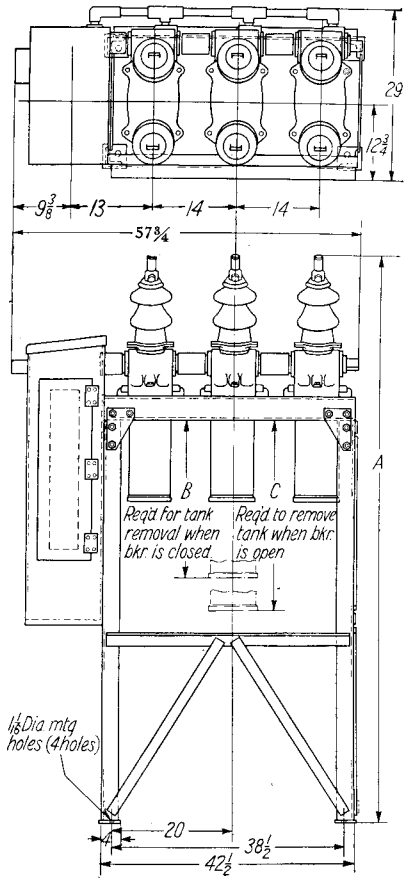


FIG. 12—TYPE GO-A OIL CIRCUIT-BREAKER, FRAME MOUNTING, 15,000 VOOTS

OUTLINE DIMENSIONS IN INCHES—3-POLE

Type	Amp.	Volts	Gallons Oil	Shipping Wt., Lb. Without Oil	DIMENSION A	DIMENSION B	DIMENSION C
GO-A	600	15000	22.5	1500	96	26½	32

MEMORANDUM

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BUFFALO OFFICE
WESTINGHOUSE ELEC. & MFG. CO.

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①Changed or added since previous issue.

January, 1937

19C232501

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TO
ENGINEERING DIVISION
BUFFALO OFFICE
WESTINGHOUSE ELEC. & MFG. CO.

33-000

Westinghouse

Type SAF-2 Operating Mechanism

for

Type F-122, 400, 600 & 800 Amp. 2 & 3 P. S. T.
and
Type F-124 600 & 1200 Amp. 2 & 3 P. S. T.
Oil Circuit Breakers

INSTRUCTION BOOK

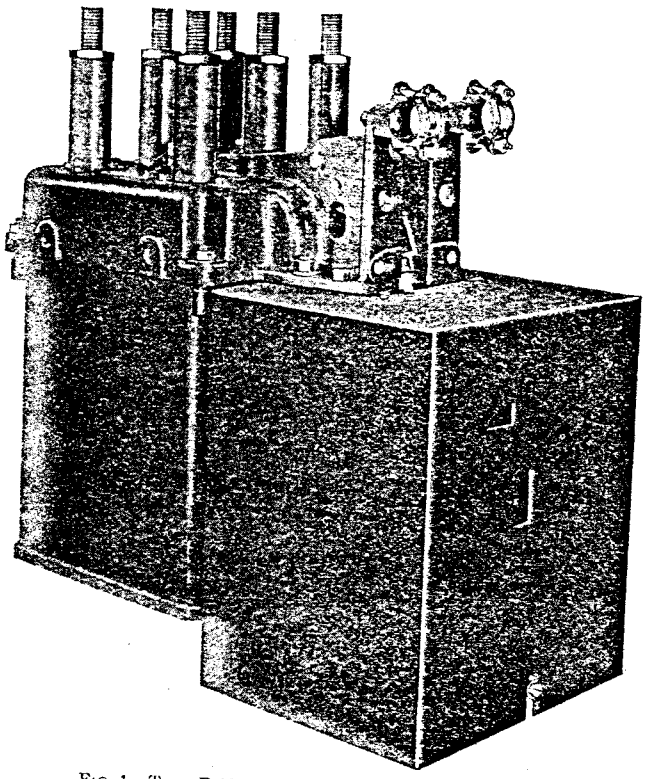


FIG. 1—TYPE F-122, SOLENOID-OPERATED BREAKER.

Westinghouse Electric & Manufacturing Company
East Pittsburgh Works
East Pittsburgh, Pa.

