RECEIVING • INSTALLATION • MAINTENANCE

INSTRUCTIONS

"De-ion" Grid

OIL CIRCUIT BREAKER

Outdoor Type G

Type 144-G-100	14.4 kv	600 Amperes
Type 144-G-250	14.4 kv	600 Amperes
Type 144-G-250	14.4 kv	1200 Amperes
Type 230-G-250	23 kv	600 Amperes

WESTINGHOUSE ELECTRIC CORPORATION
SWITCHGEAR DIVISION
EAST PITTSBURGH PLANT • EAST PITTSBURGH, PA.
NEW INFORMATION
MAY, 1954
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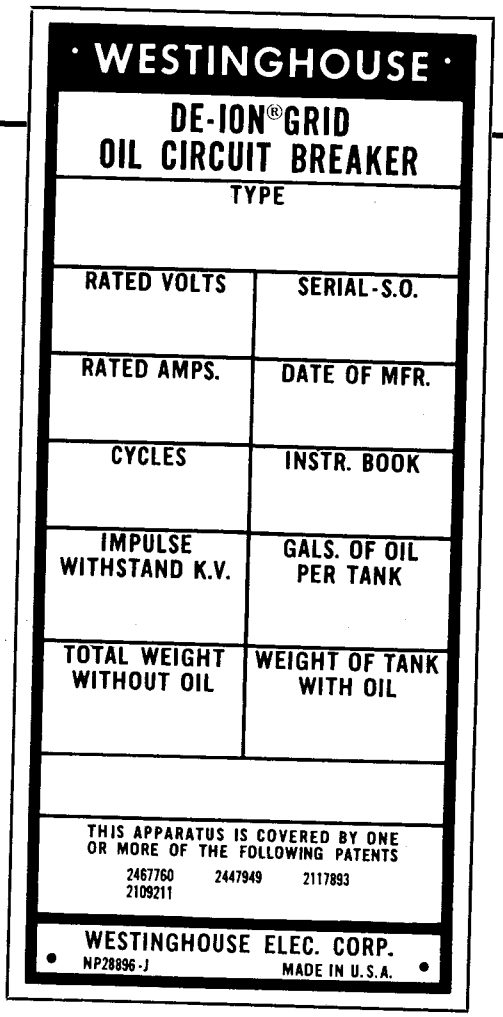
SPECIAL INQUIRIES

Extra copies of this instruction book can be obtained by request to the nearest Westinghouse representative as listed in the back of this book. To facilitate replies when reference is made to this instruction book, be sure to state fully and clearly the figure number showing parts in question and the name of the parts given. Also give the nameplate reading, particularly the Serial-S.O. number.



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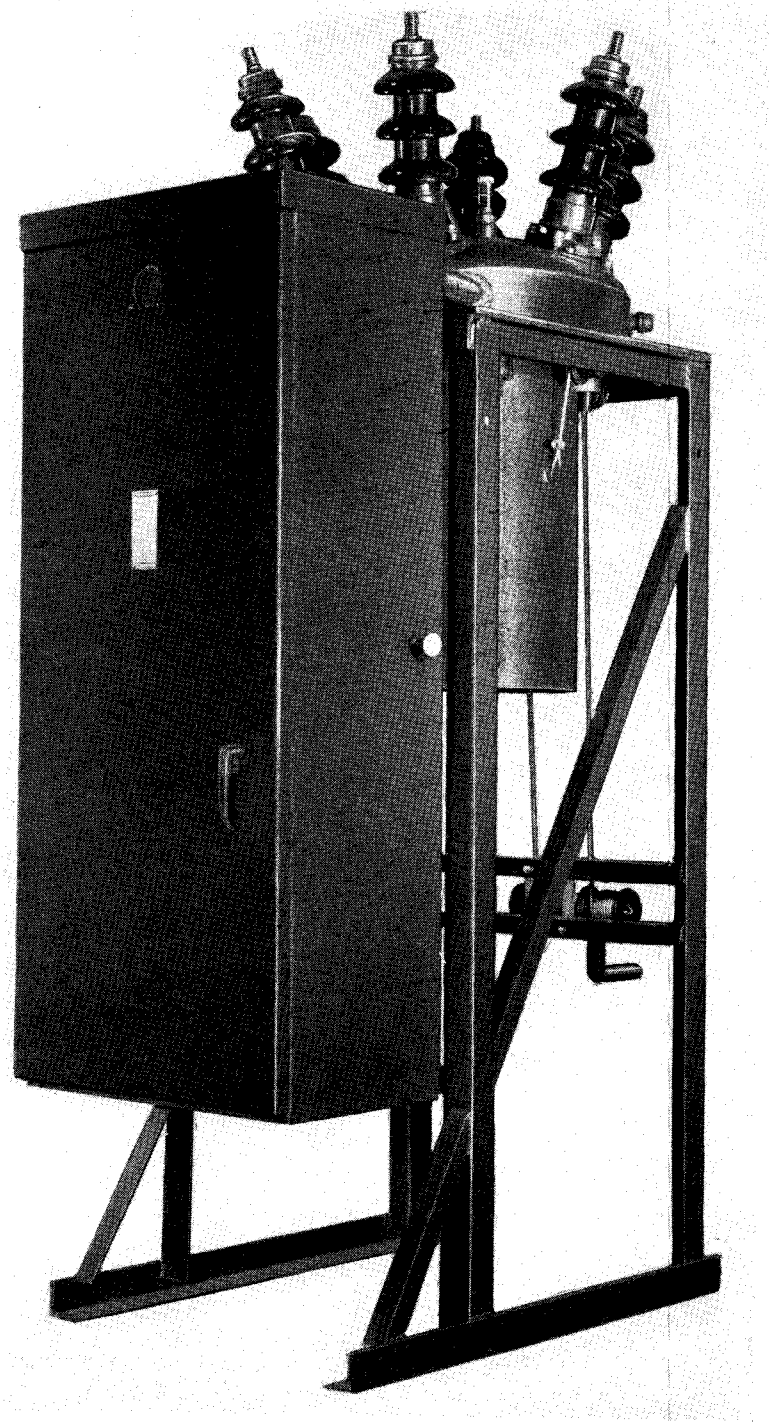


TYPE G OIL CIRCUIT BREAKER

The oil circuit breaker in a modern power system must always be ready to operate when called upon. It must close when the operator energizes the closing solenoid on electrically operated circuit breakers by moving the controller on the switchboard. It must open promptly when tripped by the operator moving the controller or when the protective relays function to energize the trip coil. It must open and interrupt the circuit, when a fault condition exists on the circuit, without damage to itself or adjacent apparatus, and continue to give satisfactory service with a minimum of maintenance.

The circuit breaker should be properly installed so that it will perform in the manner contemplated in the design. The construction should be such that maintenance can be carried out without undue skill being demanded on the part of the maintenance crew. A thorough knowledge of the construction of the circuit breaker and a complete understanding of the instructions given in this Instruction Book are essential to the satisfactory performance of the apparatus.

RECEIVING, HANDLING AND STORING

RECEIVING THE SHIPMENT

Each circuit breaker is assembled completely, and tested at the factory, previous to being prepared for shipment. Immediately upon receipt an examination should be made for evidence of any damage which may have occurred while enroute. If any injury is evident or indication of rough handling is visible, claims for damage should be filed at once with the transportation company and the nearest Westinghouse representative notified promptly.

STORING

The circuit breaker, when received, should be stored in a clean, dry location. Storing the circuit breaker near where construction work is still going on, may result in considerable expense and work in cleaning and preparing it for service. It must not be exposed to dirt, to the action of corrosive gases such as chlorine, nor to possible mechanical injury. Dust incident to work on concrete structures is especially bad as the dust may work into the bearings or sliding parts causing undue friction or destructive abrasion.

HANDLING

The blocking around the skids and the tie bars holding the breaker down on the car should be removed first. This will permit moving the breaker on its skids to truck or other transport that will transfer it to its final location where the foundation should be ready to receive it. The skids can then be removed and the breaker bolted down in place.

In case clearances make it difficult to move the breaker standing up it can be laid down on its back on suitable blocking, after removing the tank lifter, for transport by truck. The lifting eyes on the back of the housing and in the center of the dome provide convenient places to attach slings or a chain hoist. ***Do not allow the slings to bear against the porcelains of the condenser bushings.***

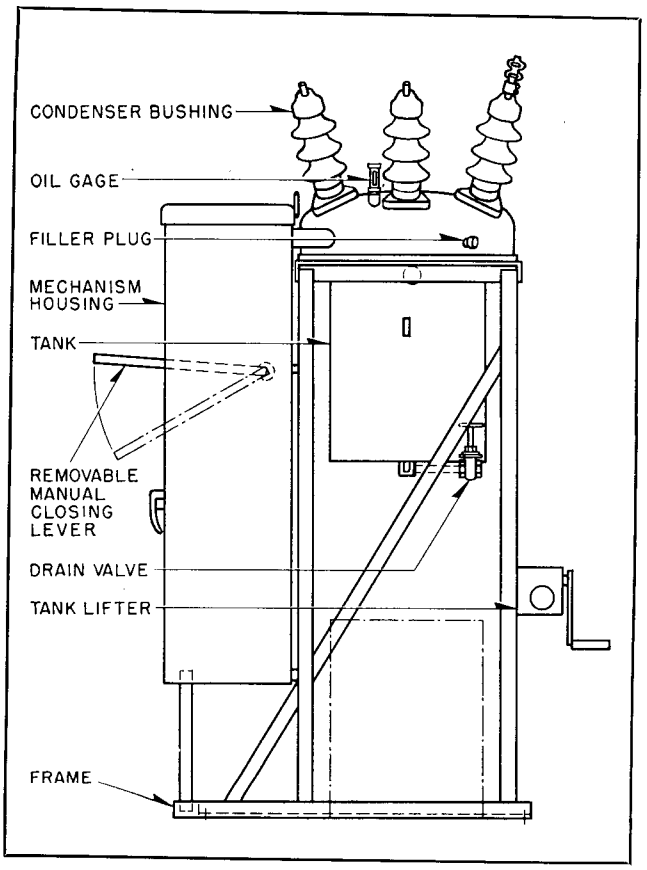


FIG. 1. Assembly

Check the breaker against the shipping list to see that everything included is accounted for and in good condition. Keep identification tags and this instruction book handy until installation is complete then the book should be placed on file where it is available to the operating and maintenance staffs. Additional copies can be obtained upon request to the nearest Sales Office of the Westinghouse Electric Corporation or any Westinghouse representative.

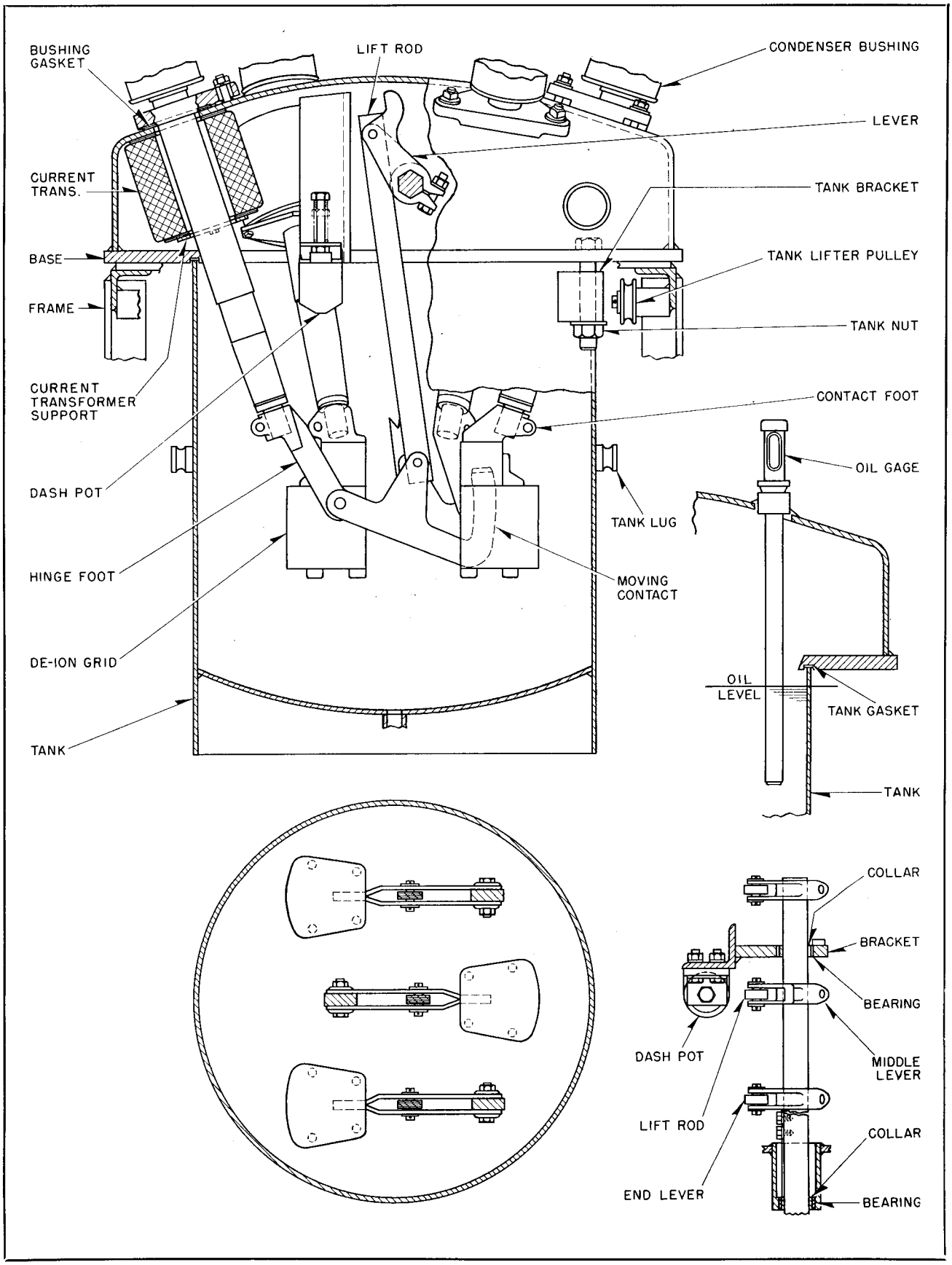


FIG. 2. Pole Unit Assembly

INSTALLATION

MOUNTING THE ASSEMBLY

1. Square up frame by placing wedges under the bottom angles. Tighten mounting bolts. Fill space under mounting angles with grout.

2. Remove the bolt holding the door handle. Open door and put stop rod in place to hold it open. Note door can be removed by taking out hinge pins.

3. Swing out relay panel, if one is included, and place hand closing lever in position to close breaker.

4. Examine solenoid closely and locate the wire holding trigger in latched position. Remove carefully so that trigger is not released.

5. Press down on hand closing lever raising closing core to the fully closed position. An increased pressure will relieve load on holding latch (see section on solenoid mechanism) which can be pushed back out of the way with a screw driver or a small stick.

6. Open breaker slowly by releasing pressure in hand closing lever. Note that pressure in hinge contacts retards opening movement when opened slowly so that movement almost stops.

Caution: Do not trip the solenoid mechanism while removing the wire ties because the breaker will move so fast that anyone caught in any of the moving parts may be seriously hurt.

7. Remove the tanks and examine the inside for evidence of moisture or foreign matter. Flush with benzine or circuit breaker oil. Tanks should not be lowered in wet weather without provision for keeping out moisture.

8. Examine the contacts to see that they are clean and in alignment. See section covering "Adjustments" on page 13.

9. Operate the breaker by hand several times, watching each pole and the operating mechanism to be sure that all parts move freely and that the moving contacts enter the De-ion grids without interference.

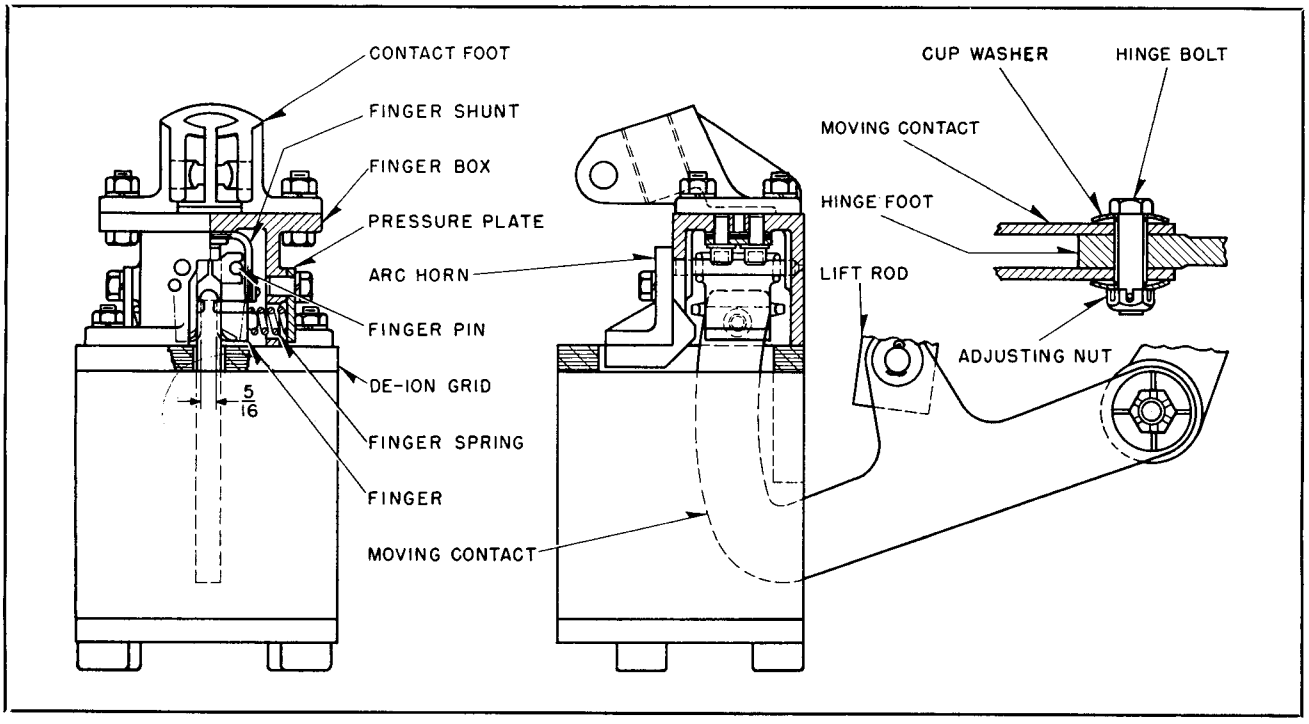


FIG. 3. Contact Assembly

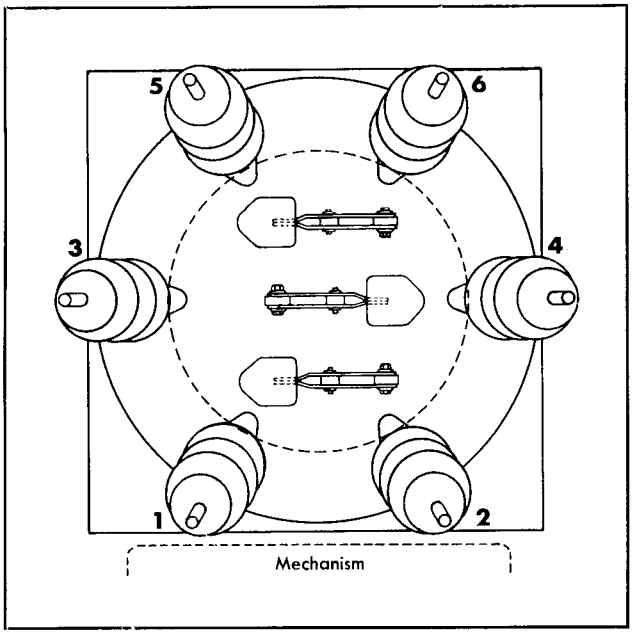


FIG. 4. Mechanism

CONTROL LEADS

Remove the plate from the bottom of the mechanism housing and drill for entrance of the conduit.

