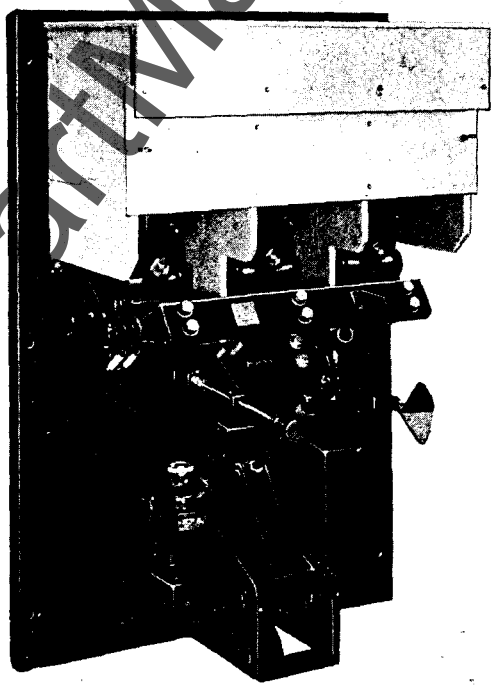
INSTRUCTIONS

Switchgear

AIR CIRCUIT BREAKER



Types
AL-2-75 and AL-2-100

GENERAL ELECTRIC

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Supersedes DEI-120538

ILLUSTRATIONS

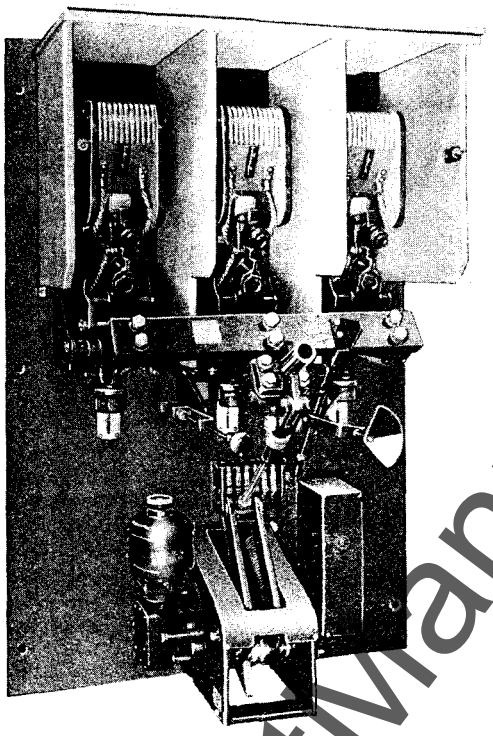


FIG. 2
ELECTRICALLY-OPERATED BREAKER WITH FRONT BARRIER REMOVED

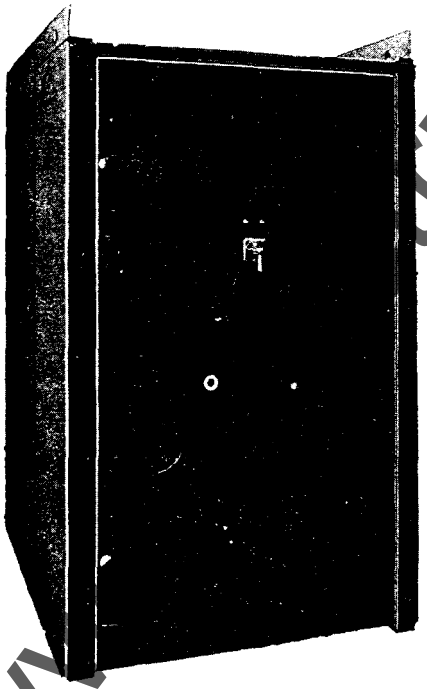


FIG. 3
ELECTRICALLY-OPERATED BREAKER ENCLOSED

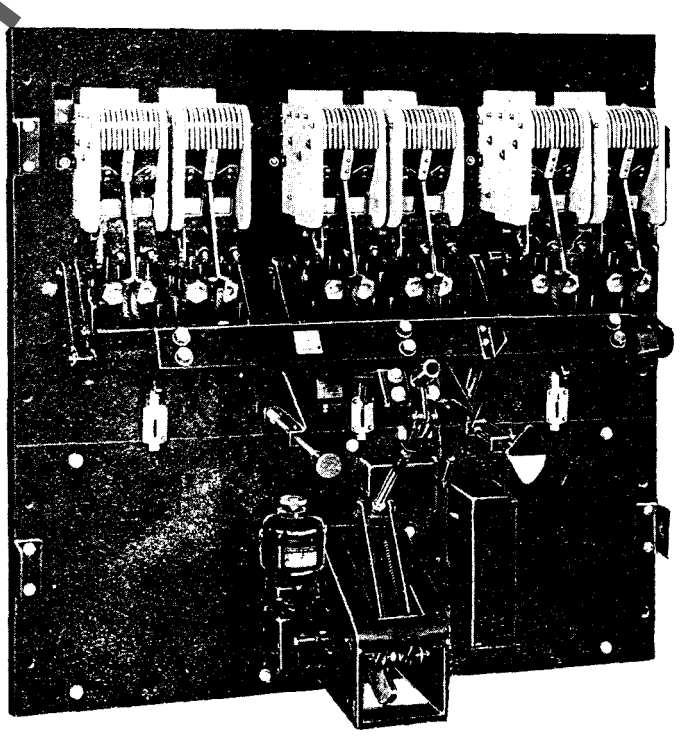
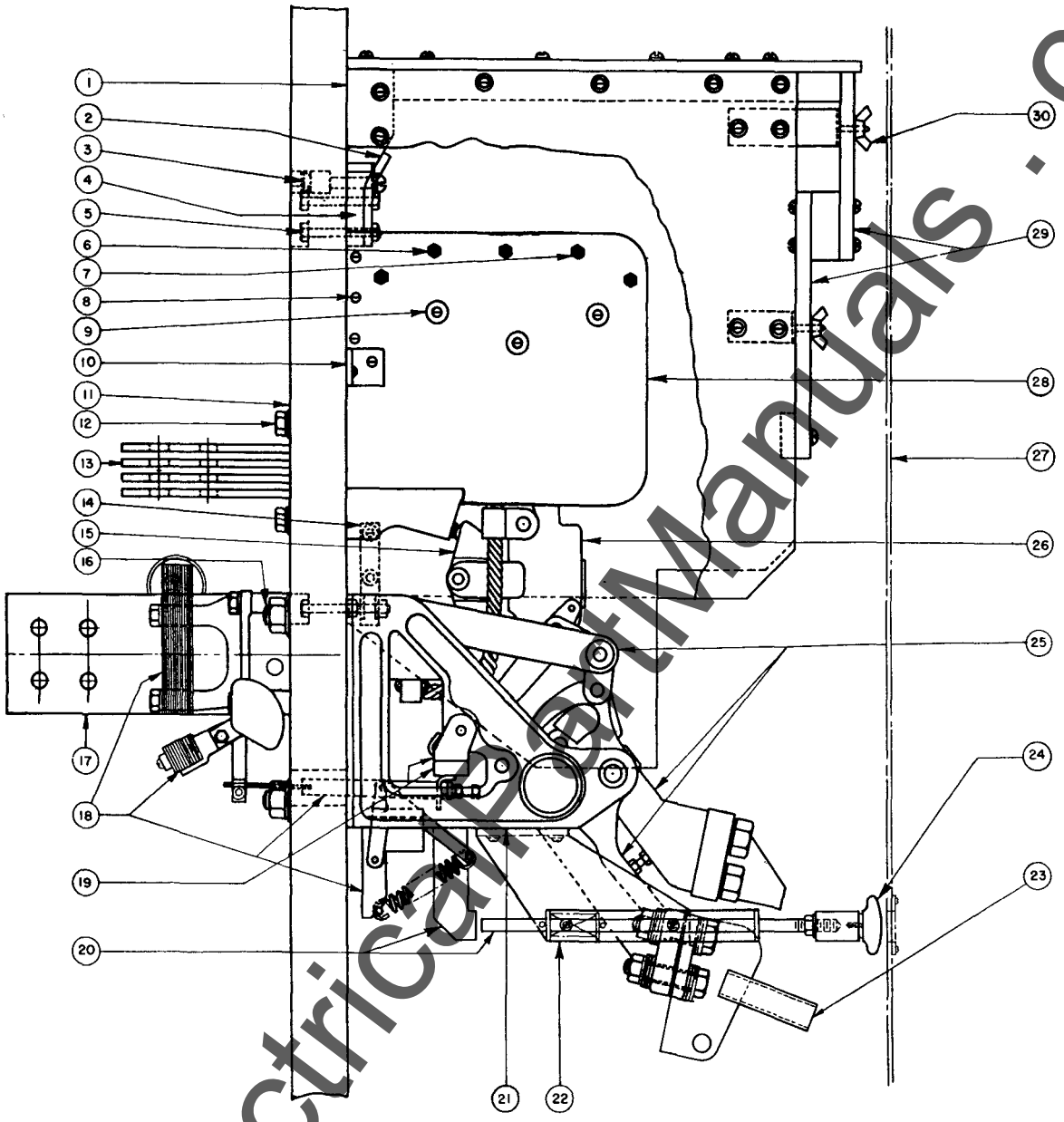