I. B. 5790
(Filing No. 33-000)

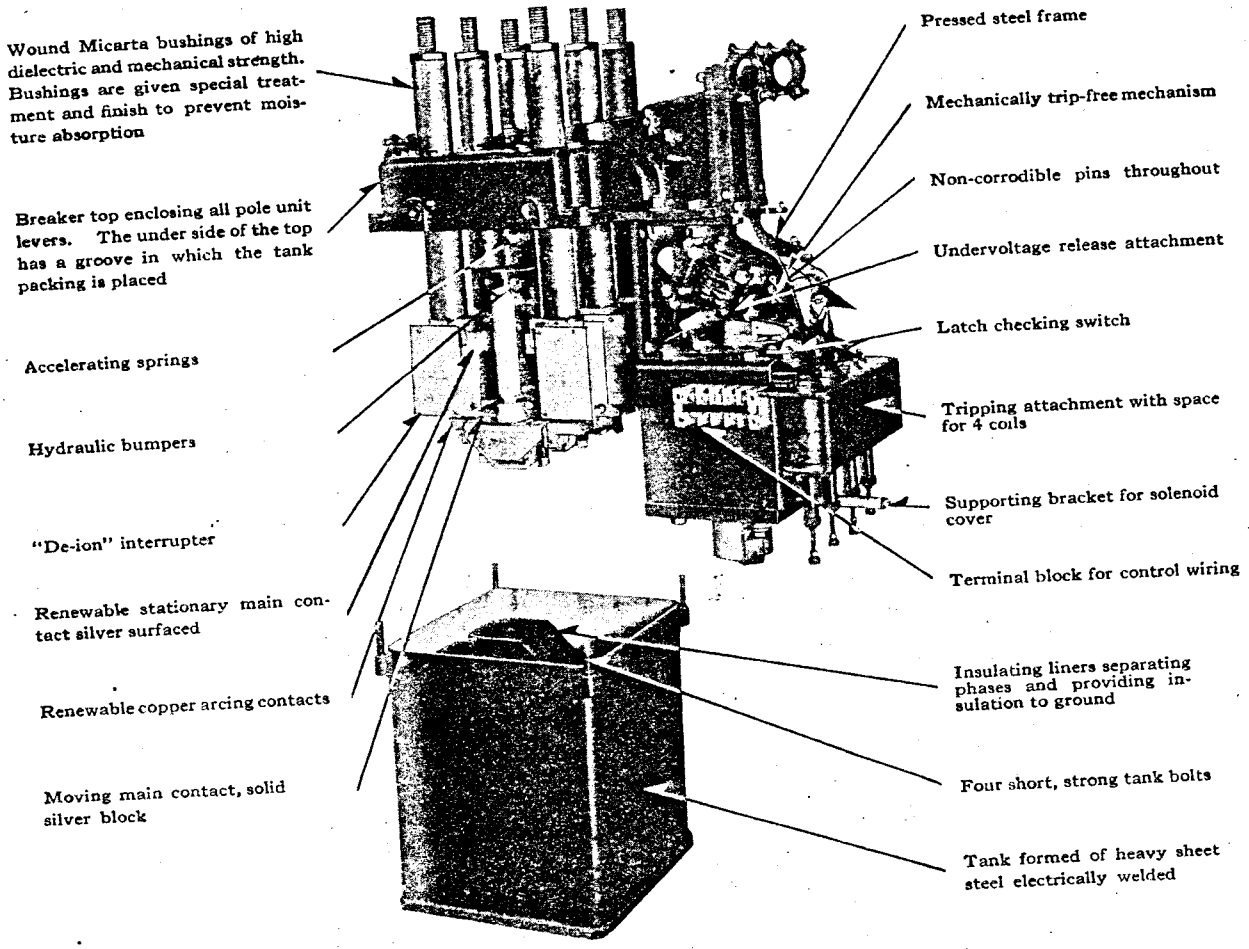


FIG. 2—TYPE F-122 BREAKER WITH TANK REMOVED AND SAF-2 SOLENOID WITH COVER REMOVED

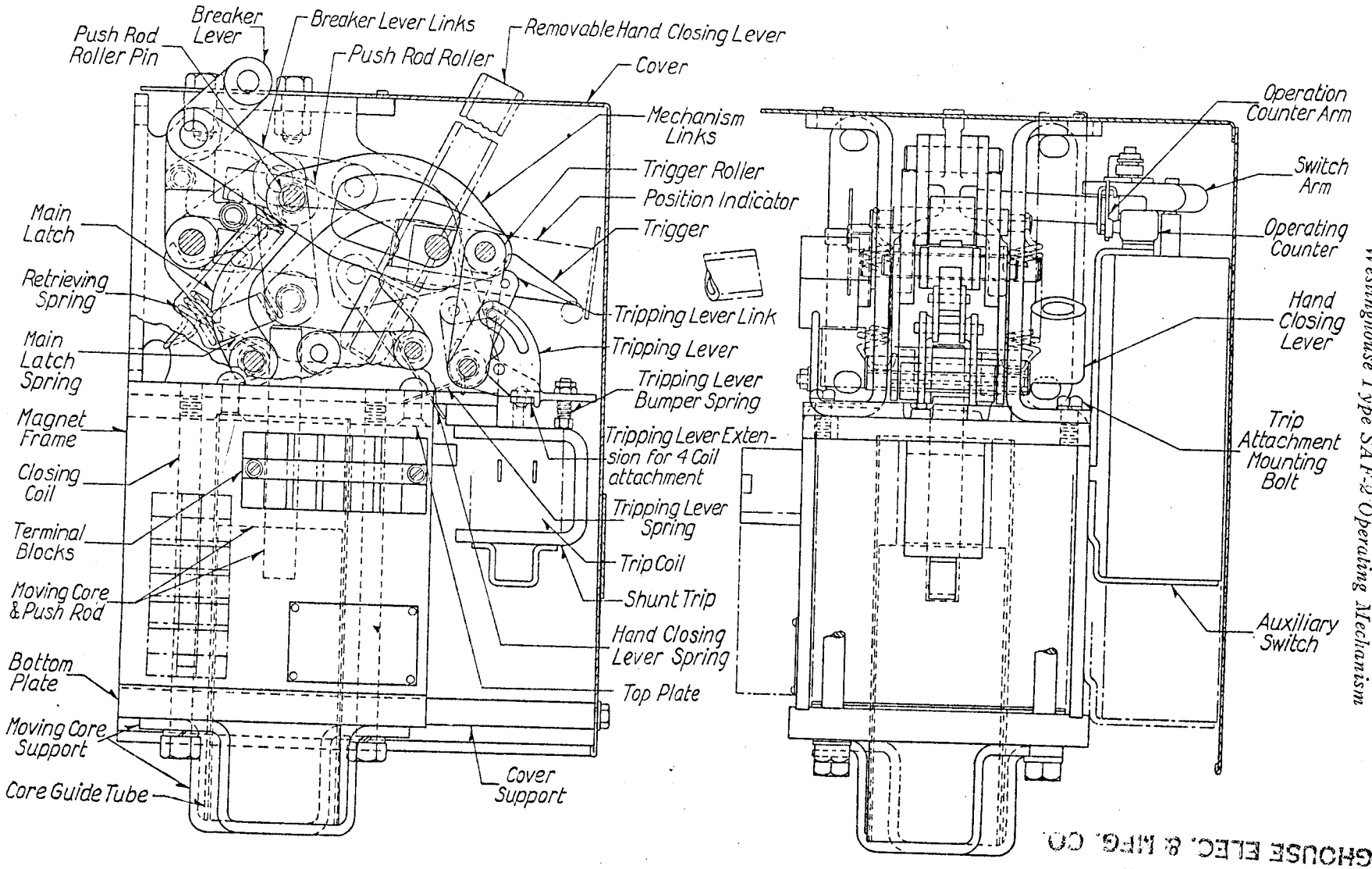


FIG. 3—CIRCUIT BREAKER—OIL-TYPE "SAF-2" MECHANISM ASSEMBLY

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BUFFALO OFFICE
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Westinghouse