Connect up the control according to the diagram supplied for the breaker. Be sure the leads which carry the closing current are large enough so the voltage drop will not be excessive. Fuses, or other thermal protective devices, placed in the main control circuit should have a rating of 30 percent to 50 percent of the normal E/R current rating of the closing coil. This will permit passage of the closing current long enough to close the breaker without interrupting the control circuit and yet will interrupt it promptly if the breaker fails to close.

Note: The switch on the control panel should be open at all times while the breaker is being worked on. This prevents unintentional operation of the breaker by the switchboard attendant with possible injury to anyone caught by any of the moving parts of the breaker.

Check the control voltage at the breaker with a voltmeter when the closing coil is energized to see that the drop in the control bus will not interfere with operation. While the operating solenoid will close the breaker at minimum control voltage, better all-around performance will be obtained by keeping the potential near the normal control voltage shown on the nameplate.

Caution: Always be sure the transformer secondary connections are completed before energizing the breaker. Short circuit unused transformers.

Transformer Taps. All taps on each transformer are brought out to the terminal blocks. When over load coils or over current relays are included they will be connected at the factory to the highest ratio tap. The bushing type current transformer nameplate should be used as an indication of the proper taps to use for relaying or current tripping for the particular load the breaker is to control. It is always necessary to check the proper taps by test.

Ground. Connect the breaker frame to ground through the grounding pad 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.

Connections. Install connections to the breaker studs. The contact surfaces at all junctions must be carefully cleaned to remove all oxide. Copper surfaces can be draw filed or rubbed with fine sandpaper. Threaded copper surfaces can be brushed vigorously with a fine steel brush. Silver

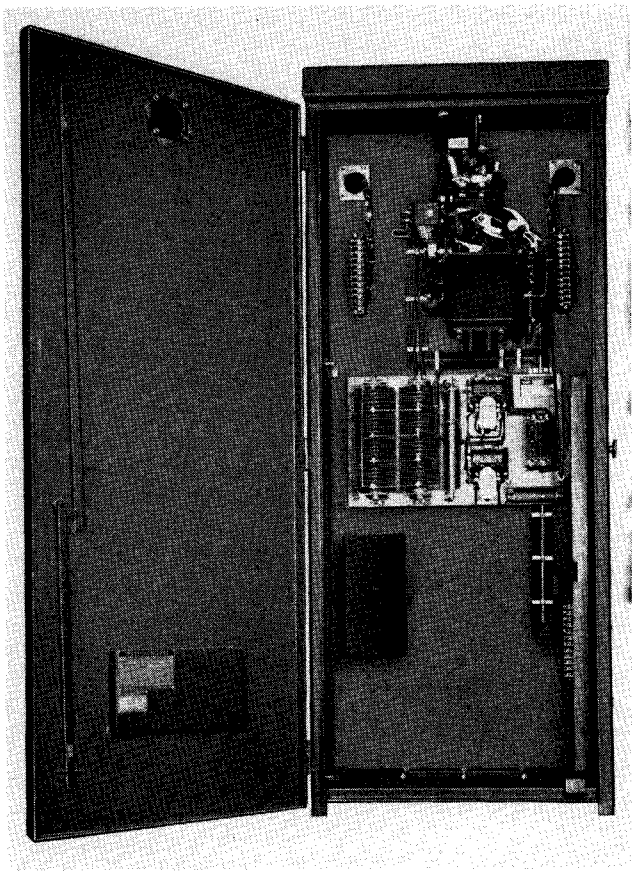


FIG. 5. Mechanism Housing

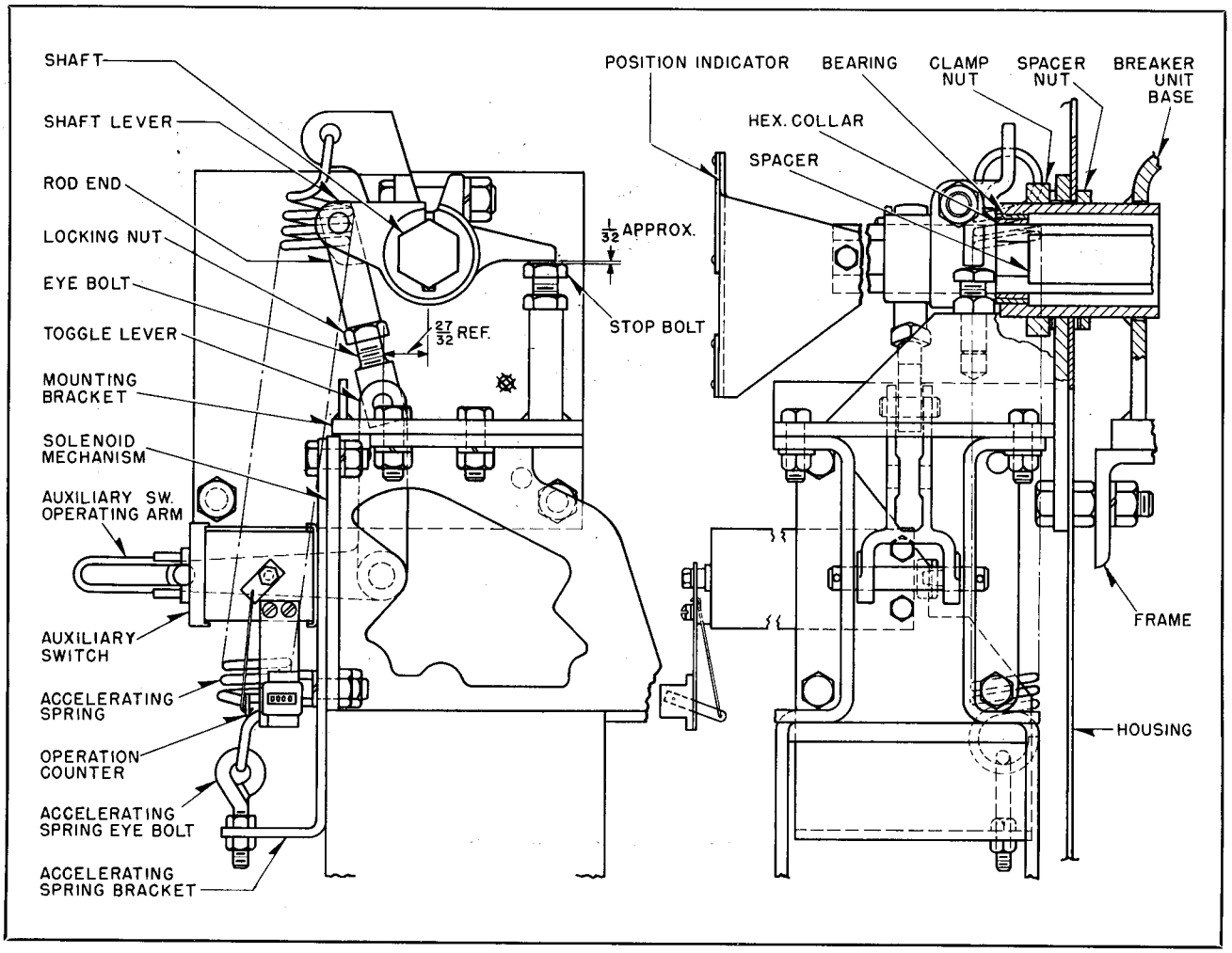


FIG. 6. Toggle Assembly

plated surfaces should be rubbed lightly with fine steel wool and never filed or sanded unless re-silvered afterwards. A light coat of linseed oil on contact surfaces and studs will make a better joint and will make breaking the joint easier when that becomes necessary.

The terminal studs are not designed to withstand undue cable or bus bar loads. An excessive strain, which at first may have no apparent effect, may eventually loosen the porcelain weather casing and permit moisture to enter the breaker. The power leads should have adequate capacity to carry the normal circuit load without overheating and to carry the possible momentary currents that may occur without excessive overheating. They should be properly braced to withstand the magnetic forces of the short circuit currents which may occur.

Close and trip a few times to be sure operation is correct. Do not operate any more than is necessary for checking when the tank is lowered as the hydraulic dashpot cushioning the stopping of movement at the end of the opening stroke is not in operation.

Tank. Fill the tank with oil to the level indicated on the nameplate. Raise tank into place with the tank lifter. Watch, in raising tank, to see that the studs on the under side of base enter smoothly into the loops welded to the sides of the tank. As soon as the studs pass through the loops start the nuts by hand. Raise the tank with lifter high enough to see that tank rim registers in the groove in the base and against the packing. Draw the nuts up evenly all around. With the tank in place adjust the oil level by drawing off surplus thru the drain valve or adding thru the filling pipe at the right rear side of the base. In hot weather it is best to leave oil level slightly high and in cool weather slightly low, as oil level will change with

