GEI-12052D

INSTRUCTIONS

AIR CIRCUIT BREAKERS

TYPES AL-2-50, ALF-2

AL-2-50Y1, AL -2-50Y2 AND AL-2-50Y3
UP TO 1600 AMPERES

(Formerly Types AL-2, AL-2Y1 and AL-2Y2)
(up to 1600 Amperes)

Switchgear

GENERAL ELECTRIC
SCHENECTADY, N.Y.

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ILLUSTRATIONS

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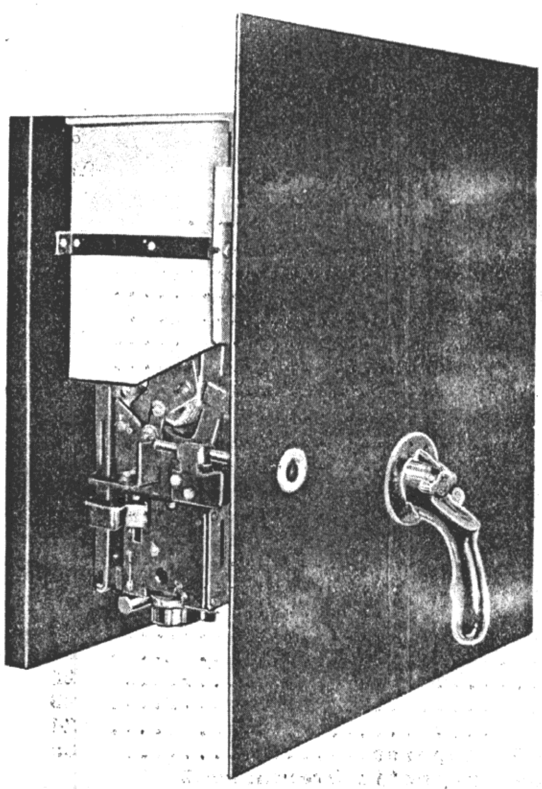


FIG. 1
MANUALLY OPERATED DEAD FRONT AIR CIRCUIT BREAKER WITH FRONT ENCLOSURE

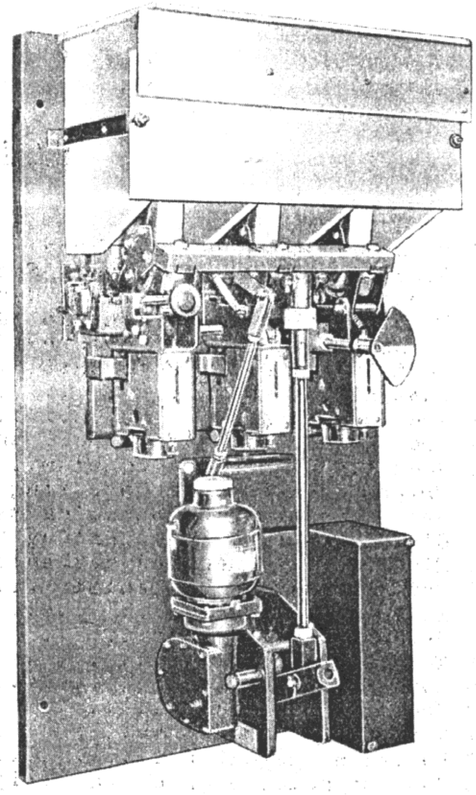


FIG. 2
ELECTRICALLY OPERATED DEAD FRONT AIR CIRCUIT BREAKER

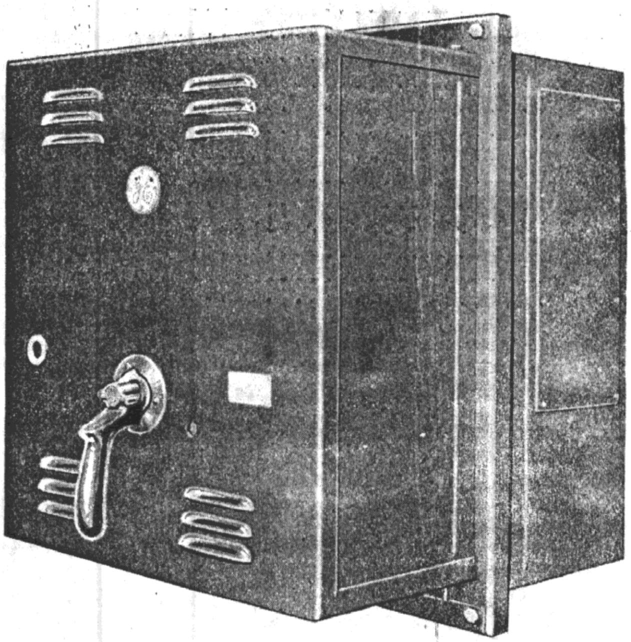


FIG. 3
MANUALLY OPERATED ENCLOSED AIR CIRCUIT BREAKER WITH PULL BOX

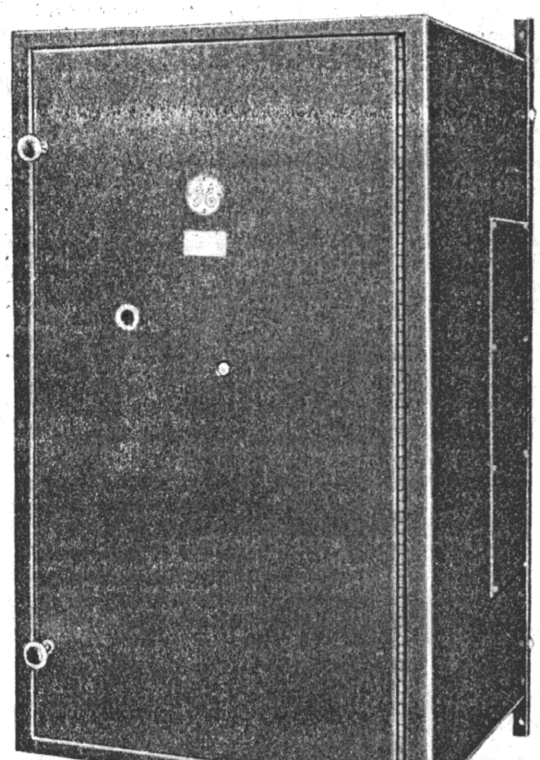


FIG. 4
ELECTRICALLY OPERATED ENCLOSED AIR CIRCUIT BREAKER

AIR CIRCUIT BREAKERS

TYPES AL-2-50, ALF-2, AL-2-50Y1, AL-2-50Y2 AND AL-2-50Y3, UP TO 1600 AMPERES

(FORMERLY TYPES AL-2, ALF-2, AL-2-Y1 AND AL-2-Y2, UP TO 1600 AMPERES)

These instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the General Electric Company.

GENERAL INFORMATION

Before unpacking, installing or attempting to operate these air circuit breakers, read this instruction book thoroughly and carefully.

APPLICATION

The Type AL-2-50 circuit breakers covered by this instruction book are generally used for the protection and control of electrical apparatus, main feeders, branch circuits, including equipment in buildings, industries, power stations and merchant marine application within the ratings designated below. Type ALF-2 circuit breakers are used for generator field control. The Types AL-2-50Y1, AL-2-50Y2 and AL-2-50Y3 circuit breakers are for use with resistance welding machines.

These circuit breakers may be equipped with a wide choice of operating and trip devices and accessories for overcurrent protection and other functions.

RATINGS

Current Ratings:
- Up to and including 1600 amperes

Voltage Ratings:
- Up to and including 600 volts a-c
- Up to and including 250 volts d-c
- From 251 to 750 volts d-c

Interrupting Capacity:
- 50,000 Amperes

OPERATING CHARACTERISTICS AND CONSTRUCTION

The circuit breakers can be furnished either dead front for switchboard mounting or enclosed in steel cases with or without a pull-box. They may be furnished single, double, triple or four poles and closed by a toggle mechanism operated manually, or electrically by motor, or by a maintenance closing handle against heavy springs back of the movable contacts and springs between the frame and operating mechanism. These springs supply the power to open the breaker when a latch is released either manually by pushing the manual trip button to the rear or by any trip device provided. The circuit breaker is trip free from the closing mechanism, as described under "Operating Mechanism".

The path of the current through the circuit breaker is through the upper studs and contact blocks, the stationary and movable contacts, the series coils and the lower studs. The main contacts close after the arcing contacts, and open before the arcing contacts separate to prevent burning of the main silver contacts. Arc quenchers and box type barriers are provided to extinguish the arcs after the arcing contacts open in circuits up to 600 volts a-c and 250 volts d-c, and blowout coils and arc chutes are provided in circuits between 251 and 750 volts d-c as described under "Contact Assembly", "Arc Quenchers and Barriers" and "Arc Chutes and Blowout Coils".

SHIPPING - UNPACKING - STORAGE

TRANSPORTATION DAMAGE

Immediately upon receipt of the breakers, an examination should be made for any damage or loss sustained during transportation. If injury or rough handling is evident a damage claim should be filed at once with the transportation company and the nearest General Electric Sales Office should be promptly notified.

UNPACKING

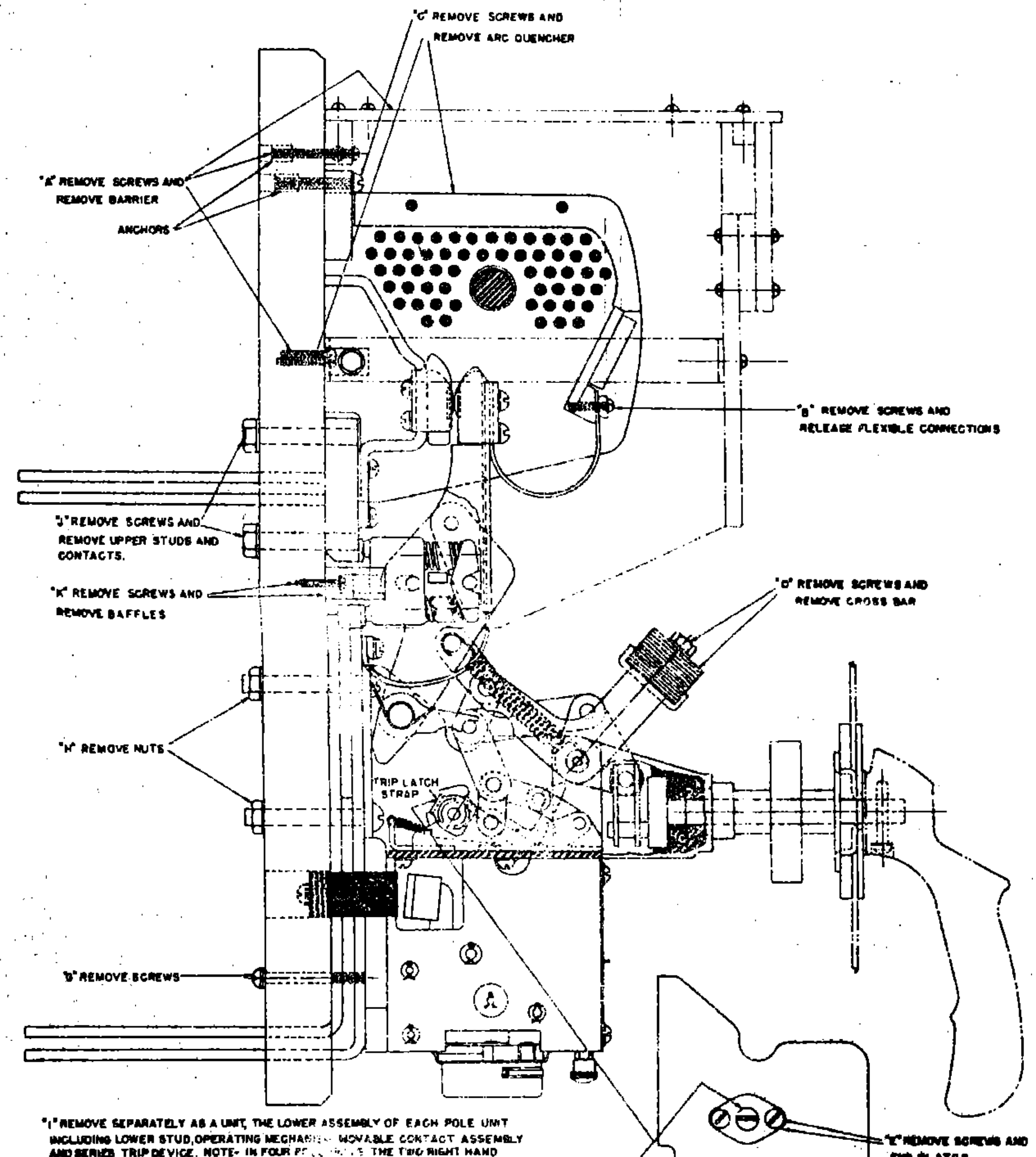
The breakers should be unpacked as soon as possible after being received as difficulty may be experienced in making claim for damage, not evident upon receipt, if delayed. Care should be used in unpacking in order to avoid damaging any of the breaker parts. Be sure that no loose parts are missing or left in the packing material. Blow out any dirt or particles of packing material that may be accumulated on the breaker parts.

STORAGE

If the breakers are not to be mounted in their permanent location at once, they should be stored in a clean, dry place and preferably placed in a vertical position. They should be supported to prevent bending of studs or damage to the breaker parts. It is best not to cover the breakers with any packing or other material that is apt to absorb moisture which may cause corrosion of breaker parts. A covering of paper will prevent dust from settling on the breaker parts.

INSTALLATION

Before installing the circuit breaker it is important that it should be in the open position.



"I" REMOVE SEPARATELY AS A UNIT, THE LOWER ASSEMBLY OF EACH POLE UNIT INCLUDING LOWER STUD, OPERATING MECHANISM, MOVABLE CONTACT ASSEMBLY AND SERIES TRIP DEVICE. NOTE- IN FOUR [illegible] THE TWO RIGHT HAND ASSEMBLIES WILL BE REMOVED AS A UNIT, [illegible] PARTICULARLY CAREFUL NOT TO BREAK OR STRAIN THE TRIP SHAFT [illegible]

NOTE FOR AL-2-50 BREAKERS UP TO [illegible]

PROCEED AS ABOVE EXCEPT: —

"G" REMOVE SCREWS AND BRACKETS THAT [illegible] LOWER STUDS, AND SCREWS FROM THE REAR THAT HOLD THE MAGNETS [illegible] TRIP DEVICES

"J" REMOVE SCREWS AND BRACKETS THAT HOLD [illegible] STUDS

INSTALLATION ON PERMANENT BASE.

1. INSERT ANCHORS IN HOLES IN BASE FOR [illegible] MOUNTING ARC QUENCHERS AND BARRIERS.
2. REASSEMBLE THE BREAKER PARTS IN THE REVERSE ORDER IN WHICH THEY WERE REMOVED, EXCEPT THAT NUTS AND [illegible] AT "G" AND "H" SHOULD NOT BE TIGHTENED UNTIL THE CROSS BARS [illegible] ATTACHED
3. CHECK LINE CONTACT OF MAIN [illegible] AS DESCRIBED UNDER "INSTALLATION."

FIG. 6

TRANSFERRING FROM TEMPORARY MOUNTING

Most circuit breakers are shipped on permanent bases or panel sections with enclosures and mounting consists of simply bolting the mounting bases to the supporting framework or installing them in the permanent structure as described below. Upon request circuit breakers may be shipped on temporary bases and installation includes transferring them from the temporary to the permanent base as described under "Transferring from Temporary Mounting".

LOCATION

The Type AL-2-50 air circuit breakers should be installed in a clean dry place where they will be readily accessible for convenient operation, inspection and maintenance. No additional clearance need be provided for dissipation of arcing gases for voltages up to 600 volts a-c and 250 volts d-c as barriers are provided which enclose the arc quenchers. However, in circuit breakers for 251 to 750 volts d-c, where arc chutes and blowout coils are provided, additional clearances will be required as will be shown in outline drawings supplied with these circuit breakers.

DEAD FRONT BREAKERS Figs. 1 and 2

These have barriers which enclose the arc quenchers and are suitable for mounting behind a front enclosure to protect the operator from coming in contact with live parts. They are designed for mounting in switchboards with other circuit breakers and control equipment. Provision is made in the front enclosure for operating control and visual position indicator. Installation consists of mounting them in the enclosing structure, mounting the front enclosure and connecting the power buses or cables and control wiring.

ENCLOSED BREAKERS

These are for separate installation and have individual steel housings. In a manually operated breaker a steel housing, provided with louvers, operating controls and visible position indicator is bolted to the front of the mounting base and completely encloses it. It may or may not, be provided with a steel pull box which is bolted to the rear of the mounting base to cover the studs and solderless connectors. In a motor operated breaker a larger steel housing encloses the entire breaker and the mounting base of the breaker is bolted to angle brackets within the housing. It is provided with a hinged door with operating controls and visual position indicator. Installation of the manually operated breaker consists of bolting the mounting base to the mounting structure and connecting the power cables and control wires direct to the solderless connectors or through cover plates in the pull box, if used. Installation of the motor operated breaker unit consists of bolting it to the supporting structure through angle brackets attached to the rear of the steel housing and connecting the power cables and control wires through the cover plates in the housing.

SILVER CONTACTS

Silver contacts, described under "Contact Assembly", should be checked as follows before the circuit breaker is put in operation:

1. Wipe off any dust which may have collected on the contact surfaces with a clean cloth.

2. Clean the contacts with a good grade of silver polish or very fine sandpaper to remove any dark surface film so that the contacts are clean and bright. If silver polish is used, be careful to remove all polish from the contacts or insulated parts after cleaning. If sandpaper is used, care must be exercised to maintain line contact.

3. Take contact impressions as described under "Contact Assembly" to determine if proper line contact is being obtained. If necessary, improve contacts as described under "Maintenance".

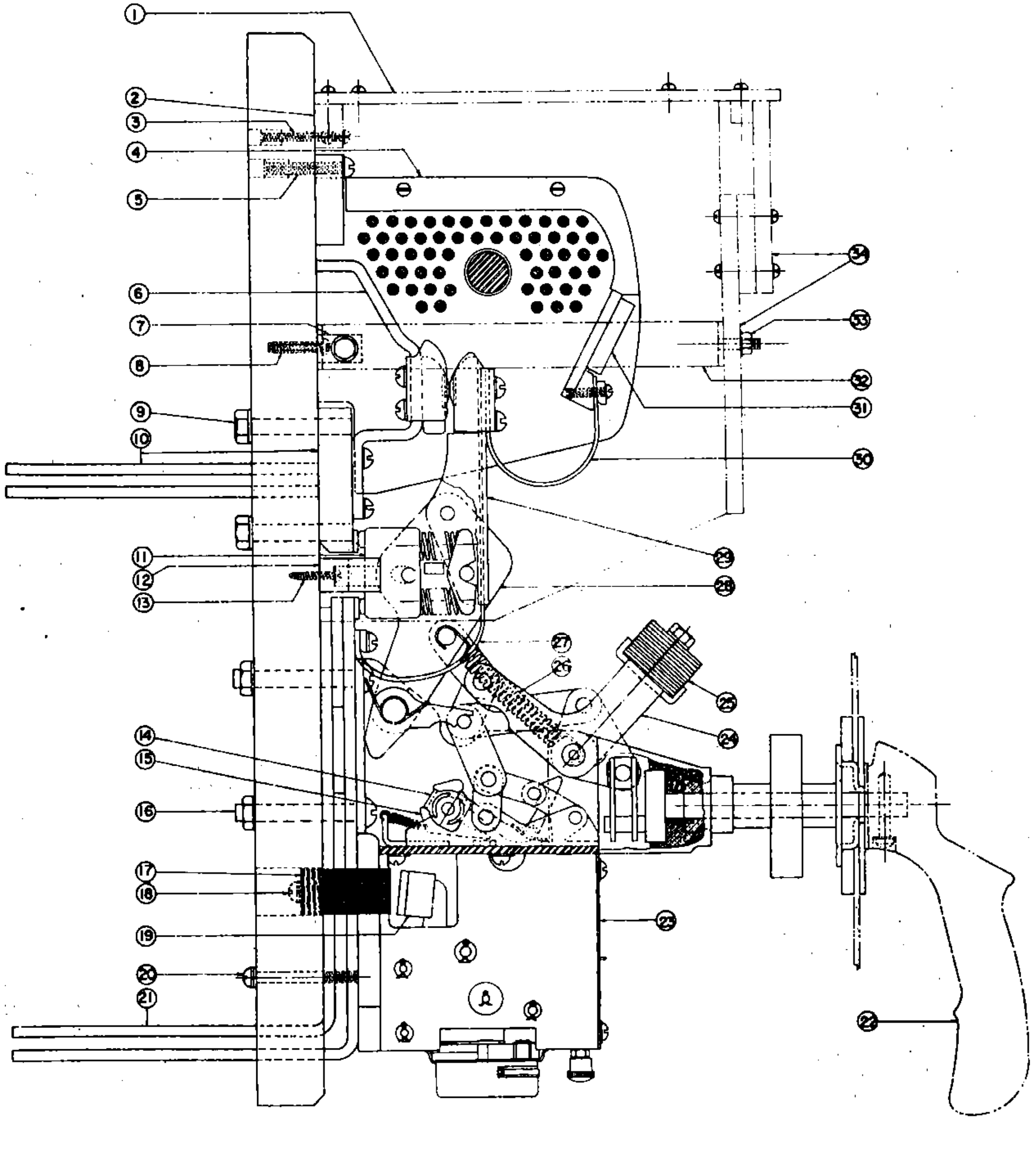
BREAKER CONNECTIONS

Before connecting current-carrying bus bars or cables or secondary control wiring, every precaution must be taken to be sure that the leads to be connected to the circuit breaker are de-energized.

The connections to the circuit breaker studs should be clean, flat and free from burrs to assure full contact area and firmly clamped or bolted in place to prevent excessive heating. In enclosed circuit breakers the cables should be clean and of ample size to assure maximum contact surface when attached to the solderless connectors. The connecting cables or bus bars should have adequate current-carrying capacity, otherwise heat will be conducted from them to the circuit breaker which could not be expected to carry normal current without exceeding the specified temperature rise. Connecting cables or bus bars should be supported so that the circuit breaker studs will not be subjected to unnecessary strains.