Type SAF-2 Operating Mechanism

INTRODUCTION

This mechanism is the direct-current solenoid type. It operates on standard direct-current control voltages or when equipped with a rectox unit, on alternating-current. It is a mechanically full automatic mechanism, trip free in all positions.

This mechanism is used principally to electrically operate the 400, 600 and 800 ampere type F122 and the 600 and 1200 ampere type F124 oil circuit breakers. This instruction book applies to the mechanism only. Instructions on adjustments and maintenance of the type F122 and F124 breakers can be found in Instruction Books 5746 and 5767 respectively.

The standard mechanism is supplied with a single shunt trip coil, a 6 pole auxiliary switch, cover, position indicator and control relay. The mechanism can be equipped with additional attachments, such as, operation counter, latch checking switch, four coil tripping attachments (in place of single shunt trip coil), a 10 pole auxiliary switch instead of a 6 pole and an under-voltage tripping attachment.

SHIPMENT

Ordinarily the mechanism will be mounted on the breaker unit, with all adjustments complete, ready for installation as described in I.B. 5746 or 5767. Occasionally, however, the mechanism will be shipped separately, fastened in the closed position.

HANDLING

Do not attempt to lift the mechanism by its attachments or levers; or to move the attachments by the coil leads. Always grasp the frame, which is designed to withstand handling.

INSTALLATION

1. When the mechanism is mounted on the breaker before shipment, it is only necessary to follow the installation procedure outlined in the breaker Instruction Books and operations 8 to 12 of this book.

2. When the mechanism is shipped separately, however, it is necessary to first mount the breaker unit as described in the above Instruction Books and then mount the mechanism to the breaker as shown in Fig. 4.

3. Bolt the mechanism to the breaker frame with the four bolts shown. If the breaker and mechanism are for wall mounting, structural steel members should be inserted between the breaker, mechanism and wall to prevent disintegration of the wall by the closing shock.

4. Remove the eye bolt from breaker lever of the mechanism; remove the fuloram pin from the toggle lever of the breaker, and the pin from the operation rod end of the breaker.

5. Screw the eye bolt into the operation rod end, with the lock nut and lock washer in plate as shown.

6. Replace the eye bolt-rod end assembly and pins, and check the operation of the mechanism.

7. Operations #4, 5 and 6 should be repeated until the length of the eye bolt-rod end assembly is such, that, with the mechanism in the closed position, the breaker toggle lever links will be $\frac{1}{32}$" away from the breaker stop pin.

8. With operation #7 completed, the main moving contact of the breaker

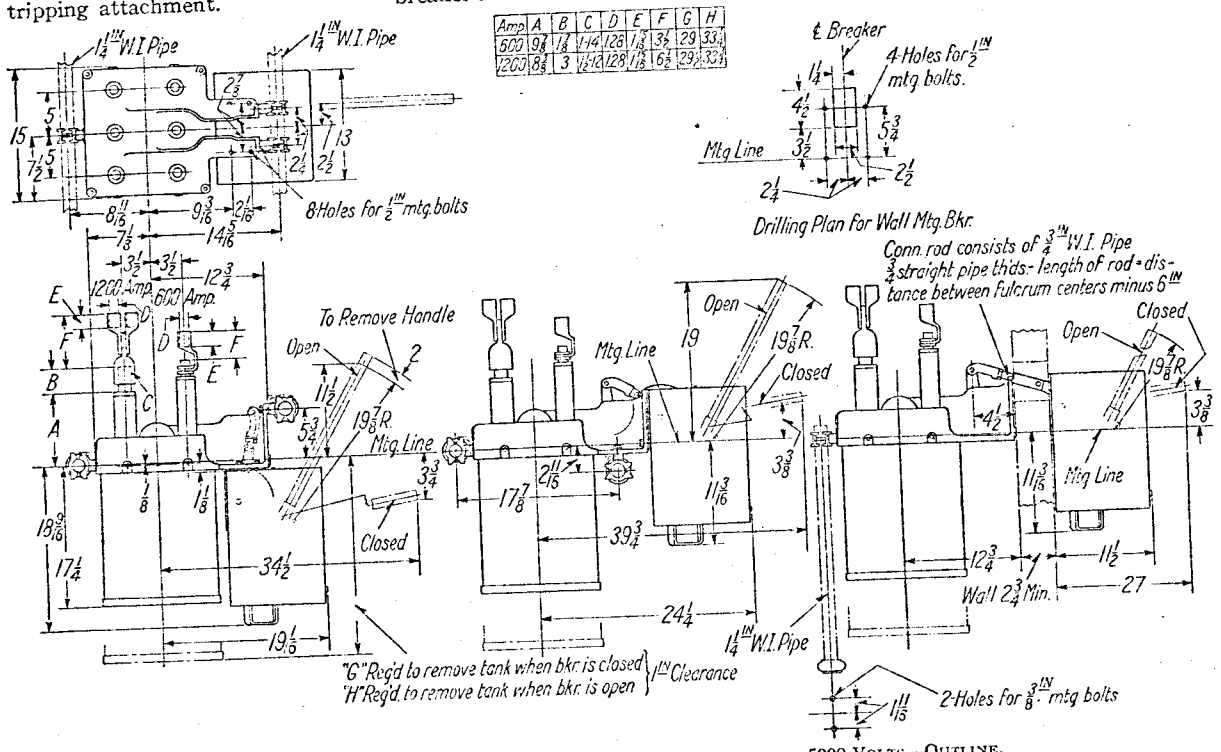


FIG. 4—STANDARD TYPE 400 AND 600-A—7500 VOLTS., 800 AMPERES, 5000 VOLTS—OUTLINE.