FIG. 4
ELECTRICALLY-OPERATED THREE-POLE BREAKER WITH BOX-LIKE BARRIER REMOVED

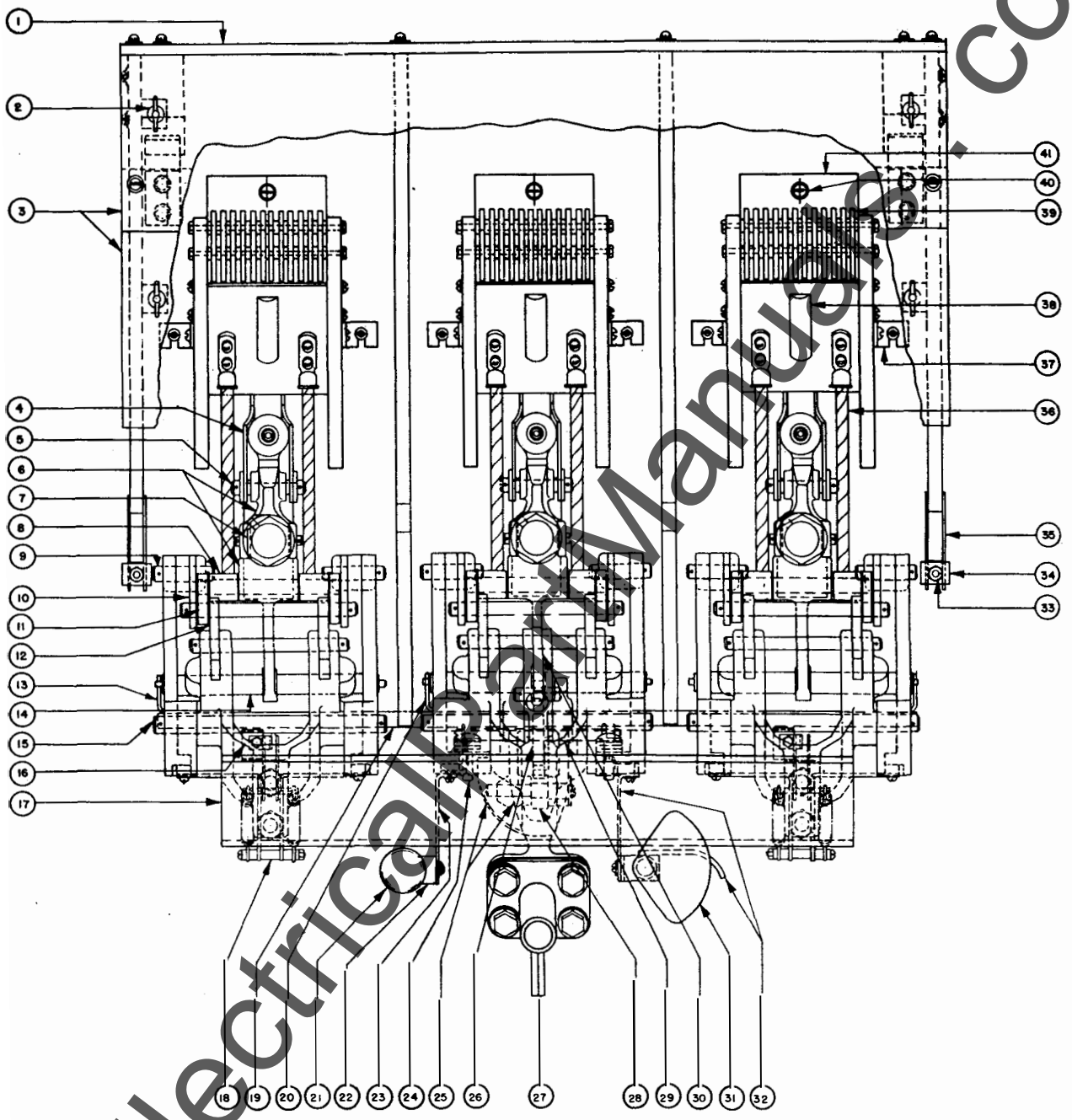


1. BARRIER SUPPORT
2. HOOK FOR BARRIER SUPPORT
3. SCREW WITH EXPANSION NUT
4. SPACING BLOCK
5. SCREW
6. STUD
7. STUD
8. SCREW, PARKER SELF TAPPING
9. SCREW
10. CLIP, RIGHT AND LEFT HAND
11. BREAKER BASE
12. SCREW
13. UPPER STUD (SEE FIG.7)
14. SUPPORT CLIPS ON BARRIER
15. BRIDGING BLOCK (SEE FIG. 7)
16. STUD
17. LOWER STUD (SEE FIG.7)
18. INSTANTANEOUS SHORT CIRCUIT TRIP DEVICE
19. TRIP BAR AND SUPPORT
20. TRIP ARM AND ROD
21. SIDE FRAME
22. SUPPORT
23. SOCKET FOR MAINTENANCE HANDLE
24. TRIP BUTTON
25. OPERATING MECHANISM (SEE FIG.10)
26. CONTACT LEVER (SEE FIG. 7)
27. FRONT ENCLOSURE
28. ARC QUENCHER (SEE FIG. 7)
29. REMOVABLE INSPECTION FRONT COVER
30. WING NUT