TORQUE BRAKE

It sometimes happens, during shipment, that oil will escape from the gear case of the motor operating mechanism and become spread over the brake drum (1) Fig. 18 and brake shoes (6) Fig. 18 of the torque brake, Figs. 15 and 18, to destroy necessary friction. It is recommended that these surfaces be examined and any oil should be removed by a clean cloth moistened with a light grade of kerosene or naptha and should be wiped dry with a clean cloth. To get at the torque brake, remove the motor by removing screws that hold it to the gear housing and lift out



1. BARRIER
2. BARRIER BRACKET
3. SCREWS AND ANCHORS
4. ARC QUENCHER (SEE FIG.8)
5. SCREWS AND ANCHORS
6. REAR ARC RUNNER AND STATIONARY ARCING CONTACT
7. BRACKET
8. SCREW
9. SCREW
10. UPPER STUD AND MAIN STATIONARY CONTACT (SEE FIG. 7)
11. BRIDGING BLOCK
12. BAFFLE
13. SCREWS
14. TRIP LATCH STRAP
15. TRIP LATCH
16. SCREW
17. MAGNET
18. SCREW
19. ARMATURE
20. SCREW
21. LOWER STUD
22. OPERATING HANDLE
23. DUAL MAGNETIC OVERCURRENT TRIP DEVICE 600 TO 1600 AMPS (SEE FIG. 23)
24. OPERATING MECHANISM
25. CROSS BAR
26. OPENING SPRING
27. FLEXIBLE CONNECTION
28. MAIN CONTACT SUPPORT (SEE FIG. 7)
29. MOVABLE ARCING CONTACT AND SUPPORT
30. FLEXIBLE CONNECTION
31. FRONT ARC RUNNER AND MAGNET
32. NUTS AND WASHERS
33. NUTS AND WASHERS
34. REMOVABLE FRONT COVERS

FIGURE 6
LEFT SIDE VIEW OF POLE UNIT

the impellor (3) Fig. 18 and the coupling (5) Fig. 18 which carries the brake shoes (6) Fig. 18. *In replacing* be sure that the impellor is placed so that it will bear against the lugs of the brake shoes when the motor revolves clockwise (looking down).

TIME DELAY OIL POTS

Oil pots used in devices to provide time delay are shipped with oil removed and a piece of paper is placed between the lapped disc surfaces. Be sure to remove this paper, clean the pots and disc surfaces with kerosene or naptha and fill the pot with oil, General Electric specifications D6B7A1, to the designated level.

TRANSFERRING FROM TEMPORARY MOUNTING

It is always preferable to have an air circuit breaker shipped on a permanent base or panel section. Remounting of a breaker by persons not entirely familiar with its detailed construction may result in misalignment or improper adjustment with resultant unsatisfactory operation. Temporary bases will not be supplied when reverse current trip devices are involved.

For those cases where a circuit breaker is shipped on a temporary base, first make sure that the permanent base or panel is properly drilled in accordance with an approved drilling plan furnished by the General Electric Company for the particular breaker. In transferring the breaker it should not be dismantled any more than is necessary to effect the transfer. Sub-assemblies, such as overcurrent trip devices, operating mechanism and other closely assembled parts, should be transferred as a unit. This will help maintain adjustments and will minimize the possibility of incorrect assembly. A recommended sequence of procedure for transferring the Type AL-2-50 circuit breaker is given in Fig. 5. It is suggested that this procedure be followed in the order in which the operations are alphabetically arranged. Re-install parts and devices in the reverse order.

In reassembling it is important that the same alignment of parts be maintained as when the breaker was originally installed and tested on the temporary base at the factory. After reassembling check for binding of trip shaft and for excessive friction elsewhere.

Clean the silver contacts, take contact impressions and improve line contact as described above under "Silver Contacts".

OPERATION AND MAINTENANCE

OPERATION

After the breaker has been installed, slowly operate it manually several times (as described below) and observe whether the contacts line up properly and make sure that all parts move freely in proper manner without binding or excessive friction. See that the breaker latches securely and trips freely. If the breaker is equipped with an undervoltage device it cannot be latched closed until the minimum operating potential, or higher, is applied to this device, or the plunger is held within the coil.

Manually operated AL-2-50 circuit breakers, covered in these instructions, are closed by first turning the operating handle in the counter-clockwise direction from the normal position of "handle-down" to a position of "handle-up", to reset the operating mechanism and then turning the handle in the clockwise direction to position of "handle-down" to close the circuit breaker, as described under "Manual Operating Mechanism". DO NOT ATTEMPT TO OPEN THE CIRCUIT BREAKER BY COUNTER-CLOCKWISE ROTATION OF THE OPERATING HANDLE. The circuit breaker is opened manually by pushing the manual trip button to the rear, as described under "Manual Trip", to release the trip latch. The handle remains in the "down" position after tripping.

Electrically operated circuit breakers may be closed manually by inserting a maintenance closing handle in a socket provided for this purpose in the front of lever (28) Fig. 15 and lowering it until the breaker is latched closed. The breaker is tripped by pushing the manual trip button and not by the maintenance closing handle.

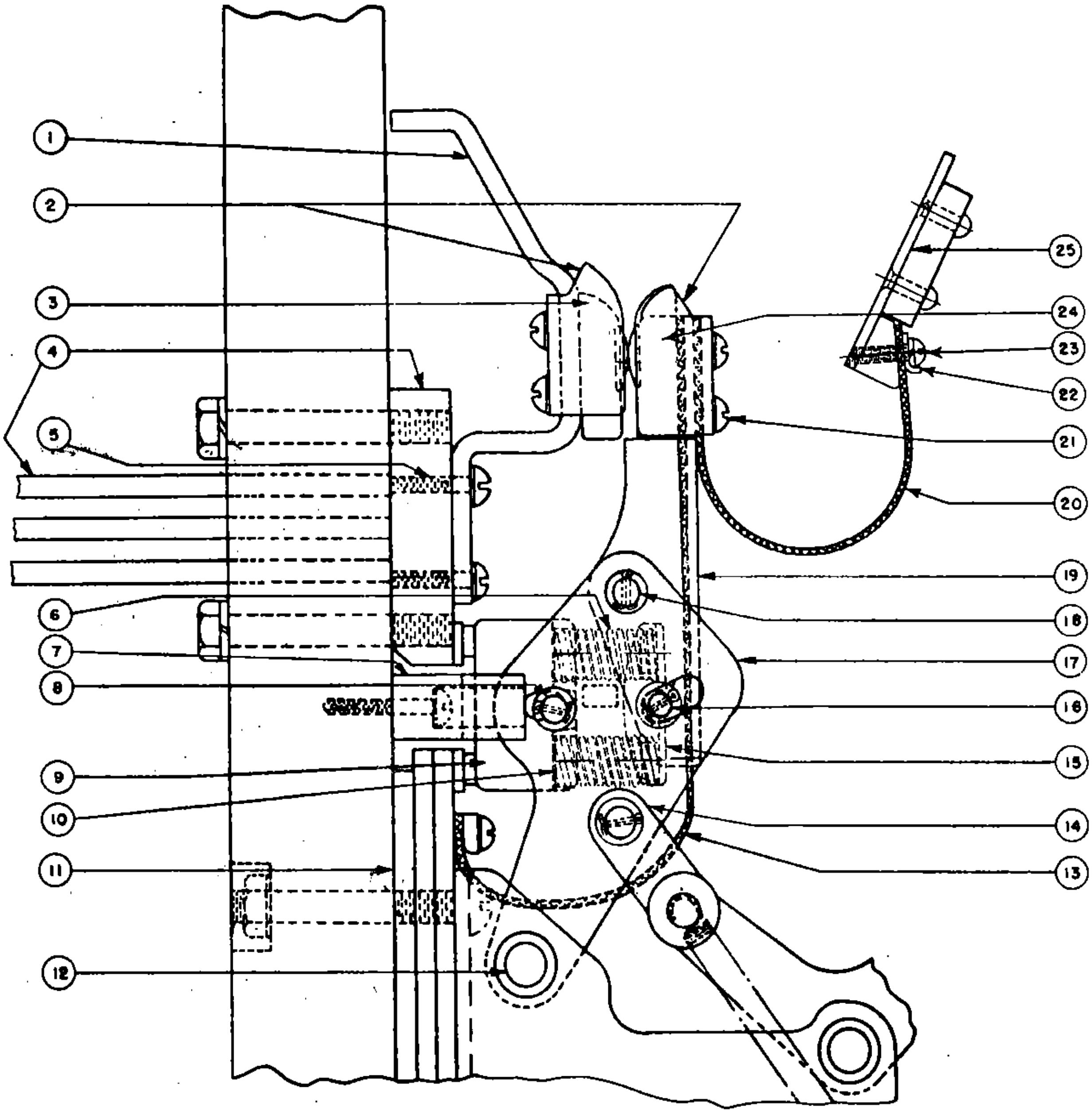
The electrically operated breaker will automatically reset itself if the maintenance handle has been removed, but may not reset itself if the handle is in place. Therefore, the handle should always be removed except during the act of manually closing.

After carefully checking the operation manually, as above, an electrically operated breaker should be operated a few times by the closing motor at rated voltage to make sure that all control circuits are properly connected and that the motor, closing relay and electrical attachments are functioning properly. It is important to bear in mind that the motor is rated for intermittent service. Reasonable care should be exercised when testing to avoid overheating of the motor by repeated operations.

MAINTENANCE

General

Before inspecting or repairing, make sure that the breaker and accessories are disconnected from all electric power, both primary and control voltages.



1. REAR ARC RUNNER
2. ARC CONTACT MAGNETS
3. STATIONARY ARCING CONTACT WITH SILVER CONTACT INSERT
4. UPPER STUD AND STUD BLOCK WITH SILVER CONTACT INSERT
5. SCREW
6. SPRINGS
7. BAFFLE
8. PIN IN MAIN CONTACT SUPPORT
9. BRIDGING BLOCK WITH SILVER CONTACT INSERTS
10. DISC
11. LOWER STUD WITH SILVER CONTACT INSERTS
12. PIN IN FRAME
13. FLEXIBLE CONNECTION
14. CLOSING LINK
15. SPRING SUPPORT
16. PIN IN MOVABLE ARCING CONTACT SUPPORT
17. MAIN CONTACT SUPPORT
18. PIN IN MAIN CONTACT SUPPORT
19. MOVABLE ARCING CONTACT SUPPORT
20. FLEXIBLE CONNECTION
21. SCREW
22. CLAMPING PLATE
23. SCREW
24. MOVABLE ARCING CONTACT WITH SILVER ALLOY INSERT
25. FRONT ARC RUNNER

FIG. 7

MAIN AND ARCING CONTACT ASSEMBLIES

Periodic inspection of the circuit breaker is recommended at least once a year or more frequently if severe load conditions, dust, moisture or other unfavorable conditions exist. An inspection of the contacts and arc quenchers should always be made after it is known that the breaker has opened a severe short circuit.

If the breaker remains open or closed for a long period of time it is recommended that arrangements be made to open and close it several times in succession, preferably under load, also clean and lubricate where necessary, as described below, to keep the contacts and moving parts in good working condition.

If overheating, not caused by overcurrent, is observed, look for loose connections, damaged contacts or flexible connections.

At all times it is important not to allow pencil lines, paint or other materials of different degrees of conductivity to short circuit insulation strips or barriers between surfaces of different potential on breaker parts or attachments. Even oil on such insulation surfaces may accumulate dirt and allow leakage of current.

Care of Silver Contacts

Periodic inspection and maintenance should always include care of silver contacts as follows:

1. Wipe off dust and clean silver contacts as described under "Installation".
2. Take contact impression, as described under "Contact Assembly", and improve contacts to obtain line contact, if necessary. Remove rough and high spots with a fine clean file or very fine sandpaper. DO NOT use emery or crocus cloth. Pittings need not be removed if 75% of line contact is obtained.

Lubrication

In general, the breaker mechanism requires very little lubrication which should be applied sparingly. Any excess amount of oil on the breaker parts is apt to collect dust and dirt and is to be avoided. A general recommendation for lubrication of an air circuit breaker mechanism is to use occasionally a few drops of a good grade of light machine oil at bearing points and wipe off the excess with a clean cloth. Latch surfaces should be kept smooth and clean with crocus cloth. They should be lightly greased and the excess removed with a clean cloth.

Time Delay Oil Pots

If the breaker is equipped with any type of oil-film time delay trip devices, make sure that the oil pots of these devices are thoroughly cleaned and kept filled with fresh oil to the proper level as marked on the pots at regular inspection periods, at least every six months, or more frequently if service is severe. A small can of oil for use in these pots is furnished with each breaker. Additional oil, per General Electric Company specifications D6B7A1, can be obtained from the factory. When cleaning these oil pots, use kerosene or naptha only, and wipe dry with a clean cloth. Other cleaning fluids may act as a solvent of the material of which the pots are made.

DESCRIPTION OF COMPONENTS AND ATTACHMENTS

Although under this heading the description and adjustable features of the AL-2-50 breaker and attachments are given, it should be understood that the breakers have already been adjusted, inspected and tested at the factory before shipment in accordance with the information given below. However, it is possible that unusually rough handling, transportation and operating conditions after installation may have resulted in some loosening or disturbance of the equipment to warrant re-checking and re-adjustment may be necessary.

CONTACT ASSEMBLY Fig. 7

The contact assembly of the Al-2-50 breaker consists of stationary contacts, a bridging block and arcing contacts, the moving elements of which are attached to contact support pivoted to the frame and actuated by the operating mechanism, as shown in Fig. 6 and detailed in Fig. 7.

The breaker is equipped with fine-silver high pressure line type main contacts silver soldered to the contact studs and the bridging block. The surfaces of these contacts have been coated with wax at the factory to prevent the formation of surface film. The wax will not interfere with operation as it will volatilize at normal operating temperatures of the breaker.

When the circuit breaker is closed two silver contacts, brazed to the rear of bridging block (9), engage silver contacts brazed to stud block (4) and the top of lower stud (11) in breakers up to 800 amperes. In smaller breakers the contact is brazed to the upper connector to which the series coil of overcurrent trip devices is attached. The bridging block is supported on pin (8) that passes through slots in main contact supports (17) which is pivoted on pin (12) in the operating mechanism frame. Springs (b) back up against pin (16) in the movable arcing contact support (19) through slots in the main contact supports (17). The stationary arcing contact (3) with silver alloy insert and magnet (2), is attached to the rear arc runner by screws and the arc runner is attached to the upper stud block by screws (5). The movable arcing contact (24), with silver

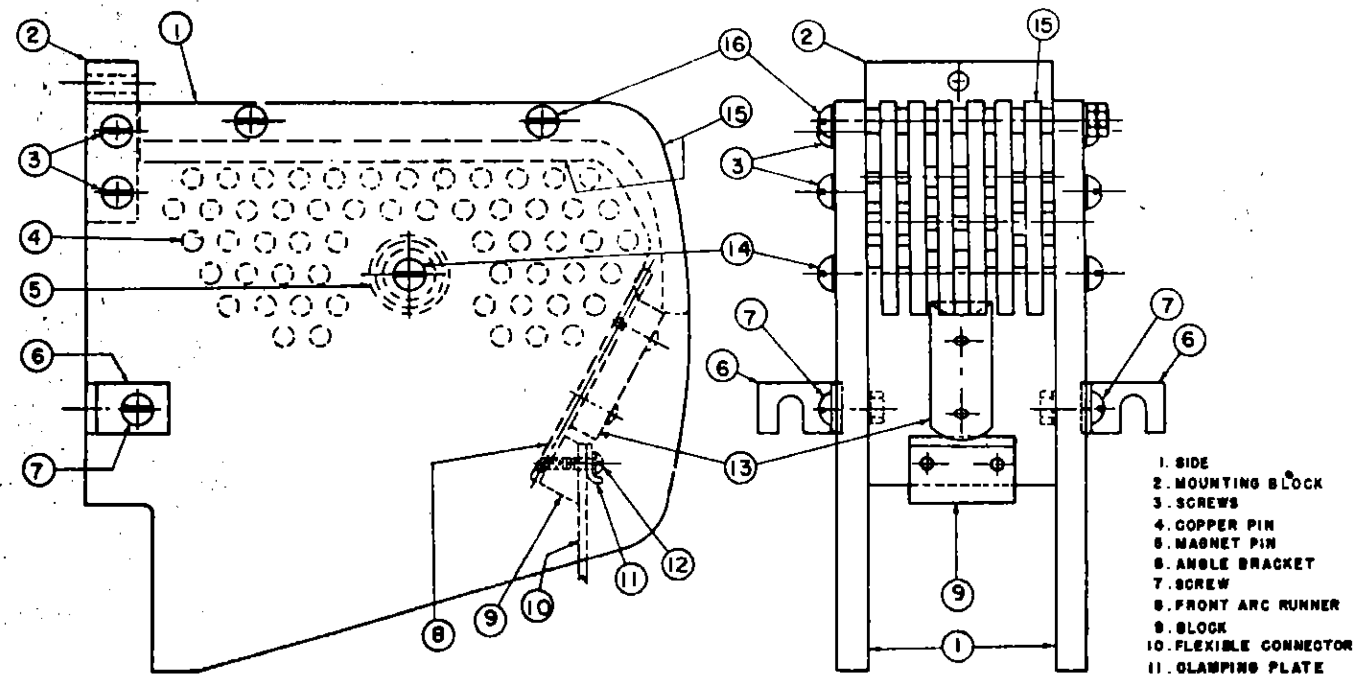


FIGURE 8
ARC QUENCHER

alloy insert and magnet, is attached to movable arcing contact support (19) which is pivoted on pin (18) in the main contact support (17).

A baffle (7) is placed between stationary silver contacts of the upper and lower studs and fastened to mounting base.

ARC QUENCHERS AND BARRIER Fig. 8

An arc quencher is provided for each pole of the Type AL-2-50 circuit breaker to extinguish arcing after the contacts open. Each arc quencher consists of a large number of small copper pins (4), one magnetic pin (5), molded compound baffles (15) and a front arc runner (8) mounted between molded compound sides (1). The magnetic pin consists of a cylindrical steel pin insulated within a copper tube and mounted between the sides by screws (14). This magnetic pin, together with the arcing contact magnets (2) Fig. 7, and magnet (13) on the front arc runner, forms a path for the magnetic field caused by the arcing at the arcing contacts to force the arc upwards among the cooling pins and baffles. The baffles are placed above and in front of the pins to provide further cooling surfaces as the arcing gases pass between them. The front arc runner is mounted in front of the pins and is connected to the movable arcing contact (29) Fig. 6 by flexible connection (10) and screws (12) after the arc quencher is mounted.

The arc quencher is attached to the mounting base by screws (5) Fig. 6 through the top into anchors inserted in the base and by self-tapping screws (8) Fig. 6 through side angle brackets (6).

A box type barrier (1) Fig. 9, of molded compound is provided for AL-2-50 circuit breaker and fits over the top, sides and front of the arc quenchers to confine the arc. It is provided with a removable front to allow inspection of the arc quenchers. It is attached to the mounting base by screws (3) Fig. 9 through the top into anchors inserted in the base and by self tapping screws through angle straps (36) Fig. 9. The removable cover is attached by nuts to screws welded to these straps.

ARC CHUTE WITH BLOWOUT COIL AND BARRIER Fig. 9

For 251 to 750 volts d-c application an arc chute with a magnetic blowout coil is provided for each pole unit to extinguish the arcing after the contacts open. The breaker is provided with a barrier which encloses the arc chutes for dead front mounting.

The arc chute consists of a blowout coil assembly, a front arcing horn and an arc splitter (5) mounted between molded composition sides (4) and attached to the mounting base by screws (33).

The blowout coil assembly consists of a blowout coil (12) which is brazed to the

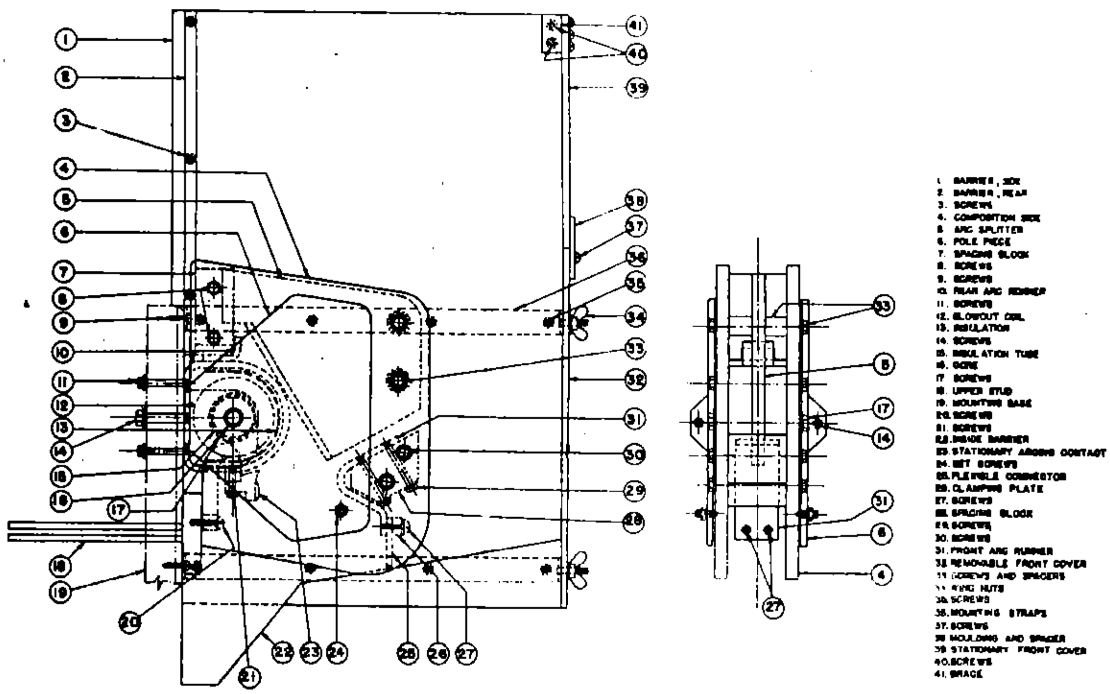


FIGURE 9
ARC CHUTE WITH BLOWOUT COIL AND BARRIER

(P-6490453 SK)

rear arc runner (10). One end of the coil is attached to the front of the upper stud by screws (20) and the rear arc runner is attached to the mounting base by screws (11). The stationary arcing contact (23) is attached to the other end of the coil by screws (21). The core (16) is inserted in the coil within an insulation tube (15) and held in place by screws (17) through the sides (4).

The front arc runner (31) is attached to spacing block (28) by screws (29) and the block is attached to the sides by screws (30). Flexible connection (25) is connected to this front arc runner by screws (27) after the arc chute is in place.

The arc splitter (5) is mounted midway between the sides, the front being supported between spacers on screws (33) and the rear rests in a slot in spacing block (7).

In order to place the arc chutes in a dead front structure they are provided with a barrier, open at the top, which is mounted above and encloses them. It consists of composition sides (1), rear (2), stationary front (39), removable front (32) and an inside barrier (22). It rests on the top of the mounting base and is attached to it by screws (9) through mounting straps (36) on the sides of the barrier. Wing nuts (34) fasten the removable front to screws welded to the front of the straps. The inside barrier is mounted midway between the sides of a two pole breaker to isolate the two arc chutes.

MANUAL OPERATING MECHANISM Fig. 10, 11, 12 and 13

The manually operated breaker mechanism Fig. 10, is operated by revolving a pistol grip handle located at the front of the mechanism. The normal position of the handle is "down" and in order to close the manually operated breaker it must first be turned counter-clockwise approximately 180° to the reset position, which resets the latch (15), and then must be turned clockwise to the "down" position to close the breaker. The mechanism is tripped manually by pushing on the button of the manual trip, Fig. 19, or by tripping devices, which revolves the trip latch (8) in the counter-clockwise direction (looking from the left) to release the latch (15). The breaker cannot be tripped by counter-clockwise rotation of the operating handle. When tripped manually or electrically, the handle remains in the "down" position. Therefore, to reclose the breaker, the handle must first be turned counter-clockwise to the "reset" position and then clockwise to the "down" position, as described above.