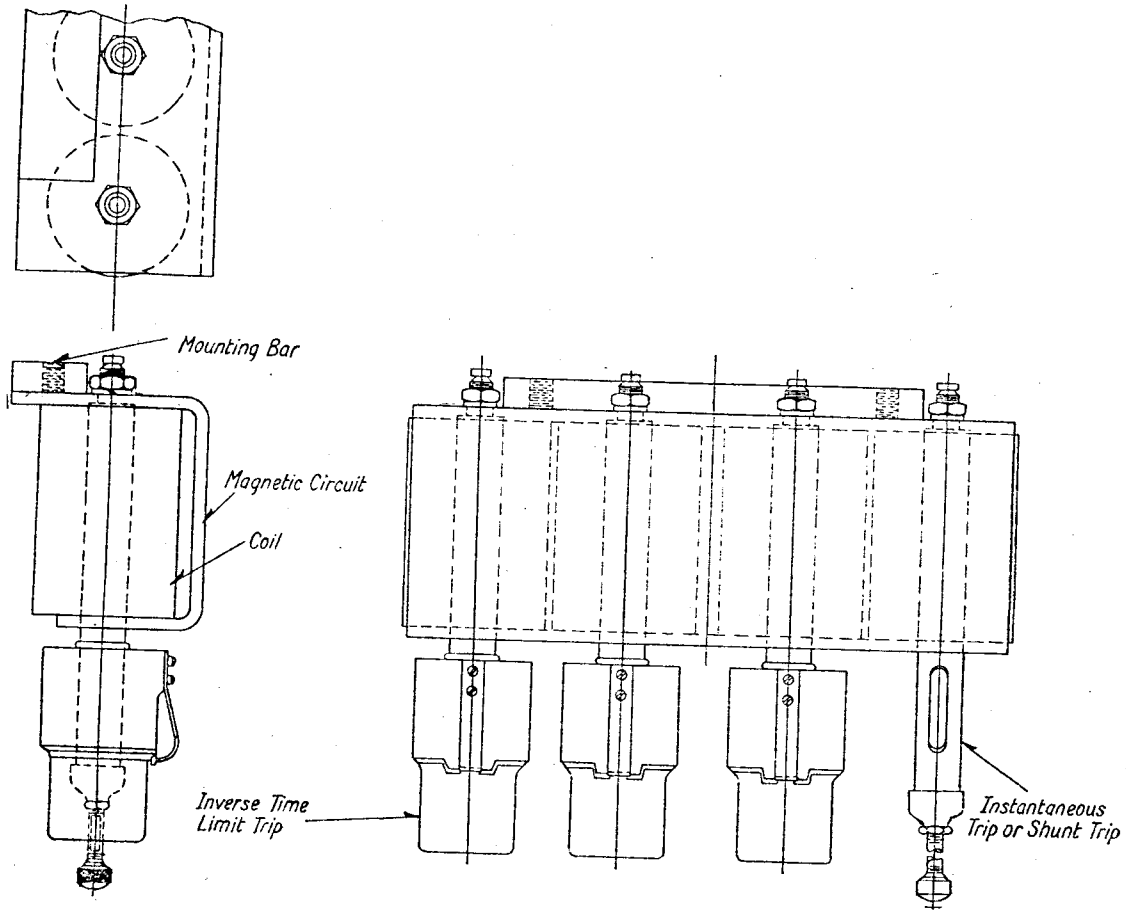


FIG. 5—INVERSE TIME LIMIT ASSEMBLY

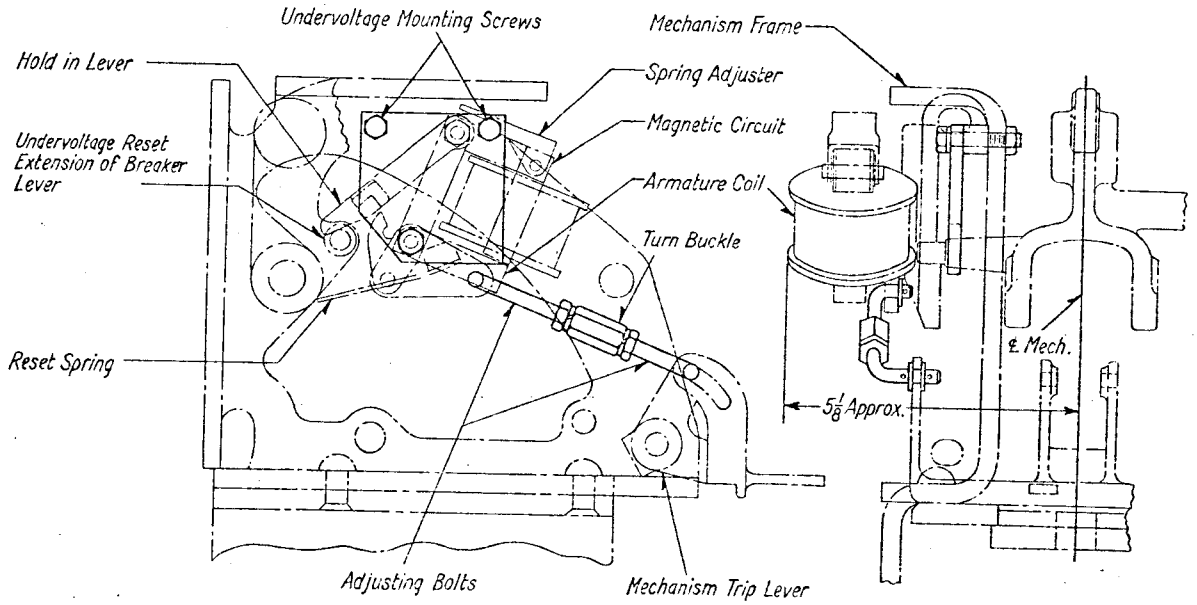


FIG. 6—UNDERVOLTAGE OPERATING ASSEMBLY

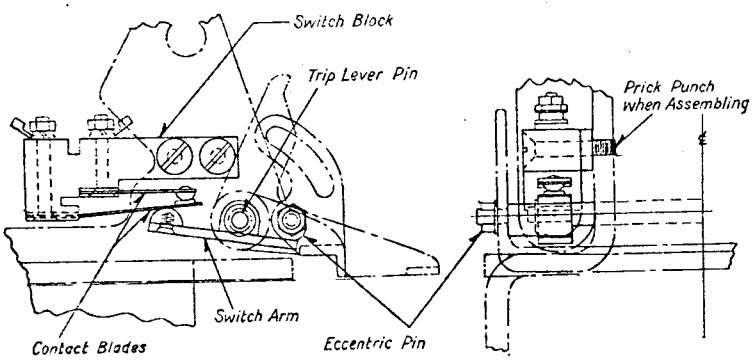


FIG. 7—LATCH CHECKING SWITCH ASSEMBLY

should be ¼" below the lift rod end as described in I.B. 5746 or 5767.

9. Mount the control panel in a convenient location.

10. Wire the control panel to the mechanism in accordance with one of the typical diagrams Figs. 8 and 9, or in accordance with the diagram covering the complete installation. (The control panel is not wired at the factory; all wiring must be done at the time of installation.)

11. Operate the attachments to make sure they are functioning properly, as described under adjustments.

12. Apply voltage to the closing coil and check the electrical operation of the solenoid. The mechanism should operate satisfactorily with 72% of normal voltage applied, measured at the coil.

ADJUSTMENTS

Mechanism Operation:

Ref. Fig. 2.

Energizing the closing coil forces the moving core and push rod upwards against the push rod roller (located at the junction of the breaker lever links and the mechanism links). This upward force straightens the toggle formed by the breaker lever links and the mechanism links which in turn rotates the breaker lever counter-clockwise, as the trigger roller (which is fastened to the mechanism links) is held stationary by the trigger. Just