FIG. 5

LEFT SIDE VIEW OF POLE UNIT

(T-6490326)



1. BOX TYPE BARRIER
2. WING NUT
3. REMOVABLE INSPECTION COVER
4. MOVABLE ARCING CONTACT SUPPORT
5. PIN
6. MAIN CONTACT SUPPORT
7. SPRING ADJUSTING NUT
8. SPACER
9. PIN IN FRAME
10. LINK
11. LINK
12. LINK
13. SUPPORT
14. PIN IN FRAME FOR CONTACT BAR
15. PIN IN FRAME FOR TOGGLE LINK AND CLOSING LEVER
16. TOGGLE LINK WITH TWO ARMS
17. CROSS BAR
18. INSTANTANEOUS SHORT CIRCUIT TRIP DEVICE
19. TRIP BAR
20. SUPPORT FOR TRIP BAR
21. TRIP BUTTON
22. BRACKET
23. SUPPORT
24. BUFFER PIN AND LEATHER WASHERS
25. CLOSING LEVER
26. LATCH
27. SOCKET FOR MAINTENANCE HANDLE
28. ROLLER IN CLOSING LEVER
29. TOGGLE LINK WITH THREE ARMS
30. CATCH
31. INDICATOR
32. LEVER AND SUPPORT
33. SCREW
34. MOUNTING PLATE
35. SUPPORT CLIPS ON BARRIER
36. FLEXIBLE CONNECTIONS
37. MOUNTING CLIPS, RIGHT AND LEFT
38. MAGNET
39. BAFFLES
40. SCREW
41. ARC QUENCHER ASSEMBLY

FIG. 6
FRONT VIEW OF THREE-POLE BREAKER

AIR CIRCUIT BREAKERS

TYPES AL-2-75 AL-2-100 AND ALF-2

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 AL-2-75 and AL-2-100 air circuit breakers covered by this instruction book are generally used for the protection and control of electrical apparatus, main feeders and branch circuits, including equipment in buildings, industries and power stations and merchant marine application. The ALF-2 circuit breakers are used for generator field control. The breakers may be equipped with a wide choice of operating and trip devices and accessories for overcurrent protection and other functions.

RATINGS

Current Ratings:
AL-2-75, 2000 and 3000 A.
AL-2-100, 4000 A. and above.
Voltage Ratings:
Up to and including 600 volts A.C. or 250 volts D.C.
Up to and including 750 volts D.C.
Interrupting Capacity:
75,000 A. for AL-2-75
100,000 A. for AL-2-100

OPERATING CHARACTERISTICS AND CONSTRUCTION

These breakers can be furnished for dead front or enclosed mounting and may have two, three or four poles. They are closed by a toggle mechanism, operated manually or electrically against heavy springs back of contacts and springs between the frame and operating mechanism. The electrically operated breaker may be closed manually by a removable maintenance closing handle. These breakers are opened by the mechanism springs when a latch is released by pushing the manual trip button to the rear or automatically by any trip device with which the breaker is equipped. The circuit breaker is "trip free" from the closing mechanism which assures that the breaker cannot be closed as long as any trip device is functioning.

The current enters the breaker through the upper stud, passes through the upper stationary contact, through the movable bridging contact, the lower stationary contact and out the lower stud. When the breaker opens, the main bridging contacts open first which shunts the current to the arcing contacts to prevent burning of the main silver contacts. When these contacts open, a magnetic field is produced, as explained under "Arc Quenchers" and "Arc Chute With Blowout Coil" which quickly extinguishes the arc.

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 and that all leads and bus work to be connected to the breaker are de-energized.

LOCATION

These circuit breakers should be installed in a clean dry place where they will be readily accessible for convenient operation, inspection and maintenance.

DEAD FRONT BREAKERS

Dead front breakers are provided with arc quenchers, box type barriers and steel front enclosures. Hence no provision for space above or in front of the breaker is necessary to dissipate arcing gases for voltages up to 250 volts D.C. and 600 volts A.C. However, breakers designed for 251 to 750 volts D.C. are provided with arc chutes and blowout coils instead of arc quenchers and additional clearance is required to dissipate arcing gases in this latter group of breakers. This is discussed later under "Arc Chute With Blowout Coil". Dead front breakers are designed for mounting in switchboards with other circuit breakers and control equipment. Provision is made in the steel front enclosure of these breakers for the operation of controls and for the visual position indicator. Installation of dead front breakers consists of mounting the breakers in the switchboard, mounting the front enclosure and connecting the power buses or cables and control wiring.

ENCLOSED BREAKERS

These breakers are for separate installations and have individual steel housings. For both manual and motor operated breakers, a steel housing encloses the entire breaker and the mounting base of the breaker is bolted to angle brackets within the housing. Each is provided with a hinged door with openings for trip button and visual position indicator. Installation of the breaker consists of bolting the enclosure in place 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 surface 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 and secondary control wiring every precaution must be taken 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 should be 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 strain.

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, destroying necessary friction. It is recommended that these surfaces of the torque brake be examined and if any oil is evident it should be removed by a clean cloth moistened with a light grade of kerosene or naptha and 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 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 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 to the designated level with oil per General Electric specifications D6B7A1.

OPERATION AND MAINTENANCE

OPERATION

After the breaker has been installed, slowly operate it manually several times and observe whether the contacts line up properly.

Also make sure that all parts move freely in the 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 unless the undervoltage device is energized with the minimum operating potential or the armature is held manually in its reset position.

Manually operated AL-2-75 and AL-2-100 circuit breakers are closed by first lifting the handle upward until the breaker latch resets. The handle is then pushed downward which places the breaker in the closed position. The breaker is opened or tripped manually by pushing the manual trip button to the rear, as described under "Manual Trip Device".

Electrically operated AL-2-75 and AL-2-100 circuit breakers may be closed manually by inserting a maintenance handle in a socket on the operating mechanism and then pushing the handle downward until the breaker is placed in the closed position. The electrically operated breaker will automatically reset itself if the maintenance handle is removed before tripping, but will not reset itself if the handle remains in the socket when the breaker is tripped. Therefore, the handle should always be removed except during the act of manually closing. Should the maintenance handle remain in the socket when tripping takes place the electrically operated breaker is reset in a manner similar to the manually operated breaker as described above.

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.

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. It should be cleaned and lubricated 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 occasionally use 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-2-75 and AL-2-100 breakers 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, Fig. 7, consists of stationary upper and lower contact studs, (8 and 13) of machined copper blocks to which are brazed the laminated copper bars which pass through to the rear of the mounting base, the solid copper bridging block (11) attached to the contact lever (16), removable arcing contacts, flexible connections and supports.