The operating mechanism, Figs. 11, 12 and 13 of the manually operated breaker consists of a group of toggles, links and latches installed in the center pole unit, or center

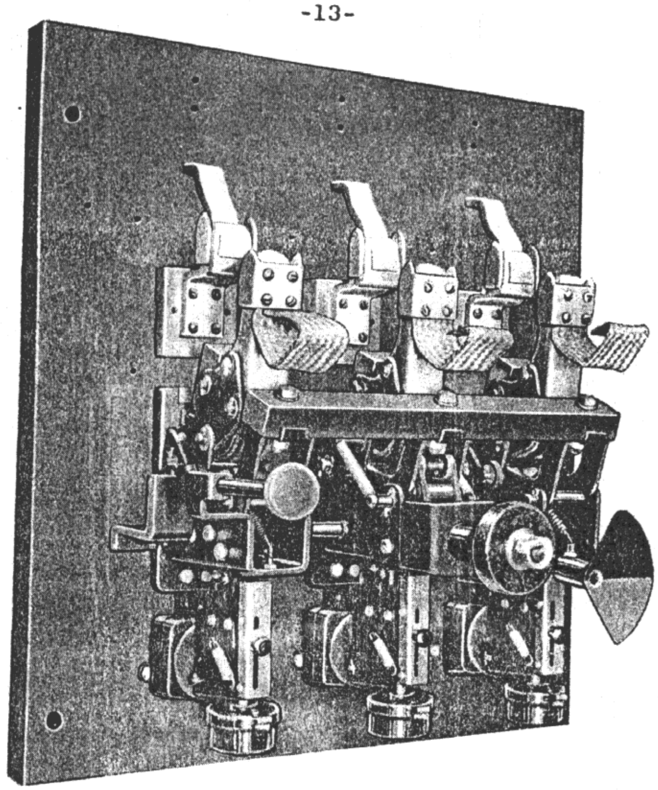


FIG. 10
MANUALLY OPERATED MECHANISM

pole location, and is connected to the other pole units by cross bar for closing and by interlock trip rods which engage both sides of trip latch strap (9). The trip latch (8) and the trip latch strap (9) are mounted on the same pin (10), and operated as one unit. The moving parts are attached by fixed pins (4 and 29) to frame (2), and by fixed pins (10, 11, 16 and 20) to the support (7) which is rigidly attached to the frame. All parts move otherwise on floating pins. By revolving the operating handle counter-clockwise, the eccentric (22) moves in the same direction to revolve the link and trunion (28) counter-clockwise (looking from the left) for the resetting operation; and then revolving the handle clockwise causes the link and trunion to revolve clockwise for the closing operation. In closing the breaker, the main contact support (1) is forced towards the rear against the contacts and extends the opening springs (36) which supply the power to open the breaker when the latch (15) is released, in that all toggles and links are off center. See Fig. 6 for the location of opening springs on the other poles.

In a cycle of manual operation, the mechanism parts take three positions as follows:

TRIPPED POSITION - As shown in Fig. 11, the latch (15) is free of the trip latch (8), and toggle links (19 and 35) are in the collapsed position with pin (18) resting on the upper oblique face of the hook of latch (15). Toggle link (32) and link (39) are held in the collapsed position by closing spring (36) which holds the main contact support (1) in the open position. Buffer washer (40) on pin (41) rests in the concave recess in frame (2) which allows spring (36) to draw the main contact support to the open position. The operating handle is in the down position. Other parts take positions as shown.

RESET POSITION - When the operating handle (26) is turned counter-clockwise to the "reset" position, with handle up, Fig. 12, the eccentric (22) revolves the link and trunion block (28) in the counter-clockwise direction (looking from left), to reset the latch (15) in the catch of trip latch (8) when toggle links (19 and 35) are extended to place pin (18) under the hook end of latch (15). Opening spring (36) has prevented the main contact support (1) from closing.

CLOSED POSITION - When the operating handle (26) is turned clockwise to the "down" position, Fig. 13, the eccentric (22) revolves the link and trunion block (28) clockwise. This extends the toggle link (32) and link (39) to move the main contact support (1) backwards, which closes the contacts and extends spring (36). Pin (14) is held in place because the latch (15) is hooked over pin (18) and will not allow toggle links (19 and 35) to collapse. At the same time, prop (5) is forced behind pin (43) by spring

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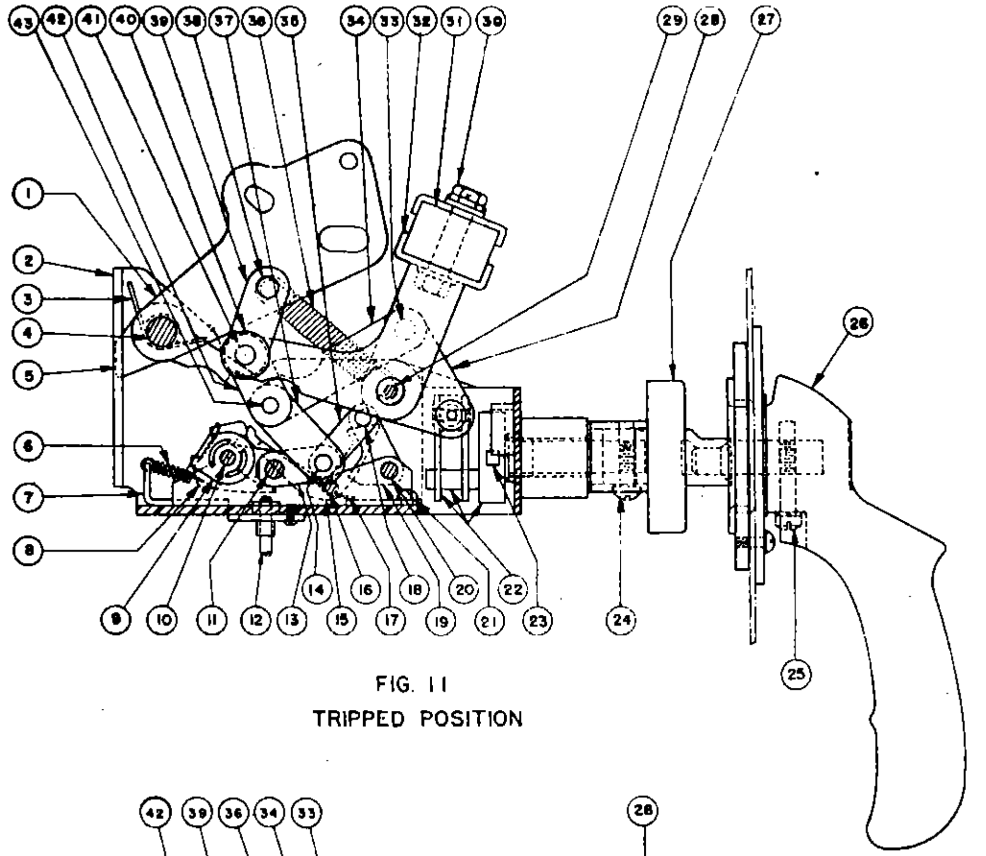

FIG. 11

TRIPPED POSITION

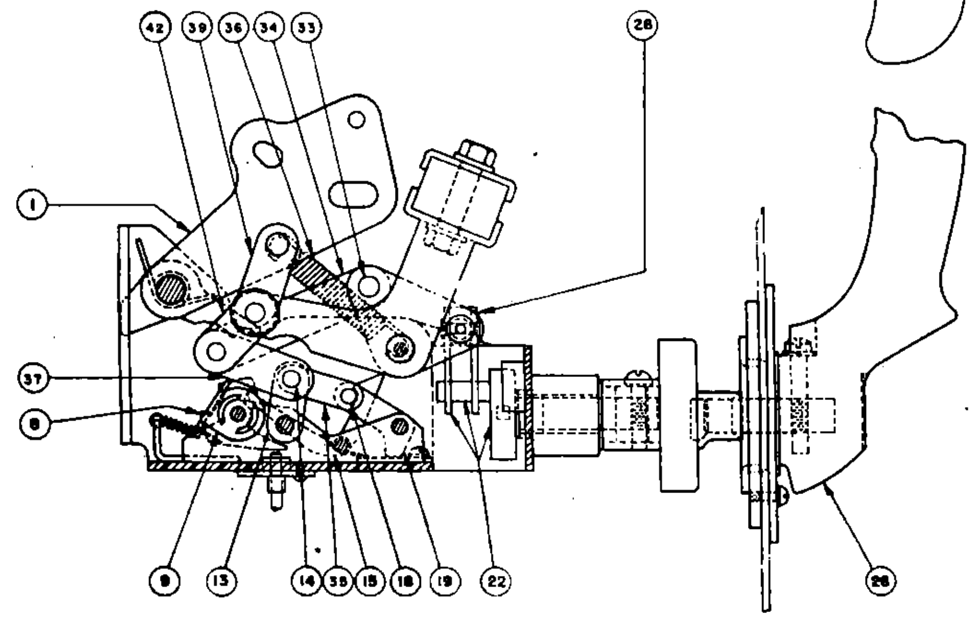

FIG. 12

RESET POSITION

OPERATING POSITIONS OF MANUALLY OPERATED BREAKER

1. MAIN CONTACT SUPPORT
2. FRAME
3. SPRING
4. PIN IN FRAME
5. PROP
6. SPRING
7. SUPPORT
8. TRIP LATCH
9. TRIP LATCH STRAP
10. PIN IN SUPPORT
11. PIN IN SUPPORT
12. TRIP ROD & GUIDE
13. LINK
14. PIN
15. LATCH
16. PIN IN SUPPORT
17. SPRING
18. PIN
19. TOGGLE LINK
20. PIN IN SUPPORT
21. SCOVILLE S.TAPPING MACH. SCREW WITH LOCKWASHER
22. ECCENTRIC, PIN AND LINKS
23. STOP
24. SCREW WITH LOCKWASHER
25. SCREW WITH LOCKWASHER
26. MANUALLY OPERATED HANDLE
27. INSULATED COUPLING & SLEEVE
28. LINK AND TRUNNION BLOCK
29. PIN IN FRAME
30. SCREW WITH WASHERS & NUT
31. CROSS BAR
32. TOGGLE LINK
33. PIN
34. LINK
35. TOGGLE LINK
36. OPENING SPRING (SEE
37. LINK
38. PIN
39. LINK
40. BUFFER WASHER
41. PIN
42. LINK
43. PIN

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(3) to prevent opening of the breaker by counter-clockwise rotation of the operating handle.

TRIPPING - When the circuit breaker is tripped manually by the trip button (11) Fig. 19, or by any automatic trip device the trip latch (8) is revolved counter-clockwise (looking from the left) about pin (10). Figs. 11, 12 and 13 show a trip rod (12) of an 800 to 1600 ampere dual magnetic overcurrent trip device installed in the operating pole, as shown in Fig. 25. The comparable arrangements for the dual magnetic overcurrent trip devices are shown in Figs. 23 and 26 respectively. Tripping from the other pole units is accomplished by trip shaft (32) Fig. 23 which engages trip latch strap (9) and therefore turns trip latch (8) counter-clockwise. This disengages the catch in the upper end of trip latch from the rear end of latch (15) and allows latch (15) to revolve clockwise about pin (16) and release pin (18) from under the hook end of latch (15). Tension in the opening springs (36) causes toggle links (19) and (35) to collapse. These and toggle links (32, 42 and 37) take positions as shown in tripped position Fig. 11. Link (39) draws the main contact support (1) and the contacts to the open position and buffer washers (40) rest in the concave recess in frame (2).

The type AL-2-50 breaker is trip free because the toggle link (32) and link (39) cannot be extended to close the contacts as long as the trip latch (8) is held in tripped position by any trip device. This will not allow the trip latch (8) to hold the latch (15) in the position shown in Fig. 12, and even if an attempt is made to close the breaker the toggle links (19 and 35) simply collapse and return to the position as shown in Fig. 11 which makes it impossible to extend toggle links (32) and link (39) against the opening spring (36) to close the contacts.

The latch surfaces should be highly polished and free of any scaling or chipping. They should be lightly greased and the excess removed with a clean cloth.

ELECTRICALLY OPERATED MECHANISM Figs. 14 and 15

Electrical operation for closing the AL-2-50 breaker is obtained by the same mechanism as for manual operation, except that it is operated by a totally enclosed series motor instead of by a rotating handle. For manual closing of the electrically operated breaker, a maintenance closing handle can be inserted into a socket welded to the front end of the lever (22) Fig. 15. Tripping is accomplished in the same manner as in the manually operated mechanism, that is, by pushing on the button of the manual trip, Fig. 19, or by any tripping device which releases the latch (15) Fig. 11 .

As shown in Fig. 15, the motor (1) and gear reduction assembly are mounted in a vertical position on the left side of frame (15) by screws (16) and the frame is attached to the mounting base by screws (13). A worm, (21), is attached to the lower end of the motor shaft through a torque brake, Fig. 18. It engages a worm wheel (6) mounted on a horizontal closing drive shaft (12). On this drive shaft, within the frame, is mounted a closing cam (8), welded to a hub which is firmly attached to the shaft by a 3/8" groov pin. Rotation of the motor causes the cam to revolve counter-clockwise (looking from left) to engage a roller (18) mounted on pin (17) in the lever (22), the rear end of which is attached to the frame by pin (14). The front end of the lever supports a vertical rod (26) and couplings (23 and 46) which are connected to the operating lever (27) which, in turn, replaces link (39) Fig. 11 of the manually operated mechanism. The remaining parts of the operating mechanism and operation are the same in both manual and electrical operation. In closing the breaker, the lever (22) reaches approximately the horizontal position which draws the rod (26) downward and the link (38) Fig. 11 forward to close the breaker. Tension springs (11) normally hold the lever (22) up and act as reset springs for the parts of the motor mechanism when the breaker is tripped. The worm and gear operate in a housing partly filled with 600 W lubricant.

Starting and stopping of the motor is controlled by means of a motor control relay, Fig. 16, with upper and lower elements, mounted on the lower part of the mounting base, in conjunction with a cut-off switch, Fig. 17, mounted on the right hand side of the frame (15) and operated by an auxiliary cam (43) on the drive shaft (12) which extends through the frame. The functions performed and the sequence of operations are as follows:

The closing of the closing switch at some remote point energizes the upper unit of the motor control relay, Fig. 16, through the normally-closed contact (21) of the lower unit. The upper unit picks up and closes both of its normally-open contacts (8 and 32). The main contact (8) of the upper unit connects the motor directly across the control power line. The auxiliary contact, (32) of the upper unit is in parallel with the closing switch and maintains voltage on the coil of the upper unit to insure a complete closing cycle even though the closing switch is opened before this closing cycle is completed. As the main closing cam (8) Fig. 15 rotates to close the breaker, the auxiliary cam (43) Fig. 15 closes contact M1 and then contact M2 of cut-off switch, Fig. 17.

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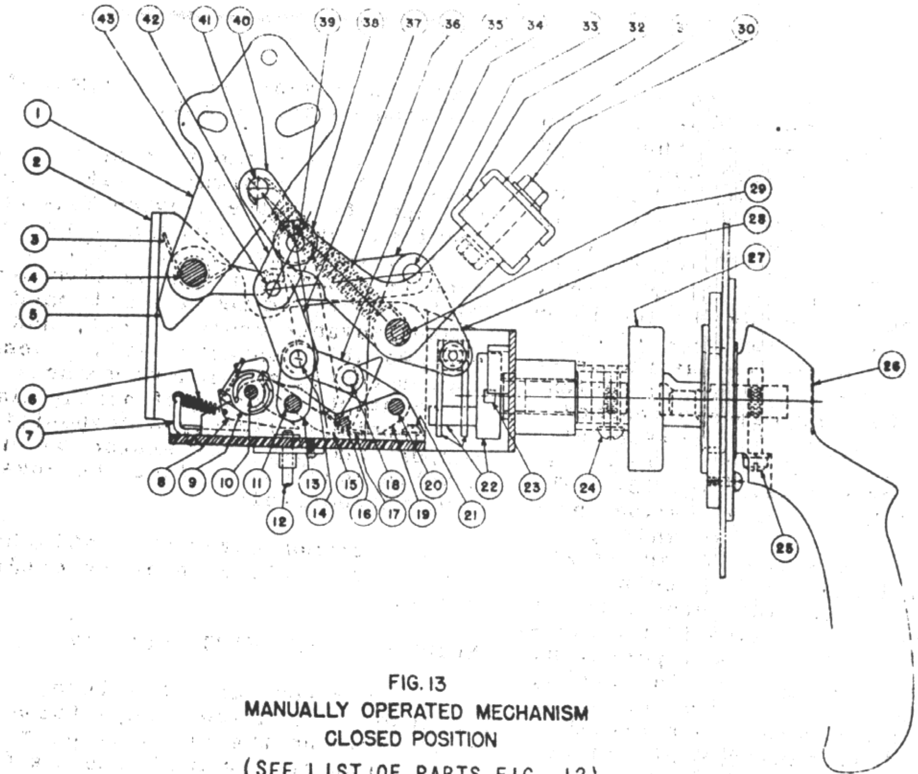


FIG. 13
MANUALLY OPERATED MECHANISM
CLOSED POSITION
(SEE LIST OF PARTS FIG. 12)

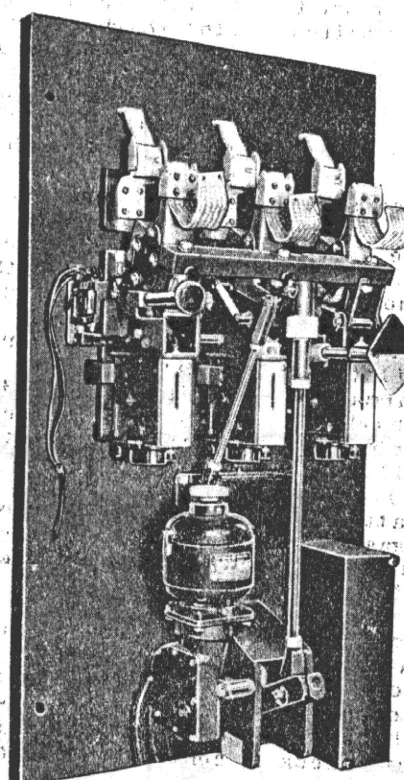


FIG. 14
ELECTRICALLY OPERATED MECHANISM

Contact M1 is in parallel with the normally-closed contact (21) of the lower unit to maintain voltage on the coil of the upper unit after the normally closed contact of the lower element opens. Contact M2 energizes the lower unit which then picks up and opens the normally-closed contact (21) and closes its normally-open contact (22). Its normally-open contact (22) parallels contact M2 and maintains voltage on the lower unit coil, either as long as the closing switch is held closed or as long as the upper unit is energized. When the breaker is latched closed and the closing cam has reached a position which will permit the breaker latch to reset, both contacts M1 and M2 are opened quickly by auxiliary cam (43, Fig. 15). The opening of contact M1 de-energizes the upper unit of the motor control relay which, in turn, opens its contacts and de-energizes the motor. Should the breaker trip free during the closing cycle, the motor will not pump or attempt to reclose even if the closing switch is held in the closed position. After the completion of one closing cycle, the lower unit remains energized and keeps the upper unit and the motor de-energized as long as the closing switch is kept closed. If the breaker has tripped during the closing cycle, open the closing switch to de-energize the lower element and to close its normally closed contact. This will permit another closing cycle when the closing switch is closed.

MOTOR CONTROL RELAY Fig. 16

The motor control relay, Fig. 16, of the AL-2-50 motor operated breaker consists of two elements with composition bases mounted on a common steel plate (27) and the entire assembly is mounted in a vertical position on the lower part of the breaker mounting base. The upper element is the motor relay and the lower element is the cut-off relay. The upper element consists of a coil (35), and magnet (34) which operate an armature (9) supported on a bracket (12) which is riveted to the lower horizontal member of the magnet. The armature is normally held in the open position by spring (15). Attached to the upper end of the armature is a movable contact clip (8) which engages the stationary contact stud (5) on the brass contact support (37) constituting the contact switch 1-2 of wiring diagram, Fig. 42 which makes and breaks the motor current. A permanent magnet blow-out (1) and pole pieces (4) are mounted around the contacts which quickly blow out the arc to open the motor circuit. The lower end of the armature supports a composition contact block (11) to which is attached the movable contact arm (32) which engages a stationary contact (31) constituting the contact switch 5-7 of wiring diagram Fig. 42. Spring (14) holds the movable contact against the composition contact block.

The lower element consists of coil (29), magnet (25) and armature (18). The armature is supported between extensions of the lower front end of the magnet and is held in the open position by spring (24). To the armature is attached a composition contact support (19) to which are attached normally closed movable contact (21), and normally open movable contacts (22). These with the corresponding stationary contacts, constitute the contact switches of wiring diagram, Fig. 42. Springs within the composition contact support and its composition cover hold the movable contacts against the cover and support respectively.

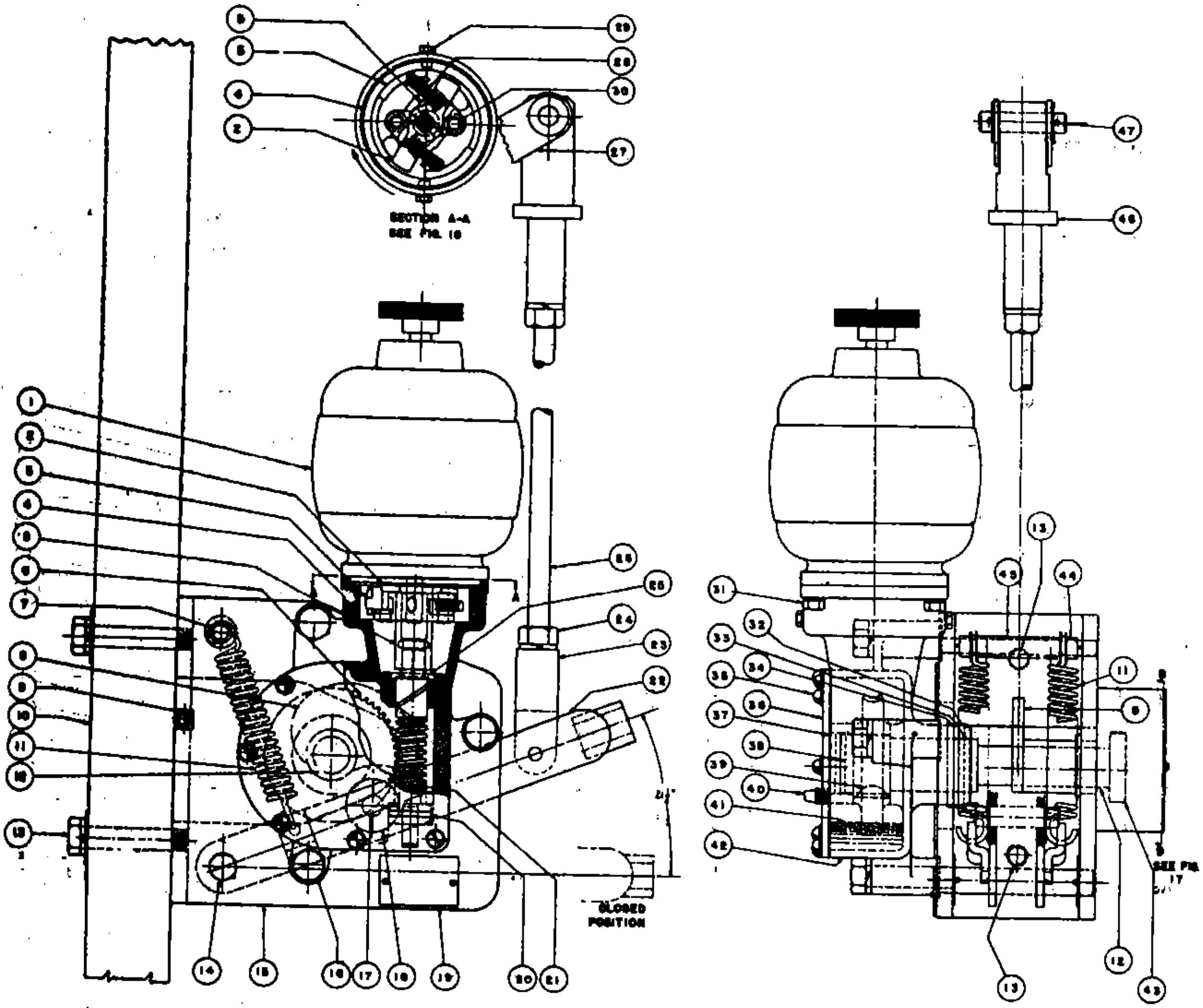
A common cover (26) attached to the steel base (27) completely encloses both units.