before the moving core strikes the top plate, the main latch is forced under the push rod roller by the main latch spring, thus locking the mechanism in the closed position. The toggle formed by the breaker lever links and the mechanism links is prevented from going over center by the push rod roller pin striking the top of the frame.

Energizing the trip coil rotates the tripping lever counter-clockwise to break the tripping toggle, and pull the trigger out of engagement with the trigger roller. This permits the entire linkage (mechanism links, breaker lever links and breaker lever) to slide horizontally off the main latch, thus permitting the mechanism to open. As the push rod roller slides off the main latch, the retrieving springs pull the push rod roller downwards to reset the mechanism.

The mechanism tripping toggle should be set either on toggle or slightly over toggle to prevent trigger failure when closing on maximum voltage.

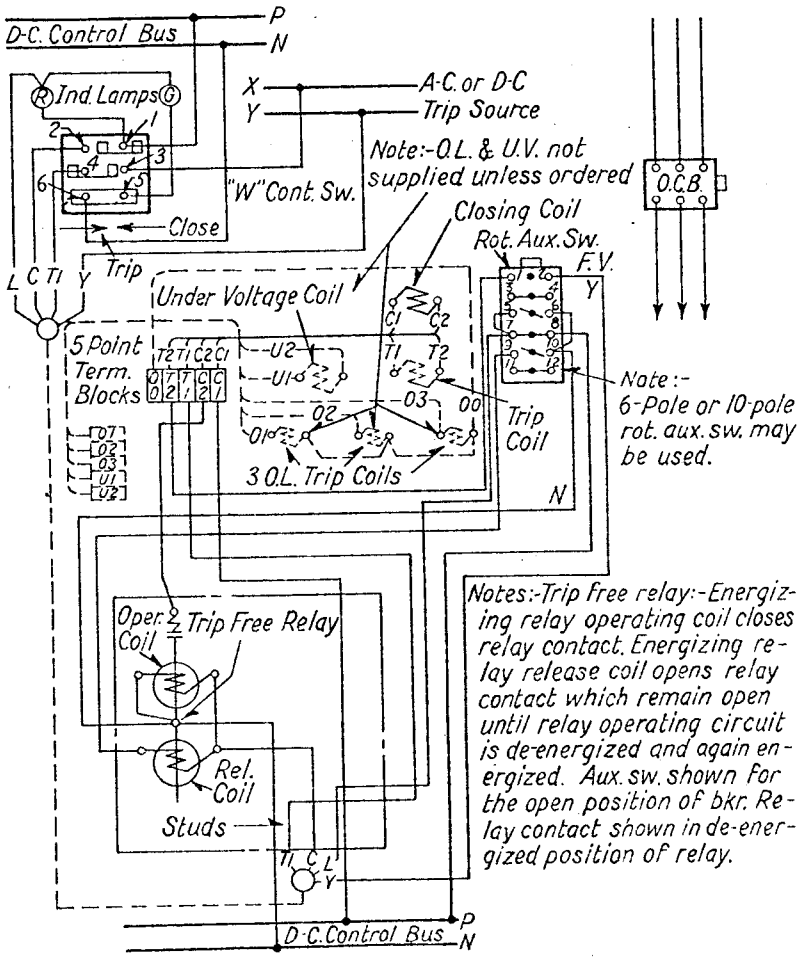


FIG. 8—DIAGRAM OF CONTROL PANEL CONNECTIONS

Four Coil Attachment:
Ref. Fig. 5 and Fig. 2

The four coil attachment bolts to the mechanism frame, in place of the single coil shunt trip attachment. In bolting the attachment in place it is only necessary to observe that the coil plungers push the tripping lever upwards sufficiently to trip the mechanism. A tripping lever with suitable extensions must be used with the four coil attachment.