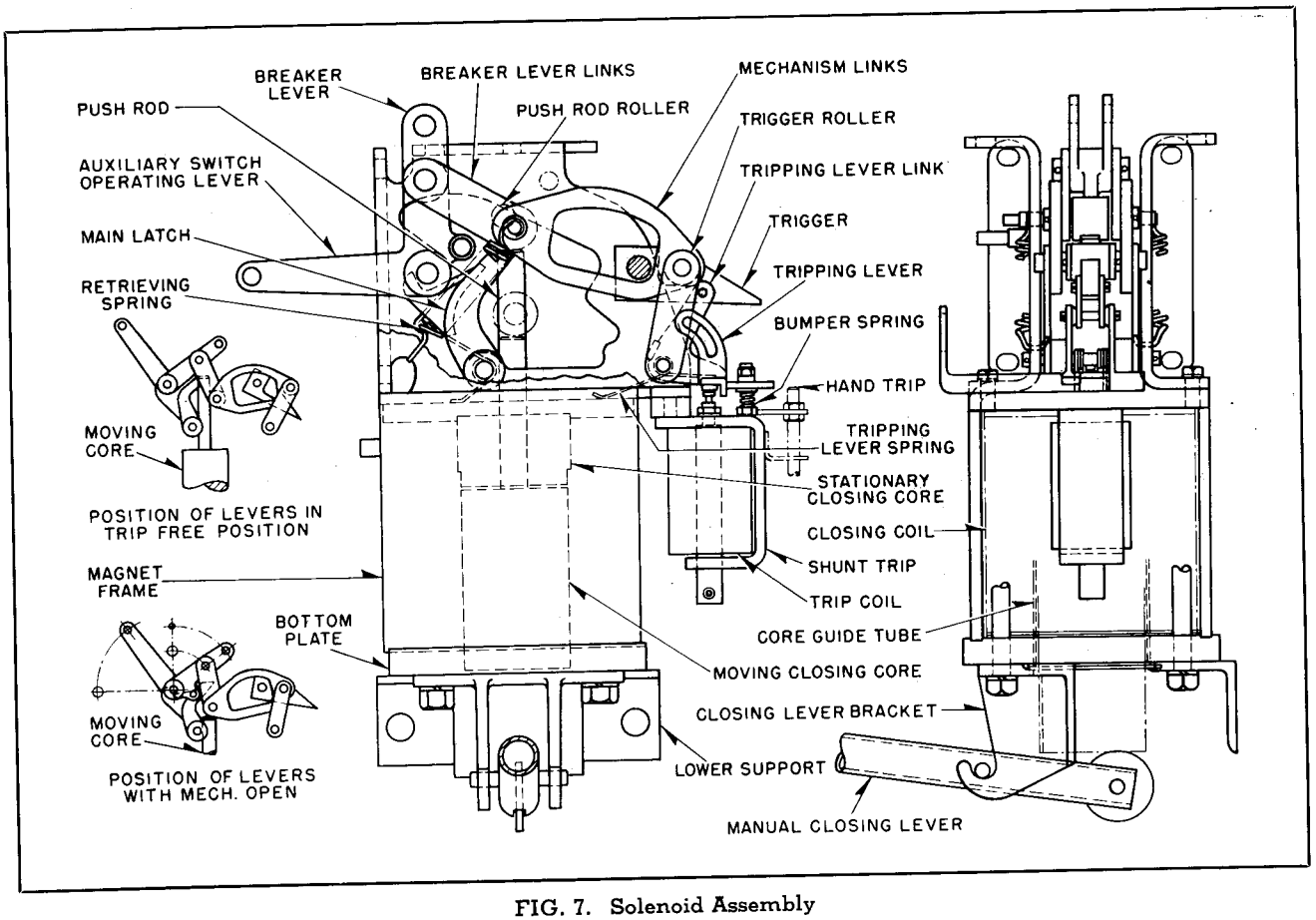


FIG. 7. Solenoid Assembly

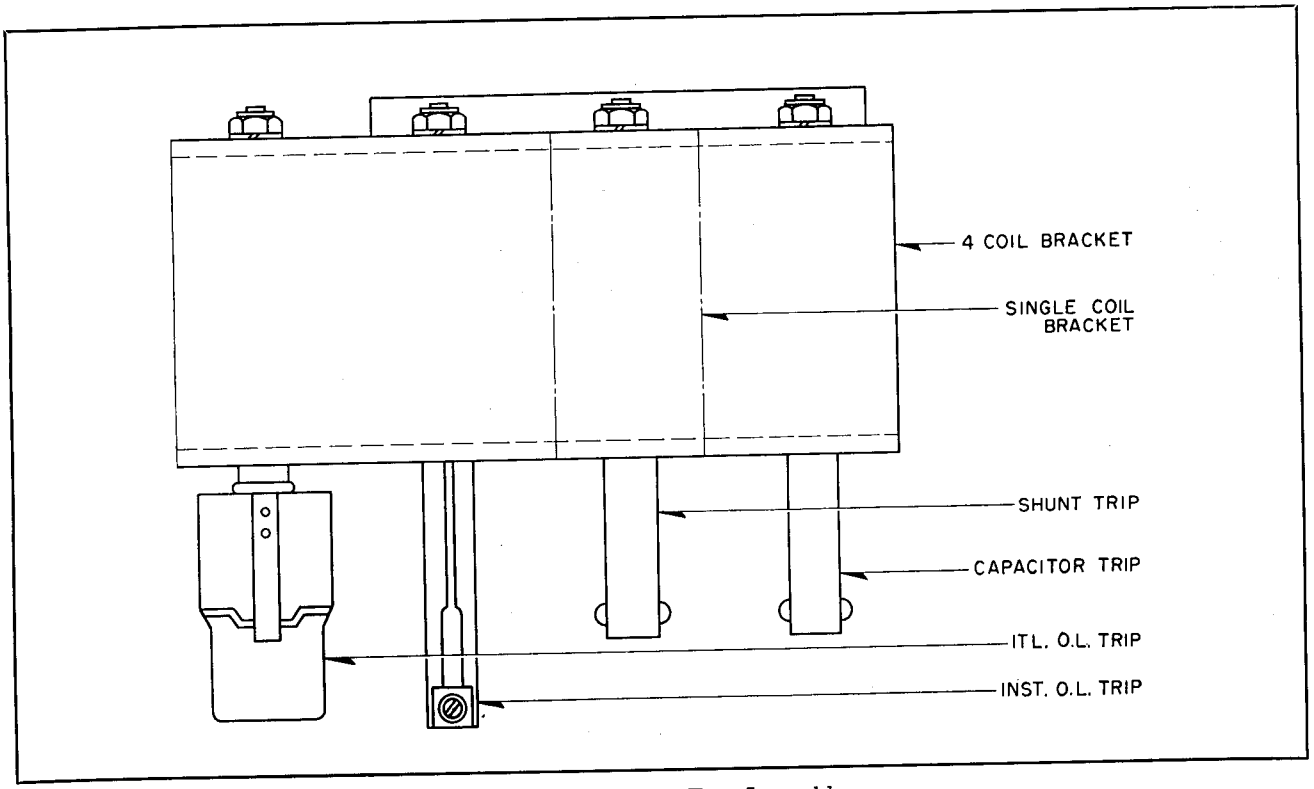


FIG. 8. Four Coil Trip Assembly

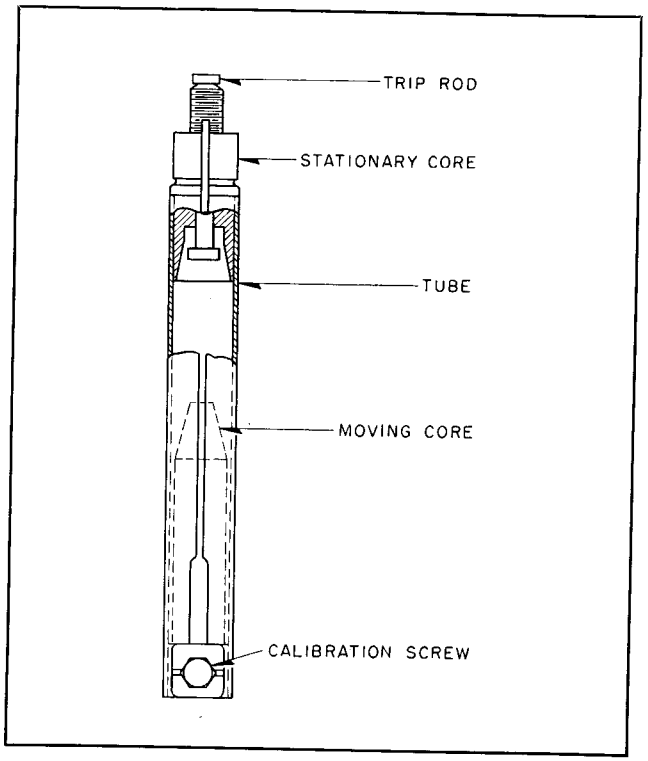


FIG. 9. Overload Trip Assembly

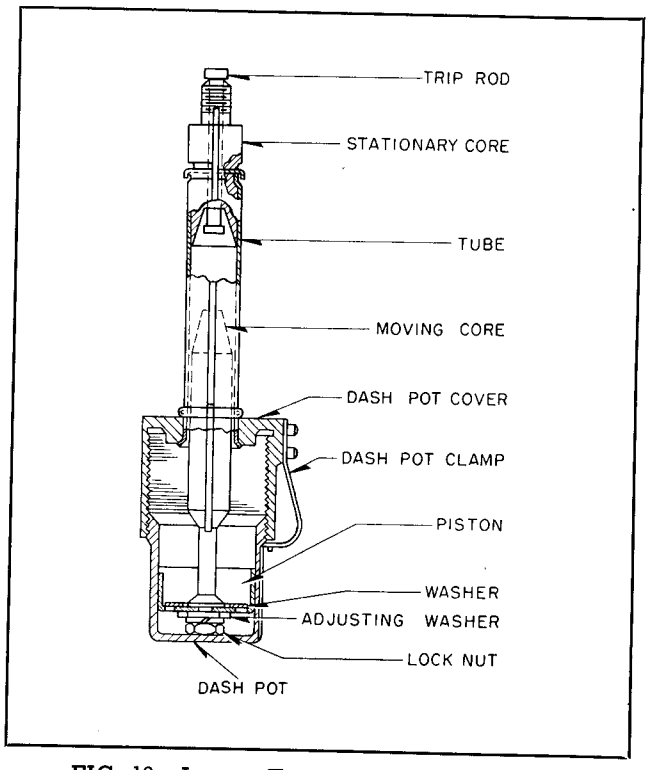


FIG. 10. Inverse Time Limit Trip Assembly

the temperature. A ratchet socket wrench with an extension reaching down below the lower edge of the tank makes tank renewal and replacement easier. A "T" handle for the extension will help to drive the tank supporting nuts on *TIGHT.*

Check of Operation. With the tank in place and all connections made the circuit breaker should be operated a number of times from the control switch to see that all circuits are clear.

1. Observe the response of the lights to the position of the breaker contacts.

2. Check each relay to see that it trips the breaker and that the target in the relay drops.

3. Check, if possible, to see that solenoid closes and latches with 90 volts (for 125 volt control) across the closing coil.

4. Check to see that 58 percent of normal potential on the trip coil trips the breaker.

5. Check to see that raising the trip core slowly by hand releases the trigger and there is approximately 1/16-inch of travel left at the instant the trigger is released.

6. Check time to close and time to part contacts with a cycle counter, which should not be over 15 cycles and 5 cycles respectively. If a Cincinnati Timer is available make a record of a closing, of an opening and of a close-trip open operation.

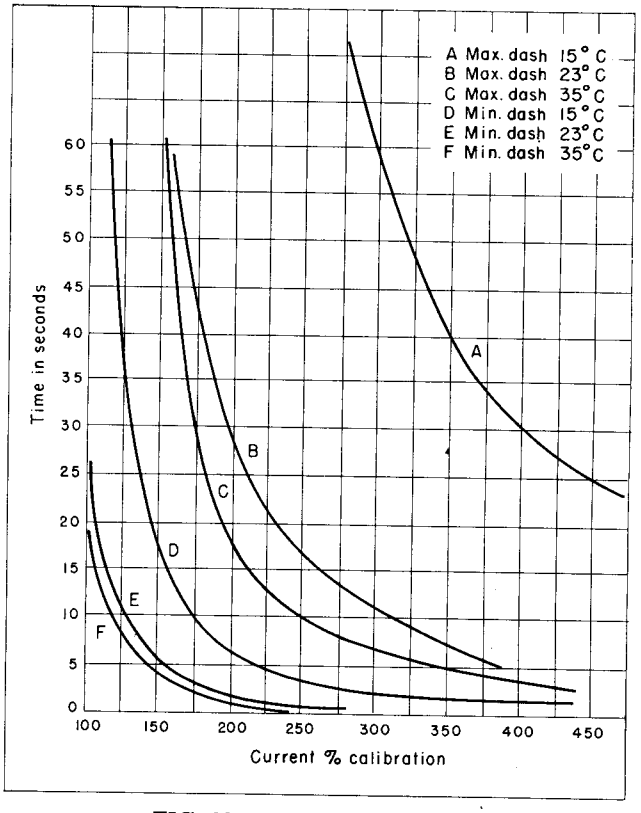


FIG. 11. Time Delay Curves

PART THREE

ADJUSTMENT AND MAINTENANCE

CONTACT ADJUSTMENT

1. Remove the arcing horn on the back of and at the top of the De-ion grids.

2. Observe that the contact fingers are approximately 5/16 of an inch apart and are centered over the slot in the grid. The grid can be moved slightly if necessary by loosening the bolts holding them to the contact box.

3. Check to see that the moving contact swings easily into the slot as the breaker is closed slowly by hand.

4. Also see that moving contact strikes centrally between the fingers and at approximately the same time on all three contacts.

5. Note particularly to see that moving contact clears the lugs on the side of the fingers. The contact box can be moved slightly on the foot by loosening the bolts holding them together. The contact feet can be screwed up or down on the threaded stud by full turns if necessary. The entire condenser bushing can be moved slightly by the amount of the clearance in the holding bolts.

Caution: Always see that flange of condenser bushing does not touch the plate forming the lower part of the top cover.

Any slight roughness found on the contacts should be smoothed with a file. Contacts should be replaced if burns penetrating more than 1/16-inch are found.

INSULATING 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 tank.

A sample of oil should be drawn off at regular intervals and tested in a standard test cup. The first oil withdrawn will clear the drain pipe and the sediment from the bottom of the tank. This should be discarded. The oil level can be brought up again by adding oil thru the filling pipe.

Only the highest grade, such as Wemco "C", or other approved oil, should be used in a circuit breaker. The oil should be new or thoroughly reconditioned by means of a filter press or centrifuge. Before use a sample should be given a dielectric test using an approved test cup with one inch circular discs spaced 0.1 inches apart. The oil should withstand 25 to 30 kv. Oil testing below 17 kv should be replaced.

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.

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 44-820-1A.

OPERATING MECHANISM

The Type SAF-2 mechanism is a solenoid-type operating on standard direct current control voltages or, when equipped with a rectifier unit, on alternating current. It is mechanically full automatic and trip free in all positions.

The standard mechanism is supplied with a single shunt trip coil and single-pole plunger type cutoff switch. Non reclosing breakers are equipped with a 7-pole rotary-type auxiliary switch for the trip coil cutoff and indicating lights. Reclosing breakers are equipped with an 11-pole rotary-type auxiliary switch and latch checking switch.

The mechanism can be supplied with a capacitor shunt trip, three instantaneous or inverse time delay transformer trip coils.

Mechanism Operation. Energizing the closing coil forces the moving core and push rod upwards against the push rod roller (located at the junction

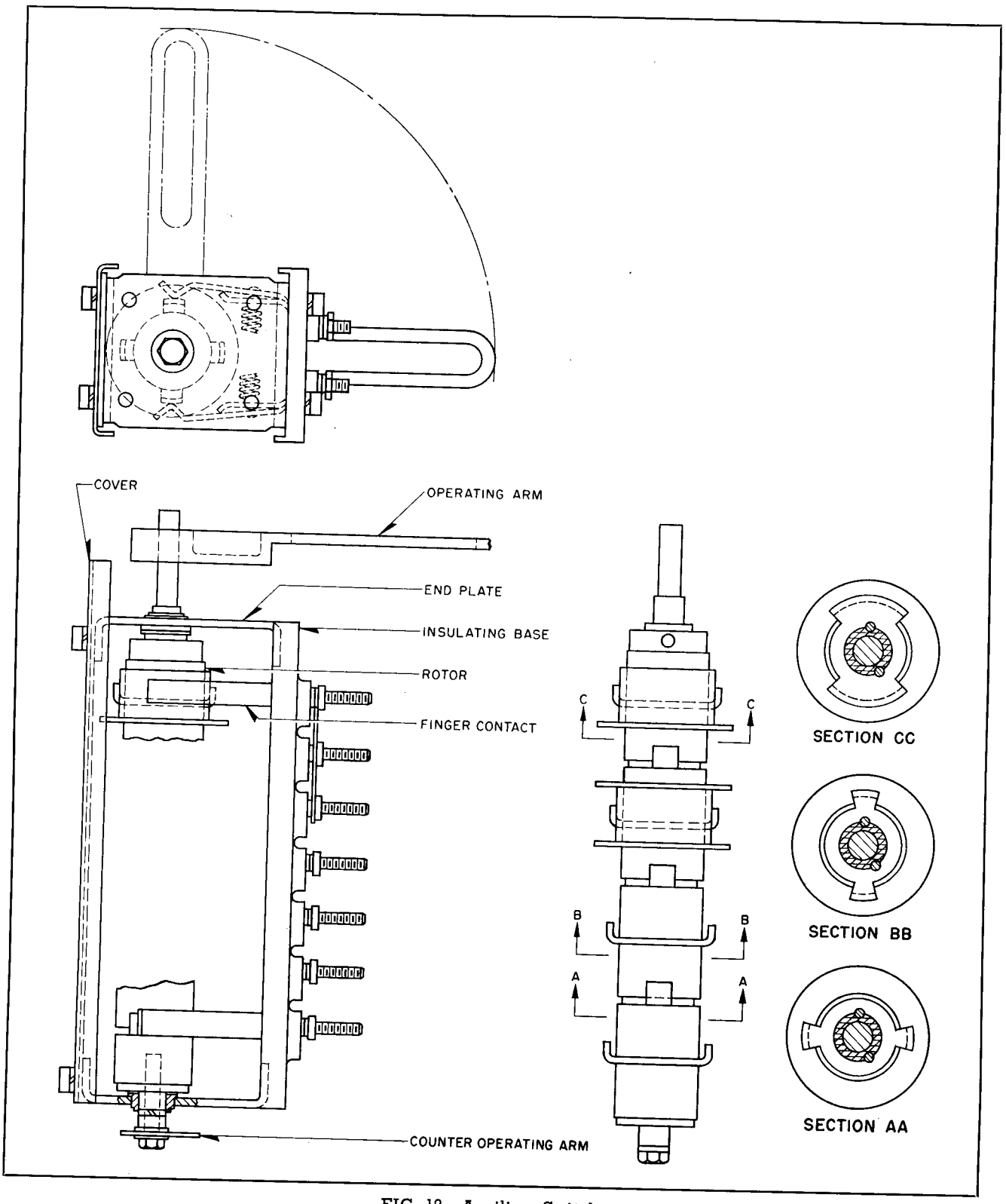


FIG. 12. Auxiliary Switch

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 pushed under the

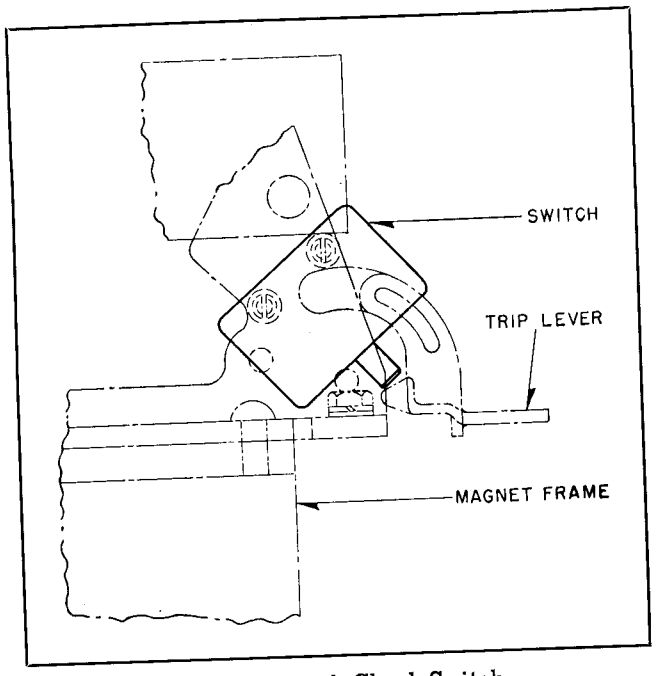


FIG. 13. Latch Check Switch

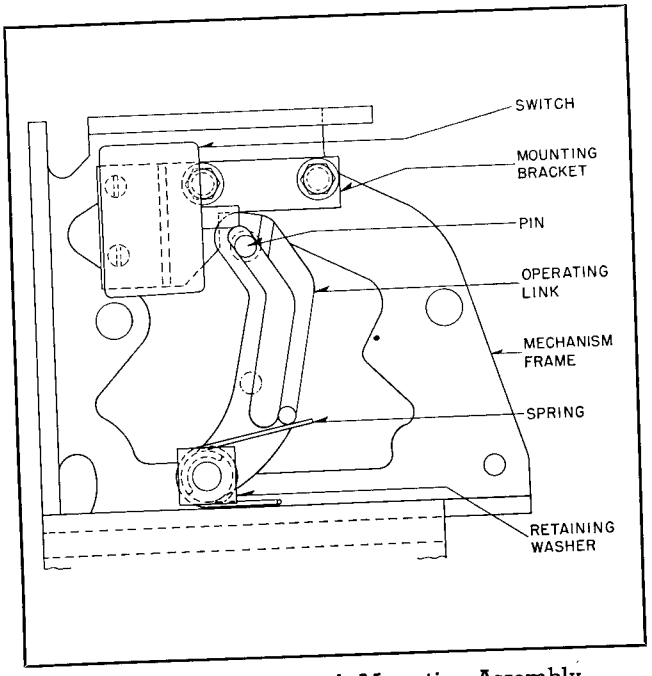


FIG. 14. Cutoff Switch Mounting Assembly

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.

MAINTENANCE SCHEDULE

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.

ATTACHMENTS

Four Coil Attachment. 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

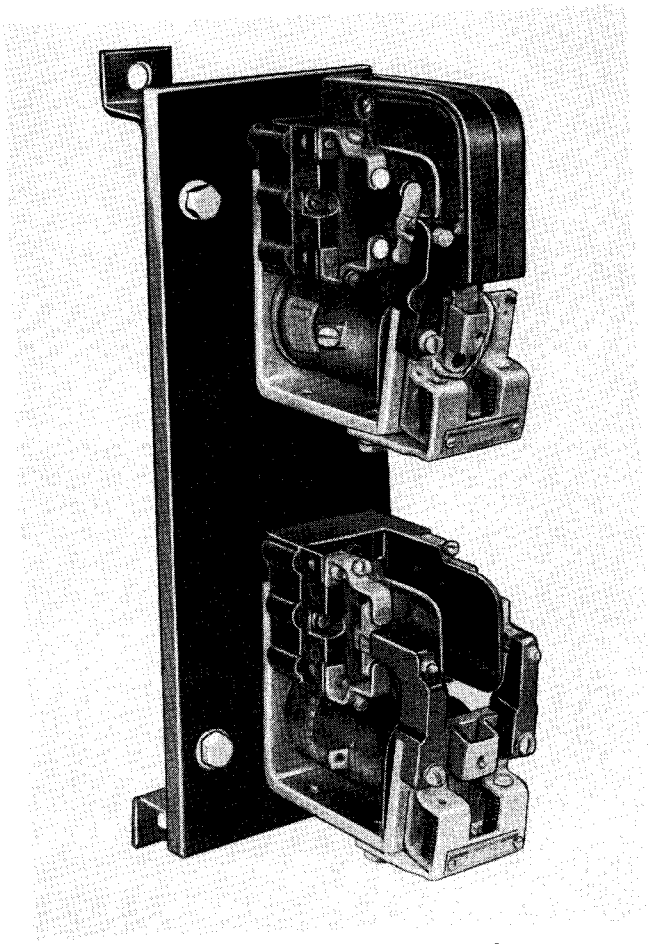


FIG. 15. D-C Control Panel

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.