The breakers are equipped with main contacts made of fine silver. When the breaker is closed, line contact is made under high pressure. The surfaces of these contacts have been coated with wax at the factory to prevent formation of surface film. The wax will not interfere with operation as it will volatize at normal operating temperatures of the breaker.

The bridging block is mounted on pin (12) in slots of extensions of contact lever and is backed up by heavy spring (18) mounted on guide pin and adjusted by lever. This lever is mounted on pin (15) in the side frame (14) and is connected by links (28) Fig. 10 of the operating mechanism.

The rear arc runner is attached to the upper stud by screws (5) and carries the removable stationary arcing contact to which are mounted a silver alloy insert and magnet by two screws (3). The movable arcing contact (27) with similar insert and magnet is attached to a contact support (9) which is pivoted to a contact lever by pin (19). Adjustment of this contact is provided by spring (25) and threaded sleeve nut (23) on coupling bolt (24) which passes through the contact lever and is attached to contact support by pin (21).

A flexible connection (6) connects the movable arcing contact to the lower stud. A separate flexible connection (10) connects the front arc runner in the arc quencher to the lower stud.

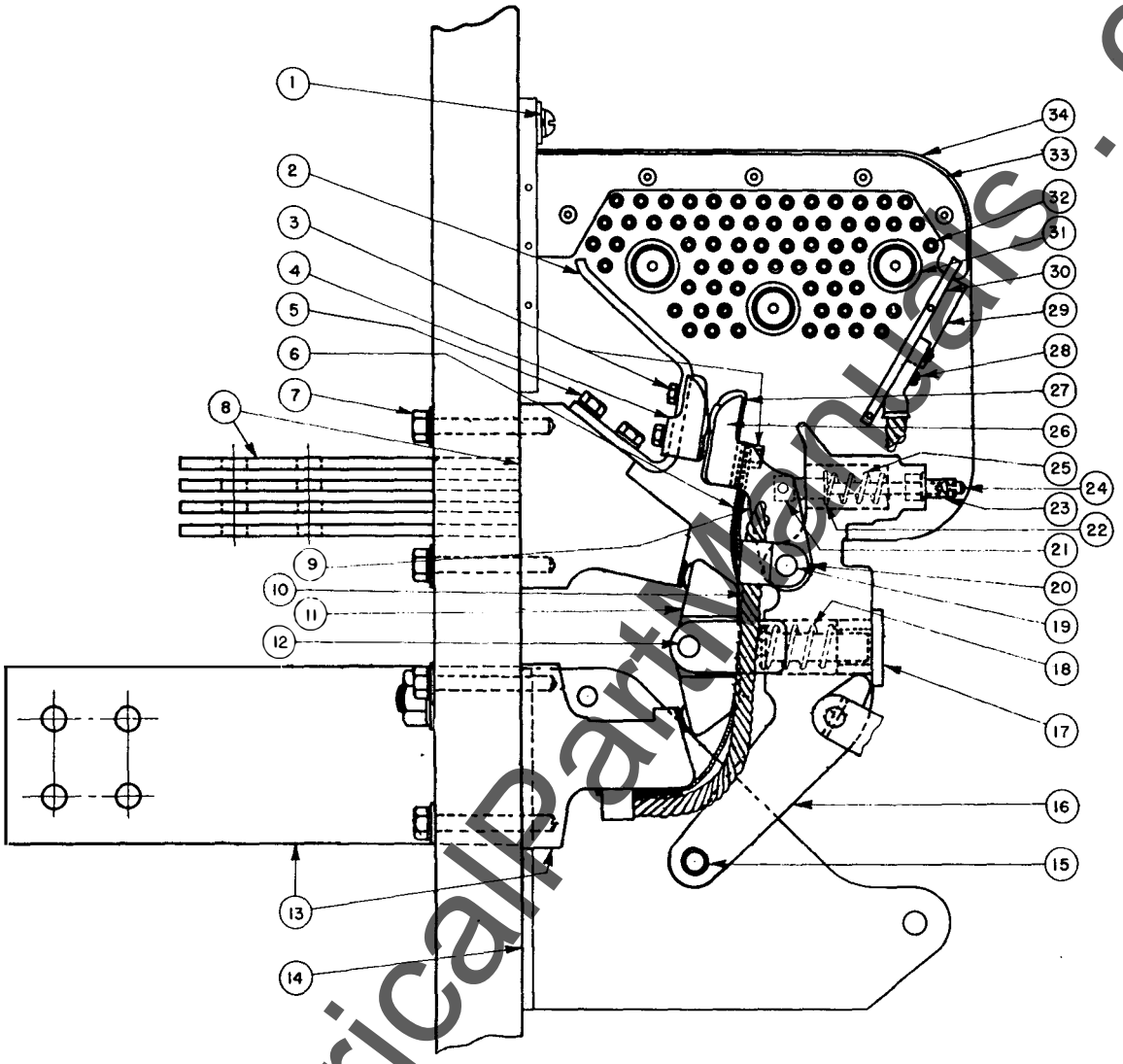
To maintain line contact the silver inserts of the stationary contacts are machined flat but those of the bridging contact are slightly curved. It is important for the proper breaker operation that adequate line contact be maintained which can be checked as follows: Hold between the contacts a piece of thin carbon paper with tissue paper and examine the impression on the paper. Good contact is indicated if a well-defined impression shows for 75% or more of the length of the contact. Good contact is also indicated if a .002 inch feeler gauge cannot be inserted between the main silver contacts for more than 25% of the length of the contact.

Should poor line contact be found, it will be necessary to improve the contacts as described under "Maintenance". One curved surface should be maintained so that the impression will not be too broad.

ARC QUENCHERS AND BARRIER - FIG. 7

An arc quencher is provided for each pole of the AL-2-75 and AL-2-100 breakers to quickly break the arc after the contacts open. Each arc quencher, Fig. 7 (See also Figs. 1 and 6) consists of a large number of small copper pins (32), and three larger magnetic pins (31), supported between molded compound (34) and placed vertically on each side of each set of contacts. Each magnetic pin consists of a steel core insulated from an enclosing copper shell. A number of molded baffles (33) are attached between the sides above and in front of the pins and separated to allow the passage of arc gases between them. The front arc runner (30) is attached between the molded compound by pins and to it is riveted a steel magnet strip (29). Two flexible shunt connections (10) are attached to the runner after the arc quencher is in place. When the arcing contacts open, the arc is quickly shunted to the arc runner when the movable contact passes under it. The magnetic field, set up by the arc, through the magnetic circuit consisting of the blow-out magnets on the arcing contacts, the steel strip on the front arc runner and the three magnetic pins, accelerates the travel of the arc up the arc runners and among the pins to lengthen and cool the arc which quickly opens the circuit. Each arc quencher is attached to the breaker mounting base by a screw (1) through the top of the rear molded compound support and by angle clips (37) Fig. 6 attached to the re-inforcing plates.