Overload Release (Fig. 10)

The overload release consists of the parts shown in the picture. The moving core is magnetically drawn against the trip rod which is pushed up against the tripping lever. The calibration is varied by changing the air gap between the moving and stationary cores, by raising and lowering the calibration screw. The lock nuts must be drawn tight after changing calibration. The calibration setting is indicated by figures on the tube opposite the line on the moving core and corresponds to amperes in the secondary of the current transformer.

If the opening of the circuit-breaker is not desired unless the overload continues, an oil dashpot is attached to the end of the moving core. The calibration is then inscribed on the dashpot and is varied by screwing the pot into the cover. The time is varied by changing the number of the holes in the bottom of the piston uncovered by the diaphragm. Instantaneous tripping is possible because the check valve action of the washer at the time of tripping varies inversely with the amount of overload and directly with the variation in the viscosity of the oil. Fig. 11 shows approximate variations of the time with the variations of the overload and the effect of changed temperature on the standard dashpot oil as supplied with the dashpot.

The values given in Fig. 11 are approximate and will vary somewhat with changes in temperature, and changes in viscosity of the oil. Where a definite time delay is required the delay should be obtained by the use of suitable relays. The oil in the dashpots should be renewed periodically to obtain the best service.

Fill with oil to ¾-inch above the inside bottom surface of the pot, with the plunger removed.

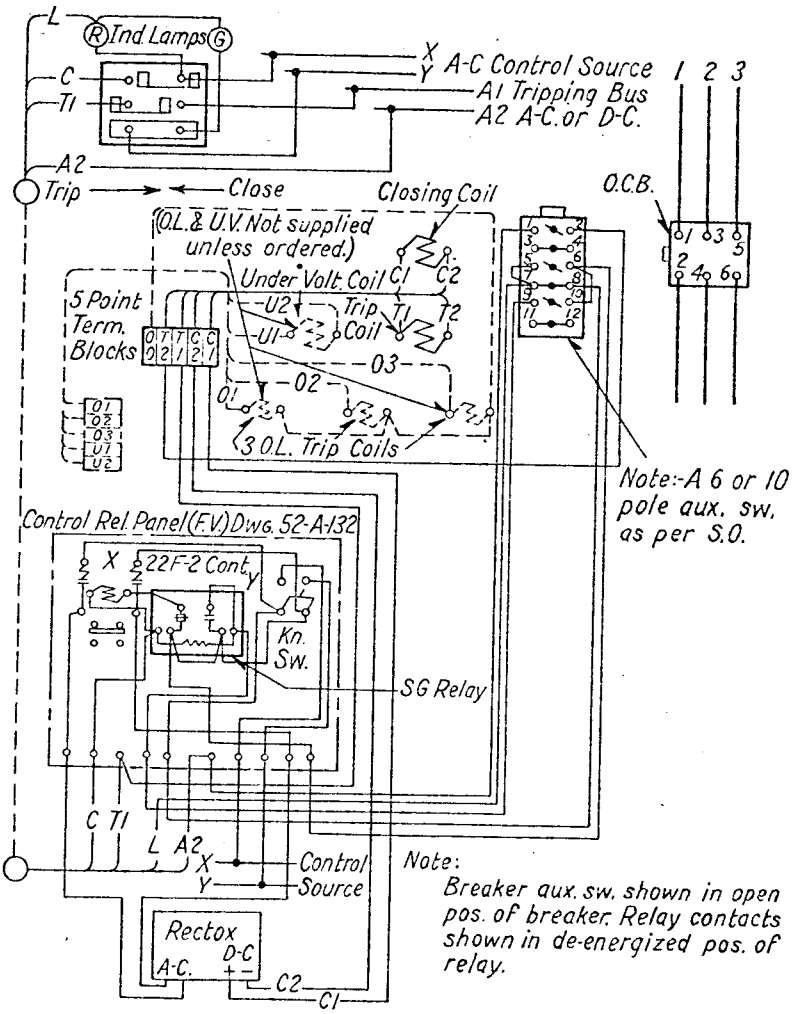


FIG. 9—RECTOX CLOSING SCHEME FOR SAF-2 MECHANISM

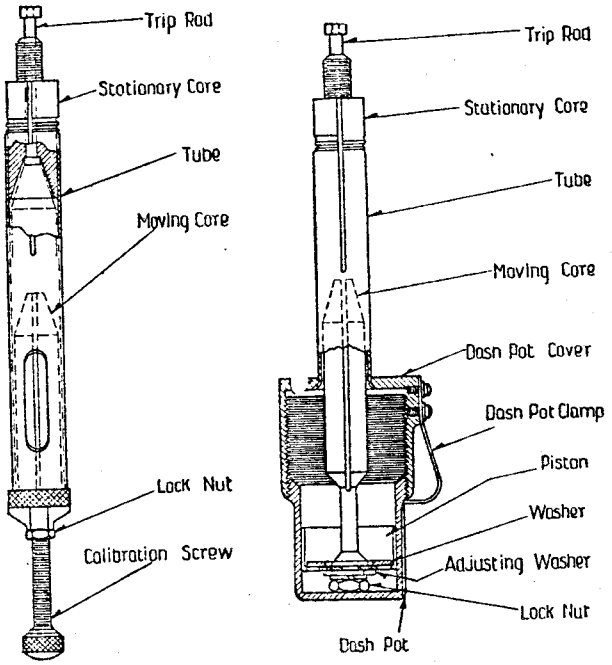


FIG. 10—OVERLOAD RELEASE CORES

AUXILIARY SWITCH

Ref. Fig. 3.