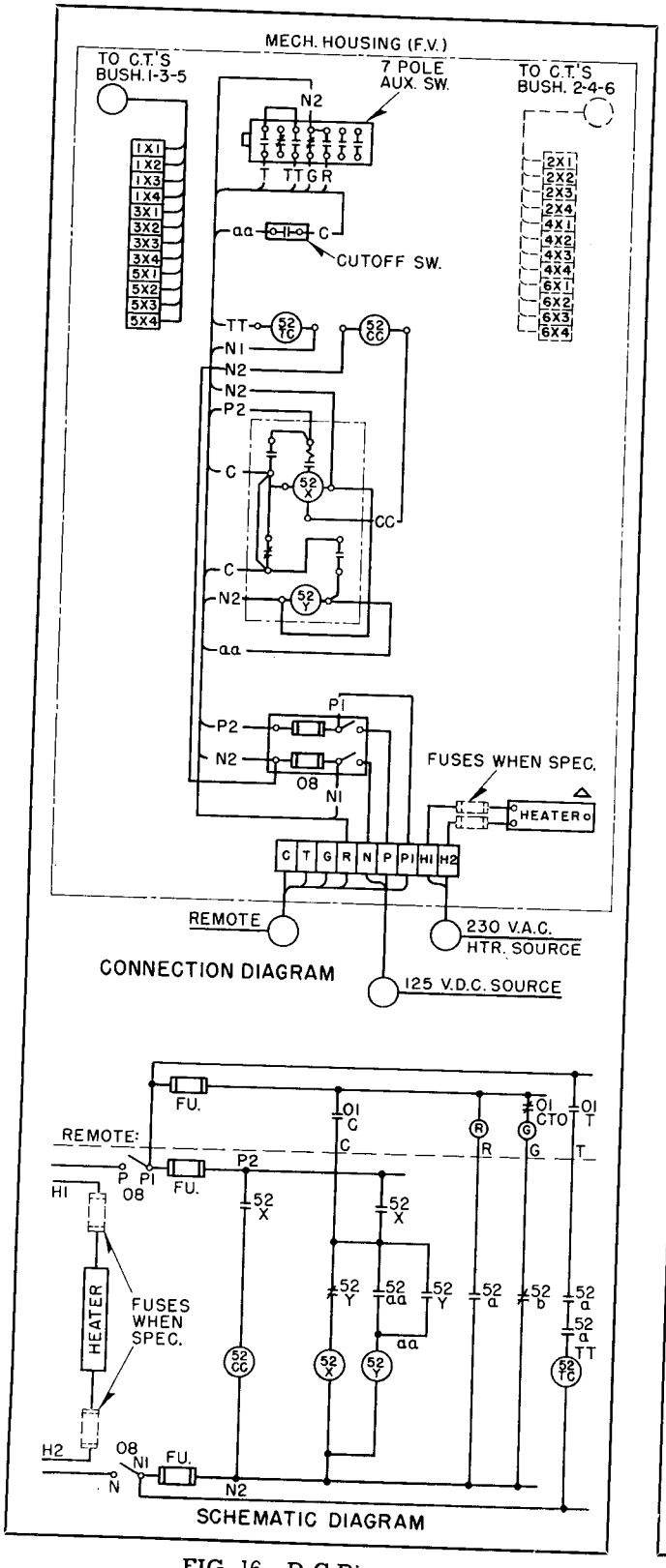


FIG. 16. D-C Diagram

Operation Counter. The operation counter mounts on the rotary auxiliary switch bracket. After mounting in place and connecting to the auxiliary switch extension of the breaker lever the operation 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.

Rotary Auxiliary Switch. A seven pole rotary auxiliary switch (eleven pole on reclosing equipments) mounts in the upper left side of the

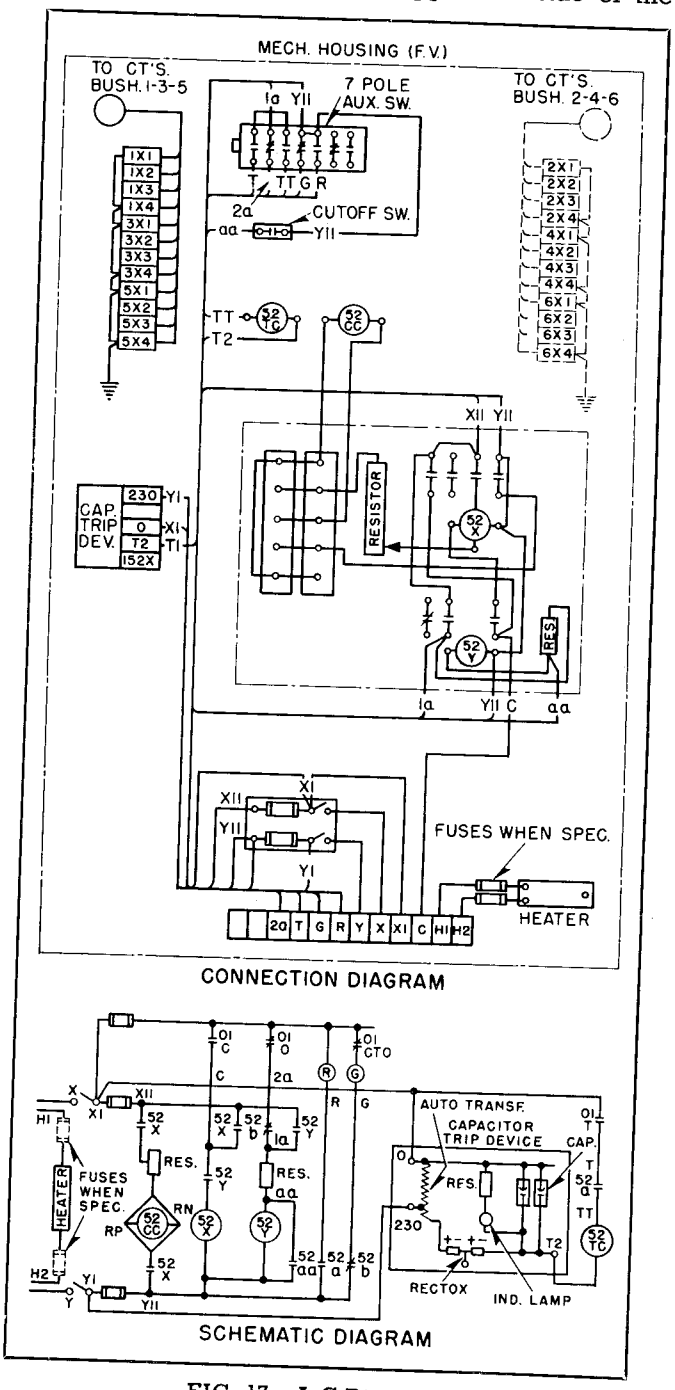


FIG. 17. A-C Diagram

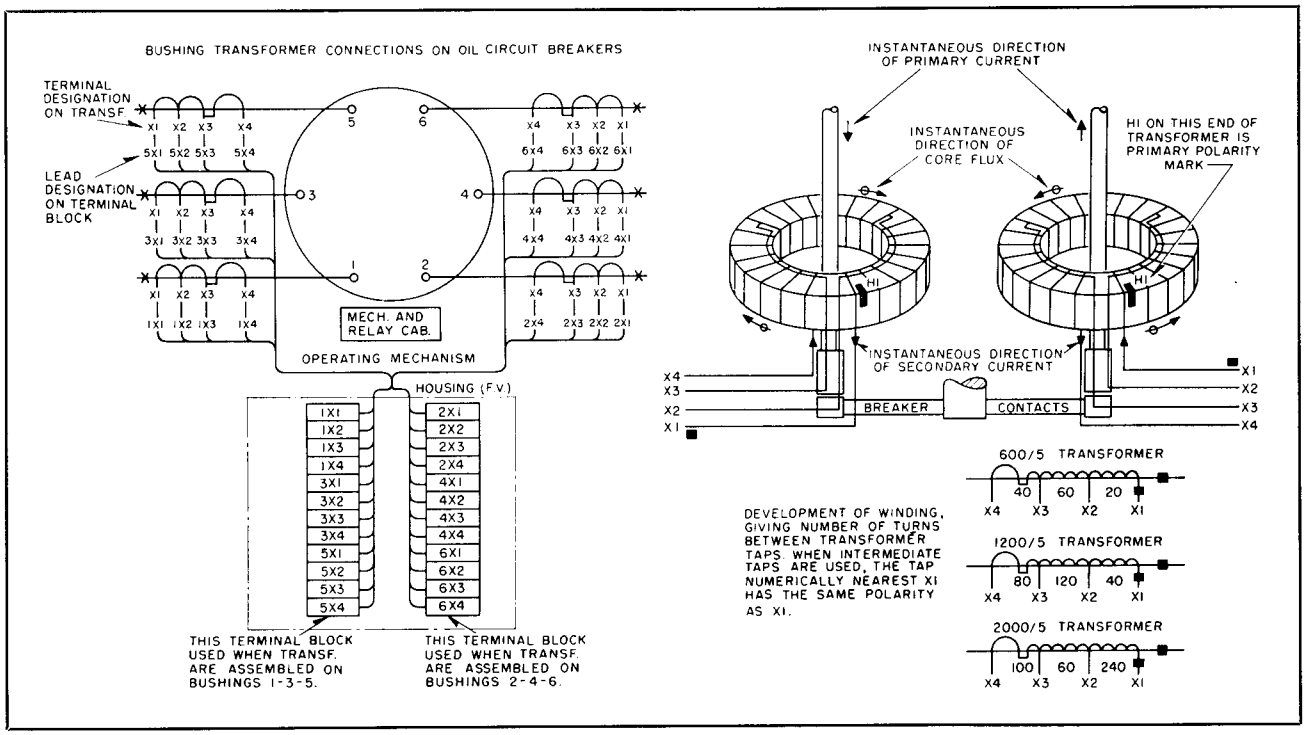
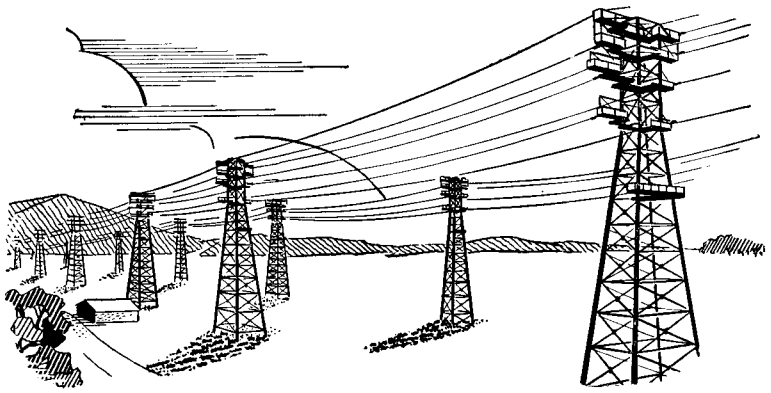


Fig. 18. Bushing Current Transformer Diagram

solenoid. The slotted arm in the switch engages a lug in the mechanism lever to turn the rotor 90 degrees. The first and third contact segments wired in series and are wider than the rest so they will make contact and complete the trip coil circuit just as the circuit breaker contacts touch. The rotor segments are arranged alternately so that the odd numbered ones make contact when the breaker contacts close and the even numbered ones make contact when the breaker contacts close. The segments can be changed from one position to the other by disassembling the rotor. Check the contacts from time to time to see that the flexible finger follows in and makes good contact with the rotor segment. Burns from arcing should be smoothed. Contacts should be replaced if burns have progressed to a point where stubbing is imminent.

Cutoff Switch. The cutoff switch mounts in the front of the mechanism. The switch operating lever pushes the switch plunger up and closes the contact. This opens the cutoff relay which in turn causes the main control contactor to drop open. Check the switch contacts from time to time to see that they are clean and not burned.

Latch Checking Switch. The latch checking switch mounts just above the trip bar in the front of the mechanism. The contacts open when the trip bar rises to trip the breaker and remains open until the triggers reset ready for another closing operation. Check switch contact from time to time to see that they are clean and not burred.



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WESTINGHOUSE
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RECEIVING • INSTALLATION • MAINTENANCE

INSTRUCTIONS

"De-ion" Grid

OIL CIRCUIT BREAKER

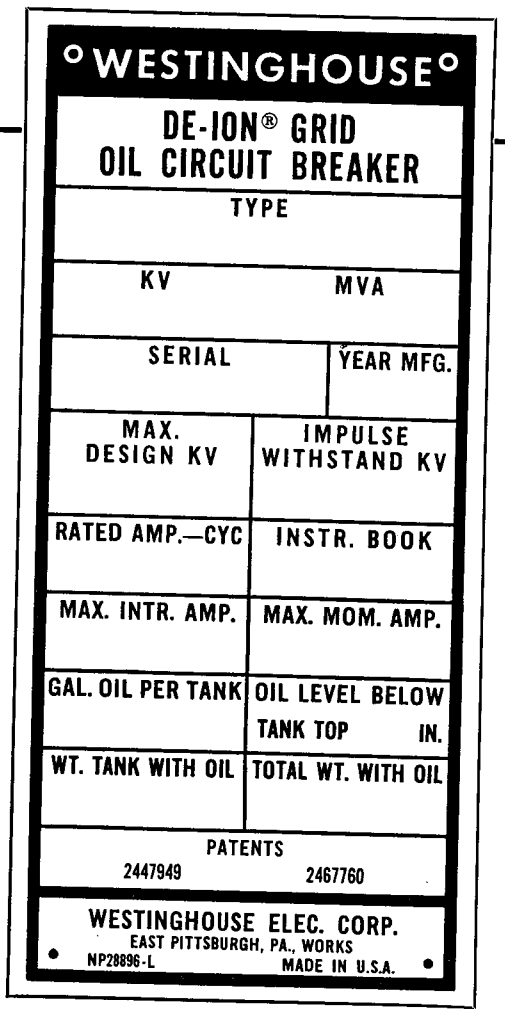
Outdoor Type G

Type 144-G-100	14.4 kv	600 Amperes
Type 144-G-250	14.4 kv	600 Amperes
Type 144-G-250	14.4 kv	1200 Amperes
Type 230-G-250	23 kv	600 Amperes

WESTINGHOUSE ELECTRIC CORPORATION
SWITCHGEAR DIVISION
EAST PITTSBURGH PLANT • EAST PITTSBURGH, PA.
SUPERSEDES I.B. 33-745-1
AUGUST, 1955
Printed in U.S.A.

SPECIAL INQUIRIES

Extra copies of this instruction book can be obtained by request to the nearest Westinghouse representative as listed in the back of this book. To facilitate replies when reference is made to this instruction book, be sure to state fully and clearly the figure number showing parts in question and the name of the parts given. Also give the nameplate reading, particularly the Serial-S.O. number.



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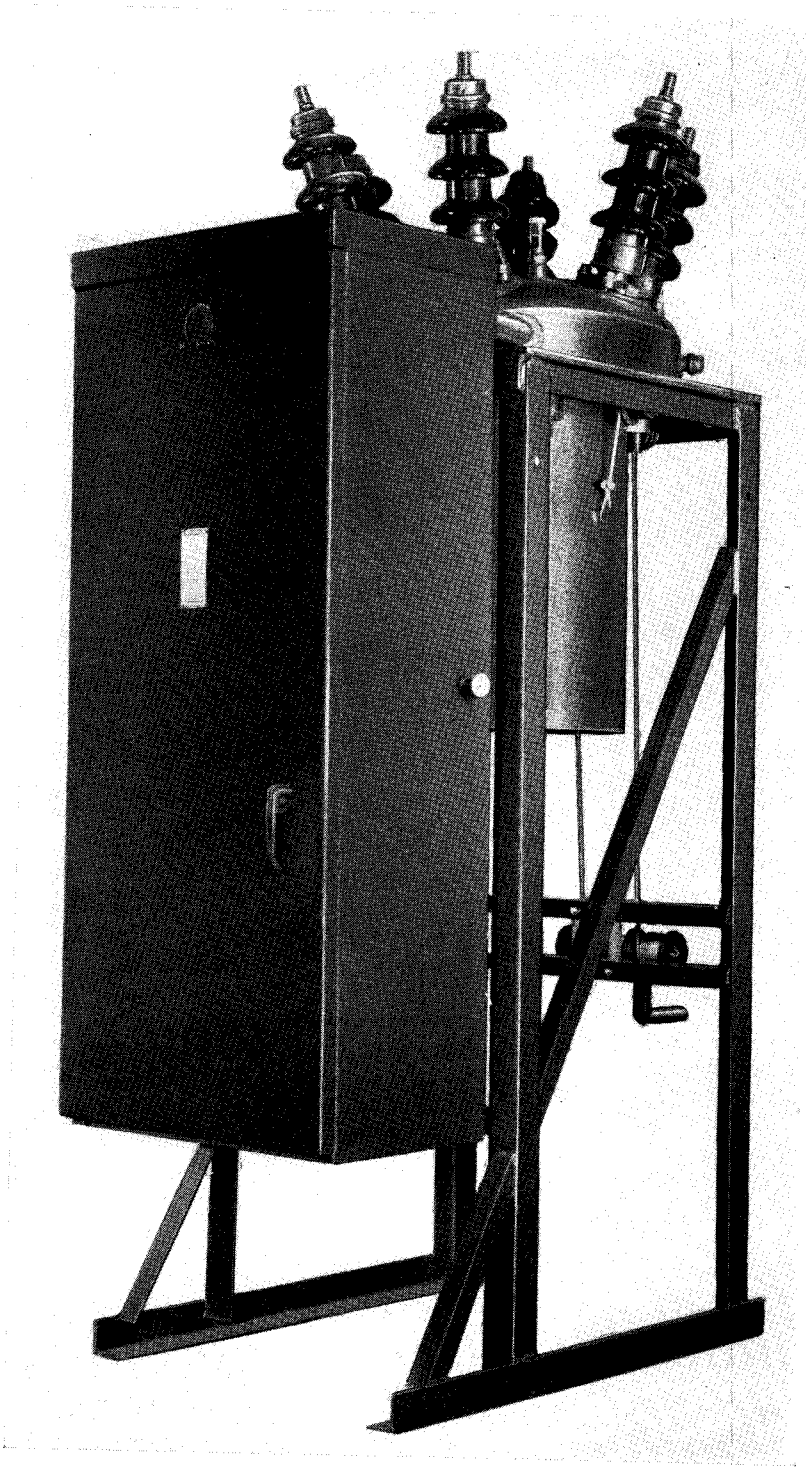


TYPE G OIL CIRCUIT BREAKER

The oil circuit breaker in a modern power system must always be ready to operate when called upon. It must close when the operator energizes the closing solenoid on electrically operated circuit breakers by moving the controller on the switchboard. It must open promptly when tripped by the operator moving the controller or when the protective relays function to energize the trip coil. It must open and interrupt the circuit, when a fault condition exists on the circuit, without damage to itself or adjacent apparatus, and continue to give satisfactory service with a minimum of maintenance.

The circuit breaker should be properly installed so that it will perform in the manner contemplated in the design. The construction should be such that maintenance can be carried out without undue skill being demanded on the part of the maintenance crew. A thorough knowledge of the construction of the circuit breaker and a complete understanding of the instructions given in this Instruction Book are essential to the satisfactory performance of the apparatus.

The breaker is made with two arrangements of terminals with relation to the mechanism and relay housing. In the first arrangement of the breaker the circuit passes from left to right when facing the housing. The terminals on the left side are numbered 1, 3 and 5 from front to rear and 2, 4 and 6 on the right side. In the second arrangement of the breaker the circuit passes from front to rear. The terminals behind the housing are numbered 1, 3 and 5 from left to right. The terminals at the rear are numbered 2, 4 and 6 from left to right.