Each breaker is provided with a box type barrier, Figs. 3 and 5, of molded compound which fits over all the arc quenchers to entirely enclose the arcs. It is made of molded compound and has a solid top and barriers to isolate each arc quencher and a removable front, Fig. 2, attached by winged nuts for inspection. It is attached to the breaker base by blocks at the top corners and clips at the bottom corners as shown in Fig. 6.



1. SCREW
2. REAR ARC RUNNER WITH STATIONARY ARCING CONTACT
3. SCREW
4. MAGNET
5. SCREW
6. FLEXIBLE CONNECTION
7. SCREW
8. UPPER STUD AND STUD BARS
9. MOVABLE ARCING CONNTACT SUPPORT
10. FLEXIBLE CONNECTION
11. BRIDGING BLOCK
12. PIN
13. LOWER STUD AND STUD BARS
14. SIDE FRAME
15. PIN
16. CONTACT LEVER
17. ADJUSTING NUT
18. SPRING
19. PIN, COTTER PINS, AND INSULATING BUSHINGS
20. CLAMP
21. PIN
22. WASHER
23. THREADED SLEEVE AND COTTER PIN
24. COUPLING BOLT
25. SPRING
26. MAGNET
27. MOVABLE ARCING CONTACT
28. SCREW
29. MAGNET
30. FRONT ARC RUNNER
31. MAGNETIC PINS
32. COPPER PINS
33. BAFFLES
34. SIDE PLATE

FIG. 7

CONTACT ASSEMBLY AND ARC QUENCHER

(P-6199492)

1. SIDE BARRIER
2. TOP BARRIER
3. SPACER BLOCK
4. COIL AND REAR ARC RUNNER
5. INSULATING PLATE
6. MOUNTING BASE
7. CORE
8. BOLT
9. INSULATION
10. UPPER STUD
11. MAIN CONTACTS
12. SECONDARY CONTACT SUPPORT
13. PIN, COTTER PIN AND INSULATING BUSHING
14. PIN
15. SPRING
16. COUPLING BOLT
17. SECONDARY CONTACTS
18. ARCING CONTACT SUPPORT
19. ARCING CONTACTS
20. FLEXIBLE CONNECTION
21. SUPPORT
22. FRONT ARC RUNNER
23. POLE PIECE
24. SCREW

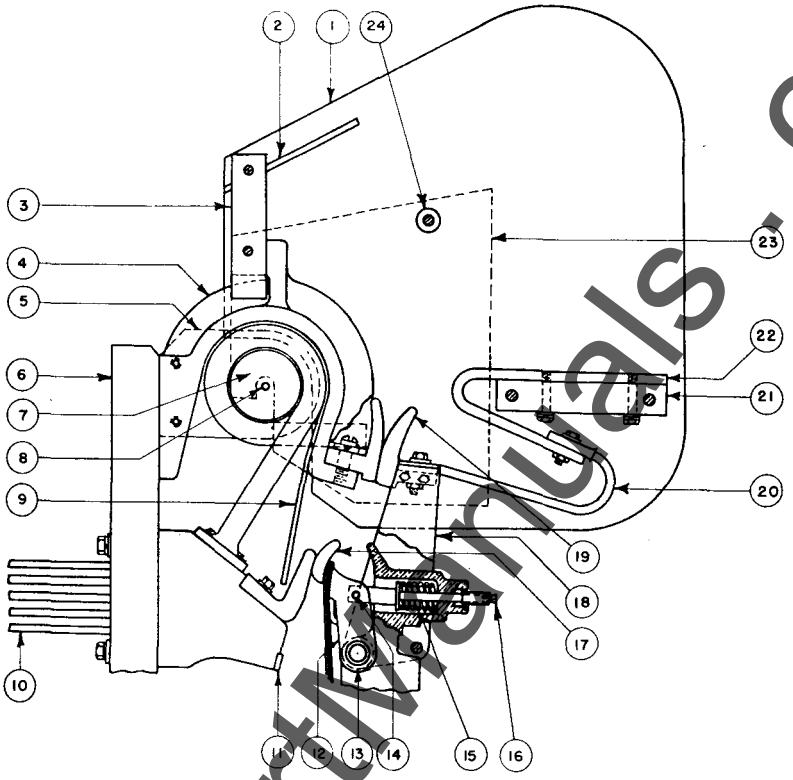


FIG.8
ARC CHUTE WITH BLOWOUT COIL

ARC CHUTE WITH BLOWOUT COIL - Fig. 8

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. Each pole unit is provided with two side barriers and a narrow top barrier (2) which is held between the side barriers in close proximity to the mounting. The purpose of this narrow top barrier is to deflect the arcing flame away from the rear of the mounting base.

The blowout coil assembly consists of a blowout coil, and a rear arc runner (4). A front arc runner (22) is supported by the sides of the chute. One end of the coil is fastened to the front part of the upper stud by screws and the other end is brazed to the rear arc runner which is screwed to the mounting base. A projection on the rear arc runner engages spacer block (3) and thereby supports the arc chute. The rear arc runner also supports the stationary arcing contact. A steel core (7) is inserted in the coil and is held in place by bolt (8) through two insulating plates (5), one on each side of the core. A pole piece (23) on the outside of each side barrier is also suspended from this same bolt (8). Each pole piece is also fastened to the side barrier by screws (24).

The front arc runner (22) is attached to support (21) which in turn is made secure to the arc chute sides by means of screws. Flexible connection (20) is connected to this front arc runner after the arc chute is mounted on the mounting base. Secondary arcing contacts (17) between the main contacts (11) and the arcing contacts (19), which open after the main contacts when the breaker trips, aid in reducing the arcing effects on contacts (11). A thin layer of insulation (9) separates the arc runner from the blowout coil. Adequate clearance is required above and in front of the arc chute to insure satisfactory interrupting performance.

MANUAL OPERATING MECHANISM - FIGS. 10 (A, B & C)

The manual operating mechanism of these breakers, Figs. 10 (A, B & C), is operated by a handle having a grip similar to that of a spade handle. It is located in the front of the mechanism and is generally attached to the center pole unit of a triple pole breaker, or the left pole unit of a two pole breaker. The normal position of the handle is "down", both when the breaker is tripped and when it is in the "closed" position. In order to close the manually operated breaker the handle must first be raised to the "reset" position, or a little above horizontal, when latch (14) will take a position on top of roller (12). It is then possible to push the handle "down" and close the breaker. The breaker is held securely in the closed position by means of holding latch (11) which hooks over pin (13) as described below. The breaker is tripped manually by pushing the trip button to the rear, Fig. 16, or electrically by trip devices, thereby releasing the latch which allows springs to open the breaker.