The adjustable linkage between the mechanism breaker lever and the switch arm should be adjusted so that the switch arm travels equally on either side of a line thru the switch arm shaft.

The length of the switch arm should be adjusted so that the contact segments make good contact with the contact fingers in both the opened and closed position of the mechanism. Make certain the operating arm of the auxiliary switch is not in dead center, otherwise damaged parts will result.

UNDERVOLTAGE RELEASE:

Ref. Fig. 6, 2 and 12.

The undervoltage mounts on the left hand side of the mechanism frame with the two mounting screws shown. The undervoltage reset extension of the breaker lever should operate between the undervoltage reset spring and the undervoltage hold in lever. As the mechanism closes, the reset extension of the breaker lever strikes the undervoltage hold in lever, which frees the undervoltage armature for operation on voltage failure. As the mechanism opens, the reset extension of the breaker lever strikes the undervoltage reset spring, retrieving the armature to within $\frac{1}{64}$" of its closed position; failure to reset the undervoltage armature properly will result in burning out the undervoltage coil, as the coil is not capable of picking up the armature if this distance is exceeded.

The turn buckle should clear the undervoltage armature during the tripping movement.

The turn buckle should be set to secure $\frac{1}{8}$" clearance between the end of the slot in the mechanism tripping lever and the outside adjusting bolt head, with the armature in the closed position.

The drop out voltage can be varied by regulating the extension of the two undervoltage tripping springs.

LAST CHECKING SWITCH:

Ref. Fig. 7.

The latch checking switch block mounts on the two screws shown. The trip lever pin must be removed and replaced with a special pin on which the switch arm can be mounted. The eccentric pin mounts on the mechanism trip lever, and should be adjusted to secure $\frac{1}{32}$" deflection of the top contact blade with the trip lever in the normal position.

OPERATION COUNTER:

Ref. Fig. 3.

The operation counter mounts on the upper switch bracket. After mounting in place and connecting to the auxiliary switch extension of the breaker lever the operation counter arm should be loosened and set so that **only** one number is recorded for each operation of the mechanism. This setting should be checked for both manual and electrical operation.

MAINTENANCE

Arrange for regular inspection to see that the apparatus is in good adjustment and functions as required.

Thoroughly inspect all bolts and nuts—and tighten if necessary. Inspect all pins, links and bearings for excessive wear. Check all cotter pins.