RECEIVING, HANDLING AND STORING

RECEIVING THE SHIPMENT

Each circuit breaker is completely assembled and tested at the factory, previous to being prepared for shipment. Immediately upon receipt an examination should be made for evidence of any damage which may have occurred while enroute. If any injury is evident or indication of rough handling is visible, claims for damage should be filed at once with the Transportation Company and the nearest Westinghouse representative notified promptly.

STORING

The circuit breaker, when received, should be stored in a clean, dry location. Storing the circuit breaker near where construction work is still going on may result in considerable expense and work in cleaning and preparing it for service. It must not be exposed to dirt, to the action of corrosive gases such as chlorine, nor to possible mechanical injury. Dust incident to work on concrete structures is especially bad as the dust may work into the bearings or sliding parts causing undue friction or destructive abrasion.

HANDLING

The blocking around the skids and the tie bars holding the breaker down on the car should be removed first. This will permit moving the breaker on its skids to truck or other transport that will transfer it to its final location where the foundation should be ready to receive it. The skids can then be removed and the breaker bolted down in place.

In case clearances make it difficult to move the breaker standing up it can be laid down on its back on suitable blocking. Always see that the circuit breaker is in closed position before laying on the side. The lifting eyes on the back of the housing and in the center of the dome provide convenient places to attach slings or a chain hoist. ***Do not allow the slings to bear against the porcelains of the condenser bushings.***

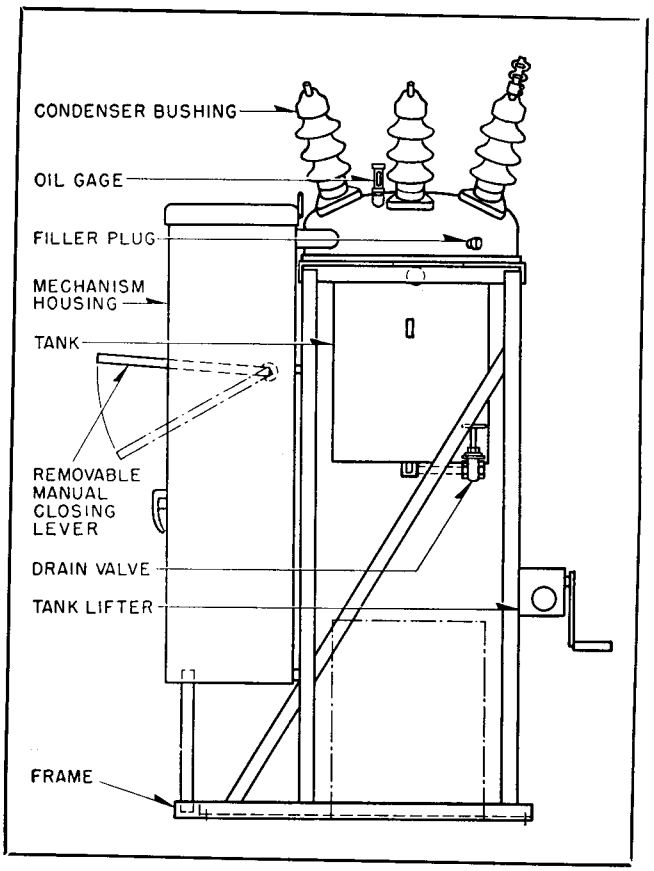


FIG. 1. Assembly

Check the breaker against the shipping list to see that everything included is accounted for and in good condition. Keep identification tags and this instruction book handy until installation is complete then the book should be placed on file where it is available to the operating and maintenance staffs. A pocket inside the door provides a convenient place to keep this book and a copy of the diagram together with the card carrying the service record for the breaker. Additional copies can be obtained upon request to the nearest Sales Office of the Westinghouse Electric Corporation or any Westinghouse representative.

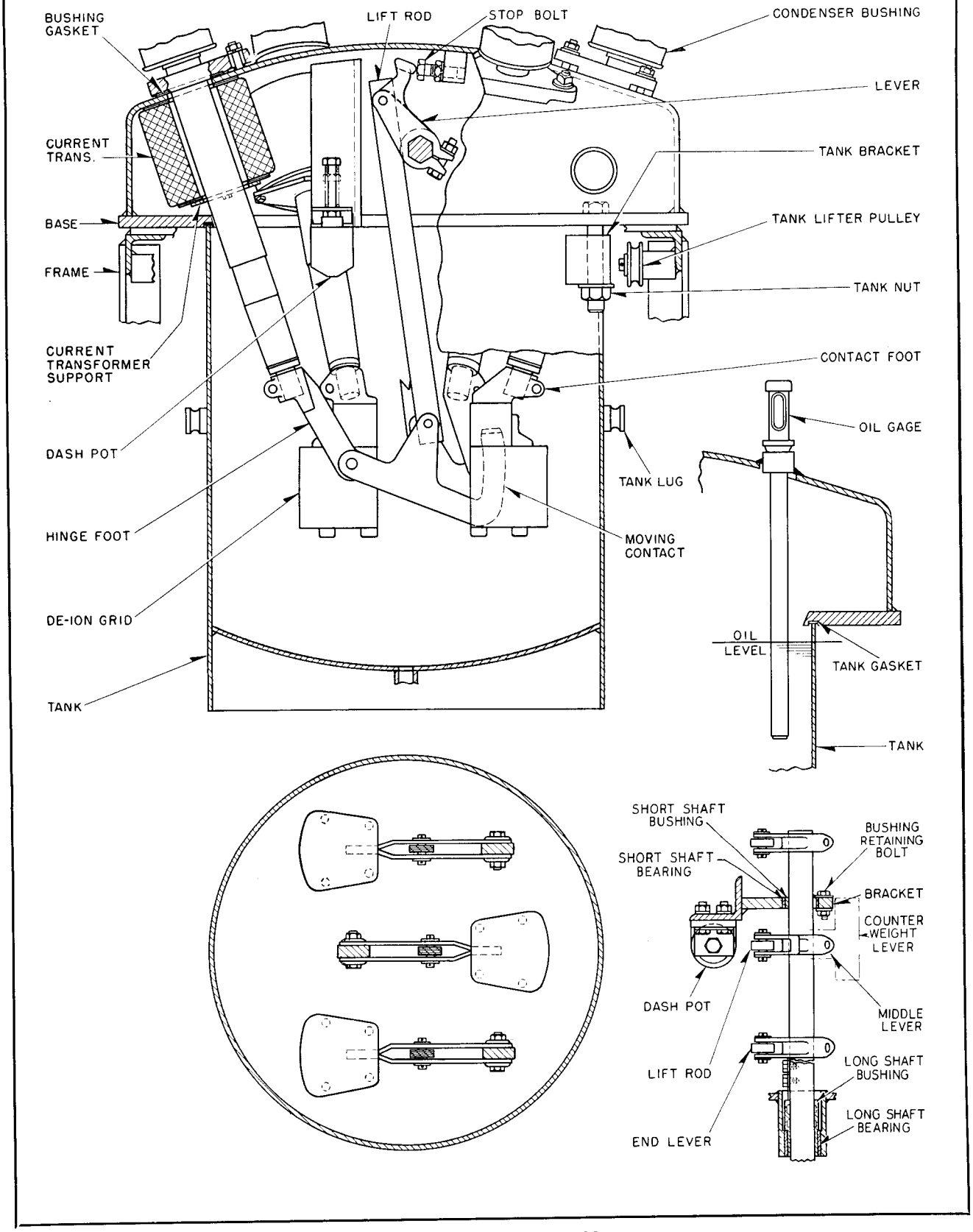


FIG. 2. Pole Unit Assembly

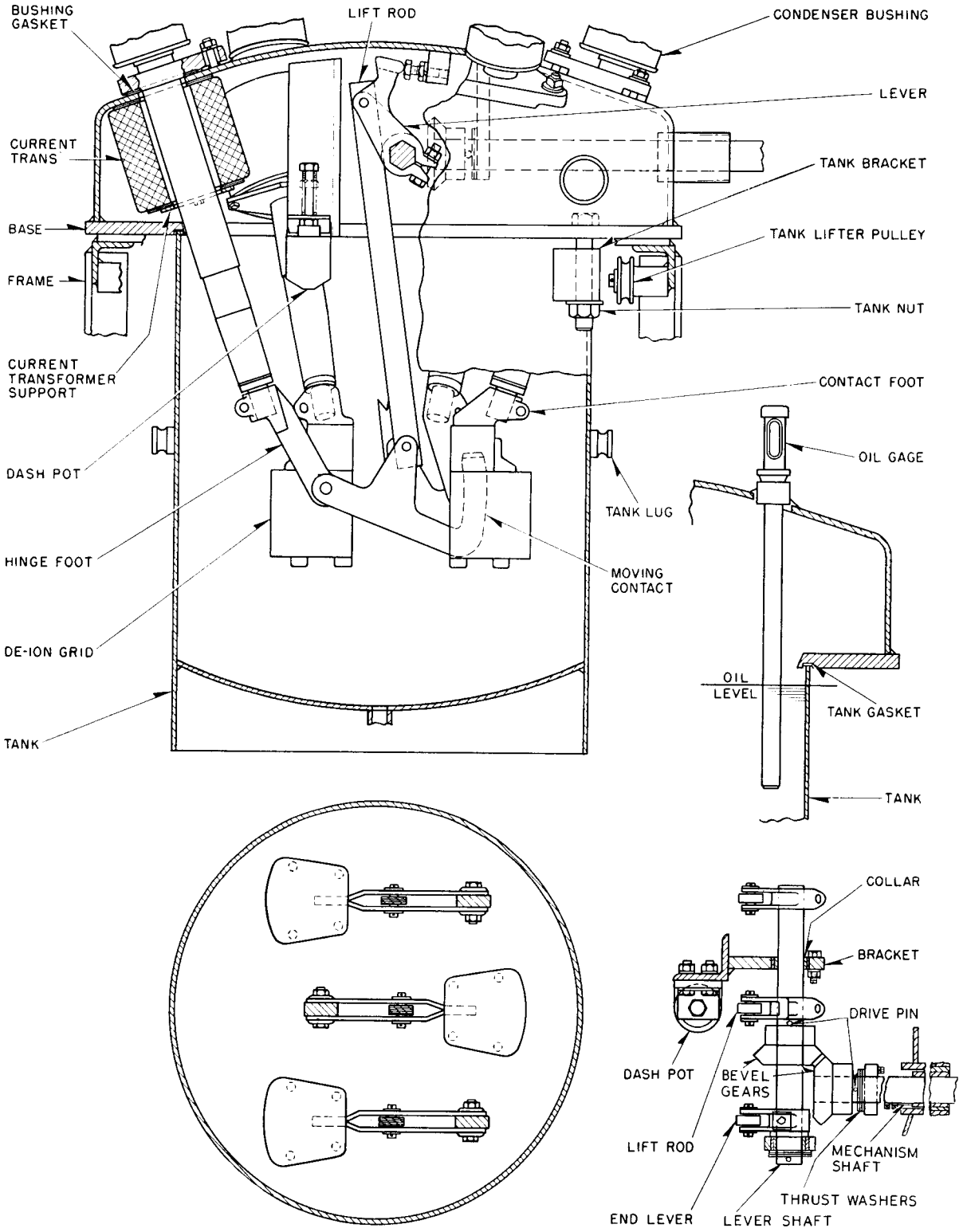


FIG. 3. Pole Unit Assembly (90° Arrangement)

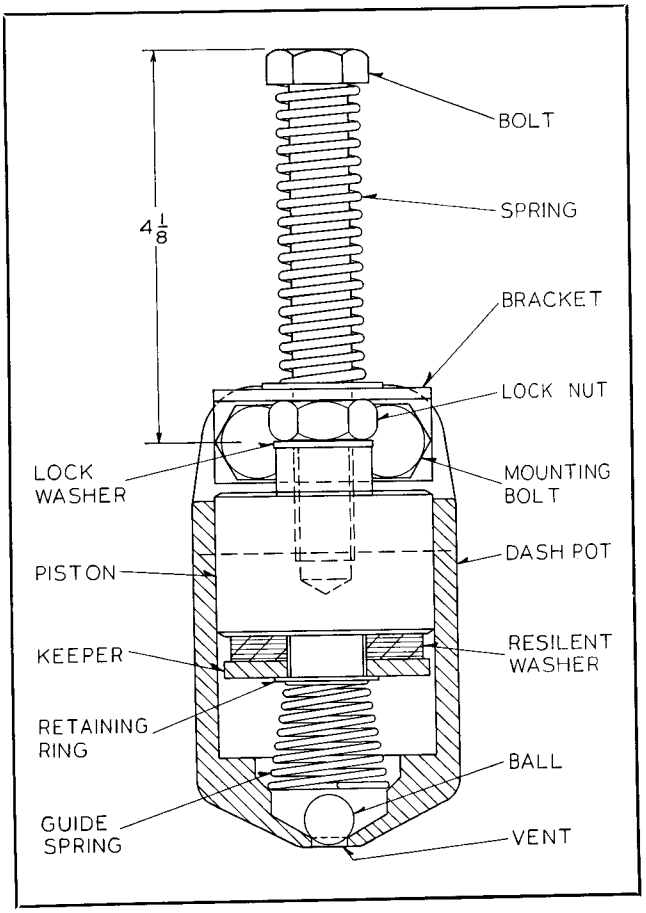


FIG. 4. Dash Pot Assembly

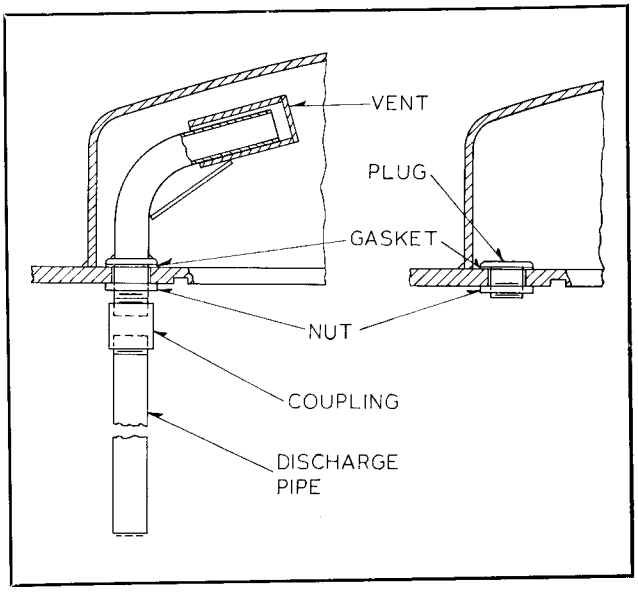
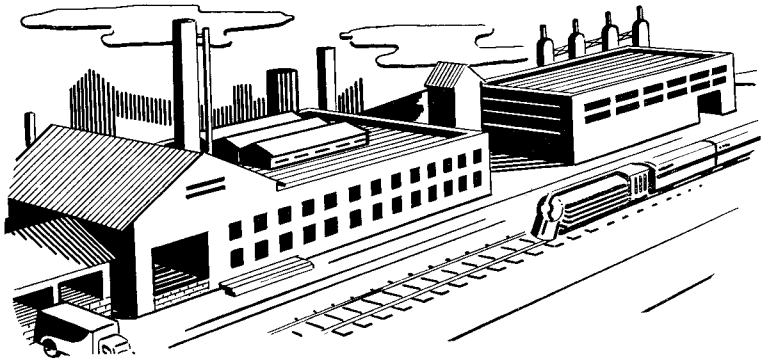


FIG. 5. Vent Assembly



INSTALLATION

MOUNTING THE ASSEMBLY

1. Square up frame by placing wedges under the bottom angles. Tighten the mounting bolts. Fill the space under mounting angles with grout.

2. Remove the bolt holding the door handle. Open door and put stop rod in place to hold it open. Note door can be removed by taking out hinge pins.

3. Swing out relay panel, if one is included, and place hand closing lever in position to close the breaker.

4. Examine solenoid closely and locate the wire holding trigger in latched position. Remove carefully so that trigger is not released.

5. Caution: Do not trip the solenoid mechanism while removing the wire ties because the breaker will move so fast that anyone caught in any removing parts may be seriously hurt.

6. Press down on hand closing lever raising the closing core to the fully closed position. The increased pressure will relieve the load on main latch (see section on solenoid mechanism) which can be pushed back out of the way with a screw driver or small stick.

7. Open the breaker slowly by releasing pressure on hand closing lever. Note that pressure in hinge contacts retards opening movement so much when opened slowly that the movement is almost stopped.

8. Remove the tank and examine the inside for evidence of moisture or foreign matter. Flush with benzine or circuit breaker oil. Tank should not be lowered in wet weather without provision for keeping out moisture.

9. Examine the contacts to see that they are clean and in alignment. See section covering adjustments on page 16.

10. Operate the breaker by hand several times, watching each pole and the operating mechanism to be sure that all parts move freely and that the moving contacts enter the "De-ion" grids without interference.