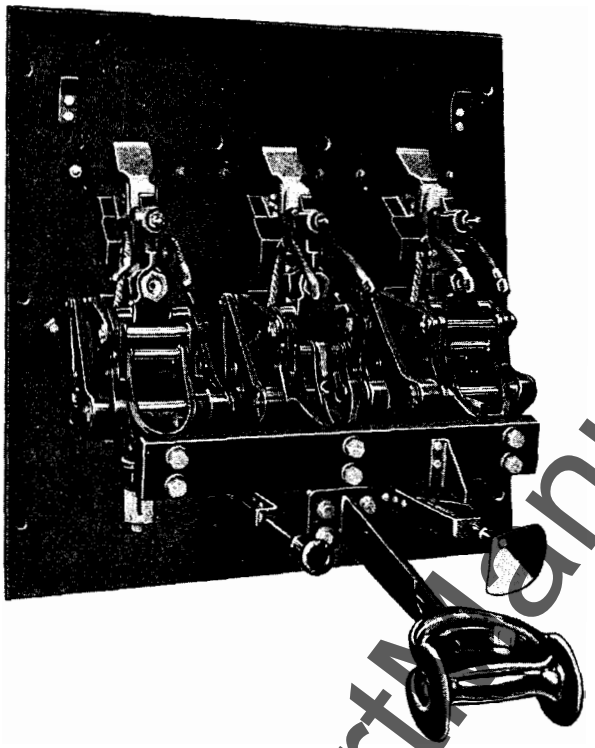


FIG. 9
MANUALLY OPERATED MECHANISM

The operating mechanism consists of a group of toggles, links, levers and springs attached on fixed pins (1, 2, 8 and 21) within the side frame (7). The remaining parts move on floating pins.

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

TRIPPED POSITION (FIG. 10A) - As shown in Fig. 10A, latch (14) is free of catch (24), also holding latch (11) is detached from pin (13). The trip bar lever has swung to the rear and spring (6) holds trip lever (10) in the position shown. The handle of the operating mechanism is in the "down" position and cross bar (18) has been rotated upward by opening springs (15). Contact lever (31) has been released from stationary contacts and the breaker is open. Compare Fig. 10A with Figs. 10B and 10C to see positions taken by other parts.

RESET POSITION (FIG. 10B) - Closing lever (17) has two arms pivoted on pin (21) in the frame (See Fig. 6), and when it is lifted to the "reset" position a small curved extension on the right arm engages the long extension "C" of trip lever (10), pivoted on pin (8) in the frame, to force the upper end (D) forward which allows the trip bar lever (3) to return to its normal position, suspended below pin (2) in the frame. The roller (12) between extensions of the three arms of closing lever (17) is drawn downward and forward and passes under the lower ends of catch (24) and latch (14) within toggle link (20). As it passes under the lower end of the catch the compression spring (23) between the upper ends of the catch and the latch, forces the upper end of the catch against the upper end of the latch. Then as the roller passes under the lower end of the latch the same spring forces the latch behind the roller. This allows the latch surfaces of the upper ends of catch and latch to engage which ties the closing lever (17) and the toggle links (20) together so that they will move as a unit in the closing operation described below. Fig. 10B shows the parts in the reset position of the breaker.

CLOSED POSITION (FIG. 10C) - When the handle is pushed to the "down" position, the roller (12) in the closing lever (17) bears against latch (14) in the central arm of toggle link (20) which parts rotate clockwise (looking from left) as one unit on pin (21). As the toggle link revolves it forces links (26 and 28) against the main contact lever (31), causing it to revolve counter-clockwise about its pin (2) in the frame to close the breaker contacts. It will be noticed that pin (27) between links (26 and 28) is connected by link (30) to pin (1) in the frame to prevent these links from collapsing without applying the necessary pressure to close the breaker. At the same time the left arm of toggle link (20) disengages the holding latch (11) and its torsion spring (5) forces the lower end forward to hook over pin (13) in the closing lever to hold the breaker closed.