MOTOR CUT-OFF SWITCH Fig. 17

The motor cut-off switch, Fig. 17, is enclosed in a molded composition box shaped base (10) on the right side of the frame which supports the drive shaft and main closing cam of the motor operating mechanism. Three round head screws (7) fasten the base to the frame. On the end of the drive shaft (16) which extends through the switch base, is fastened the auxiliary cam (6) by screw (9) and pin (8). The cam engages switch shaft (5) which moves the three pointed bridging contact (12) against stationary contacts A, B, and C in the following manner: It will be noticed that the stationary contact faces of A, B and C are in a vertical plane at right angles to the base, but contact faces A', B' and C' are in another vertical plane not parallel with plane of A, B and C and not at right angles to the base. Contact B is farther from the base than contacts A and C. As the cam revolves clockwise (looking from the right) it forces the switch shaft to the right and forces the bridging contact (12) to bridge contacts A and C which constitutes contact switch M1 of wiring diagram, Fig. 42. As the switch shaft is advanced farther, it tilts the bridging contact (12) to close B and B' also, which constitutes contact switch M2 of the wiring diagram. This assures that M1 closes before M2.

When the main closing cam advances far enough to close the breaker, the auxiliary cam of this device reaches the cut-off point which allows the opening spring (2) to open all contacts which de-energizes the motor control relay to open the motor circuit.

The cover (15) is attached by screw (4) to the molded composition support which supports the switch shaft.



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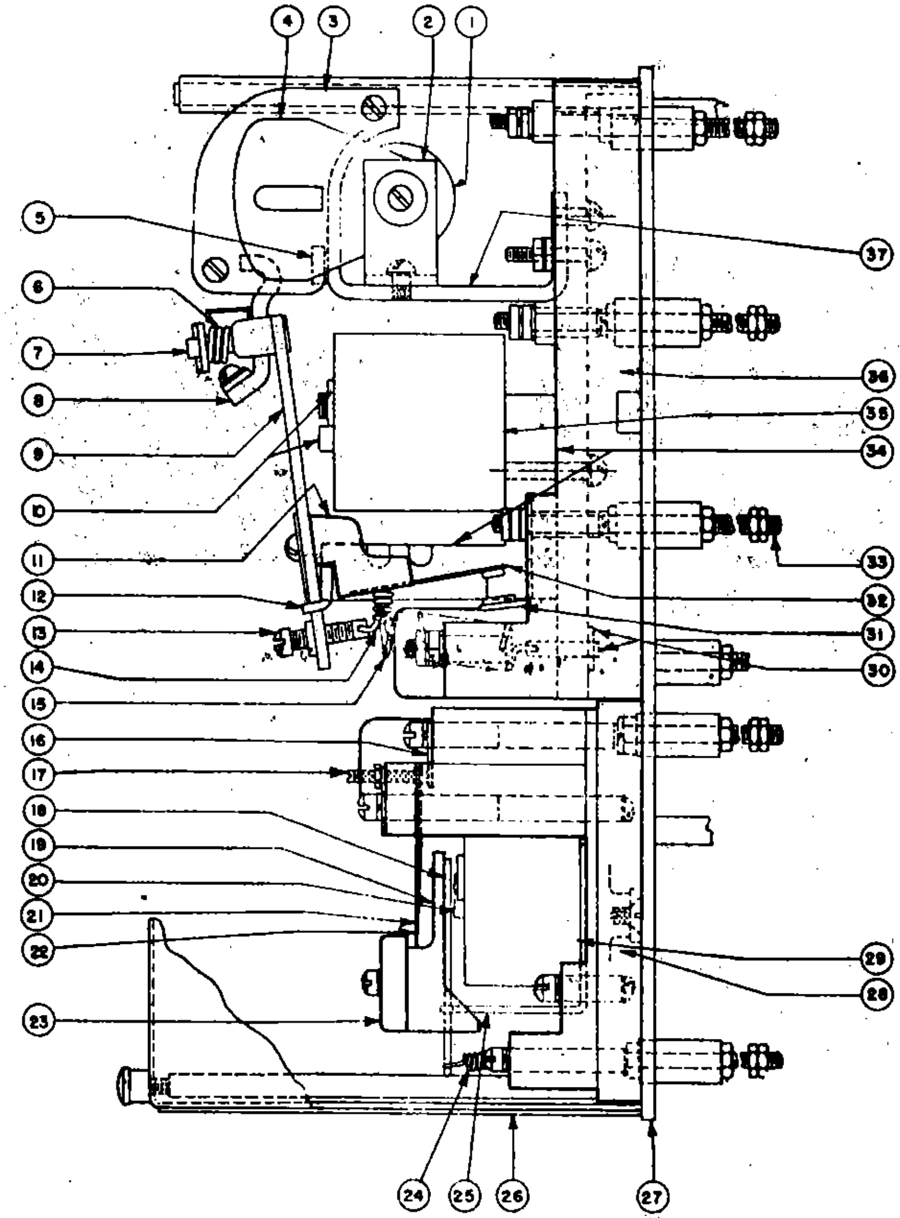
1. MOTOR
2. IMPELLER
3. BRAKE SHOE
4. BRAKE DRUM
5. BRAKE COUPLING
6. WORM GEAR
7. PIN
8. CLOSING CAM
9. INSULATING TUBE
10. MOUNTING BASE
11. SPRING
12. CLOSING CAM SHAFT
13. SCREW
14. PIN AND WASHER
15. FRAME
16. SCREW
17. PIN AND WASHER
18. ROLLER
19. NAME PLATE
20. THRUST BEARING
21. WORM
22. LEVER
23. COUPLING
24. HEX. NUT AND LOCKWASHER
25. RETAINER
26. ROD
27. OPERATING LEVER
28. SPRING
29. STOP SCREW AND NUT
30. PIN
31. SCREW AND LOCKWASHER
32. CUP
33. LEATHER WASHER
34. FELT WASHER
35. SCREW
36. COVER
37. GASKET
38. FELT AND LEATHER WASHERS
39. WOODRUFF KEY #9
40. PIPE PLUG
41. LUBRICANT
42. GEAR BOX
43. AUXILIARY CAM
44. SPACER
45. SPACER
46. INSULATING COUPLING
47. PIN, WASHER AND COTTER PINS

FIG. 15
MOTOR OPERATING MECHANISM
BREAKER IN OPEN POSITION



1. PERMANENT MAGNET BLOWOUT
2. ARC CHUTE SUPPORT
3. ARC CHUTE
4. POLE PIECES
5. STATIONARY CONTACT STUD
6. SPRING
7. PIN, SPRING SEAT AND COTTER PIN
8. MOVABLE CONTACT CLIP
9. ARMATURE
10. MAGNET CORE AND SHADING RING
11. COMPOSITION CONTACT BLOCK
12. BRACKET WITH STOP, RIVETED TO MAGNET
13. SCREW FOR ADJUSTING SPRING PT. 15
14. SPRING FOR MOVABLE CONTACT ARM, PT. 32
15. SPRING FOR ARMATURE
16. REAR STATIONARY CONTACT
17. FRONT STATIONARY CONTACT AND ADJUSTING SCREW
18. ARMATURE
19. COMPOSITION CONTACT SUPPORT
20. MAGNET CORE AND SHADING RING
21. LEFT MOVABLE CONTACT, NORMALLY CLOSED
22. RIGHT MOVABLE CONTACT, NORMALLY OPEN
23. COMPOSITION CONTACT BLOCK AND COVER
24. SPRING FOR ARMATURE
25. MAGNET
26. COVER
27. STEEL MOUNTING PLATE
28. COMPOSITION BASE
29. COIL
30. SPRING POST AND CLIP
31. STATIONARY CONTACT
32. MOVABLE CONTACT ARM
33. TERMINALS AND NUTS
34. MAGNET
35. COIL
36. COMPOSITION BASE
37. CONTACT TRIP SUPPORT

FIG. 16

MOTOR CONTROL RELAY

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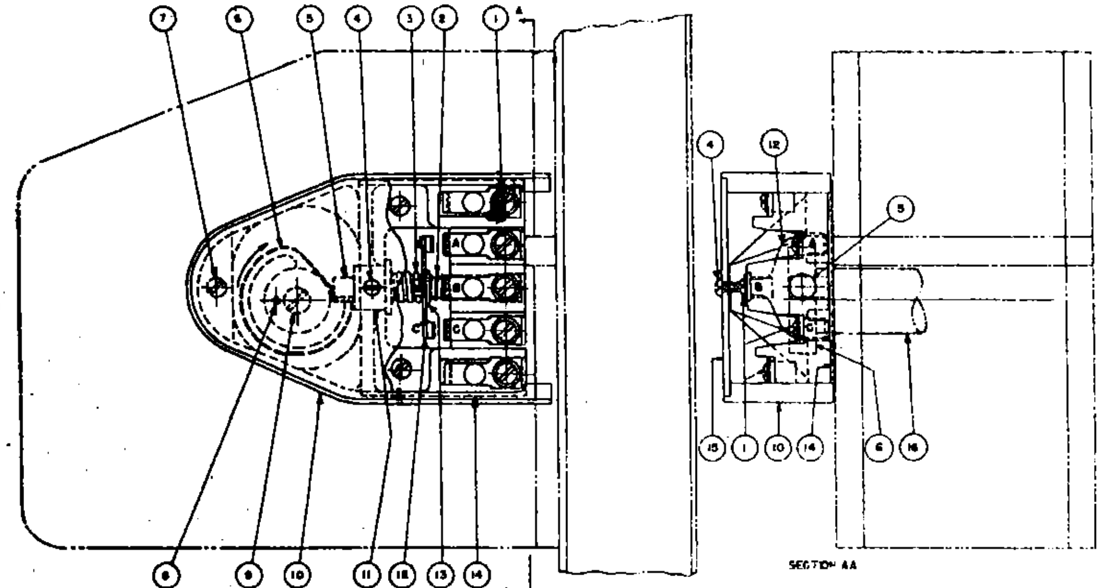

SECTION BB
FIG 15

1. BINDING SCREW AND STATIONARY CONTACTS
2. OPENING SPRING
3. CONTACT PRESSURE SPRING
4. SCOVILLE SELF TAPPING MACHINE SCREW
5. SHAFT OF SWITCH
6. CAM OF MOLDED COMPOUND
7. SCREW
8. GROOV PIN [illegible] DIA X [illegible] LG
9. SCREW
10. BASE OF MOLDED COMPOUND
11. MOLDED SUPPORT FOR SHAFT AND FRONT COVER
12. BRIDGING CONTACT WITH THREE CONTACT POINTS
13. SLEEVE
14. BOTTOM COVER
15. TOP COVER PARTLY CUT AWAY
16. CLOSING CAM SHAFT

FIG. 17
MOTOR CUT-OFF SWITCH

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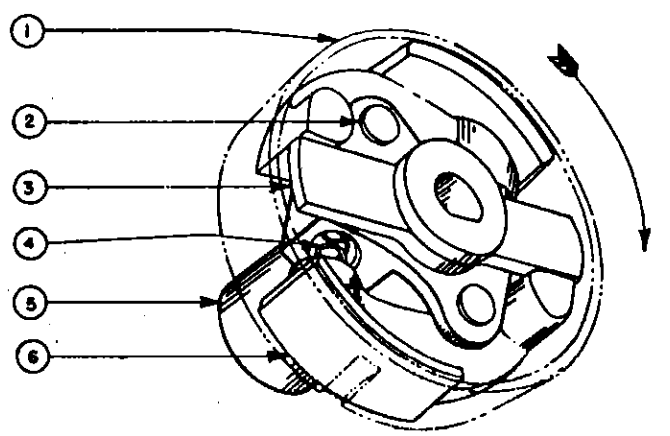


(SECTION "A-A" - FIG.15)

1. BRAKE DRUM
2. PINS
3. IMPELLER
4. SPRING
5. BRONZE COUPLING
6. BRAKE SHOES

FIG. 18

TORQUE BRAKE

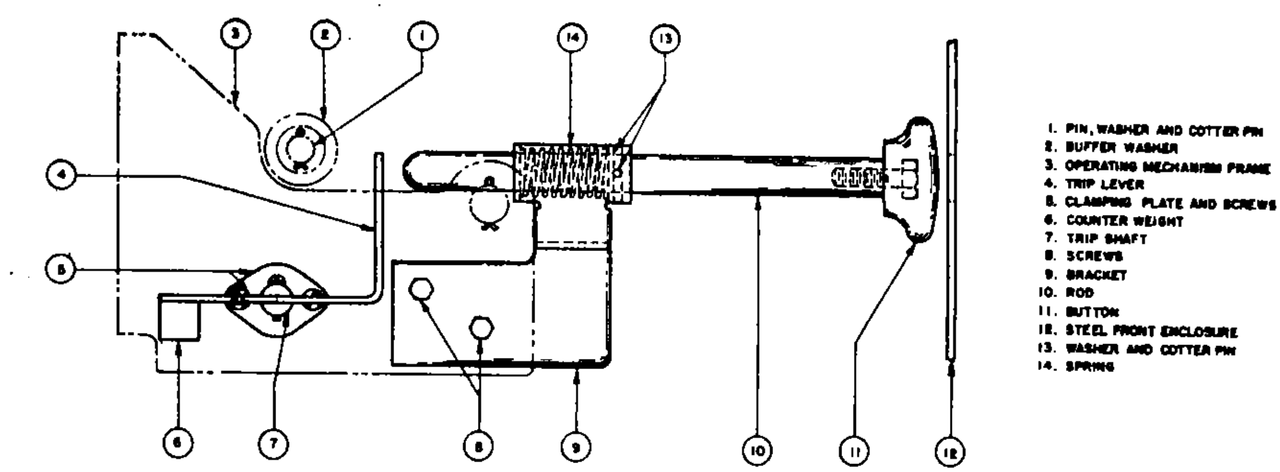


FIG. 19
MANUAL TRIP DEVICE

TORQUE BRAKE Fig. 18

The torque brake of the AL-2-50 breaker is the coupling assembly, Fig. 18, between the high speed starting motor and the worm gears that allows rapid closing of the breaker and quick stopping of the motor.

It consists of a bronze coupling (5) into the top of which is inserted a freely revolving impeller (3) and into the bottom of which fits the square shaft of the worm (21, Fig. 15). The motor shaft has a flat on it and fits into a hole of the same contour in the impeller. Two brake shoes (6) are pivoted to the coupling by pins (2). The curved end of each brake shoe normally engages the inner surface of the brake drum (1) under pressure of a spring (4) to provide friction against the brake drum which is rigidly keyed to the inside of the housing that enclosed the torque brake and supports the motor as shown in Section A-A, Fig. 15. The other end of each brake shoe has a lug which is engaged by the impeller (3) in such a way that when the motor drives the impeller in a normal clockwise direction (looking down) the curved bearing end is forced free of the brake drum allowing the motor to freely drive the coupling and worm shaft.

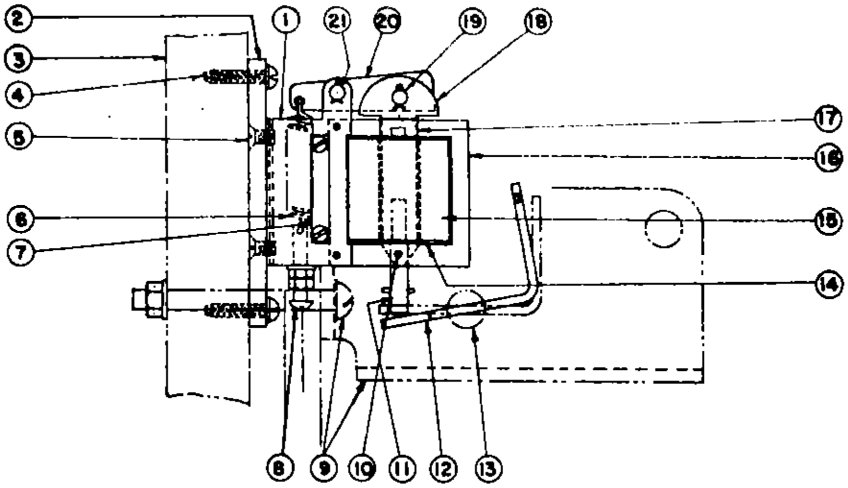
When the motor is de-energized, the impeller no longer imposes pressure against the lugs of the brake shoes. The springs (4) then force the curved ends of the brake shoes against the brake drum so that friction quickly brings the motor and worm gears to a standstill. The gear reduction is so great, that a few revolutions of the motor will cause a very small movement of the closing cam (8, Fig. 15) which stops in the correct position for prompt closing of the breaker in a following cycle of operation.

MANUAL TRIP Fig. 19

The manual trip consists of a push rod (10) and button (11) mounted in a bracket (9) which is attached to the frame of the left hand pole unit by two screws (8). A spring (14), backed up in the rear against the bracket, bears against washer and cotter pin (13) in the push rod to hold it normally forward. When the button is pressed to the rear, the push rod bears against the trip lever (4) causing the trip shaft (7) to revolve counter-clockwise (looking from the left) to trip the breaker. The button is pressed by pushing the finger through a hole in the steel front enclosure (12) of the dead front and enclosed breakers.

SHUNT TRIP DEVICE Fig. 20

A shunt trip device is available for this breaker. Its function is to trip the



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1. FRAME
2. SPACER
3. MOUNTING BASE
4. SCREWS
5. SCREWS
6. TENSION SPRING
7. NAME PLATE
8. ADJUSTING SCREW
9. OPERATING MECHANISM FRAME AND SCREW
10. SELF TAPPING SCREW
11. PLUNGER WITH COTTER PIN
12. TRIP LEVER
13. INTERLOCK TRIP ROD
14. INSULATION
15. COIL
16. MAGNET
17. BRASS GUIDES
18. ARMATURE
19. PIN AND COTTER PIN
20. LEVER
21. PIN AND COTTER PIN

FIGURE 20
SHUNT TRIP DEVICE

breaker when its coil is energized by the closing of a switch, or relay contacts, at some remote point. The coil is designed for intermittent service only. Hence it should be so connected that the opening of the breaker, by any means, will open the shunt trip device circuit. When this is impossible the shunt trip coil should be connected to "a" contacts of an auxiliary switch which will open the circuit when the breaker is opened.

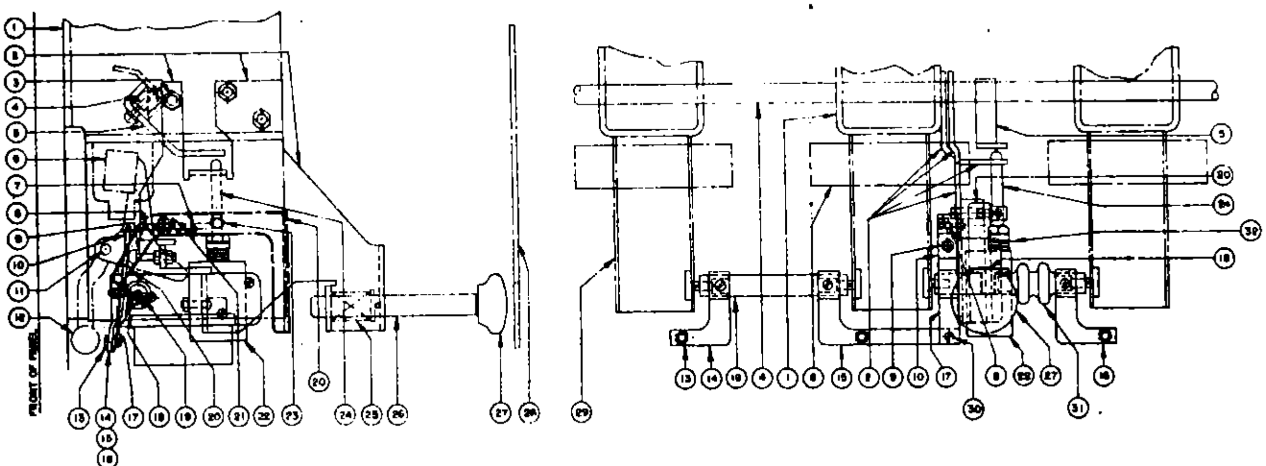
The device in this breaker is mounted on a spacer block (2) on the front of the mounting base, usually to the left of the left hand pole unit, above and behind the interlock trip shaft which engages the trip latch strap (9) Fig. 11. It consists of a solenoid with coil (15) and armáture (18) in a vertical position and when energized the armature is drawn downwards into the coil which causes the plunger (11) in the lower end of the armature to engage the rear end of the trip lever (12). This causes the interlock trip shaft (13) to turn counter-clockwise (looking from the left) to trip the breaker. When de-energized the tension spring (6) lifts the armature out of the coil to allow the trip lever to return to the normal position.

The coil (15) is mounted in the magnet (16) which is riveted to the frame (1) and over two brass guides (17), between which the armature (18) is free to move. The upper ends of the guides are clamped over the magnet and against the coil to hold it firmly in place and the lower ends are fastened to the magnet by self-tapping screws (10).

HAND RESET LOCKOUT DEVICE Fig. 21

The purpose of this device is to provide a means by which the circuit breaker cannot be reclosed after it has been tripped automatically until the device is manually re-set by the operator at the circuit breaker. Fig. 21 shows the device applied to three dual magnetic overcurrent trip devices, 800 to 1600 amperes. Applications to other automatic trip devices are essentially the same.

The device consists of a shaft (19) and (31) of two inter-connected parts mounted between the frames (29) of the three time delay overcurrent trip devices, together with trip fingers, latches, a two circuit push type switch and other assembled parts as described below. When the circuit breaker trip shaft (4) is operated by any other means than by overcurrent, this hand re-set lockout device is not affected in any way. But when the circuit breaker is operated by the overcurrent trip device, the trip shaft is operated in the normal manner, and at the same time counterweights (12) rigidly suspended from the armature assemblies, operate the shaft (19) of this device. This locks the trip shaft in the tripped position until manually re-set as described below.