11. Check the toggle adjustment, see figure 10, to see that, with the solenoid in the closed and latched position, the pin joining the eye bolt and the toggle link is approximately in the position shown, to see that the clearance at the stop bolt is approximately 1/32" and to see that the clearance between the stop bolt and the middle lever inside

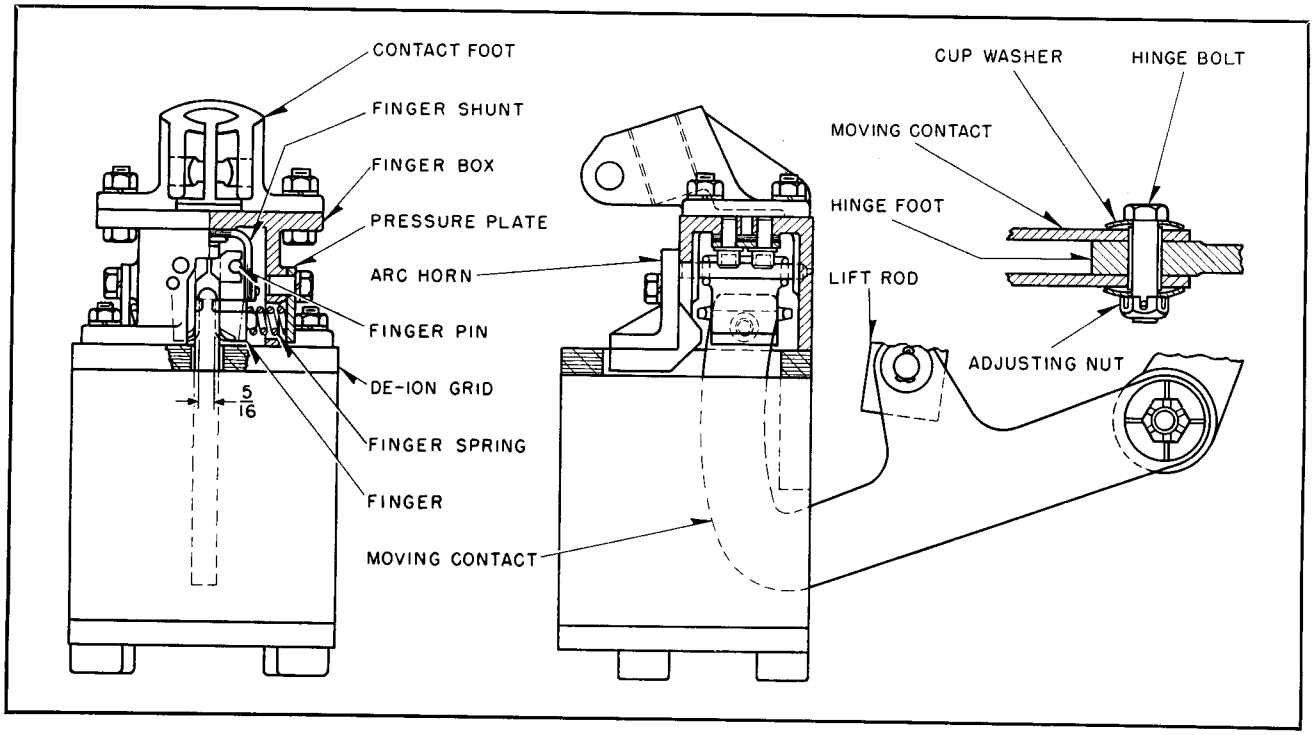


FIG. 6. Contact Assembly

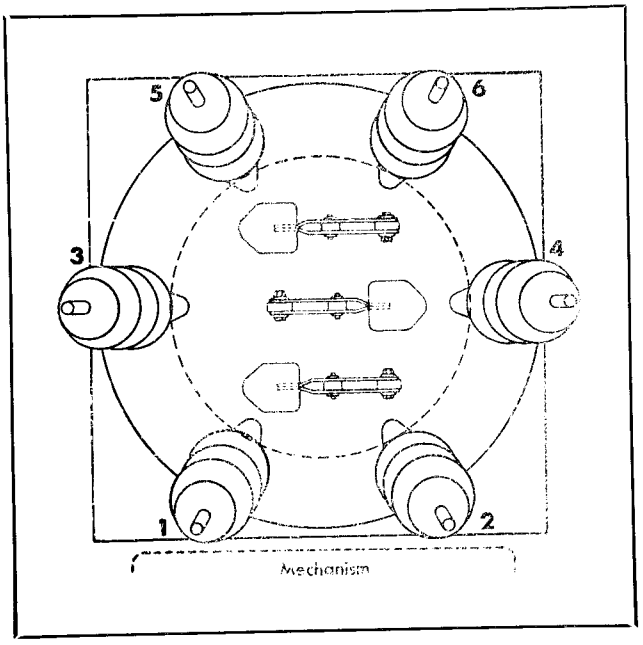


FIG. 7. Top View

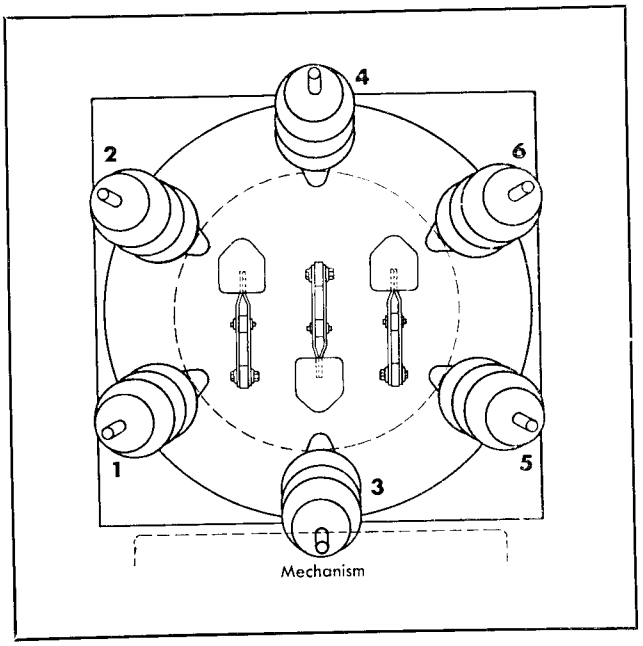


FIG. 8. Top View (90° Arrangement)

the dome (used only in the type 144-G-250 breaker) is approximately 1/32". These adjustments should not require change unless the parts have been disassembled for some reason.

12. Check the auxiliary switch contacts to see that fingers are approximately centered on the rotor segments. Lighting out the circuits during initial installation is a good practice.

13. Check "back-lash" at the main latch by closing the breaker electrically and noting clearance between the latch on the roller while closing coil is still energized. This is easily checked by preventing Y contactor from interrupting the X contactor coil circuit. The clearance should be about 1/16". When breaker is in this position, trip the trigger to see that the breaker "Trips Free" and opens without interference.

Shaft Bearings. The bearings are special bronze tubes pressed into the steel seats. Bronze bushings broached to fit the shaft turn in these bearings. The short bearings and bushings are held in place by a through bolt with wide washers on the opposite sides of the steel seat. The long bearings and bushings are held in place by the locking plate bolted to the shaft. In the 90° arrangement of the breaker the bearings and bushings next to the double gears are held in place by the spacing washers and the drive pin.

Vent. A baffled vent is provided only in the type 144-G-250 breakers to relieve the pressure due to the gases generated when interrupting the higher short circuit currents, while preventing the expulsion of oil. On the 230-G-250 and the 144-G-100 breakers with their lower current interrupting ratings the vent is replaced by a plug.

Counter Weight. A counter weight lever is added to the middle pole of type 144-G-250 break-

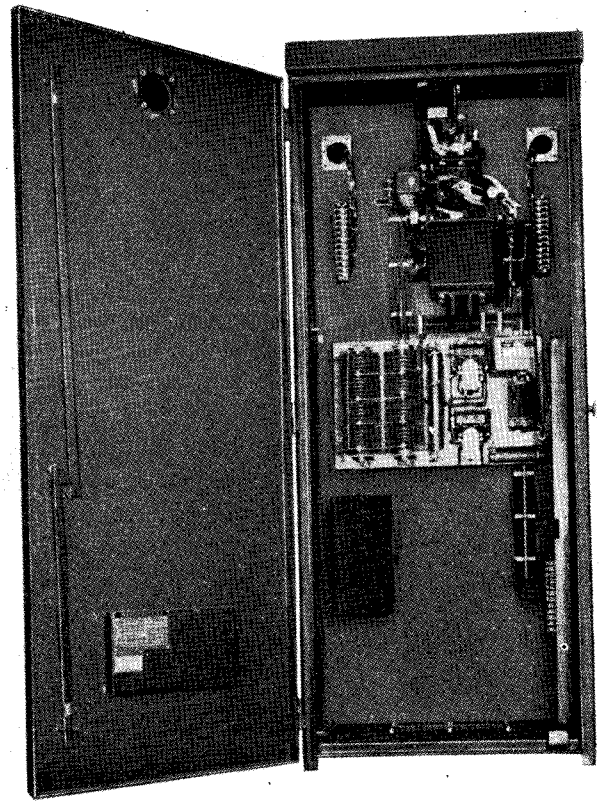


FIG. 9. Mechanism Housing Assembly

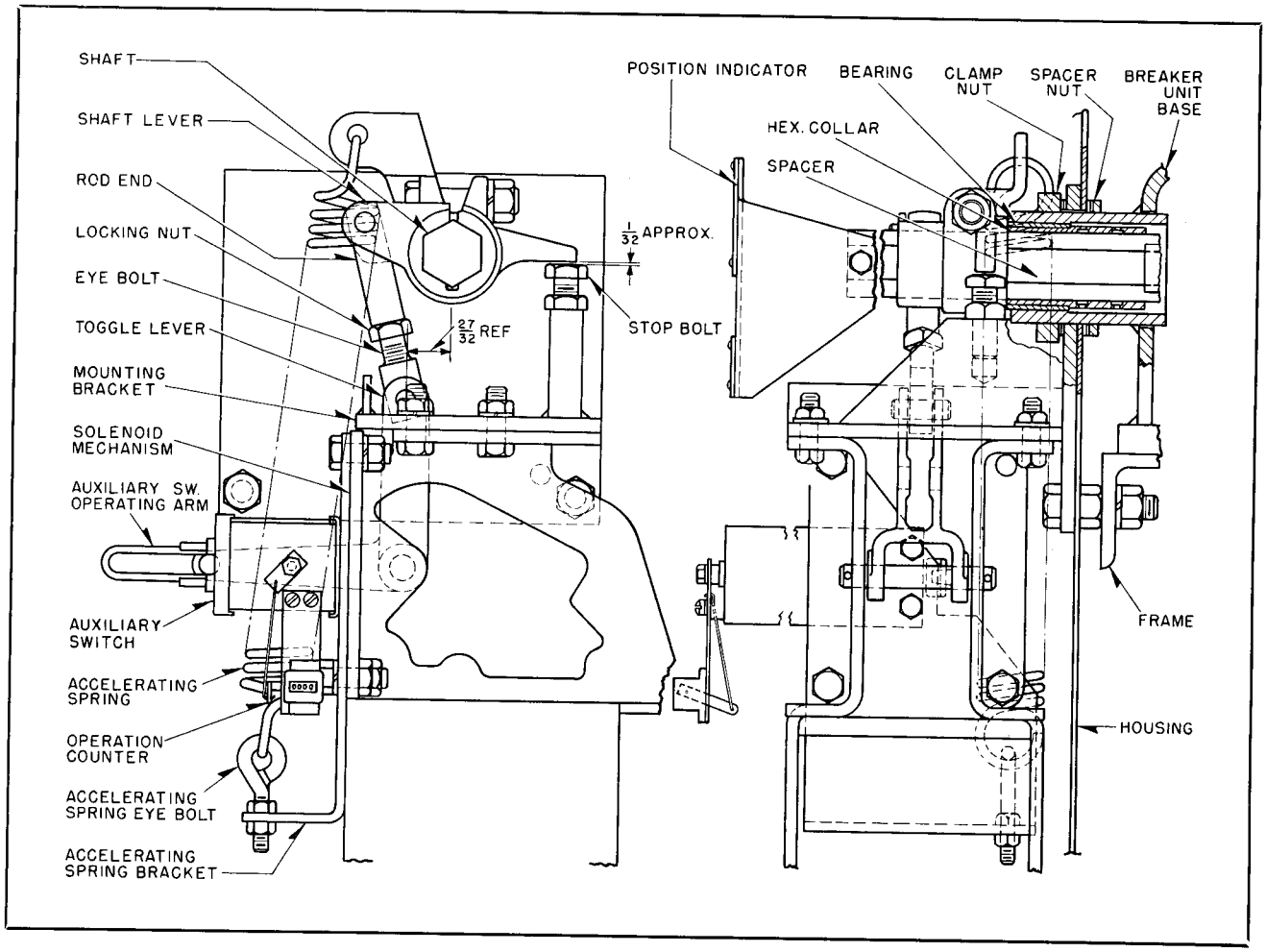


FIG. 10. Toggle Assembly

ers to prevent the contacts acquiring an excessive speed due to the added blowout affect from the magnetic forces of the higher currents to be interrupted.

Pole Unit Mechanism (90° Arrangement). To relocate the mechanism housing 90° from the standard position the shaft with the pole unit levers is cut-off and provided with a bevel gear at one end. The shaft from the toggle mechanism entering the pole unit is similarly cut-off and provided with a mating bevel gear. These gears are not duplicates and must be reassembled, if ever removed, so as to maintain exactly the same relation between the two shafts with the hexagons exactly lined up.

CONTROL LEADS

Remove the plate from the bottom of the mechanism housing and drill for the entrance of the conduit. Connect up the control according to the diagram supplied for breaker.

Be sure the leads which carry the closing current are large enough so that the voltage drop will not be excessive. Fuses, or other thermal protective devices, placed in the main control circuit should have a rating of 30% to 50% of the normal E/R current rating of the closing coil. This will permit passage of the closing current long enough to close the breaker without interrupting the control circuit and yet will interrupt it promptly if the breaker fails to close.

Note: The switch in the control should be open at all times while the breaker is being worked on. This prevents unintentional operation of the breaker by the switchboard attendant with possible injury to anyone caught by any of the moving parts of the breaker.

Check the control voltage at the breaker with a voltmeter when the closing coil is energized to see that the drop in the control bus will not interfere with operation. While the operating solenoid will close the breaker at minimum control voltage, better all around performance will be obtained by keeping the potential near the normal control voltage shown on the nameplate.

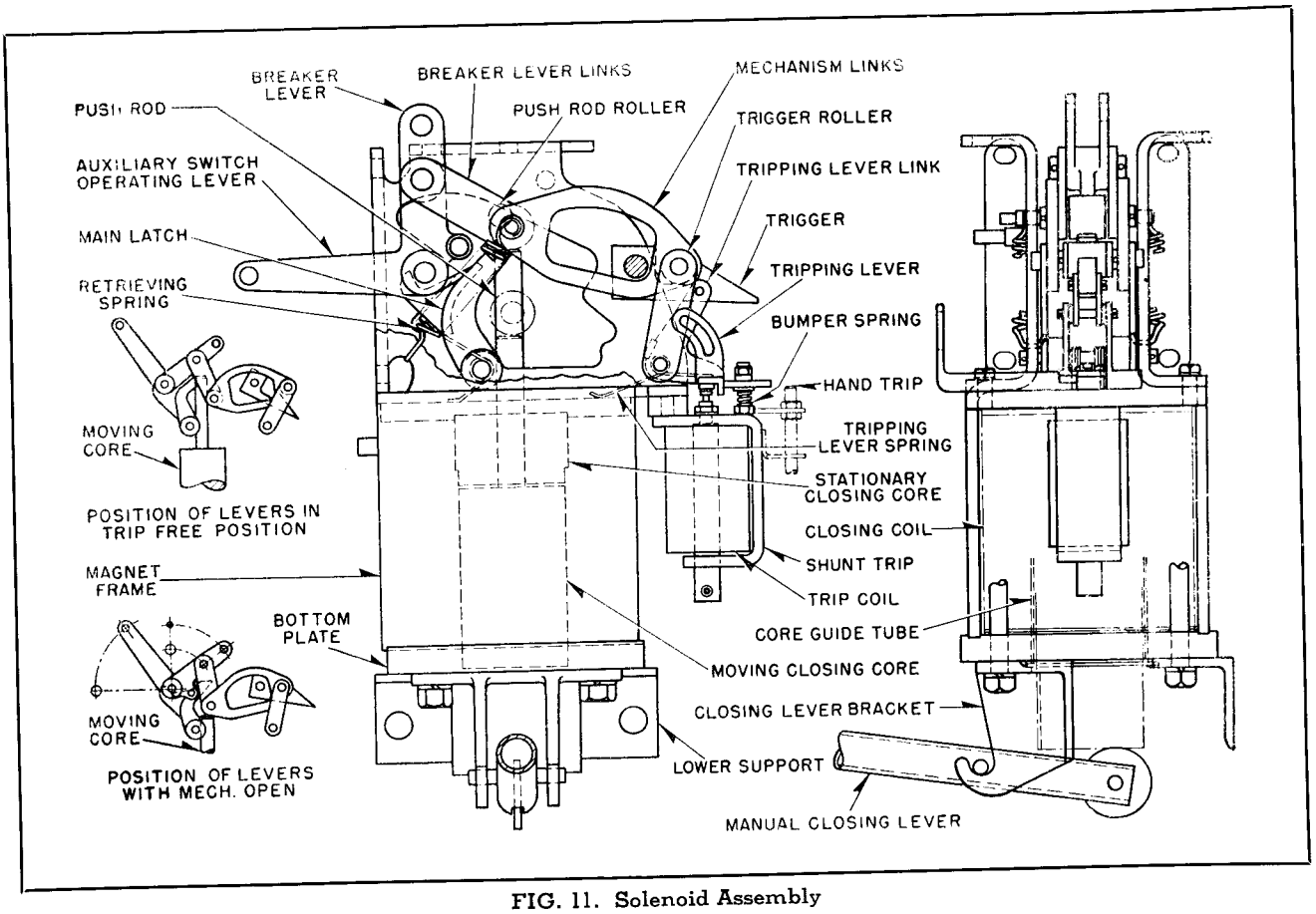


FIG. 11. Solenoid Assembly

Caution: Always be sure the transformer secondary connections are completed before energizing the breaker. Short circuit unused transformers.

Transformer Taps. All taps on each transformer are brought to the terminal block. When overload coils or overcurrent relays are included they will be connected at the factory to the highest ratio tap. The bushing type current transformer nameplate should be used as an indication of the proper taps to use for relaying or current tripping for the particular load the breaker is to control. It is always necessary to check the proper taps by test.

Ground. Connect the circuit breaker frame to ground through the grounding pad on the breaker frame. The National Electric Code requires grounding cable to have $^1/_5$ 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.

Connections. Install connections to the circuit breaker studs. The contact surfaces at all junctions must be carefully cleaned to remove all oxide. Copper surfaces can be draw filed or rubbed with fine sand paper. Threaded copper surfaces can be brushed vigorously with a fine steel brush. Silver plated surfaces should be rubbed lightly with fine steel wool and never filed or sanded unless resilvered afterwards. A light coat of linseed oil on the threaded surface will make a better joint and will make breaking the joint easier when that becomes necessary.

The terminal studs are not designed to withstand undue cable or bus bar loads. An excessive strain, which at first may have no apparent affect, may eventually loosen the porcelain weather casing and permit moisture to enter the bushing. The power leads should have adequate capacity to carry the normal circuit load without overheating and to carry the possible momentary currents that may occur without excessive overheating. They should be properly braced to withstand the magnetic forces of the short circuit currents which may occur.