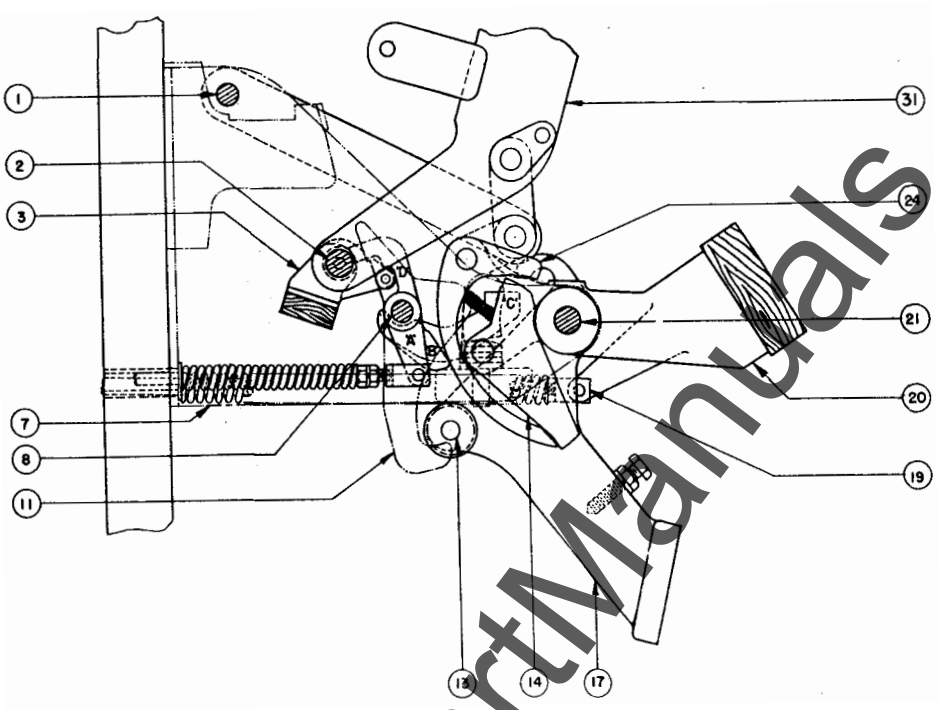


FIG. 10A
TRIPPED POSITION

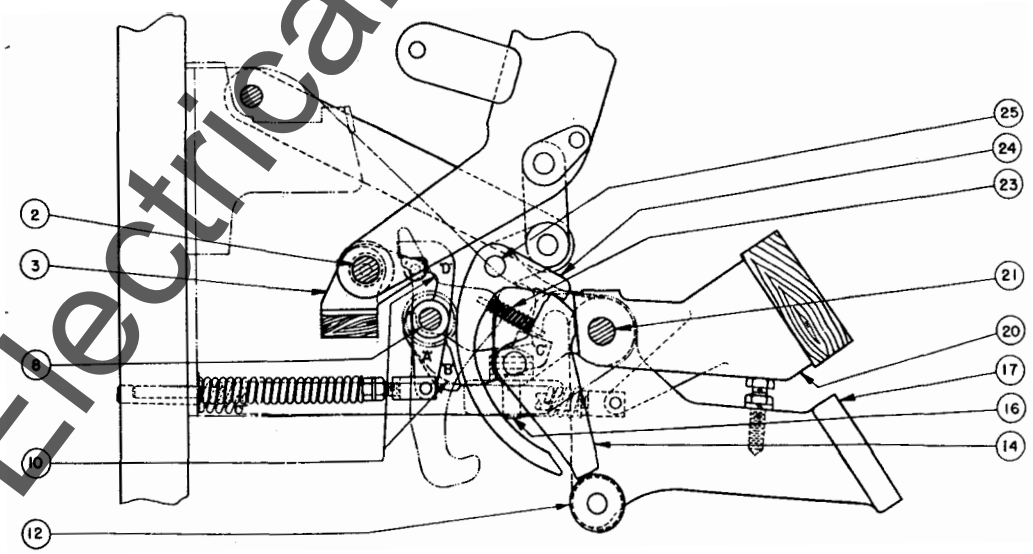
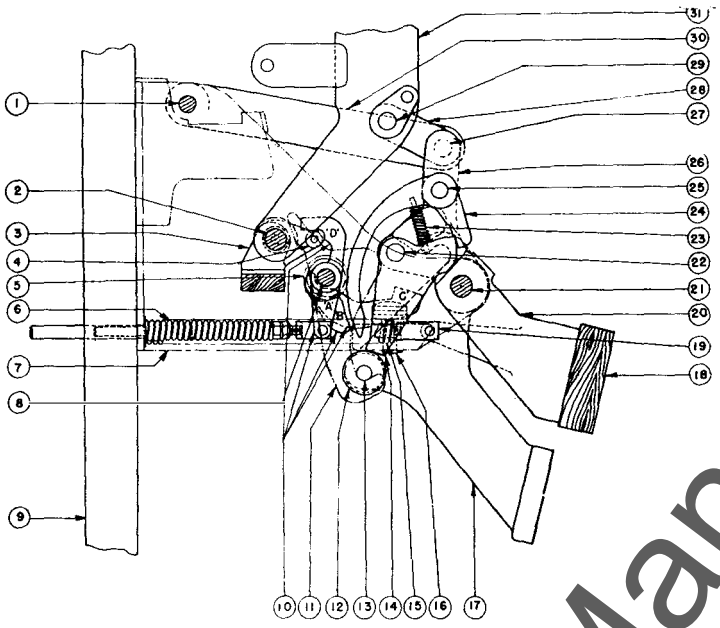


FIG. 10B
RESET POSITION



1. PIN IN FRAME
2. PIN IN FRAME
3. TRIP BAR LEVER
4. ROLLER IN TRIP BAR LEVER
5. TORSION SPRING
6. TRIP ROD SPRING
7. SIDE FRAME
8. PIN IN FRAME
9. BREAKER BASE
10. TRIP LEVER (A,B,C, & D)
11. HOLDING LATCH
12. ROLLER IN CLOSING LEVER
13. PIN IN CLOSING LEVER
14. LATCH
15. OPENING SPRING
16. LEATHER BUFFER AND PIN
17. CLOSING LEVER (SEE PT 25 FIG 6)
18. CROSS BAR
19. SPRING GUIDE
20. TOGGLE LINK (SEE PT 29, FIG 6)
21. PIN IN FRAME
22. PIN IN TOGGLE LINK FOR LATCH
23. COMPRESSION SPRING
24. CATCH
25. PIN IN TOGGLE LINK FOR CATCH
26. LINK
27. PIN
28. LINK
29. PIN IN CONTACT LEVER
30. LINK
31. CONTACT LEVER

FIG. 10C
CLOSED POSITION
POSITIONS OF OPERATING MECHANISM (A, B & C)

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An extension of the right side of toggle link under pin (21) compresses the opening spring (15) which supplies the power to open the breaker as described below. Fig. 7C shows the parts in the closed position of the breaker.

When the trip bar, attached to the trip bar lever (3), is operated to trip the breaker, manually or by any trip device, the trip bar lever is revolved clockwise about its pin (2) which causes the roller (4) in the upper end of the trip bar lever to be lowered. This allows the trip lever (10) to revolve counter-clockwise about its pin (8) under pressure of trip lever spring (6), also extension "B" of the trip lever (10) exerts a hammer blow against the lower curved end of catch (24) to disengage its upper end from latch (14). This separates the tie between the toggle link (20) and closing lever (17) and allows the former to revolve counter-clockwise under pressure of opening springs (15) and springs (18) Fig. 7, back of the bridging block, but leaves the closing lever (17) in the "down" position. The left end of toggle link promptly engages holding latch (11) and forces the hook end free of pin (13) of the closing lever and the breaker assumes the tripped position as shown in Fig. 10A. When the breaker opens under pressure of the heavy springs, the impact of toggle link (20) against the frame is cushioned by lugs on the sides of the toggle link which engage leather buffers supported on buffer pins (16) secured to the frame. It is important that the height of these buffers be maintained in order that the mechanism will reset properly.

The trip bar extends horizontally through all poles and is supported by brackets (2) Fig. 16 attached by pins to the end side frames which correspond to the pin that supports the trip bar lever (3).

These breakers are trip free with respect to the closing handle since the breakers cannot be closed either manually or electrically as long as the trip bar lever (3) is held in the "tripped" position. Even though the breakers can be placed in the "reset" position they cannot be closed because roller (4) is held in the lowered position causing spring (6) to hold trip lever (10) in the "tripped" position and disengaging catch (24) from latch (14) early in the downward stroke of the closing lever.

MOTOR OPERATING MECHANISM - FIG. 12

Electrical operation for closing these breakers is obtained by the same mechanism as for manual operation, except that it is operated by a totally enclosed series motor (1) Fig. 12 instead of by the manually operated handle. For manual operation of the electrically operated breaker a maintenance closing handle can be inserted into a socket welded to the front end of the operation crank (19). Tripping is accomplished in the same manner as in the manually operated

breaker, that is, by pushing the trip button to the rear, Fig. 16, or by any tripping device, which releases the latch (14) Fig. 10.

As shown in Fig. 12, with the breaker in the closed position, the motor (1) and the gear housing (3) are mounted in a vertical position on the left side of frame (4) by screws (5) and the frame is attached to the mounting base by screws (43). A worm (8), attached to the lower end of the motor shaft by a torque brake, Fig. 15, drives a double reduction, consisting of gears (9, 12 and 14), the latter being pinned to the cam drive shaft (21). The closing cam (15) is welded to a hub which is fastened to the driving shaft by a 3/8 groov pin. The worm and first gear are located in a gear housing, partly filled with 600 W lubricating oil. A counter shaft (10), carrying intermediate gears, extends through the frame to bearing in bearing yoke (33) welded on the inside of the frame. The intermediate and last gear, the closing cam and the drive shaft are within the frame.

Rotation of the motor causes the closing cam (15) to revolve clockwise (looking from the left) to engage a roller (17) mounted on pin (16) on the operating crank (19) which operates within the frame on its pin (22) to revolve it counter-clockwise. A rod (26), a coupling (28) and crank (32) connect the rear end of the operation crank (19) by pin (6) to the closing lever (17) Fig. 10 which is lowered to close the breaker when the operating crank (19) is lowered by the closing motor or the maintenance closing handle is lifted against heavy springs (20). The extension of these springs supplies the power to automatically reset the breaker after tripping.