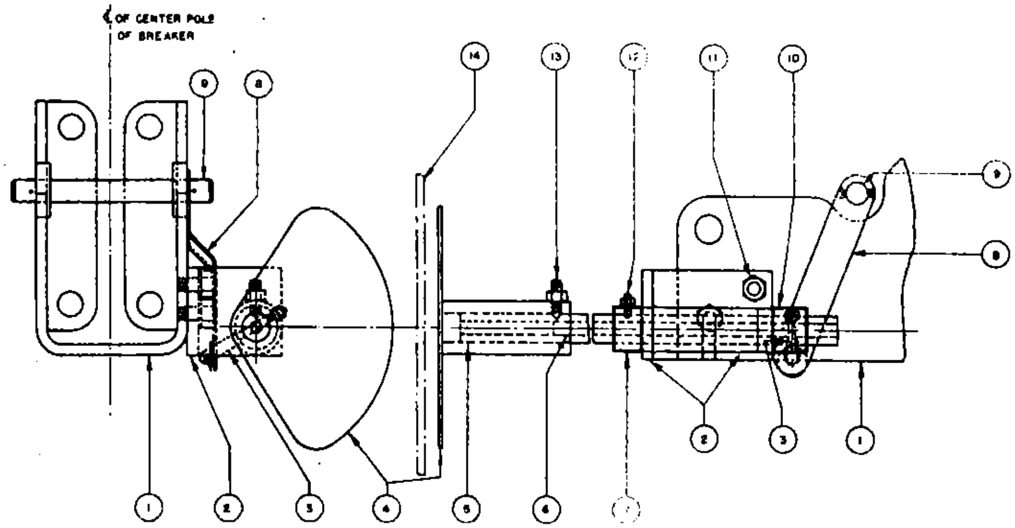
1. FRAME OF OPERATING MECHANISM
2. FLANGED BRACKET
3. SCREWS
4. TRIP SHAFT
5. TRIP FINGER
6. ARMATURE OF OVERCURRENT TRIP DEVICE
7. SPRING POST
8. SPRING
9. ADJUSTING STOP SCREW
10. STOP PLATE
11. PIN
12. COUNTERWEIGHT
13. ADJUSTING SCREW
14. LEFT FINGER
15. CENTER FINGER
16. RIGHT FINGER
17. LOWER ARM BRAZED TO 10
18. TRIP PLATE
19. INSULATING SHAFT
20. LATCH ARM
21. PIN FOR LATCH ARM
22. TWO CIRCUIT SWITCH
23. PIN
24. OPERATING ROD
25. SPRING
26. RESET ROD
27. BUTTON
28. STEEL FRONT ENCLOSURE
29. FRAME OF OVERCURRENT TRIP DEVICE
30. SCREW
31. INSULATING SHAFT
32. SPRING

FIG. 21
MANUAL RESET LOCKOUT DEVICE

Three fingers (14, 15 and 16) mounted on shaft (19 and 31) have adjusting screws (13) which are engaged by counterweights of the three overcurrent trip devices. Central finger (15) is connected to lower arm (17) of stop plate (10) by screw (30) which ties the two parts of shaft together to move as a unit. The upper end of the stop plate (10) is pulled forward by spring (8), attached to the flanged bracket (2) and rests against adjustable stop screw (9) also attached to the flanged bracket. This bracket is attached to the right side of the center pole mechanism frame (1) by three screws (3). This fixes the normal position of shaft. Trip plate (18) is attached to the shaft (19) and is normally latched under the rear end of the inverted U-shaped latch arm (20) which is pivoted on pin (21) in the flanged bracket. A two circuit switch (22) is mounted vertically on the flanged bracket and its operating rod (24) and is pivoted on pin (23) in latch arm (20). The upper end of the operating rod extends through another flange of the bracket to engage trip finger (5) on the trip shaft (4) when the overcurrent trip device operates. Normally when the latch arm (20) is set on trip plate (18), the operating rod (24) is forced downward, free of the trip finger (5) and compresses the spring (32) on the operating rod. This opens the upper contacts and closes the lower contacts of the switch. Re-set rod (26) is mounted in flanges of bracket (2), and spring (25) normally holds the button (27) on the front end approximately 3/16" behind a hole in the steel front enclosure.

When any of the overcurrent trip devices operate, counterweight (12) swings forward and engages the corresponding finger (14, 15 or 16) on shaft (19 or 31). This revolves the shaft counter-clockwise (looking from the left) and removes the trip plate (18) from under the latch arm (20). Spring (32) on the operating rod causes the latch arm to revolve counter-clockwise about pin (21). The rear end falls against the shaft and the operating rod (24) is forced upwards to engage the trip finger (5) and revolves the trip shaft counter-clockwise to the tripped position. As the latch arm (20) revolves counter-clockwise the front end moves forward and upward and nearly touches the rear end of the re-set rod (26). The trip shaft and latch arm will remain in these positions until the device is manually re-set as described below. Lifting the operating rod (24) closes the upper contacts and opens the lower contacts of the switch.

Re-setting consists of pushing the re-set rod (26) to the rear by inserting a finger through the hole in the steel front enclosure which causes the latch arm (20) to revolve clockwise. This allows the trip plate (18) to be re-set under the latch arm and lowers operating rod (24) to allow the trip shaft to return to normal position. The circuit breaker is now in a position to be tripped by any means.



FRONT VIEW

RIGHT SIDE VIEW

1. OPERATING MECHANISM FRAME
2. BRACKET AND TUBULAR BEARING
3. TRIGGER WITH WASHER AND COTTER PIN
4. INDICATOR AND HUB
5. INDICATOR SHAFT
6. STEEL ROD
7. COLLAR
8. LINK
9. PIN (SEE 41, FIG. 11)
10. COLLAR
11. SCREWS, LOCKWASHERS AND NUTS
12. SET SCREW
13. SET SCREW
14. STEEL FRONT ENCLOSURE

FIG. 22
POSITION INDICATOR

(P-6490452 SK)

The latch engagement should be approximately one-half of the thickness of the trip plate (18) in order to be sure that shock of operation of the circuit breaker does not operate the hand re-set lock-out device. The air gap between the overcurrent trip device armature and magnet should be approximately 1/64" when the latch of the lock-out device releases.

POSITION INDICATOR Fig. 22

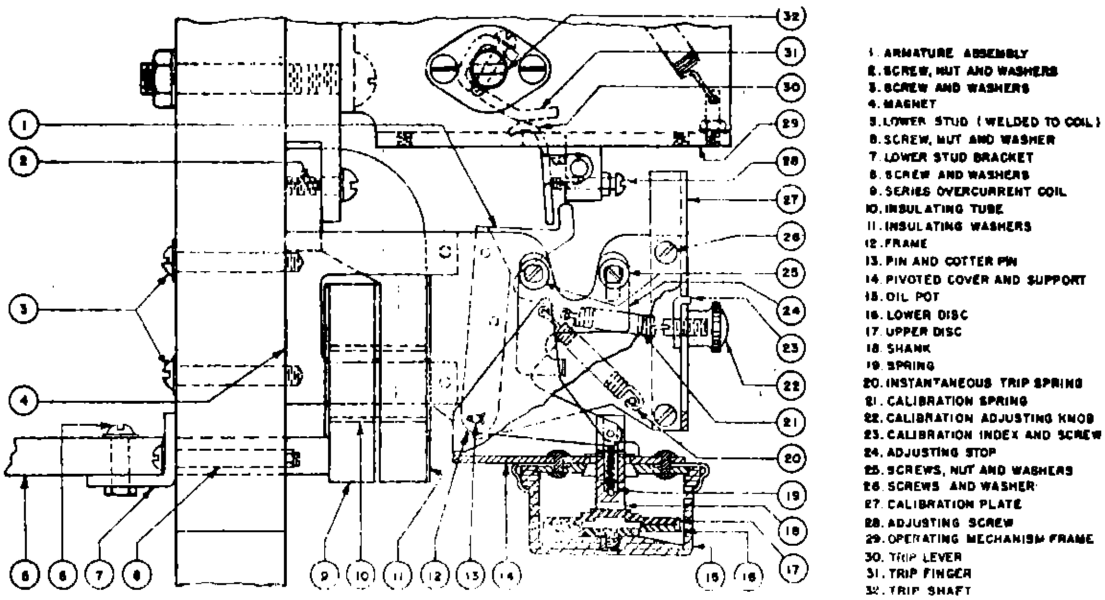
The position indicator is mounted on the right side of the operating mechanism frame. It consists of an indicator which revolves on a shaft so that a green or a red area can be seen through a hole in the steel front enclosure of a dead front or enclosed breaker to show the open or closed position of the breaker.

The indicator with hub (4) is attached by set screw (13) to an indicator shaft of insulating material (5) which is reinforced by an internal steel rod (6). This shaft passes through the tubular bearing welded to bracket (2) which is attached to the operating mechanism frame (1) by two screws (11). Collars (7) and (10) are attached to the shaft by set screw (12) and trigger (3) respectively. A link (8) is connected freely to the trigger (3) by cotter pin and washer and to pin (9) by cotter pin. Pin (9) is pin (41) Fig. 11. When the breaker is in the open position, buffer washers (40) Fig. 11 on pin (8) rest in the concave recess in the operating mechanism frame, as shown in Fig. 11 which places the indicator in position to show the green area through the hole in the front enclosure. When the breaker opens pin (8) is raised which revolves the indicator clockwise (looking from front) to show the red area.

DUAL MAGNETIC OVERCURRENT TRIP DEVICE (up to 600 amperes) Fig. 23

This device, automatically trips the breaker under two distinct conditions of overload; first, with inverse time delay for overcurrents in excess of calibration setting and less than ten times rated current; and second, with instantaneous tripping for interrupting overloads exceeding ten times rated current.

To accomplish inverse time tripping the current in the series coil (9) sets up a magnetic circuit which tends to pick up armature (1) pivoted on pin (13) in frame (12) and operates trip finger (31) and turns the trip shaft counter-clockwise (looking from the left). The armature (1) is restrained by a calibration spring (21) held under tension between the armature assembly and the calibration index (23), and also by a thin oil film between upper disc (17), which is pivoted to the armature assembly, and the lower disc (16) attached to the bottom of oil cup (15) which holds the oil in which both discs are immersed. For currents below



(M-6490622 SK)

FIG. 23
DUAL MAGNETIC OVERCURRENT TRIP DEVICE UP TO
600 AMPERES FOR TYPE AL-2-50 AIR CIRCUIT BREAKERS

the calibration setting, the calibration spring prevents the armature from picking up and no force is exerted to separate the discs in the oil pot. For currents in excess of the calibration setting the magnetic pull on the armature exceeds the pull on the calibration spring (21) and the excess force tends to pull the two flat disc surfaces (16) and (17) apart by rupturing the oil film between them. Once this oil film is ruptured, the armature picks up and trips the breaker. The time required to rupture the oil film varies inversely with the force applied and hence inversely with the current through the breaker. Thus, if the overcurrent falls below the calibration setting before the oil film is ruptured the breaker will not trip.

For instantaneous tripping for current in excess of ten times the breaker rating the armature is further restrained by a pair of heavier instantaneous trip springs (20), one on each side of the device, attached at the lower front end to the fixed frame (12) and at the upper rear end to the cover and support (14). This cover is pivoted on pin (13) and supports the oil pots. Thus, if overcurrent demands immediate tripping, the heavier pull on the upper disc lifts the complete oil pot assembly, as the springs yield, without waiting for the rupture of the oil film, allowing the armature to pick up and trip the breaker immediately.

When the armature (1) picks up, a finger on the armature assembly engages trip lever (30) which revolves clockwise (looking from the left) and engages trip finger (31) on trip shaft (32). This causes the trip shaft to revolve counter-clockwise and trip the breaker as described under "Manual Operating Mechanism".

Calibration settings for 100, 125, 150, 175, and 200 per cent of breaker normal current rating are marked in amperes on the calibration plate (27). For general feeder applications, the calibration setting should not be less than 125 per cent of actual load being carried by the breaker.

An adjustment is provided for varying the amount of time delay obtained. This is accomplished by turning the oil pot (15) to different marked time delay settings, which increases or decreases the area of disc surfaces separated by oil film. The disc surfaces have part of their contact area cut away in the form of a wide band parallel to the diameter of the disc surfaces. The smaller the contact area between discs, the shorter will be the time delay obtained.

The armature air gap is adjusted at the factory by an adjustable stop (24) which is pivoted to the frame (12) by screw (25) in the rear end and adjusted by a similar screw through a slot in the front end. This stop registers with the pivoted cover and support (14) which carries the oil pot. By raising or lowering the oil pot, the armature air gap is changed because shank (18) is pivoted to both the armature assembly and to the upper disc (17). The air gap should not be changed unless means are available for the recalibration of the complete device.

Be sure that there is a definite clearance between trip lever (30) and trip finger (31). This clearance is obtained by the adjusting screw (28).

Insert a .010 inch feeler gauge in the air gap between the magnet and the armature. Then the circuit breaker should positively trip when the oil cup is lifted by hand to close the armature against the magnet. However, when a .020 inch feeler gauge is similarly inserted in the air gap the breaker should not trip. To adjust for proper tripping bend the lower part of the trip lever (30) so that the finger on the armature will engage the trip lever sooner or later as required.

It is important that the facing surfaces of the discs be clean and smooth, otherwise the time delay will be affected. If these surfaces are damaged or affected in any way they should be relapped or made smooth by rubbing them over crocus cloth backed up by a smooth, flat surface. It is of utmost importance that the oil in the cup be kept clean and at the proper level. See "Maintenance".

If a new series coil is required, or any considerable repair is necessary, it is recommended that a complete factory calibrated dual magnetic overcurrent trip device be supplied.

A typical time-current tripping curve for this device is shown in Fig. 24. This curve is approximate and considerable variation in time delay may be expected depending upon the cleanliness of the oil forming the film, the time allowed for resetting, and the ambient temperature.

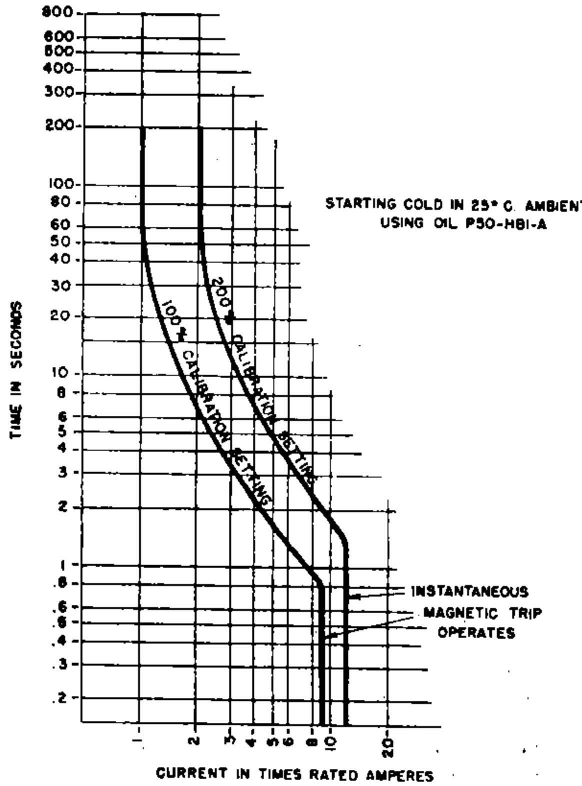
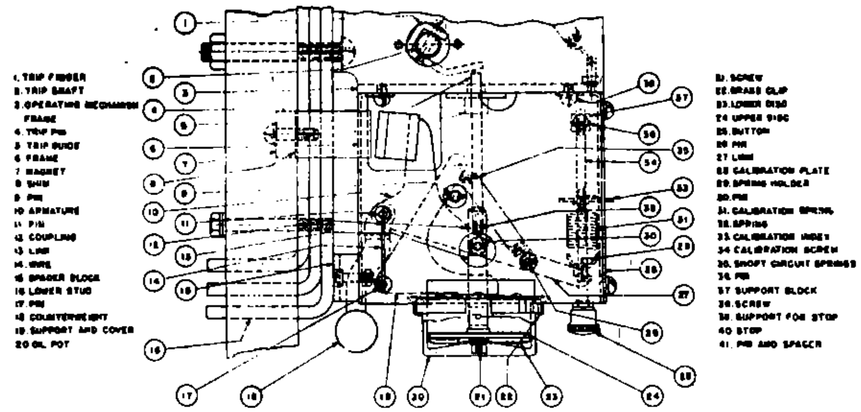


FIG. 24
APPROXIMATE TIME-CURRENT CHARACTERISTIC OF DUAL MAGNETIC OVERCURRENT TRIP DEVICE

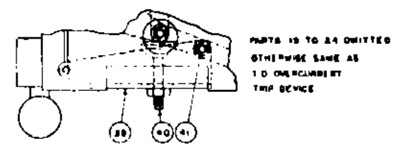
DUAL MAGNETIC OVERCURRENT TRIP DEVICE (800-1600 Amperes) Fig. 25

This device performs the same time delay and instantaneous tripping functions in 800 to 1600 ampere circuits as described above for circuits up to 600 amperes. However, the construction and mounting are decidedly different.

A magnet (7) is placed around the vertical part of the lower stud (16) and the breaker current sets up a magnetic field which tends to pick up the armature (10), with a counterweight (18), pivoted on pin (11) in the frame. The armature assembly is attached by pin (30) to coupling (12) and to link (13). Link (13) is attached to the upper disc (24) immersed in oil in the oil pot (20), and the lower disc (23) is rigidly attached to the bottom of the oil pot. The oil pot is attached to the cover and support (19) which is pivoted on pin (17) in the frame and maintained in the normal position against stop pin (9) by a



TIME DELAY OVERCURRENT TRIP DEVICE



INSTANTANEOUS OVERCURRENT TRIP DEVICE

FIG. 25

MAGNETIC OVERCURRENT TRIP DEVICES

800 TO 1600 AMPERES

pair of heavy short circuit springs (35) which are attached to the frame by pin (26). Link (27) is pivoted on pin (26) in the frame and its front end is attached to spring holder (29) which freely slides over the calibration screw (34). Calibration spring (31) is attached at its upper end to index (33) which is threaded over the calibration screw. The front of the index moves in a slot in the calibration plate (28) which is attached to the front of the frame.

To change the calibration setting, the calibration screw (34) must be lifted until the groov pin (36) is lifted out of a slot in support block (37) and then turned to raise the index and increase the tripping value, or to lower it and reduce the tripping value.

The device is mounted on the bottom of the mechanism frame (3) by screws (38).

For current values below the calibration setting, the calibration spring (31) prevents the armature from picking up and no excess force is exerted to separate the discs in the oil pot. For currents in excess of calibration setting the magnetic pull on the armature exceeds the pull on the calibrating spring and the excess force tends to pull the two flat disc surfaces apart by rupturing the oil film between them. Once the oil film is ruptured the armature picks up and the trip pin (4) is lifted which revolves trip finger (1) and turns the trip shaft (2) counter-clockwise (looking from the left) to trip the breaker. The time required to rupture the oil film varies inversely with the force applied and hence inversely with the current through the breaker. Thus, if the overcurrent falls below the calibration setting before the oil film is ruptured the breaker will not trip.

For instantaneous tripping for currents in excess of ten times the breaker rating the armature is further restrained by a pair of heavy instantaneous short circuit trip springs (35) connected between the cover and support (19) and pin (26) in the frame. When an overcurrent demands immediate tripping the heavier pull on the upper disc lifts the complete oil pot with cover and support (19) and the heavy springs yield, without waiting for the rupture of the oil film, allowing the armature to pick up and trip the breaker immediately.

To check for tripping, the clearance between magnet and armature should be approximately 1/32" when the breaker trips. If the clearance is greater it can be decreased by filing the top of the trip rod.

Calibration settings and adjustment of the oil pot for varying the amount of time delay are same as described for the 600 ampere dual magnetic overcurrent trip device, Fig. 23.

The armature air gap is adjusted at the factory by varying the thickness of shim (8)

(P-6490454 SK)

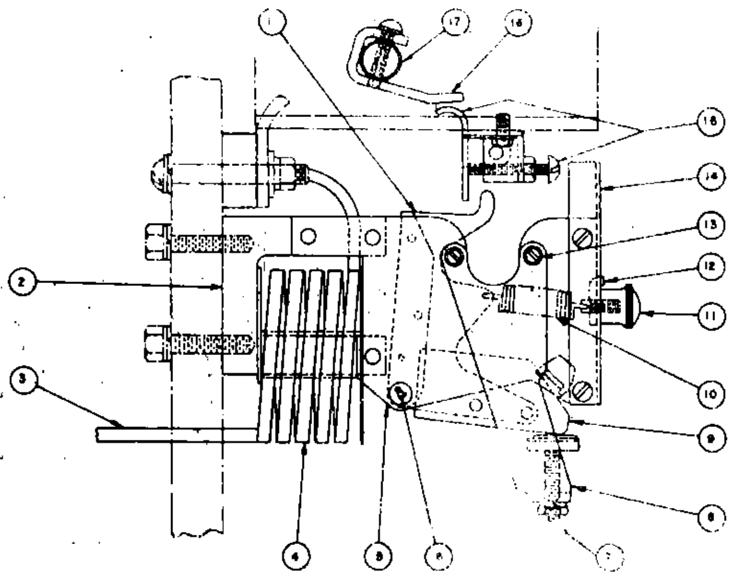


FIG.-26

MAGNETIC INSTANTANEOUS OVERCURRENT TRIP DEVICE

1. ARMATURE ASSEMBLY
2. MAGNET
3. LOWER STUD
4. SERIES COIL
5. FRAME
6. PIN AND COTTER PINS
7. STOP AND HEX. NUT
8. SUPPORT FOR STOP
9. STOP PLATE, RIVETED TO ARMATURE ASSEMBLY
10. CALIBRATION SPRING
11. CALIBRATION ADJUSTING
12. CALIBRATION INDEX
13. SCREW AND LOCKWASHERS
14. CALIBRATION PLATE
15. TRIP LEVER AND ADJUSTING SCREW
16. TRIP FINGER
17. TRIP SHAFT

(M-6490619 SK)

between the magnet and the rear of the lower stud. It is recommended that the air gap should not be changed unless means are available for the recalibration of the complete device.

Care of the disc surfaces and conditions of oil in the oil pot are the same as in the 600 ampere dual magnetic overcurrent trip device, Fig. 23.

MAGNETIC INSTANTANEOUS OVERCURRENT TRIP DEVICE. UP TO 600 AMPERES. Fig. 26

This device, Fig. 26, is magnetically operated to trip the breaker instantaneously by the current through the breaker when this current exceeds the calibration setting. Standard calibration settings for 100, 125, 150, 175 and 200 per cent of breaker normal current rating are marked on the calibration plate. For general applications, the calibration setting used should not be less than 125 per cent of normal load.