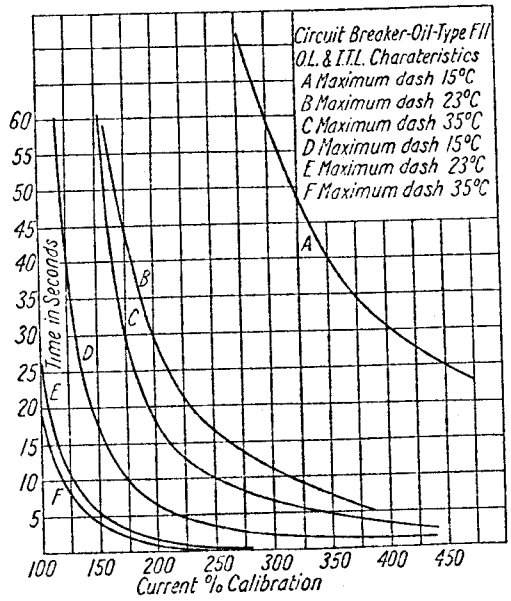


FIG. 11—CALIBRATION CURVE

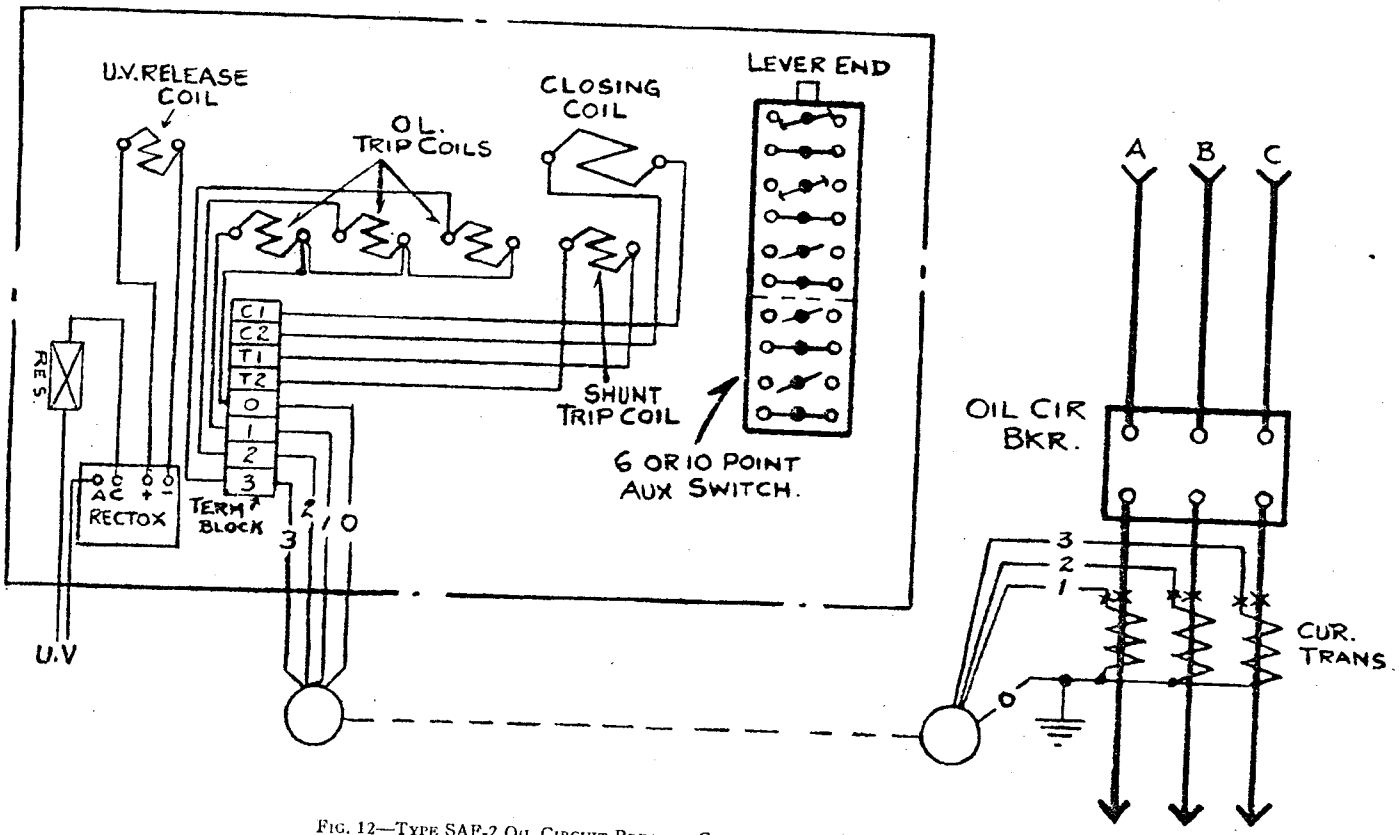


FIG. 12—TYPE SAP-2 OIL CIRCUIT BREAKER CLOSING MECHANISM WIRING DIAGRAM

RENEWAL PARTS DATA

Type SAF-2 Solenoid-operated Mechanism For Oil Circuit Breakers

Style No. 1020985, A, B—Vertical-Push—F-122
Style No. 1020986, A, B—Vertical-Push—F-124
Style No. 1021052, A—Horizontal-Push—F-124
Style No. 1021053, A—Horizontal-Push—F-124

(For Illustration of Parts—See Figure 3)

Mechanisms in use up to and including			1	5	
Ref. No.	Name of Part	Number Per Unit	Recommended for Stock		Style No. of Part
..	Mechanism Complete	1	0	0	. . . . .
1	Breaker Lever (Vertical-Push—F-122)	1	0	0	1 021 011
1	Breaker Lever (Horizontal-Push—F-122)	1	0	0	1 021 054
1	Breaker Lever (Vertical-Push—F-124)	1	0	0	1 021 012
1	Breaker Lever (Horizontal-Push—F-124)	1	0	0	1 021 055
2	Breaker Lever Link	2	0	0	1 020 990
3	Mechanism Lever	2	0	0	1 020 991
4	Mechanism Lever Retrieving Spring	2	0	1	1 021 000
5	Moving Core and Push Rod	1	0	0	1 020 988
6	Moving Core Push Rod Roller	1	0	0	970 132
7	Moving Core Push Rod Roller Pin	1	0	0	1 020 994
8	Moving Core Guide Tube	1	0	0	1 021 005
9	Tripping Lever (F-122)	1	0	0	1 021 073
10	Bumper Spring (F-122)	1	0	1	1 035 810
9	Tripping Lever (F-124)	1	0	0	1 020 996
10	Bumper Spring (F-124)	1	0	1	1 035 809
11	Tripping Lever Link	1	0	0	1 020 992
12	Tripping Lever Spring	1	0	1	1 020 999
13	Main Latch	1	0	0	1 020 989
14	Main Latch Pin	1	0	0	673 870
15	Main Latch Spring	1	0	1	1 020 998
16	Trigger	1	0	0	1 017 949
17	Trigger Roller	2	0	0	1 016 906
18	Trigger Link	1	0	0	1 020 993
19	Hand Closing Lever	1	0	1	1 021 003
20	Hand Closing Lever Spring	1	0	0	1 020 008
21*	Type W Auxiliary Switch— 6 Pole	1	0	0	501 821
21*	Type W Auxiliary Switch—10 Pole	1	0	0	. . . . .
22	Operation Counter	1	0	1	. . . . .
23‡	Closing Coil	1	1	1	‡
24‡	Trip Coil	1	0	1	‡
25‡*	Overload Trip Coil	1	0	1	‡
26‡*	Undervoltage Trip Coil	1	0	1	‡

* Not Illustrated.

‡ When ordering, specify identification number stamped on coil.
Parts indented are included in the part under which they are indented.

ORDERING INSTRUCTIONS

When ordering Renewal Parts, always specify the name of the part wanted as shown on the illustrations in this Instruction Book, giving Shop Order Number, and the type of Mechanism as shown on the nameplate. For example:

One tripping lever for Type SAF-2 solenoid operated mechanism, SO-31-F-187, shown in Instruction Book 5790.

To avoid delays and misunderstandings, note carefully the following points:

1. Send all correspondence and orders to the nearest Sales Office of the Company.

2. State whether shipment is to be made by freight, express or parcel post. In the absence of instructions, goods will be shipped at our discretion. Parcel post shipments will be insured only on request. All shipments are at purchaser's risk.

3. Small orders should be combined so as to amount to a value of at least $1.00 net. Where the total of the sale is less than this, the material will be invoiced at $1.00.