Preliminary Operation. Close and trip the breaker a few times to be sure operation is correct. Do not operate any more than is necessary for checking when the tank is lowered as a hydraulic dashpot, cushioning the stopping of the movement at the end of the opening stroke, is not in operation.

Tank. Fill the tank with oil to the level indicated on the nameplate. Raise the tank into place with the tank lifter. Watch, in raising, to see that the

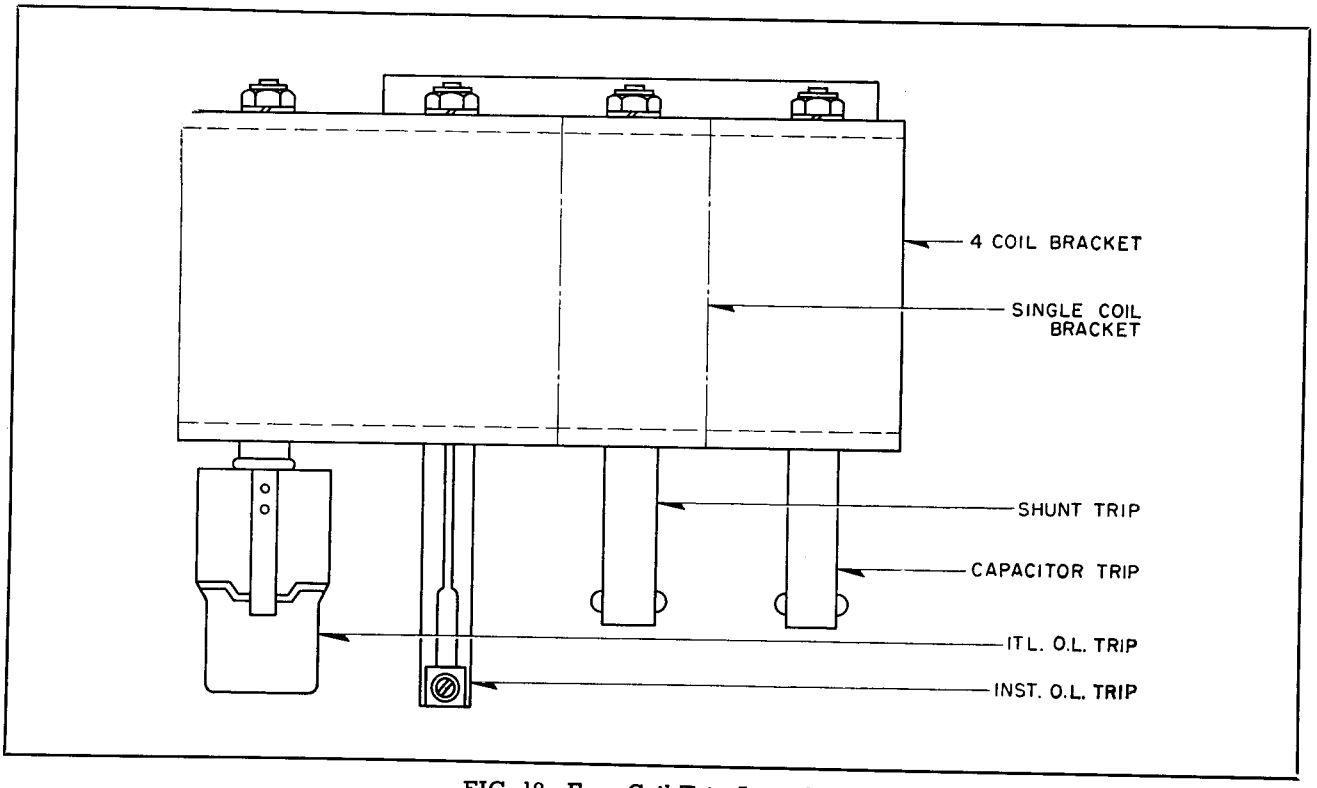


FIG. 12. Four Coil Trip Assembly

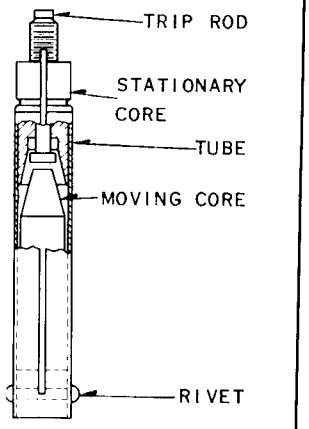


FIG. 13. Shunt Trip Assembly

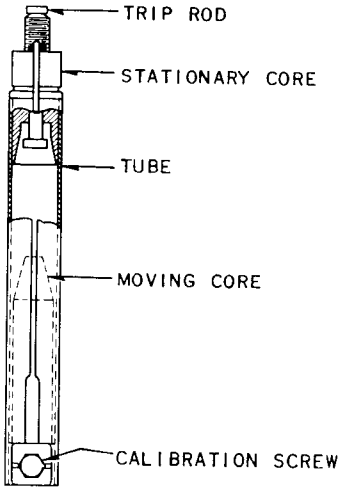


FIG. 14. Overload Trip Assembly

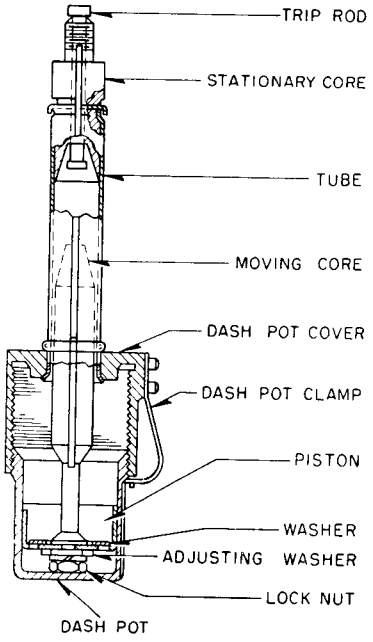


FIG. 15. Inverse Time Limit Trip Assembly

studs on the underside of the base enter smoothly into the loops welded to the sides of the tank. As soon as studs pass through the loops start the nuts by hand. Raise the tank with the lifter high enough to see that the tank rim registers in the groove in the base and against the packing. Draw the nuts up evenly all around. With the tank in place adjust the oil level by drawing off the surplus through the drain valve or adding through the filling pipe at the right rear side of the base. In hot weather it is best to leave the oil slightly high and in cool weather slightly low, as the oil level will change with the temperature. A ratchet socket wrench with an extension reaching down below the lower edge of the tank makes removal and replacement easier. A "T" handle for the extension will help to drive the tank supporting nuts on TIGHT.

Check of Operation. With the tank in place and all connections made, the circuit breaker should be operated a number of times from the control switch to see that all circuits are clear.

1. Observe the response of the lights to the position of the breaker contacts.

2. Check each relay to see that it trips the breaker and that the target in the relay drops.

3. Check, if possible, to see that the solenoid closes and latches with 90 volts (for 125 volt control) across the closing coil with the coil energized.

4. Check to see that 58% of normal potential on the trip coils trips the breaker.

5. Check to see that raising the trip coil slowly by hand releases the trigger when there is approximately 1/16" of travel left at the instant the trigger releases.

6. Check time to close and part contacts with a cycle counter. This should not be over 15 cycles and 5 cycles respectively. If a Cincinnati timer is available make a record of a closing, of an opening, and of a close trip-open operation.

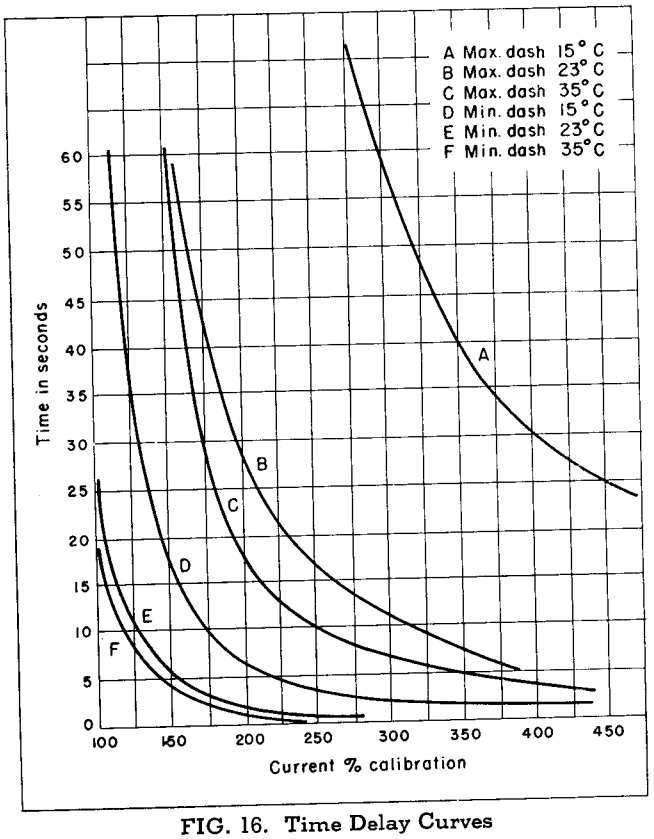
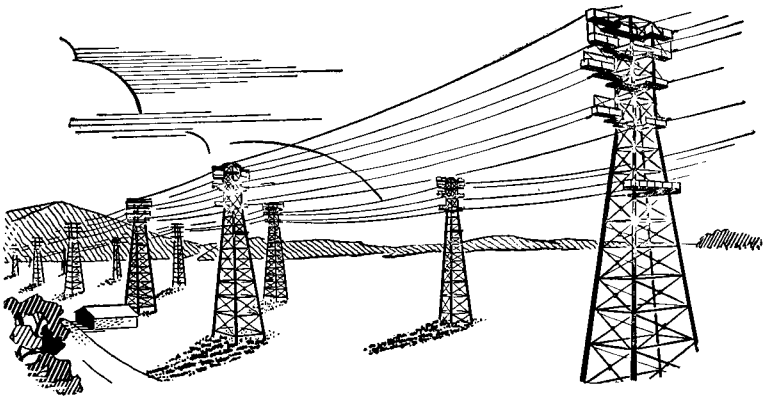


FIG. 16. Time Delay Curves



PART THREE

ADJUSTMENT AND MAINTENANCE

CONTACT ADJUSTMENT

1. The adjustment on the breaker should be checked occasionally after installation to be sure that no changes are taking place which will interfere with the proper functioning of the breaker.

2. Remove the arcing horn on the back of and at the top of the "De-ion" grids and observe that the contact fingers are approximately 5/16" apart and are centered over the slot in the grid. The grid can be moved slightly if necessary by loosening the bolts holding them to the contact box.

3. Check to see that the moving contact swings easily into the slot in the grid as the breaker is closed slowly by hand.

4. See that the moving contacts strike centrally between the fingers and at approximately the same time on all three contacts.

5. Replacing the fingers in the stationary contact is most easily done if complete spare assemblies consisting of finger boxes and grids are available. The four bolts holding the finger box to the contact foot can be removed and the new assembly put in place. Snug the finger bolts finger tight. Closing the circuit breaker will line up the contacts and then the bolts should be tightened. This procedure takes the breaker out of service the shortest time. The fingers in the removed contacts can be replaced in the shop whenever convenient. When replacing fingers make sure the contact surface in the inside top of the finger box and the outside surface of the shunt is clean and free of oxide. Be sure Allenhead bolts holding them together are drawn up tight.

6. When replacing moving contacts avoid excess pressure on the hinge. Make contacts fit hinge snugly without spreading. Tighten nut and bolt finger tight and then take up to the next slot in the castle nut. This will provide all the pressure necessary.

7. Note particularly to see that the moving contact clears the lugs on the sides of the fingers. The contact box can be moved slightly on the foot by loosening the bolts holding them together. The contact feet can be screwed up or down on the threaded stud by full turns if necessary. The entire condenser bushing can be moved slightly by the amount of the clearance in the holding bolts.

Caution: Always see that the flange of the condenser bushing does not touch the plate forming the lower part of the top cover.

Any slight roughness found on the contacts should be smoothed with a file. Contacts should be replaced if burns penetrating more than 1/16" are found.

INSULATING OIL

The care of the insulating oil in circuit breakers is of 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.

A sample of oil should be drawn out at regular intervals and tested in a standard test cup. The first oil withdrawn will clear the drain pipe and the sediment from the bottom of the tank. This should be discarded. The oil level can be brought up again by adding oil through the filling pipe.

Only the highest grade, such as Wemco "C" or other approved oil, should be used in a circuit breaker. The oil should be new or thoroughly reconditioned by means of a filter press or centrifuge. Before use, a sample should be given a dielectric test using an approved test cup with 1" circular disc spaced 0.1" apart. The oil should withstand 25 to 30 kv. Oil testing below 17 kv should be replaced.

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 on a short circuit, the tank and the 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.

A little more than ordinary care in oil handling will be 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 44-820-1.

OPERATING MECHANISM

The type SAF-2 mechanism is a solenoid type operating on standard direct current control volt-

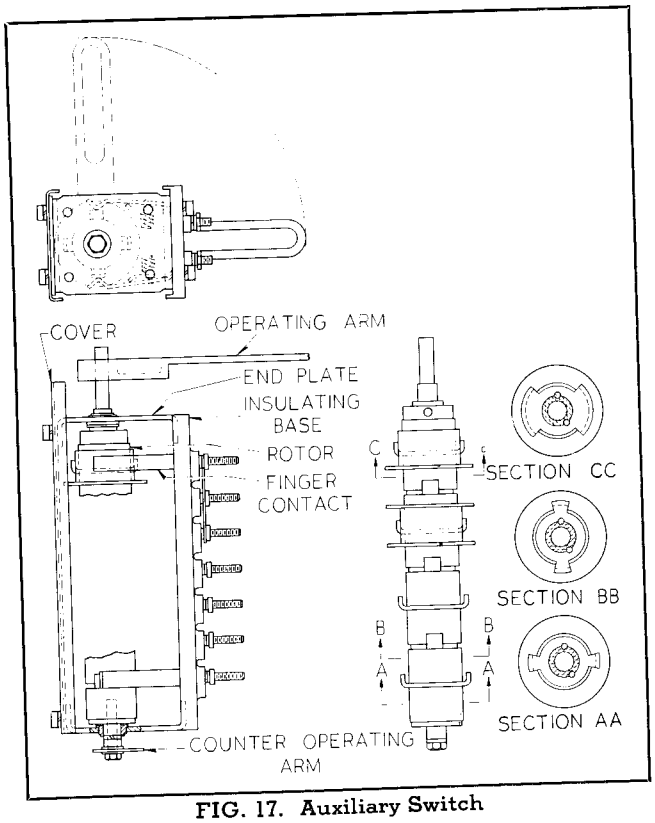


FIG. 17. Auxiliary Switch

ages or, when equipped with a rectifier unit, on alternating current. It is mechanically full automatic and trip free in all positions. The standard mechanism is supplied with a single shunt trip coil and a single plunger type cut-off switch. Non-reclosing breakers are equipped with the seven-pole rotary type auxiliary switchboard for trip coil cut-off and operation of indicating lights. Reclosing breakers are equipped with an eleven-pole rotary type auxiliary switch and latch checking switch.

The mechanism can be supplied with a shunt trip coil or a capacitor shunt trip and three instantaneous or inverse time delay transformer trip coils.

Mechanism Operation. Energizing the closing coil forces the moving core and pushrod upwards against the pushrod roller (located at the junction of the breaker lever links and the mechanism links). This upward push 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 mechanism latch is pushed under the pushrod 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 pushrod 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 toggle 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 pushrod roller slides off the main latch, the retrieving springs pull the pushrod 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. Maintenance at regular intervals is necessary to keep the breaker in the condition necessary for it to handle any emergency that may arise in the system to be protected. The frequency of inspection periods should be based on experience. Many users place a card in the pocket on which there are places for entering the date, the veeder counter reading, purpose of inspection, nature work done, etc., each time the breaker is taken out of service or the mechanism door is opened.

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

ATTACHMENTS

Four Coil Attachment. The four coil attachment is bolted 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. The instantaneous overload trip as shown in

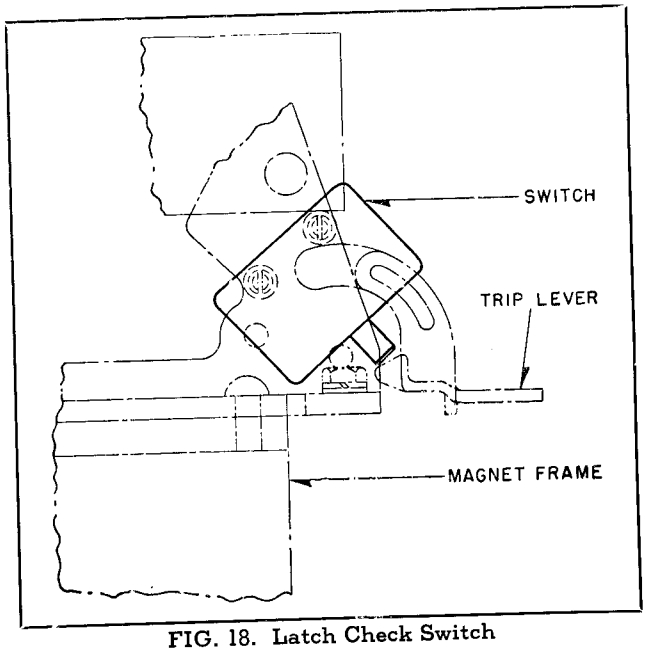


FIG. 18. Latch Check Switch

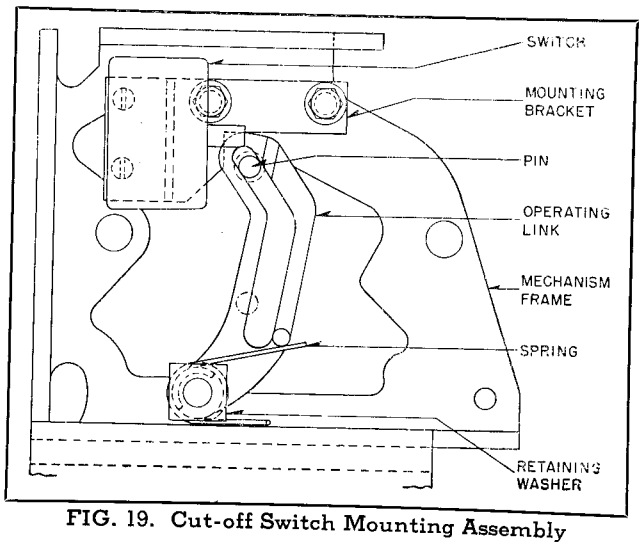


FIG. 19. Cut-off Switch Mounting Assembly

Figure 14 consists of a trip coil and trip details assembled in a bracket of the four coil trip. The distance between the moving and stationary cores can be varied as indicated by the calibration markings for tripping between 5 and 9 amperes. By using current transformers of suitable ratio tripping can be accomplished at any desired primary current. In assembly be sure that the wedges are put in below the coils. Also check to see that the trigger is released when the moving tripping core is raised slowly mechanically to within 1/16" of its total travel. Also check to see that tripping occurs if moving core is raised mechanically until trip rod touches the trigger and then 5 amperes applied suddenly to the coil.