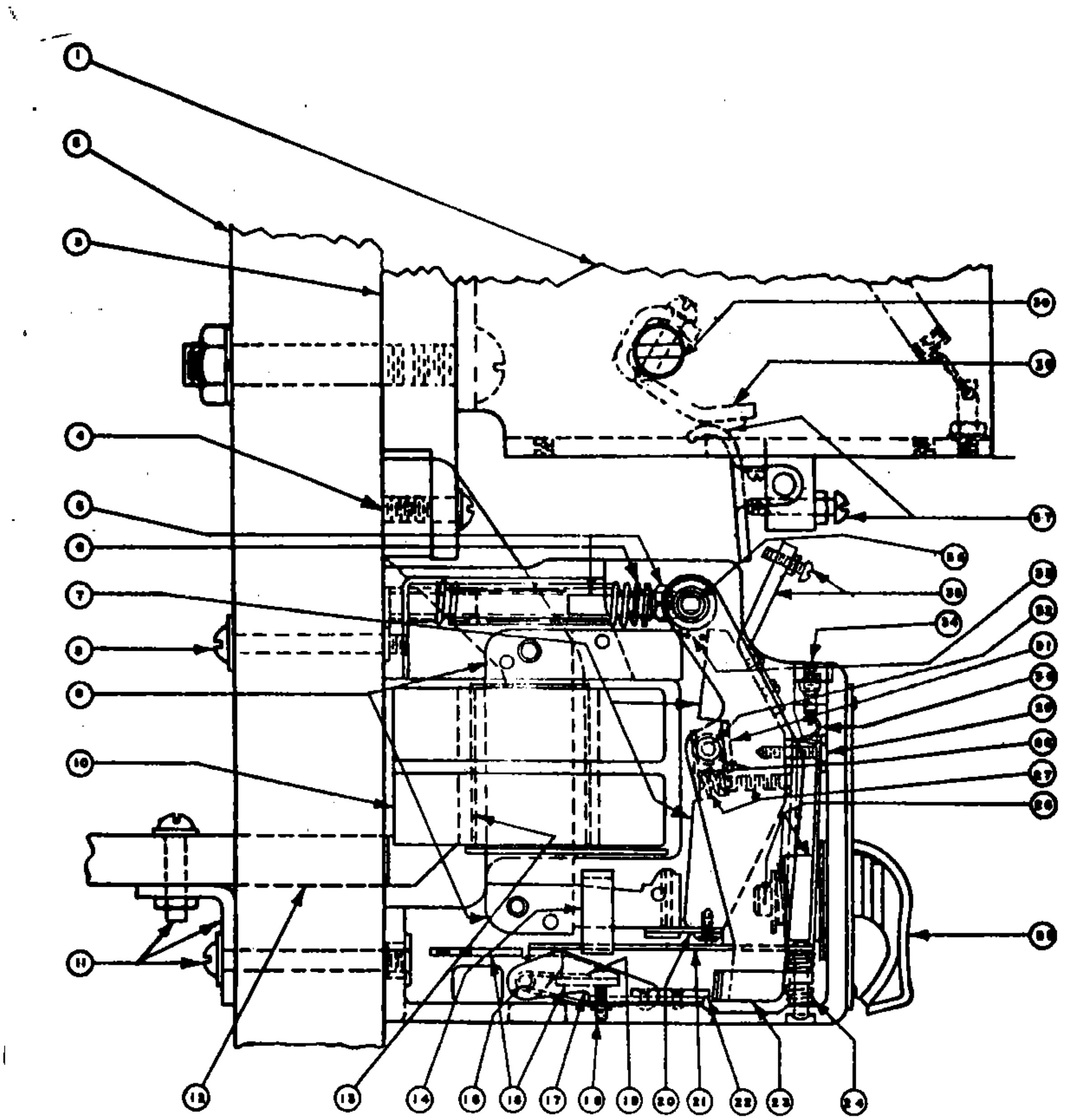
This device is similar to the dual magnetic overcurrent trip device without the time delay assembly and support and the heavy instantaneous trip springs. As shown in Fig. 26, the armature has a stop plate or weight (9) riveted to it and is pivoted on pin (6) in the frame (5). It is restrained by the calibration spring (10) only. The armature air gap is adjusted by raising or lowering the stop (7) in support (8) which is attached to the frame (5) by screws (13).

MAGNETIC INSTANTANEOUS OVERCURRENT TRIP DEVICE, 800 TO 1600 AMPERES, Fig. 25 (bottom)

This device is magnetically operated to trip the breaker instantaneously when the current through the breaker exceeds the calibration setting. Standard calibration settings for 100, 125, 150, 175 and 200 per cent of breaker normal current rating are marked on the calibration plate in amperes. For general application, the calibration setting used should not be less than 125 per cent of normal load.

This device is similar to and operates in the same manner as the dual magnetic overcurrent trip device for 800 to 1600 amperes, as shown in the upper part of Fig. 25, except that the oil pot (20), support and cover (19), link (13) and short circuit springs (35) are omitted. As shown in the lower part of Fig. 25, a support (39) is mounted on pins (17) and (26) through which a stop screw (40) is threaded from below. The coupling (12) on which the trip pin (4) is mounted, rests on the top bearing surface of this stop screw. An overcurrent through the breaker in excess of the breaker setting will allow the armature to pickup immediately and trip the breaker.

No adjustment should be made in the field with the stop screw.



1 - OPERATING MECHANISM FRAME
2 - MOUNTING BASE
3 - UPPER CONNECTOR WITH STATIONARY CONTACT
4 - SCREW
5 - SPRING GUIDE & LOCKNUT
6 - SHORT CIRCUIT SPRING
7 - ARMATURE
8 - SCREW
9 - MAGNET
10 - SERIES COIL
11 - SCREWS & BRACKET
12 - LOWER STUD
13 - INSULATION
14 - INDUCTION RING
15 - PIN
16 - THERMAL TRIP ARM
17 - LATCH SUPPORT
18 - ADJUSTING SCREW
19 - TORSION SPRING
20 - SPRING HINGE
21 - BIMETALLIC STRIP
22 - LATCH PLATE
23 - YOKE
24 - SPRING FOR THERMAL TRIP ARM
25 - CALIBRATING KNOB
26 - CALIBRATING CAM, SPRING, AND COTTER
27 - ADJUSTING SCREW & SPRING
28 - FLAT BUFFER SPRINGS
29 - ADJUSTING SCREW & NUT
30 - RESET SPRING FOR YOKE
31 - LEATHER BUFFER
32 - YOKE & ARMATURE PIN
33 - AIR GAP
34 - ADJUSTING SCREW
35 - TRIP ARM WITH ADJUSTING SCREW
36 - PIN
37 - TRIP LEVER WITH ADJUSTING SCREW
38 - TRIP FINGER
39 - TRIP SHAFT

FIG. 27

THERMAL MAGNETIC OVERCURRENT TRIP DEVICE

(352921)

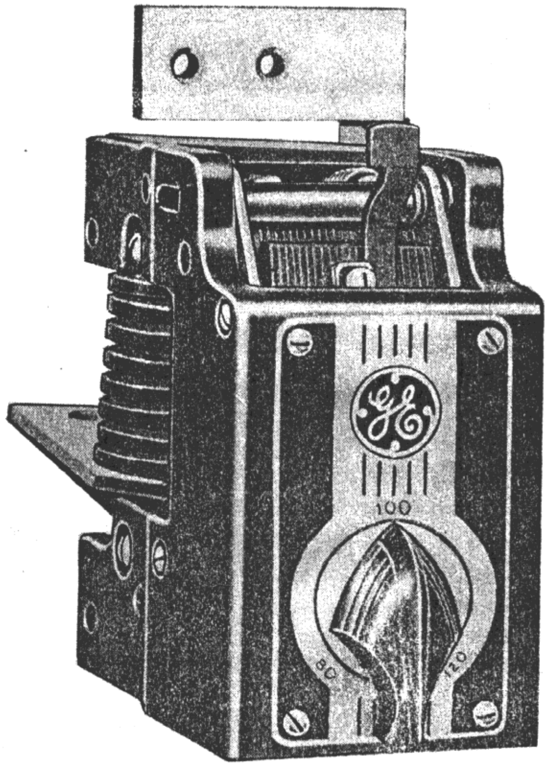
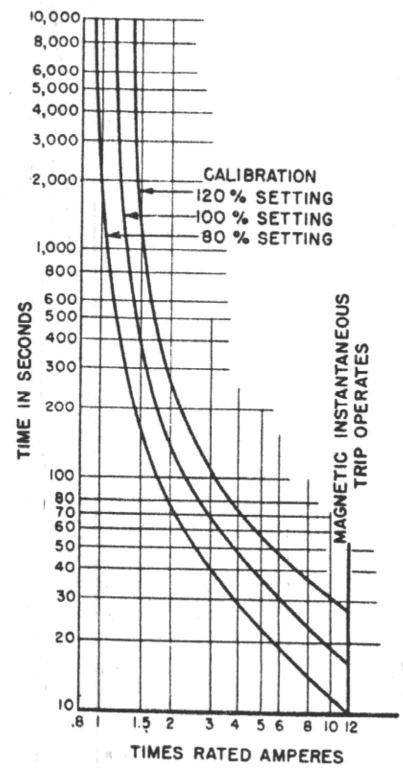


FIG. 28
THERMAL MAGNETIC OVERCURRENT TRIP DEVICE



APPROXIMATE TIME CURRENT CHARACTERISTIC
(STARTING COLD IN 24°C AMBIENT)

(R.P.-6738A)

FIG. 29
APPROXIMATE TIME-CURRENT CHARACTERISTIC
OF THERMAL MAGNECTIC OVERCURRENT TRIP DEVICE

THERMAL MAGNETIC OVERCURRENT TRIP DEVICE Figs. 27 and 28.

This device Fig. 27, also automatically trips the breaker under two distinct conditions of overcurrent; first, with inverse time delay when the current exceeds the value of calibration setting and is less than 12 to 15 times the breaker rating, the inverse time tripping being obtained by the time required to heat and flex a bimetallic strip; and second, instantaneously when the breaker current exceeds 12 to 15 times the normal breaker current.

This device operates on alternating current only, and is principally used for motor protection. The unit is enclosed in a molded frame as shown in Fig. 28.

Current in the series coil (10) sets up a magnetic circuit which tends to pick up the armature (7) as described below. When the armature closes against the magnet, trip arm with adjusting screw (35) bears against the lower end of trip lever (37). The upper end of the trip lever will engage trip finger (38) on trip shaft (39) and revolve it counter-clockwise (looking from the left) and trip the breaker. The armature is attached to the lower member of the magnet (9) by a spring hinge (20) and is restrained by a yoke (23) which is pivoted to the center of the armature by pin (32) between two flat buffer springs (28). The yoke is restrained at the bottom by a latch plate (22) and also at the top by two heavy compression short circuit springs (6) supported between pin (36) in the yoke and the rear frame. Current in the series coil induces current in the short-circuited ring (14), mounted around the lower magnet member, generating heat which is conducted to the bimetallic strip (21). This strip is riveted at its rear end to the thermal trip arm (16) and held at the front end between the calibrating cam and compression spring (26). The thermal trip arm (16) is pivoted to the frame on pin (15). When sufficient heat has been developed to cause the bimetallic strip (21) to bend, with the convex surface downward, the thermal trip arm will tend to revolve about pin (15) in a clockwise direction (looking from left) and bear against an adjusting screw (18), set in the latch support (17), also pivoted on pin (15), to cause the latch plate (22) to disengage the yoke (23) at the lower end. This will allow the armature to be picked up and trip the breaker as the lower end of the yoke moves to the rear over the latch plate (22) while the upper end of the yoke is held fixed by the heavy springs (6). A torsion spring (19) is mounted over pin (15) to hold the thermal trip arm (16) and latch support (17) together against the adjusting screw (18). Thus, if the overcurrent falls below the calibration setting before the bimetallic strip is sufficiently bent, the breaker will not be tripped.

Should the overcurrent exceed 12 to 15 times the breaker rating, the heavier pull on the armature (7) will cause the upper end of yoke (23) to compress the heavy short circuit springs (6), while the lower end of the yoke is held fixed against latch plate (22). As these heavy springs yield the armature will pick up and trip the breaker immediately without waiting for release of latch plate (22) by the heating of the bimetallic strip as described above.

The lock nut on spring guide (5) controls the compression of the short circuit spring (6) and is adjusted at the factory to provide instantaneous tripping when the current exceeds approximately 12 to 15 times normal breaker current.

The adjustable stop screw (29) is secured to the armature (7) and provides a stop against the front molded frame to control the clearance of 1/16" to 3/32" between the latch surface on the yoke (23) and the latch plate (22) to insure positive reset. The reset spring (30) between adjusting screw (34) and the lower end of yoke (23), provides the proper tension to the yoke to insure positive resetting after a tripping operation by drawing the lower end of the yoke forward to engage the latch plate (22).

The adjusting screw (18) controls the latch plate (22) engagement and calibration time for a given current by varying the distance through which the bimetallic strip (21) must bend before releasing the latch plate (22) to trip the breaker.

The calibration adjustment knob (25) can be turned to revolve the cam (26) to indications as marked on the nameplate to change the calibration range from 80 to 120 per cent of breaker rating. Revolving this cam raises or lowers the front end of the bimetallic strip against spring (24).

It is necessary to maintain a slight clearance between the trip finger (38) and the trip lever (37). This clearance can be obtained by means of the adjusting screw attached to the trip lever (37). To check this device for positive tripping, pick up the armature manually and the breaker should trip with approximately 1/32" gap between the armature and the magnet. To obtain the proper air gap adjust the screw on trip arm (35) so that the trip arm engages the trip lever (37) sooner or later as required.

There are available other special accessories that can be attached to the extension of the thermal trip arm (16) to perform special functions when the bimetallic strip (21) flexes. These are special and information concerning them should be obtained from the nearest sales office of the company.

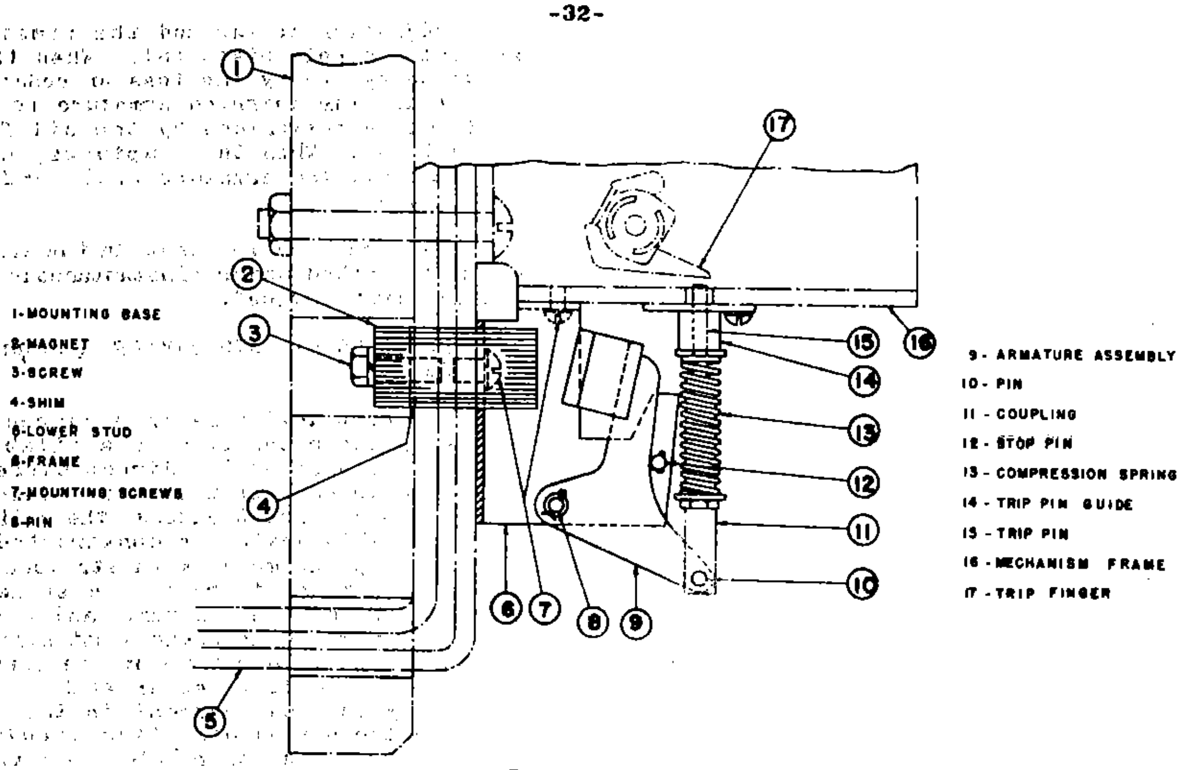


FIG. 30

INSTANTANEOUS SHORT CIRCUIT TRIP DEVICE

Typical time-current tripping curves for this device are shown in Fig. 29. These curves are approximate and variations in time delay may be expected depending on the ambient temperature, the time for resetting, etc.

INSTANTANEOUS SHORT CIRCUIT TRIP DEVICE Fig. 30

According to NEMA rules all air circuit breakers should be inherently automatic. Hence, if the breaker is not equipped with an overcurrent trip device, instantaneous short circuit trip devices are provided. These are designed to trip the breaker instantaneously at approximately fifteen times normal breaker rating. No adjustment for changing this setting is provided.

This device consists of a magnet (2) attached around the vertical part of lower stud (5) by screw (3). An armature (9) is mounted in frame (6) on pin (8) and, in normal position, rests against stop pin (12). The front of the armature assembly is attached to coupling (11) by pin (10) and the trip pin (15) is screwed into the coupling. The trip pin passes through trip rod guide (14) and through the bottom of the mechanism frame (16). The trip rod is restrained by a compression spring (13) mounted over it and backed up against the trip rod guide at the top and the coupling at the bottom.

When the armature is picked up the trip pin is lifted through the mechanism frame and engages the trip finger (17), which revolves the trip shaft counter-clockwise (looking from left) to trip the breaker.

INSTANTANEOUS UNDERVOLTAGE TRIP DEVICE Fig. 31

The function of this device is to trip the breaker when the voltage drops below a predetermined value. As long as a voltage of this value, or greater, is impressed on the coil the armature is held up within the coil and the device has no effect upon closing or tripping of the breaker in any way. But when the voltage drops to approximately 50 per cent of normal, or lower, the magnet is weakened and a heavy weight, attached to the bottom of the armature, drops the armature out of the coil and causes the breaker to trip. The breaker cannot be reclosed until the armature is reset within the coil, as described below, and normal voltage is applied to hold the armature within the coil.

The device is mounted on the front of mounting base either to the left of the left pole unit or to the right of the right pole unit, and directly below the trip shaft. Fig. 31 shows the device with the coil energized and the breaker in the closed position.

The coil (11) is mounted over a brass guide (12) and within the magnet frame (18) which is attached to a spacer block (7) by flat head screws (9). A pole piece (8) is threaded through the upper leg of the magnet and extends within the coil. The armature (17) is free to travel within the brass guide (12) and brass bushing (13) in the lower leg of the magnet. On the bottom of the armature is attached a heavy weight (15) by screw (14) and enclosed within insulation. Pin (4) is threaded into the top of the armature (17) and has an adjusting collar (6) threaded over its upper end. The position of the adjusting collar is fixed by pin (5) at the factory and should not be changed in the field. The resetting link (22) is pivoted on pin (21) in an extension of the magnet frame (18). The rear end of the resetting link engages the adjusting collar to lift the armature against the pole piece (8) when the front end is lowered by spring guide (2) which is attached to pin (1). This pin is (38) Fig. 11. Spring (3) acts as a buffer between pin (1) and the resetting link (22).

When the voltage drops to the predetermined value the magnet is weakened to a point which allows the weighted armature and adjusting collar to fall and engage the trip lever (20) causing the breaker to trip. In the act of opening of the breaker spring guide (2) is lowered which causes the reset link to revolve clockwise (looking from left) about pin (21) and the rear end lifts the adjusting collar which raises the armature into the coil. This constitutes the resetting operation made necessary because the pull of the magnet is not sufficient to lift the armature from the lowered position.

For direct current application brass discs rest on the top of armature (17) to slightly separate the armature from the pole piece to prevent sticking due to residual magnetism.

No provisions are made for adjustments to the device in the field.

TIME DELAY UNDERVOLTAGE TRIP DEVICE
Fig. 32

This device is constructed and operated in a similar manner as in the instantaneous undervoltage trip device with the addition of an oil film time delay attachment and lever (34). The rear end of this lever is inserted between the adjusting collar (6) and the trip lever (20) to delay the tripping of the breaker until the oil film in an oil pot is ruptured as described below.

The time delay attachment consists of a disc (25) immersed in oil in an oil pot (24) which is attached to a cover (27). This cover is attached to the front of the magnet (18) by bracket (28) which supports lever (34) on pin (33). The disc is attached to lever (34) by rod (26) coupling (31) and pin (32). Springs (30) attached to pin (32) and spring posts (29) normally hold the disc against the lapped surface of the bottom of the oil pot, and at the same time hold the rear end of the lever up to lift the adjusting collar and the armature up against the pole piece (8). When the coil is de-energized by the loss or reduction of potential, the weighted armature is free to fall but is restrained by the oil film in the oil pot. When this ruptures, after a time delay, the armature falls and trips the breaker.

The armature is reset in the same manner as described under "Instantaneous Undervoltage Trip Device".

REVERSE CURRENT TRIP DEVICE (Rotor Type)
Fig. 33

A direct acting reverse current trip device of the rotor type is available for the AL-2-50 breaker for direct current application which will trip the breaker when the reversed current exceeds the calibration setting. This device is constructed similar to a bipolar motor with stationary pole assembly in which is mounted a series coil carrying the breaker current, and a rotating armature on which is wound a potential coil. The magnetic field set up by the current in the potential coil together with the field set up by the load current in the series coil, in the normal direction, produces a torque which tends to rotate the armature in a direction to prevent tripping. However, when the current in the series coil is reversed, the torque is reversed to cause the reverse rotation which trips the breaker.

As shown in Fig. 33, the motor element is mounted on the rear of the mounting base by studs (21). The armature shaft extends through to the front to operate the tripping equipment. For 600 amperes and less, a vertical bar diagonally slotted, is brazed to one end of the coil (38) and extends upwards to external bus (39). To the other end of the coil, a horizontal bar also slotted, is brazed and to it is brazed at right angles another horizontal bar which is connected to the lower stud (16). In sizes above 600 and including 800 amperes, the bar extends horizontally to the bus and in sizes above 800 amperes, the bar to the bus is horizontal and the bar from the other end of the coil is connected directly to the lower stud as shown in smaller scale in Fig. 33.

The armature shaft (8) is supported in bronze bearing castings (20) and (28) which are fastened to the pole shoes (31) by studs (21) and nuts housed in a spacer (22) for the front bearing, and by screws (27) for the rear bearing. An escutcheon plate (7) is mounted on the front of the mounting base by studs (21) and to it are riveted two posts for the calibration plate (11) and two posts for stop screws (4) and (6). A trip crank (5) is clamped firmly by screw and set screw to the extended armature shaft (8) and supports the trip arm assembly (3) on pin (14). A trip lever (2) is screwed to the interlock trip rod (1) and is free to move over the

(P-6490455 SK)

1. PIN (SEE ALSO 38 FIG. 11)
2. SPRING GUIDE
3. SPRING
4. PIN
5. PIN
6. ADJUSTING COLLAR
7. SPACER BLOCK
8. POLE PIECE
9. SCREW
10. DISCS
11. COIL
12. BRASS GUIDE
13. BRASS BUSHING
14. SCREW
15. WEIGHT
16. INSULATION
17. ARMATURE

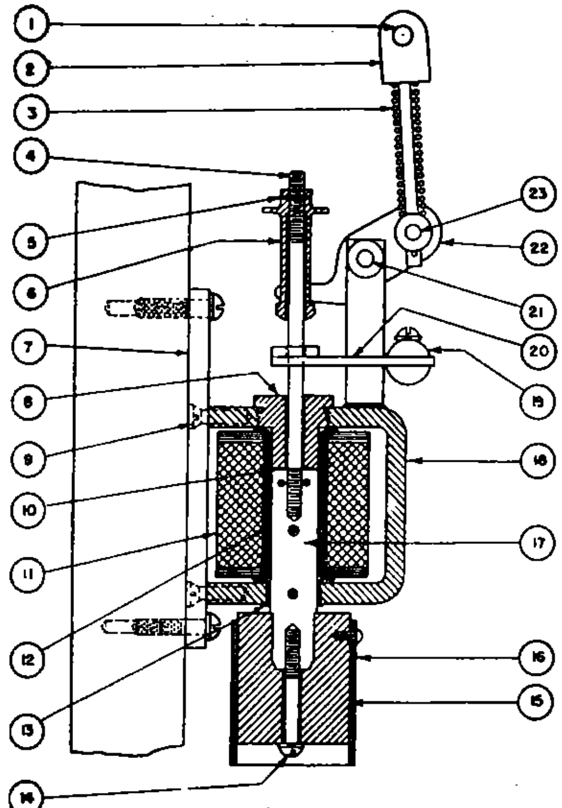


FIG. 31

INSTANTANEOUS UNDERVOLTAGE TRIP DEVICE

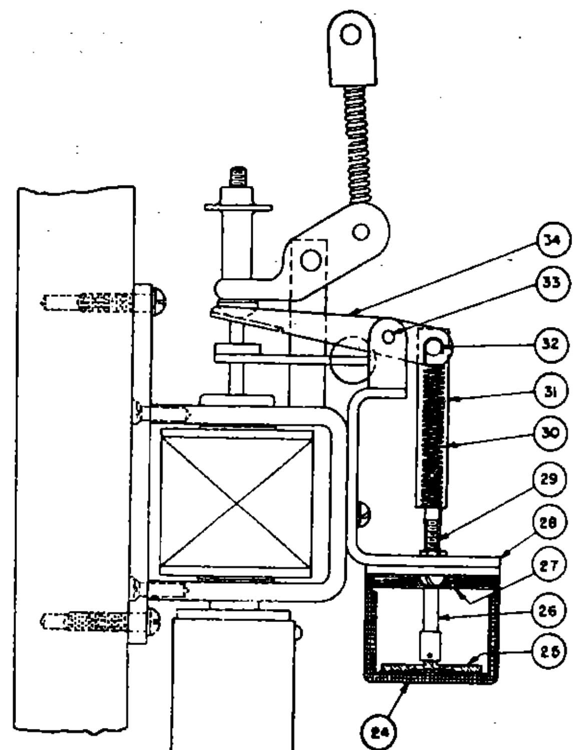
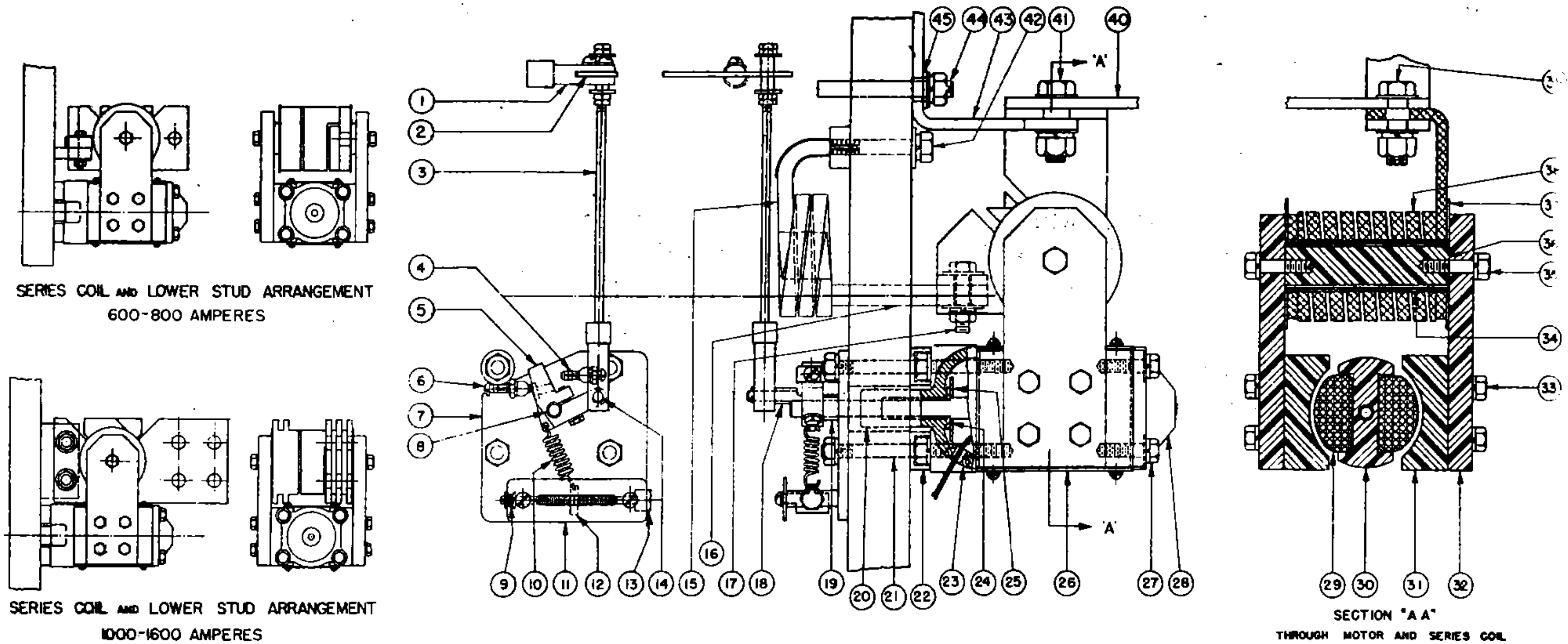


FIG. 32

TIME DELAY UNDERVOLTAGE TRIP DEVICE

18. MAGNET FRAME
19. TRIP SHAFT
20. TRIP LEVER
21. PIN
22. RESET LINK
23. PIN AND TRUNNION
24. OIL POT
25. DISC
26. ROD
27. COVER
28. BRACKET
29. SPRING POSTS
30. SPRINGS
31. COUPLING
32. PIN
33. PIN
34. LEVER



1. INTERLOCK TRIP ROD
2. TRIP LEVER
3. TRIP ARM ASSEMBLY
4. STOP SCREW FOR REVERSED CURRENT
5. TRIP CRANK
6. STOP SCREW FOR NORMAL CURRENT FLOW
7. ESCUTCHEON PLATE
8. ARMATURE SHAFT
9. COMPRESSION SPRING
10. CALIBRATION SPRING
11. CALIBRATION PLATE
12. CALIBRATION INDEX
13. CALIBRATION SCREW
14. PIN IN TRIP CRANK
15. OVERCURRENT COIL OF OVERCURRENT DEVICE
16. LOWER STUD
17. SCREW
18. SPACER ON PIN PT. 14
19. SPACER ON ARMATURE SHAFT
20. FRONT BRONZE MOTOR BEARING
21. STUD
22. SPACER WITH NUT HOUSING
23. BUSHING
24. THRUST BEARING
25. INSULATION WASHER
26. DUST COVERS (TOP AND BOTTOM)
27. SCREW
28. REAR BRONZE MOTOR BEARING
29. ARMATURE COIL
30. ARMATURE
31. POLE SHOE
32. SUPPORT
33. SCREW
34. INSULATION TUBES
35. SCREW
36. CORE
37. INSULATION WASHERS
38. COIL WITH SLOTTED STRAPS
39. SCREW
40. EXTERNAL BUS CONNECTION
41. SCREW
42. SCREW
43. SUPPORT
44. SCREW
45. INSULATION SPACER AND WASHER

FIG. 33

REVERSE CURRENT TRIP DEVICE

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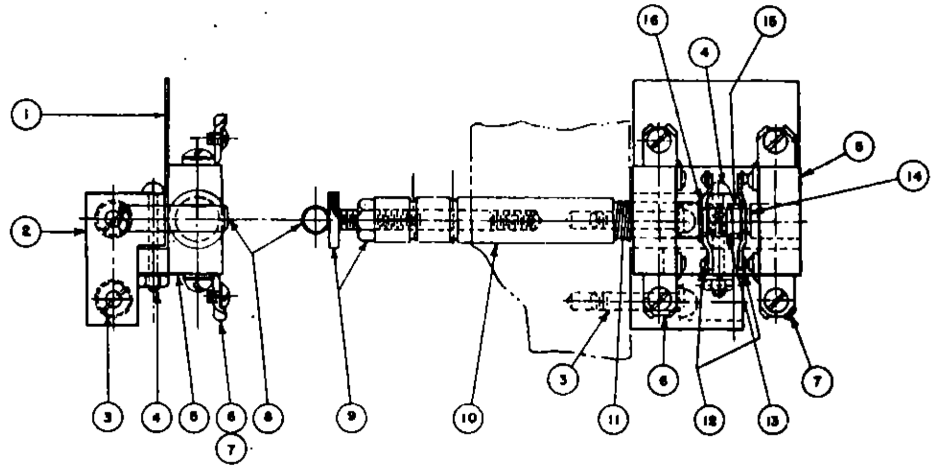

1. INSULATING BARRIER
2. MOLDED BRACKET
3. SCREW
4. SCREW
5. MOLDED BASE
6. CONTACT BRACKET WITH STATIONARY CONTACT AND BINDING SCREW
7. CONTACT BRACKET WITH STATIONARY CONTACT AND BINDING SCREW
8. PIN 3 7/8" LONG .3125 DIAMETER
9. SCREW WITH FLAT KNURLED HD.
10. COMPOSITION PLUNGER
11. COMPRESSION SPRING FOR PLUNGER
12. MOVEABLE CONTACT STRIPS
13. CONTACT SPRING
14. GUIDE
15. INSULATION WASHER
16. INSULATION WASHER

FIG. 34

PUSH TYPE AUXILIARY SWITCH

SHOWN IN CLOSED POSITION OF BREAKER

upper end of the rod between properly spaced jam nuts to permit sufficient travel when the breaker is tripped by other devices.

When current passes through the series coil in the normal direction, the armature will tend to revolve counter-clockwise, (looking from the front) to force the trip crank (5) against stop screw (6). The calibrating spring (10) also normally holds the trip crank against this stop screw. But when current passes through the series coil in the reverse direction, the armature will tend to rotate clockwise, away from this stop screw, and when the calibration setting is reached, it will rotate in the reverse direction and lower the trip rod (3) to trip the breaker. The stop screw (4) limits the reverse rotation travel. A calibration plate (11) is mounted on posts on the escutcheon plate. The calibration screw (13) passes through these posts and carries a threaded calibration index (12) attached to the calibration spring (10). By turning the hexagonal head of the calibration screw against the compression spring (9), the reverse current setting can be changed.

The trip crank (5) is clamped to the armature shaft so that the potential coil (29) will be located approximately in the horizontal position with a somewhat larger air gap on the trip side when the crank rests against stop screw (6) extended approximately 1/16" to 3/32" beyond the post. When rated voltage is applied to the potential coil with no current passing through the breaker and the calibration spring is connected, there should be no movement of the armature in the tripping direction. However, if a movement is detected, back off slightly on the stop screw (6) to increase the air gap to the pole piece on the trip side.

After this adjustment has been completed, the stop screw (4) can be set to limit the travel of the armature so that the trip crank (5) will be stopped slightly past the vertical position. Now adjust the nuts at the top of trip rod (3) so that the breaker will trip with 1/32" overtravel of the trip lever (2) measured at the trip rod (3). Slight variations of these adjustments may be necessary to improve the operation of the device.

The adjustment of stop screw (6) and the tripping crank (5) will affect the calibration of the reverse current device so their setting should not be changed unless facilities for checking calibration are available.

Because the potential must not drop below 80% of normal, the potential coil should be connected to a reliable constant potential source, preferably to a station battery bus, if possible.

PUSH TYPE AUXILIARY SWITCH Fig. 34

To give light indications for open and closed positions of the breaker, a push-type auxiliary switch, is mounted on the rear of the breaker base on a horizontal line midway between, and to the right of, the main stationary contacts of the right hand pole unit. A limited number of other operating functions may be provided for by other auxiliary switches similarly located. A plunger of insulating material extends through the breaker base and engages a 3-7/8" long pin which replaces pin (8) Fig. 7 that supports the main bridging contact of the breaker in its support. One normally closed and one normally open set of contacts are provided (one to show and the characteristics of circuits to be controlled such as indicating lamps, control circuits, bell alarm, interlocking of breakers, etc.

The contacts are designed to carr [illegible] amperes continuously or 250 amperes fo [illegible] seconds. The number of contacts used singly or in series should be determined from the following table of current and voltage of circuits to be controlled.

INTERRUPTING RATINGS - AMPERES

CIRCUIT VOLTS	NON INDUCTIVE CIRCUIT			INDUCTIVE CIRCUIT (AVERAGE TRIP COIL)		
	NUMBER OF CONTACTS					
	1	2 IN SERIES	4 IN SERIES	1	2 IN SERIES	4 IN SERIES
24 d-c	6	30		4	20	30
48 d-c	5	25	40	3	15	25
125 d-c	2.7	11	25	2	6.25	9.5
250 d-c	.75	2	8	.7	1.75	6.5
600 d-c	.25	.45	1.35	.15	.35	1.25
115 a-c	40	75		24	50	
220 a-c	25	50		12	25	40
440 a-c	12	25		5.	12	20
550 a-c	6	12		4.	10	15

a green light when the breaker is open and the other to show a red light when the breaker is closed). Fig. 34 shows the switch in the closed position of the breaker.

The contact brackets (6) and (7) with stationary contacts and binding posts are mounted on a molded base (5). The plunger (10) passes through one wing of the base and a guide (14), screwed to the end of the plunger, passes through the other wing of the base. The two movable contact strips (12) move over a square section of the guide and are separated by contact spring (13) which maintains adequate pressure against the stationary contacts. Spring (11) normally holds the contacts and plunger to indicate the open position of the breaker.

The molded base (5) is attached to the bracket (2) by screw (4) and the bracket is attached to the breaker base by self tapping screws (3). An insulation barrier (1) is fastened between the base and bracket and extends upwards for protection from the breaker stud.

ROTARY TYPE AUXILIARY SWITCH Fig. 35

The rotary type auxiliary switch, is the SB-1 type and is used on all electrically operated AL-2-50 breakers. It is generally placed on the mounting panel below the operating mechanism and connected by crank (7) and rod and couplings (3) to the cross bar (1). The number of stages and the arrangement of contact switches are determined by the auxiliary functions desired

The auxiliary switch is a cam operated, multi-circuit rotary switch. It is provided with "a" and "b" contacts, and "a" contact being one that is open when the breaker is open, and a "b" contact being one that is closed when the breaker is open. In Fig. 35 where the AL-2-50 breaker is shown in the open position, Stage 1, next to the crank (7) has "a_1" contacts because its operating cam (15) is advanced 15° ahead of a regular "a" stage in closing. This is necessary because its contacts must close before the arcing contacts of the breaker close. Stage 2 has closed contacts which are designated "b" contacts. The crank (7) is forward and the horizontal position. When the breaker closes the crank rotates 60° clockwise (looking at the crank end) and the contacts take the opposite position.

A square shaft (8) extends through the unit, the length depending upon the number of stages used. Each stage consists of one cam (15) and bushing (16) fitted over the square shaft and two movable contacts (6) attached to a barrier (13), all assembled in a plane at right angles to the shaft. A stationary contact support (4) carries the stationary contacts of all stages and is attached to the front frame and the rear barrier by two round head screws. Two bolts (10) pass through the molded barriers (13) and through the bases (9) and (14). When the shaft is rotated the cam of each stage opens or closes both movable contacts simultaneously. In the AL-2-50 breaker both sets of switch contacts are in series to provide two breaks in each controlled circuit. The cam bushing fits over the square

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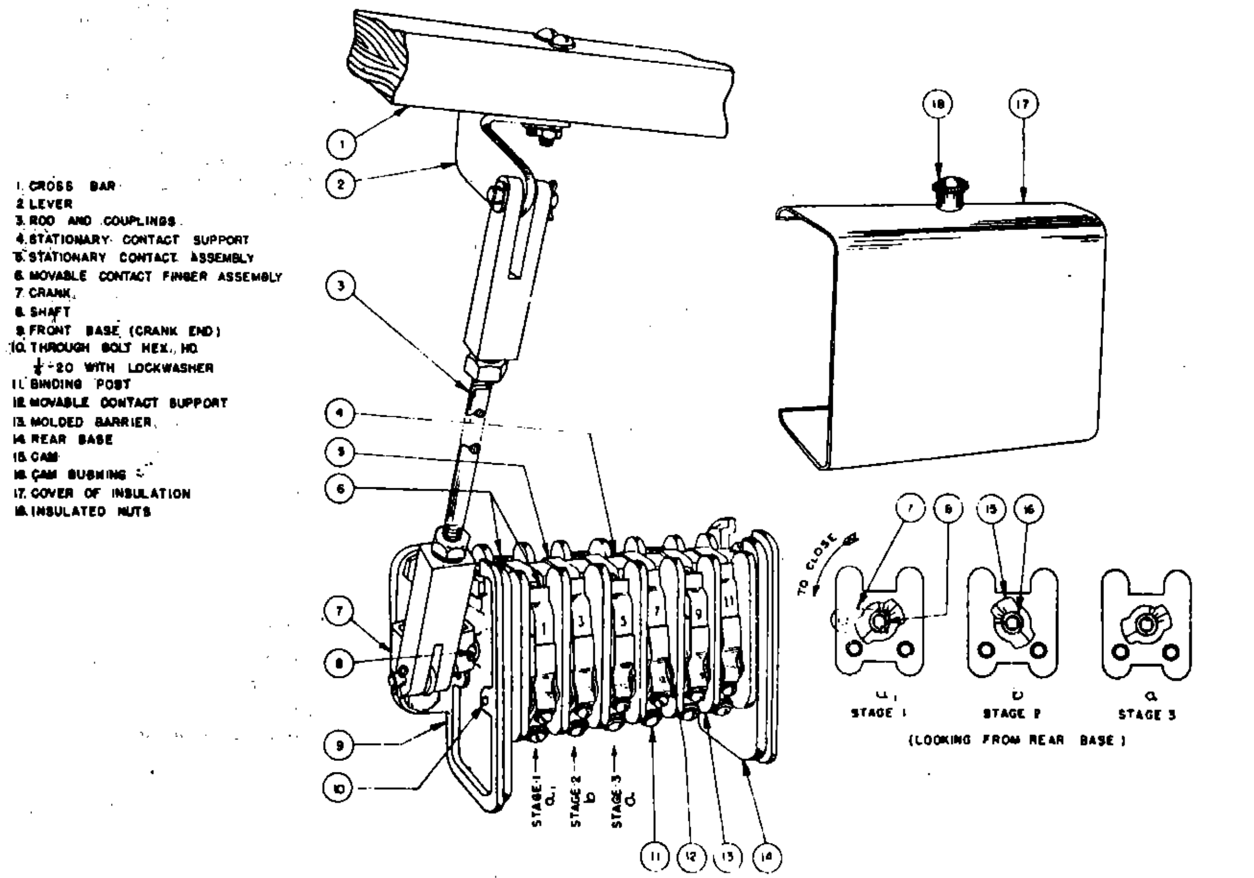


FIG. 35

ROTARY TYPE AUXILARY SWITCH

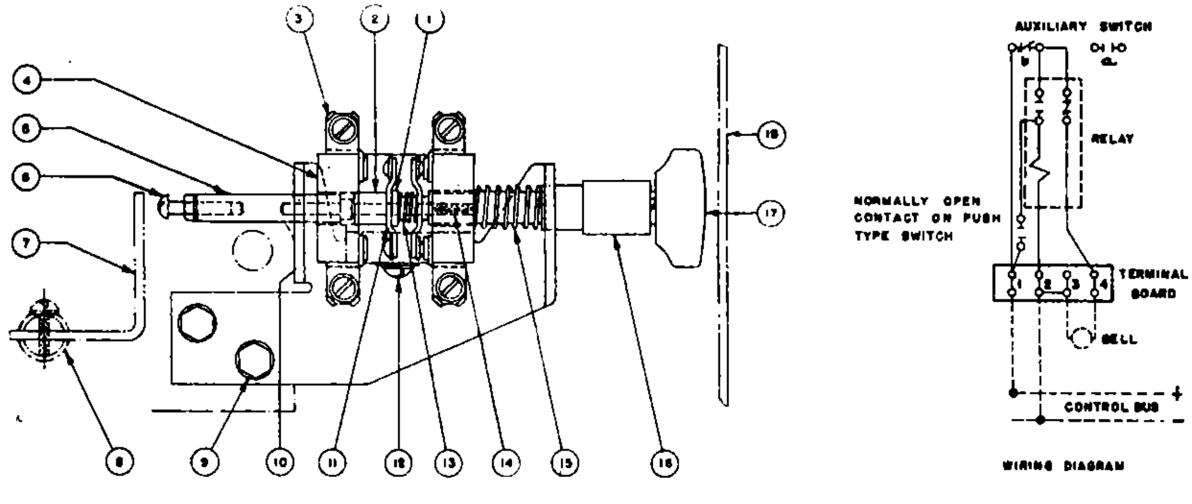
IN OPEN POSITION OF BREAKER

shaft (8) and has 24 external teeth and the cam (15) with 24 corresponding internal teeth fits over the bushing to allow steps of 15° placement with reference to its setting on the shaft. The proper placement of the cam on the bushing and the bushing on the shaft is important for proper operation of the breaker. There is an index mark on the bushing and reference marks on the cam for this purpose.

The contacts of any stage may be changed from "a" to "b", or any intermediate position required, by a change in breaker operation by changing the position of the cam with reference to the shaft. If a change of 90° is required, the cam and bushing should be removed together and replaced on the square shaft in the proper position. If the change is 15° or a multiple of 15° the cam will have to be relocated on the bushing. Each reference mark on the cam represents 15° of angular placement.

To make the change in the field, first remove interfering wiring and the stationary contact support (4) with all the stationary contacts (5) by removing two round head screws. Then remove the two tie bolts which hold the molded barriers (13) to the bases (9) and (14). Now remove the rear molded barrier with the two movable contacts of the rear stage, which will leave the cam and bushing of the rear stage exposed. Continue removing molded barriers, cams and bushings until the cam to be changed is exposed. In removing cams and bushings be particularly careful to make an accurate sketch showing the relation of reference marks on the cams, the index mark on the bushing and the position of the bushing on the shaft, and keep the parts of each stage together. The cam can then be changed to its new position and the auxiliary switch can be reassembled.

At regular inspection periods of the breaker, the auxiliary switch should be examined for burned contacts, and broken shunts on contact fingers. If contacts are slightly pitted or coated with oxide, scrape them gently with a sharp knife or dress with a fine file. If the moving contact is burned or has a broken shunt, the entire contact finger assembly should be replaced. If a stationary contact is burned or damaged the complete stationary contact support and contact (4) should be replaced.