The shunt trip attachment for tripping from a separate source of power as shown in Figure 13 is essentially a non-adjustable overload trip. The coil should pick-up and trip the circuit breaker if 60% voltage is applied. If the moving core is raised to bring the trip rod in contact with the trigger, tripping should occur if full voltage is applied to the coil. If tripping is actuated by a relay an auxiliary switch is to be used to interrupt the coil circuit to save the relay contacts.

Time delay overload trip as shown in Figure 15 is similar to the instantaneous trip with a dashpot added to the moving core to hold it back. The time delay can be changed by rotating the partial disc on the lower end of the trip rod so as to change the number of holes uncovered. A loose washer provides for quick resetting. Current calibration is obtained by screwing the pot into or out of the dashpot cover.

The viscosity of the oil affects the time delay. The temperature of the oil affects this viscosity. The time delay also varies inversely with the size of the overload. Hence, this device cannot be used to obtain a definite time delay. Overloads persisting for a short time such as occur when starting a motor will not trip the breaker. If the overload persists tripping will take place.

Operation Counter. The operation counter mounts on the rotary auxiliary switch bracket. Operating arm is 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.

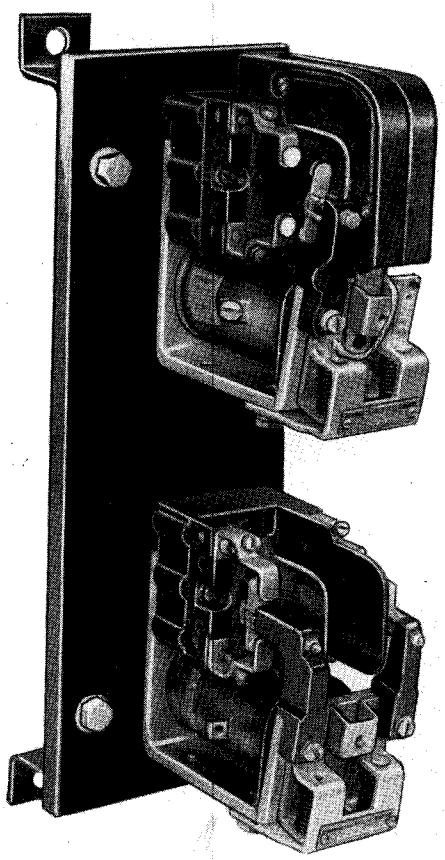


FIG. 20. D.C. Control Panel

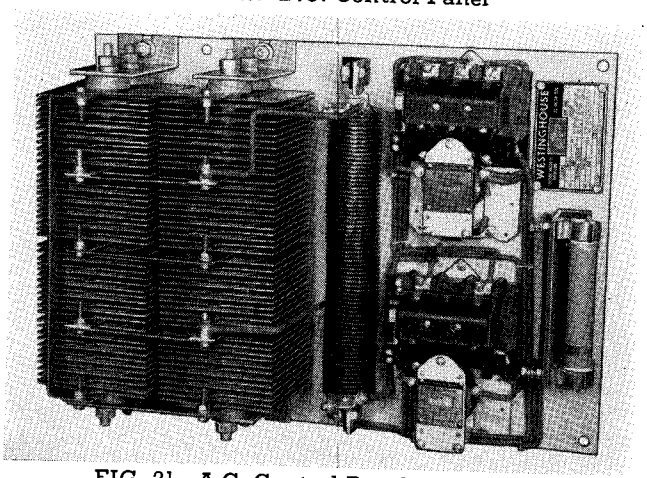


FIG. 21. A.C. Control Panel and Rectox

Rotary Auxiliary Switch. A seven-pole rotary auxiliary switch (11-pole on reclosing equipments) mounts on the upper left side of the solenoid. The slotted arm on the switch engages a lug on the mechanism lever to turn the rotor approximately 90°. The first and third contact segments are connected in series and are wider than the rest so they will make contact and complete the trip coil circuit just as the circuit breaker contacts touch. The rotor segments are arranged alternately with the odd numbered ones making contact when the breaker contacts close and the even numbered ones making contact when the breaker contacts open. The segments can be changed from one position to the other by disassembling the rotor. Check the contacts from time to time to see that the flexible finger follows in and makes good contact with the rotor segment. Burns from arcing should be smoothed. Contacts

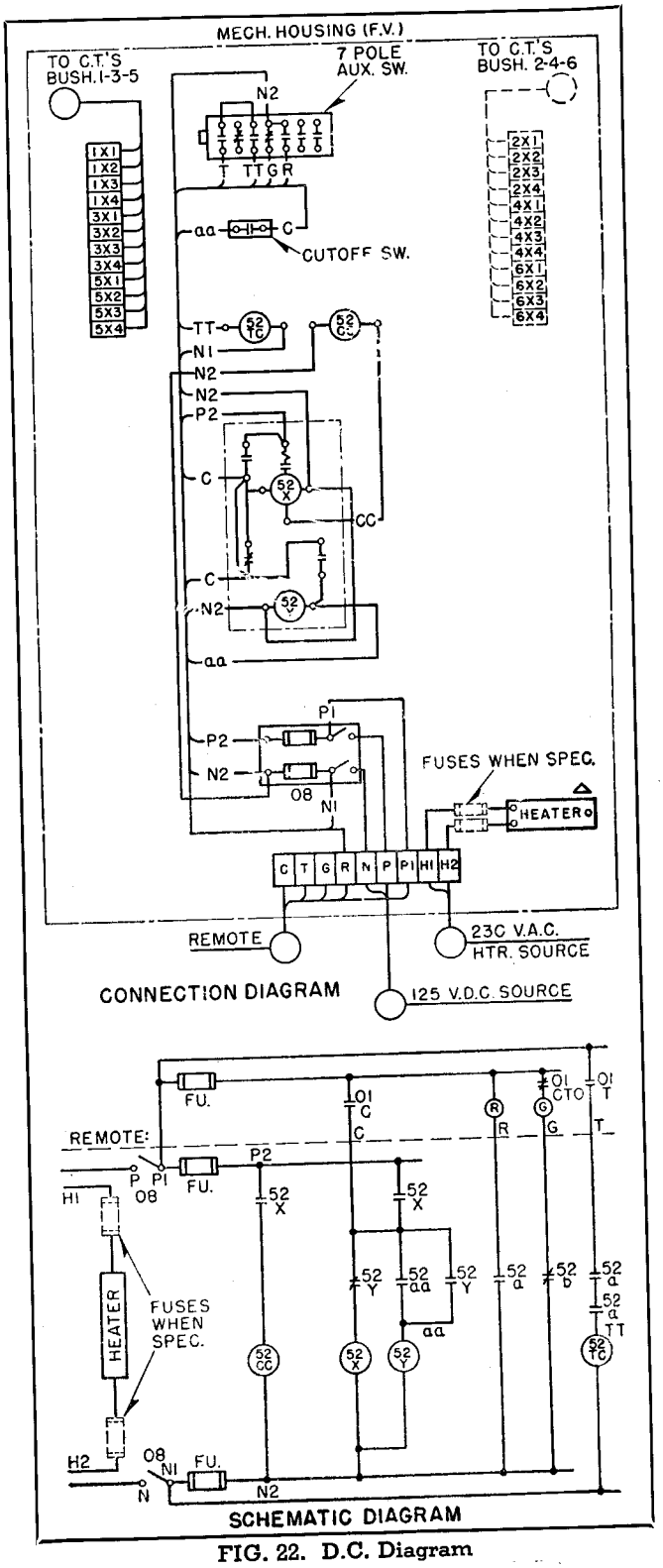


FIG. 22. D.C. Diagram

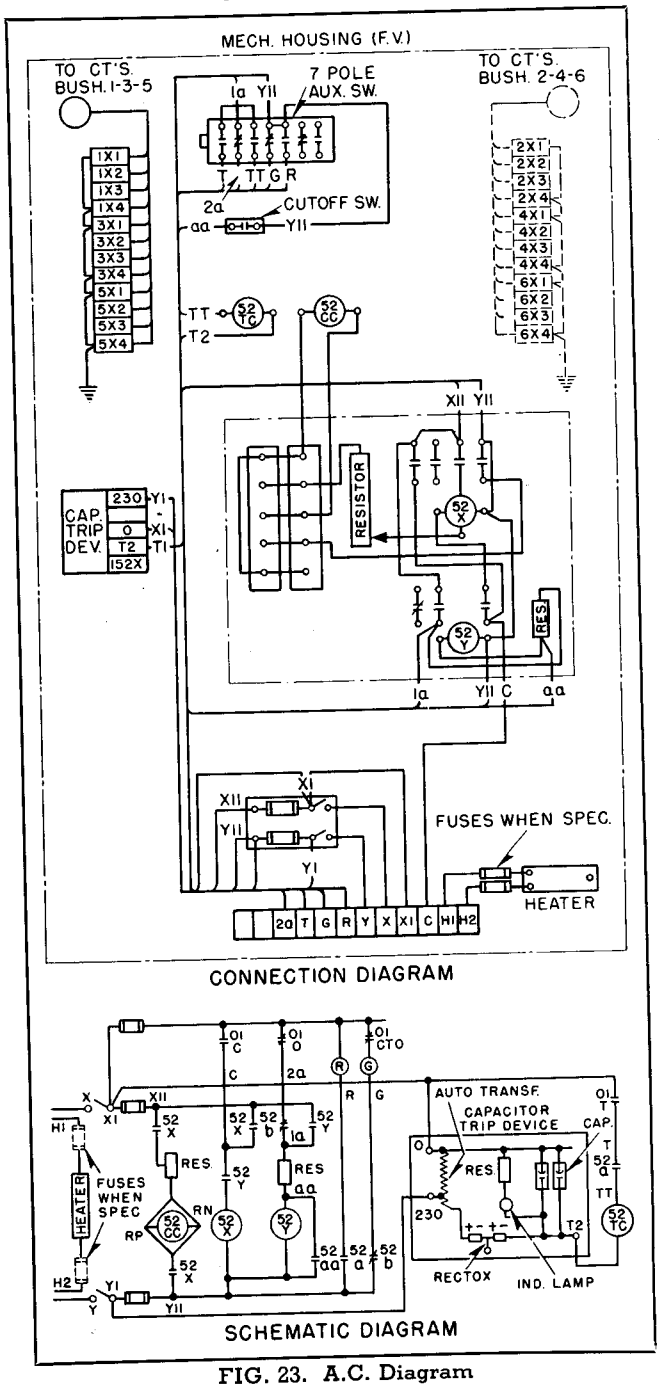


FIG. 23. A.C. Diagram

should be replaced if burns have progressed to a point when stubbing is imminent.

Cut-off Switch. The cut-off switch mounts on the front of the mechanism. The switch is a normally closed switch but is held in the open position by the pin in the slot in the operating link. The operating link is pressed against the switch by the spring. As the breaker closes the pin travels upward in the slot of the operating link and at the upper end of the stroke pulls the link back away from the switch permitting the switch to close. During a trip free operation the pin travels horizontally to the right pulling the operating link still farther away from the switch and finally travels downward in the slot holding the link away from the switch until the mechanism retrieves for subsequent operation.

Latch Checking Switch. The latch checking switch mounts just above the trip bar in front of the mechanism. The contacts open when the trip bar rises to trip the breaker and remains open until the trigger is reset ready for another closing operation. Check switch contacts from time to time to see that they are clean and are not burned.

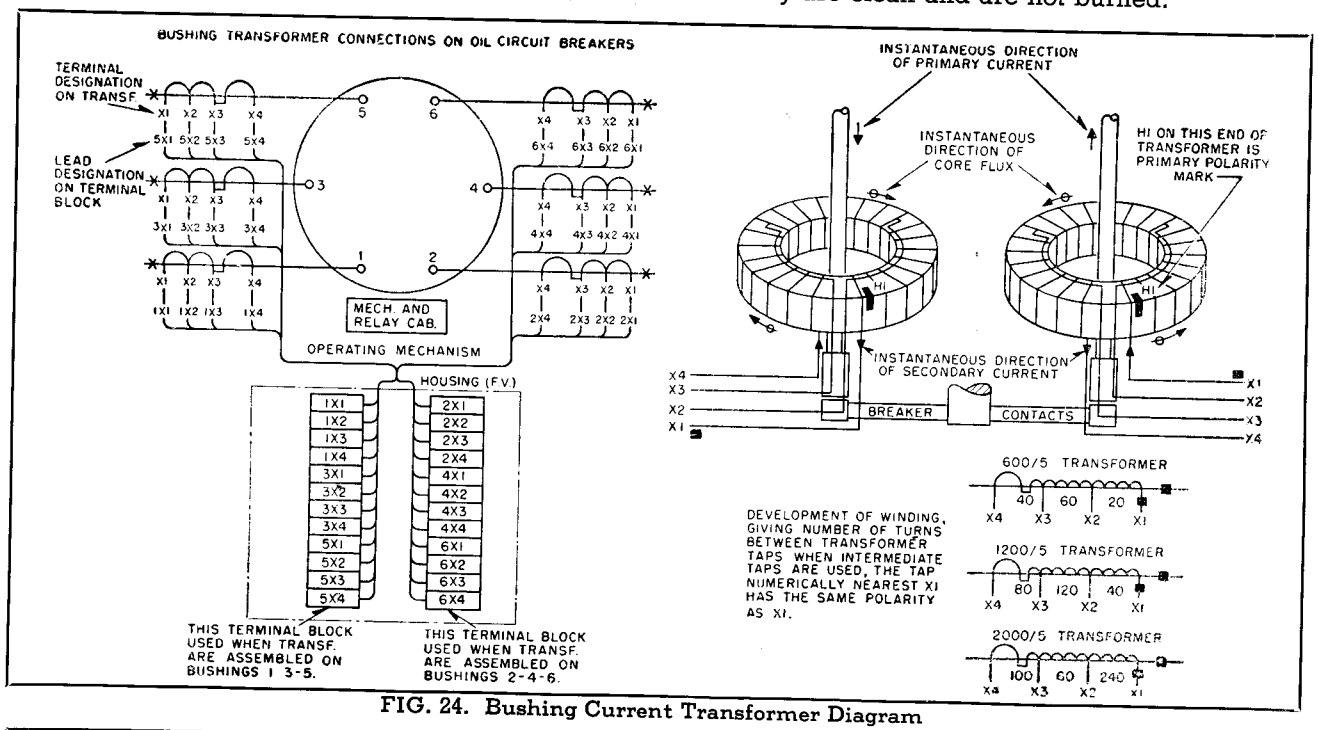


FIG. 24. Bushing Current Transformer Diagram

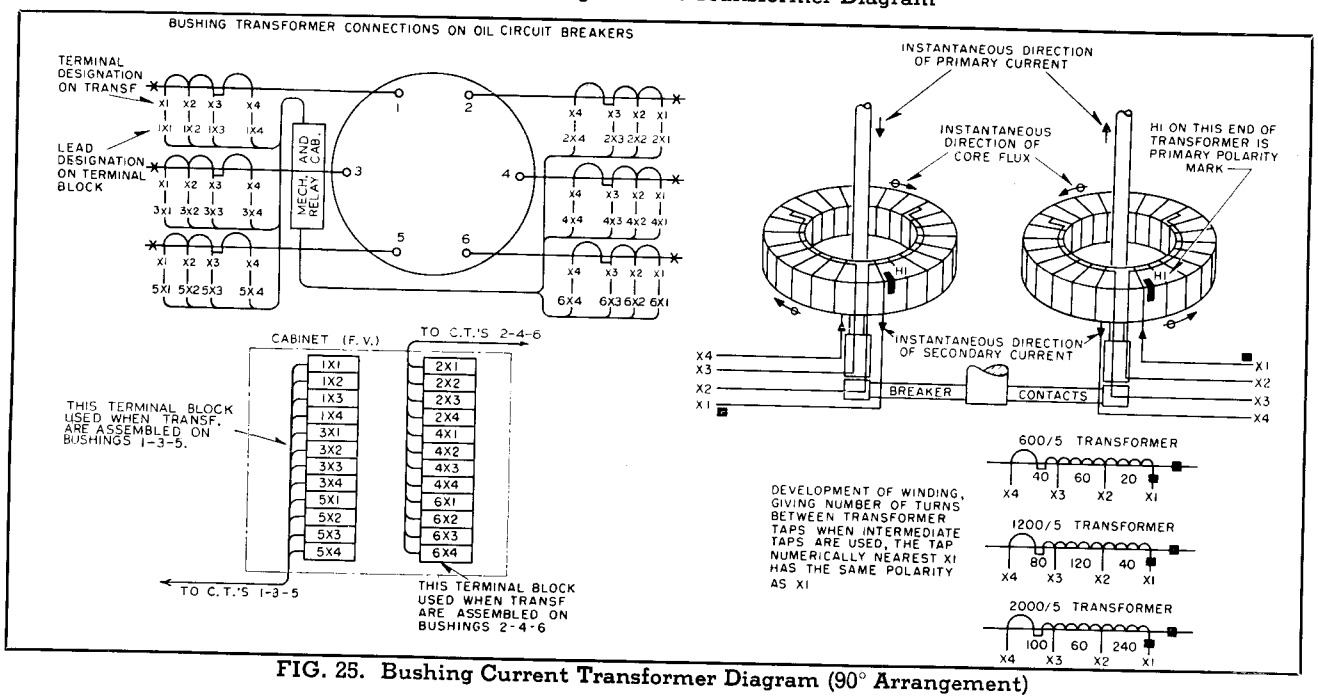


FIG. 25. Bushing Current Transformer Diagram (90° Arrangement)