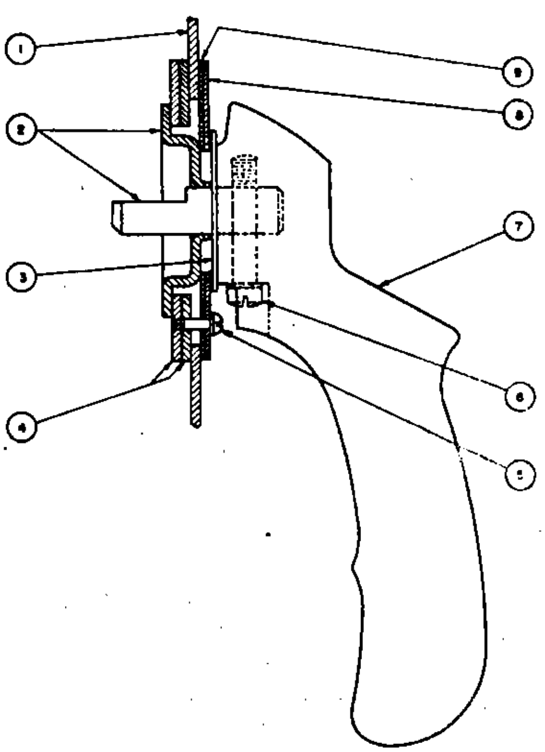


PUSH TYPE SWITCH

FIG. 36
BELL ALARM DEVICE

1. INSULATING WASHER
2. GUIDE
3. BRACKETS WITH CONTACTS & BINDING SCREWS
4. MOLDED BASE
5. ROD
6. ADJUSTING SCREW
7. TRIP ARM
8. TRIP SHAFT
9. SCREWS
10. BRACKET
11. CONTACT STRIP
12. SCREW
13. SPRING
14. STUD
15. SPRING
16. PLUNGER
17. BUTTON
18. STEEL FRONT ENCLOSURE

(M-6490628 SK)



1. STEEL DOOR OR ENCLOSURE
2. SHAFT AND BRAZED PLATE
3. WASHER
4. CLAMPING RINGS
5. SCREW
6. SCREW
7. HANDLE
8. NAME PLATE
9. BACKING PLATE

FIG. 37

OPERATING HANDLE

(M-6490625)

BELL ALARM DEVICE Fig. 36

This device, together with an HGA relay, includes a push button and rod and a push type switch. It is designed to provide a means of silencing the bell alarm whenever the breaker is automatically tripped and to prevent the bell from ringing when the breaker is manually tripped. It is mounted on a flanged bracket (10) which is attached to the left side of the left pole unit frame by screws (12) in the same location as the "Manual Trip" Fig. 10. A left side view and wiring diagram are shown in Fig. 36.

When the breaker is tripped automatically a "b" contact of the auxiliary switch is closed to ring the bell alarm through the normally closed contact of the HGA relay. Then when the hand trip button is operated the normally open contacts of the push type switch are closed to close a circuit through the relay coil. This opens the normally closed contacts of the relay to open the bell circuit. At the same time the normally open contacts of the relay are closed which seals the relay in this position by energizing the coil through the closed "b" contacts of the auxiliary switch and the relay contacts which have just been closed. This silences the bell.

When the breaker is tripped manually by the trip rod, the normally open contacts of the push type switch will be similarly closed as above so as to energize the seal in the relay and open the bell alarm circuit before the breaker is opened, even if the "b" contacts of the auxiliary switch are closed after the breaker opens, as described below.

A two circuit push type switch with molded base (4), is attached by screw (12) to a flange of bracket (10). Contact strips (11) slide over a square section of guide (2) with spring (13) between them to provide contact pressure. The guide is attached to plunger (16) in front and to rod (5) in the rear by stud (14). Button (17) is attached to the front of the plunger and is operated by finger pressure through a hole in the steel front enclosure (18). An adjusting screw (6) is attached to the rear of rod (5) to engage the trip arm (7) on trip shaft (8). Contact strips (11) engage contact brackets with stationary contacts and binding screws (3). Spring (15) normally holds the rear contacts open.

The normally closed contacts of the push type switch are not used in the bell alarm device as described above and therefore can be used for other purposes as may be desired.

OPERATING HANDLE Fig. 37

For the manually operated dead front and enclosed circuit breakers a disconnect operating handle is mounted in the steel door or enclosure to engage a shaft and coupling of the manually operated breaker mechanism.

Clamping rings (4) are attached to the steel door or enclosure (1) by three screws (5) which pass through the nameplate (8) and backing plate (9). The shaft and brazed plate (2) pass through the steel enclosure from the rear. Handle (7) and washer (3) are attached to the front of the shaft by screw (6). When the door closes, or the front enclosure is put in place, the rear end of shaft (2) fits into a coupling on the front end of the shaft of the manually operated breaker mechanism.

A shim may be necessary between the clamping rings (4) and the front enclosure (1) to make a close clearance between washer (3) and nameplate (8).

To prevent undue friction in the movement of the handle it is recommended that a lubricant be applied to the engaging surfaces between shaft and plate (2) and clamping rings (4) and back plate (9). Lubriplate #130-A, G.E. Spec. D50H10, or an equivalent, should be used.

TYPE ALF-2 FIELD SWITCH WITH DISCHARGE CONTACTS FIG. 38

The type ALF-2 field switch with discharge contacts is used for the control of generator shunt field circuits. It consists of a regular non-automatic two-pole type AL-2-50 air circuit breaker, manually or electrically operated, but equipped with field discharge contacts, described below, and placed between the two main poles of the field switch. The discharge contacts are closed and opened by a self-contained mechanism connected to the operating mechanism of the field switch.

The discharge contacts are operated and constructed, as described below, to connect a discharge resistor across the shunt field terminals when the field switch opens the field circuit. The connection of this resistor prevents a high induced voltage across the field terminals caused by the rapid collapse of flux in the magnetic circuit of the shunt field.

This field switch is not used with synchronous condensers or synchronous motors which start on alternating current as induction motors at full or reduced voltage.

FIELD DISCHARGE CONTACTS Fig. 39

The field discharge contacts, Fig. 39 of the ALF-2 field switch consist of an upper stud (7) with a silver alloy contact, a lower stud (11) both mounted through the bases of both the field switch and the discharge contact, a contact lever (34), pivoted on pin (27) in the frame (23) and an operating mechanism. The contact lever is connected to the lower stud by flexible connection (12) and has a silver alloy contact at the top which registers with a similar contact on the upper stud. The crank (14) is operated by operating rod and coupling (17) which is connected to stud (18) in link (20). This link is connected to pins (19) and (21) which are pins (4) and (38) Fig. 11. In this way the con-

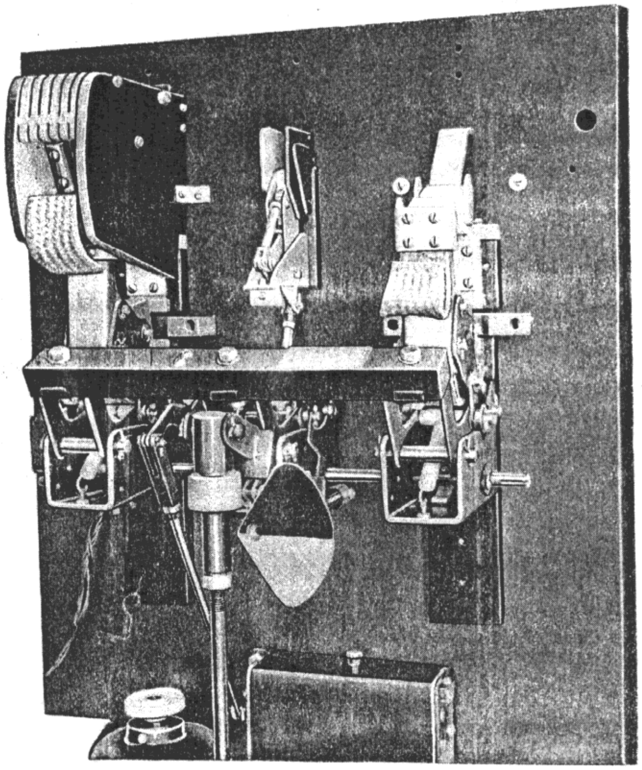


FIG. 38

TYPE ALF-2 FIELD SWITCH WITH CONTACTS

tacts of this field discharge switch will close when the type ALF-2 field switch opens, and likewise open when the field switch closes. The closing of these contacts connects the discharge resistor directly across the terminals of the shunt field to discharge the induced high voltage in the field, as shown in the accompanying connection diagram. Fig. 39 shows the discharge contacts in this position.

When the main contacts of the field switch close, the spring rod (26) is pulled forward through pin (32) in the contact lever against the pressure of compression spring (30), but before the locknuts (33) engage the pin, the catch (28) engages rivet (29) also in the contact lever, and draws the contact lever forward to open the contacts far apart. Then, as the lower end of catch (28) rides over the kick-off screw (22) as a fulcrum, the catch disengages the rivet (29) and the spring rod (26) now pushed to the rear allows compression spring (30) to force the contact lever in the closing direction but the contacts do not close because pin (32) is stopped by the locknuts to keep the contacts apart 1/8 of an inch.

Then when the main contacts of the field switch open, the spring rod and locknuts move to the rear to close the discharge switch contacts.

An arc chute encloses the contacts with a barrier (1) and pole pieces (2) on each side and supported to the field switch base by support (3), rivets (4) and self-tapping screw (5). A magnet (8) is supported between the barriers below the upper stud (7) by rivet (9). In live front field switches barriers (35) are attached to the discharge switch base (6) by self-tapping screws (10).

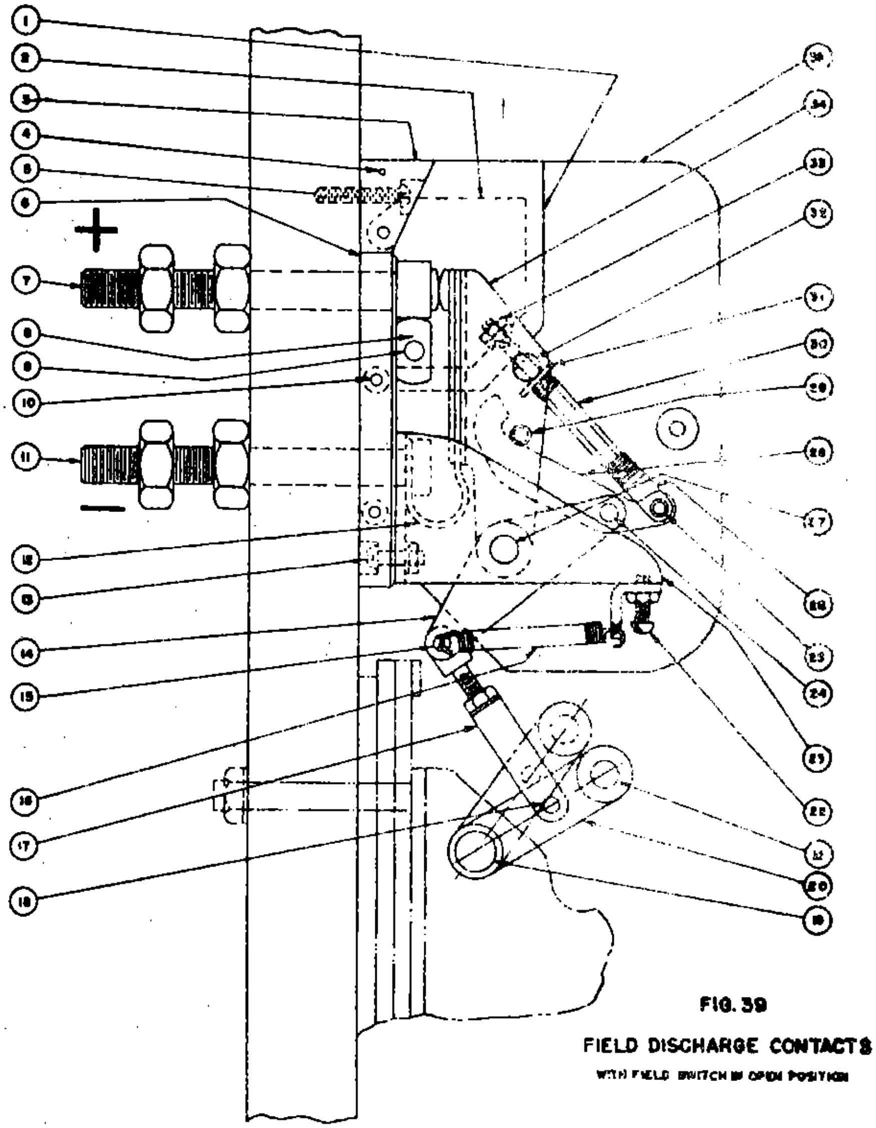
The first adjustment consists of lengthening or shortening operating rod and coupling (17) so that the discharge contacts on contact lever (34) and upper stud (7) open just before the main contacts of the field switch close.

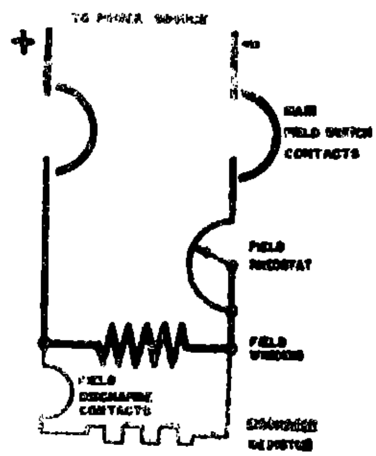
The second adjustment consists of adjusting the kickoff screw (22) so that the catch (28) disengages rivet (29) just before the field switch is fully closed.

The third adjustment consists of adjusting the locknuts (33) on spring rod (26) until the contacts of the discharge switch are 1/8 of an inch apart when the field switch is fully closed.

TYPES AL-2-50Y1, AL-2-50Y2 AND AL-2-50Y3 CIRCUIT BREAKERS

These circuit breakers are designed for the protection of resistance welding machines to instantaneously trip at higher current settings than provided with instantaneous overcurrent trip devices as shown in Figs. 25 and 26. The breakers differ from the regular type AL-2-50 breakers because slightly different overcurrent trip parts are required to secure the special calibration.





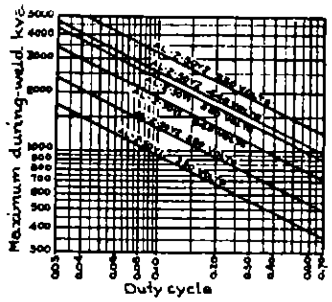
TYPICAL CONNECTION DIAGRAM

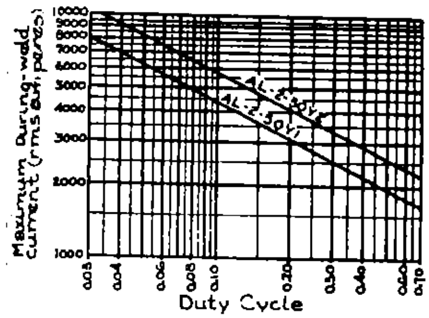
FIG. 39

FIELD DISCHARGE CONTACTS

WITH FIELD SWITCH IN OPEN POSITION

1. BARRIER FOR ARC CHUTE
2. POLE PIECE FOR ARC CHUTE
3. SUPPORT FOR ARC CHUTE
4. RIVETED PIN
5. SCREW
6. BASE
7. UPPER STUD AND CONTACT
8. MAGNET
9. RIVETED PIN
10. SCREW
11. LOWER STUD
12. FLEXIBLE CONNECTION
13. SCREW
14. CRANK
15. PIN AND SPACER
16. TENSION SPRING
17. OPERATING ROD AND COUPLING
18. STUD (IN LINK 20)
19. PIN (PIN 4 FIG. 11)
20. LINK WITH BOSSES AND STUD
21. PIN (PIN 30 FIG. 11)
22. KICK-OFF SCREW
23. FRAME
24. CONTACT LEVER
25. RIVET
26. SPRING ROD
27. PIN, COTTER AND SPACER
28. CATCH
29. RIVET
30. COMPRESSION SPRING
31. WASHER
32. PIN
33. LOCKNUTS AND LOCKWASHERS
34. CONTACT LEVER
35. BARRIER



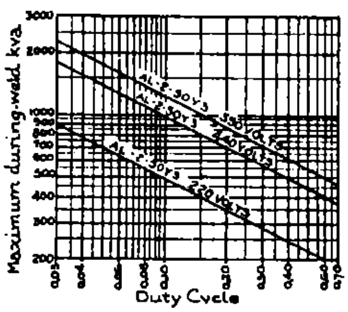


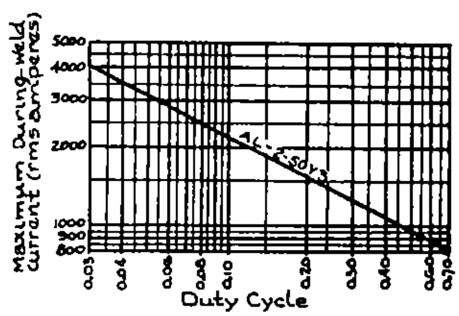
AL-2-50Y1 Breaker

Duty Cycle	During-weld AMP Rms	During-weld KVA 220 Volts	440 Volts	550 Volts
0.03	8000	1760	3520	4400
.04	6925	1525	3050	3810
.05	6200	1365	8730	3410
.06	5650	1243	2486	3110
.07	5230	1150	2300	2880
.08	4900	1078	2156	2695
.09	4620	1016	2032	2540
.10	4380	986	1972	2415
.20	3100	682	1364	1706
.30	2530	556	1112	1390
.40	2190	482	964	1205
.50	1960	431	862	1078
.60	1788	393	786	983
.70	1650	363	726	907

AL-2-50Y2 Breaker

Duty Cycle	During-weld AMP Rms	During-weld KVA 220 Volts	440 Volts	550 Volts
0.03	10680	2350	4100	5870
.04	9260	2040	4080	5100
.05	8280	1820	3640	4550
.06	7550	1660	3320	4150
.07	6990	1540	3080	3840
.08	6540	1440	2880	3600
.09	6170	1360	2720	3390
.10	5860	1290	2580	3220
.20	4140	910	1820	2280
.30	3380	744	1488	1860
.40	2925	644	1288	1610
.50	2620	576	1152	1440
.60	2390	526	1062	1315
.70	2210	486	972	1210





Duty Cycle	During-weld AMP Rms	During-weld KVA 220 Volts	440 Volts	550 Volts
0.03	4040	890	1780	2225
.04	3500	770	1540	1925
.05	3130	689	1378	1722
.06	2860	629	1258	1574
.07	2640	580	1161	1453
.08	2740	544	1087	1360
.09	2330	513	1025	1282
.10	2215	487	974	1219
.20	1566	345	689	861
.30	1278	281	562	703
.40	1107	244	487	609
.50	990	218	436	545
.60	903	199	398	497
.70	836	184	368	460

FIG. 40

CURRENT AND DUTY CYCLES OF AL-2-50Y1, AL-2-50Y2 AND AL-2-50Y3 BREAKERS

Standard calibration ranges are 600 to 1500 amperes, 1400 to 4000 amperes, 2000 to 5000 amperes and 4000 to 10,000 amperes. Within reasonable limits other ranges can be provided where the highest calibration settings will not exceed 2½ times the lowest settings.

As the duty imposed on these welding circuit breakers is intermittent and quite variable depending upon various types of welding to be done, the breakers are not given continuous current ratings. They are designed to safely carry "during weld amperes" or "during weld KVA" at welding periods not to exceed the corresponding "duty cycles" as tabulated in Fig. 40.

RENEWAL PARTS

When ordering renewal parts address the nearest Sales Office of the General Electric Company, specifying the quantity required and describing the parts by catalogue numbers as shown in Renewal Parts Bulletin.

In the absence of a Renewal Parts Bulletin the described parts should be referred to by giving the complete nameplate data of the circuit breaker or accessory, and referring to part numbers and figure numbers where illustrated in this instruction book.

If several parts are desired as an assembly, reference should be made to each part with instructions to ship assembled. If a part has not been given a part number in any of the figures in the instruction book, it should be referred to as being between or adjacent to parts with numbers. A sketch giving approximate size and shape would be helpful in some cases.

Spare parts which are furnished may not be identical with the original parts since changes and improvements are made from time to time. However, parts which are furnished will be interchangeable with the original parts with no extra work for replacement beyond that required to install parts identical. If additional work or caution is required, complete instructions will accompany the parts. If identical parts to the original parts are required the order must state that they are to be identical.

WIRING DIAGRAM

Figs. 41 and 42 show schematic and typical wiring diagrams for electrically operated AL-2-50 breakers.

The standard arrangement for direct current circuits is to have voltage coils connected solidly to the negative bus or line if possible.

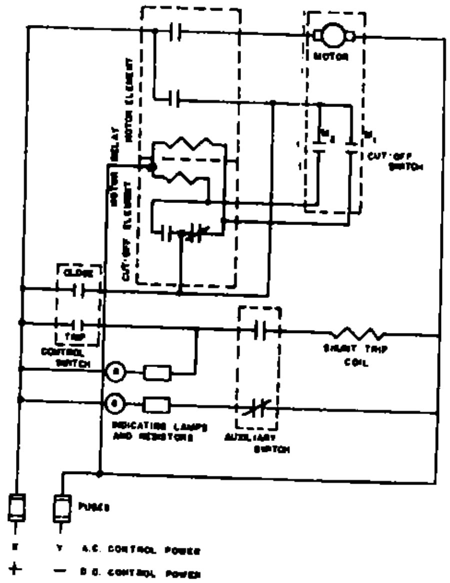


FIGURE 41
SCHEMATIC WIRING DIAGRAM

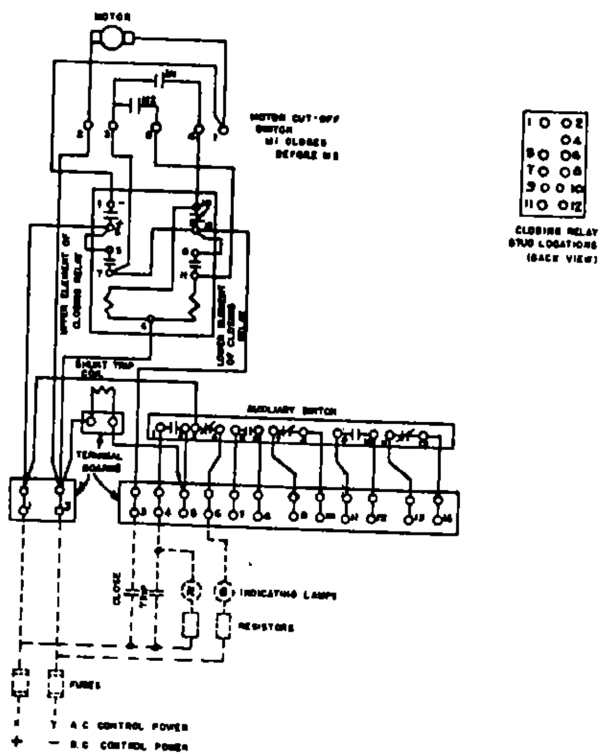


FIGURE 42
TYPICAL WIRING DIAGRAM