Starting and stopping of the motor are controlled by means of a motor control relay, Fig. 13, mounted on the lower part of the mounting base, in conjunction with a cut-off switch, Fig. 14, mounted on the right hand side of the frame (4). The cut-off switch is operated by an auxiliary cam (6) Fig. 14 on the end of the drive shaft (21) which extends through the frame. The functions performed and the sequence of operation are as follows:

The closing of the closing switch at some remote point energizes the upper unit of the motor control relay, Fig. 13, through the normally-closed contact (21) Fig. 13 of the lower element. The upper unit picks up and closes both its normally-open contacts (8 and 32) Fig. 13. The main contact (8) Fig. 13 of the upper unit connects the motor directly across the control power line. The auxiliary contact (32) Fig. 13 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 the closing cycle is completed. As the main closing cam (15) Fig. 12 rotates to close the breaker the auxiliary cam (6) Fig. 14 closes contact M_1 and then contact M_2 of the cut-off switch, Fig. 14, as described under "Motor Cut-off

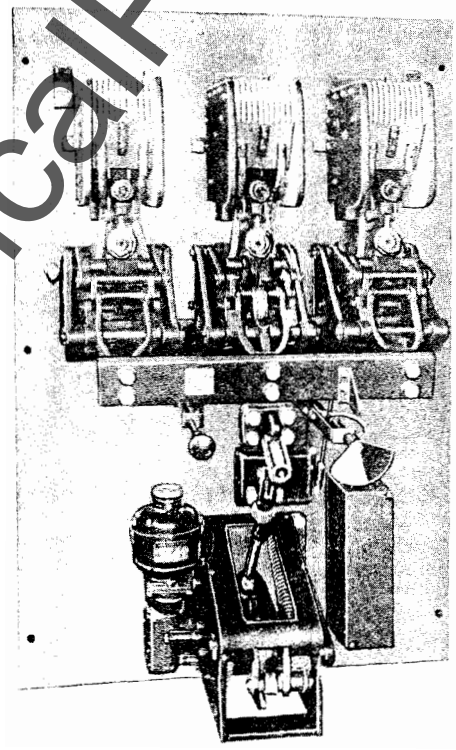
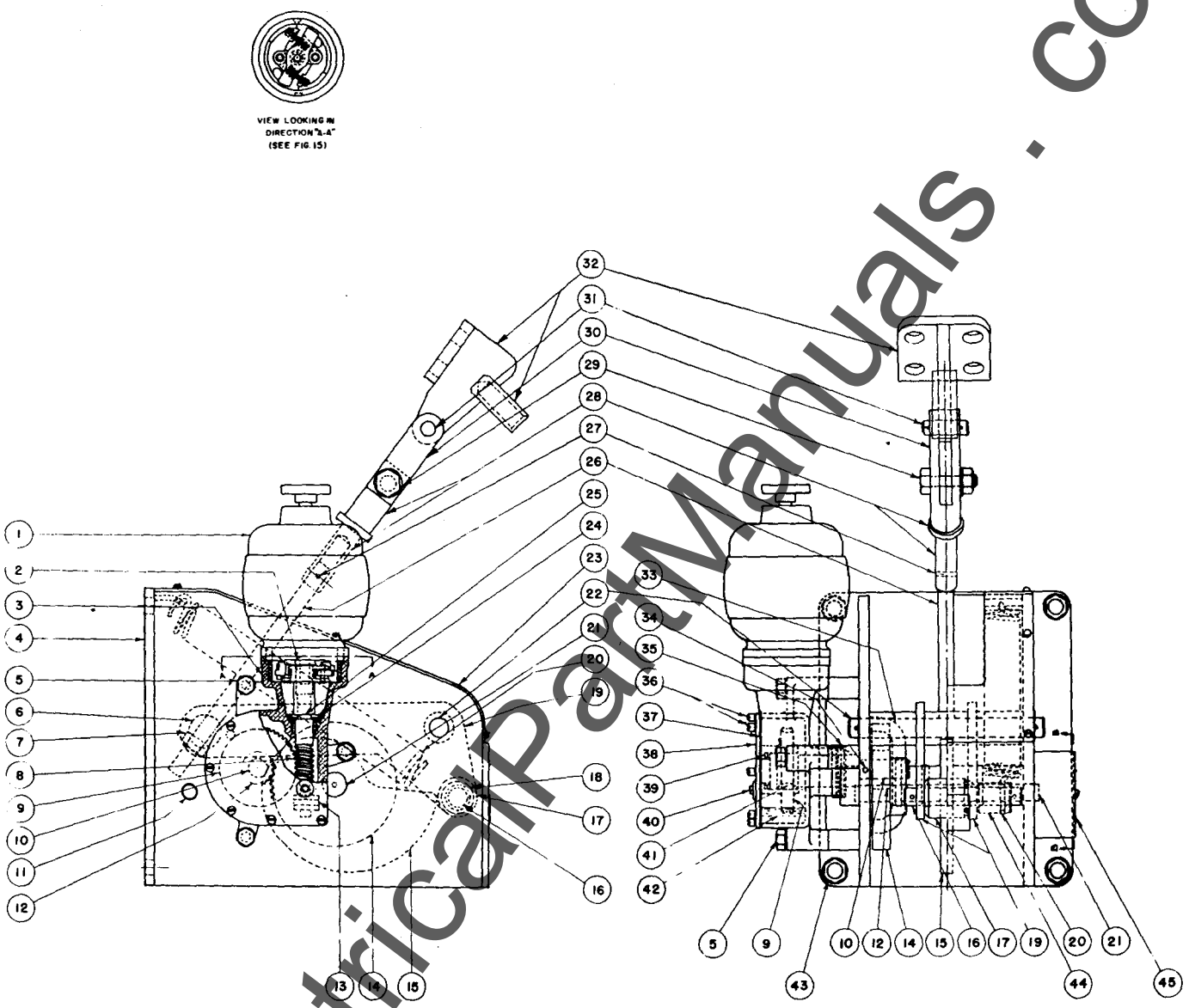


FIG. 11
ELECTRICALLY OPERATED MECHANISM



1. MOTOR
2. TORQUE BRAKE (SEE "AA" AND FIG.13)
3. GEAR HOUSING
4. FRAME
5. SCREWS
6. PIN IN OPERATING CRANK
7. LOCKNUT AND SPACER
8. WORM
9. GEAR
10. COUNTER SHAFT
11. INSULATION TUBING
12. GEAR
13. THRUST BEARING
14. GEAR
15. CLOSING CAM
16. PIN IN OPERATING CRANK
17. ROLLER IN OPERATING CRANK
18. SPACER
19. OPERATING CRANK
20. RESETTING SPRING
21. DRIVING SHAFT
22. PIN IN FRAME
23. COVER
24. SCREWS
25. RETAINER
26. ROD
27. PIN
28. INSULATING COUPLING
29. BOLT
30. COUPLING PLATES
31. PIN
32. CRANK AND HANDLE SOCKET
33. BEARING
34. GROOV PIN
35. CAP, LEATHER AND FELT WASHERS
36. SCREWS
37. GASKET
38. COVER
39. LEATHER AND FELT WASHERS
40. PIPE PLUG
41. KEY, WOODRUFF #9
42. 600 W OIL
43. SCREWS
44. BUSHING
45. CUT-OFF SWITCH (SEE FIG 14)

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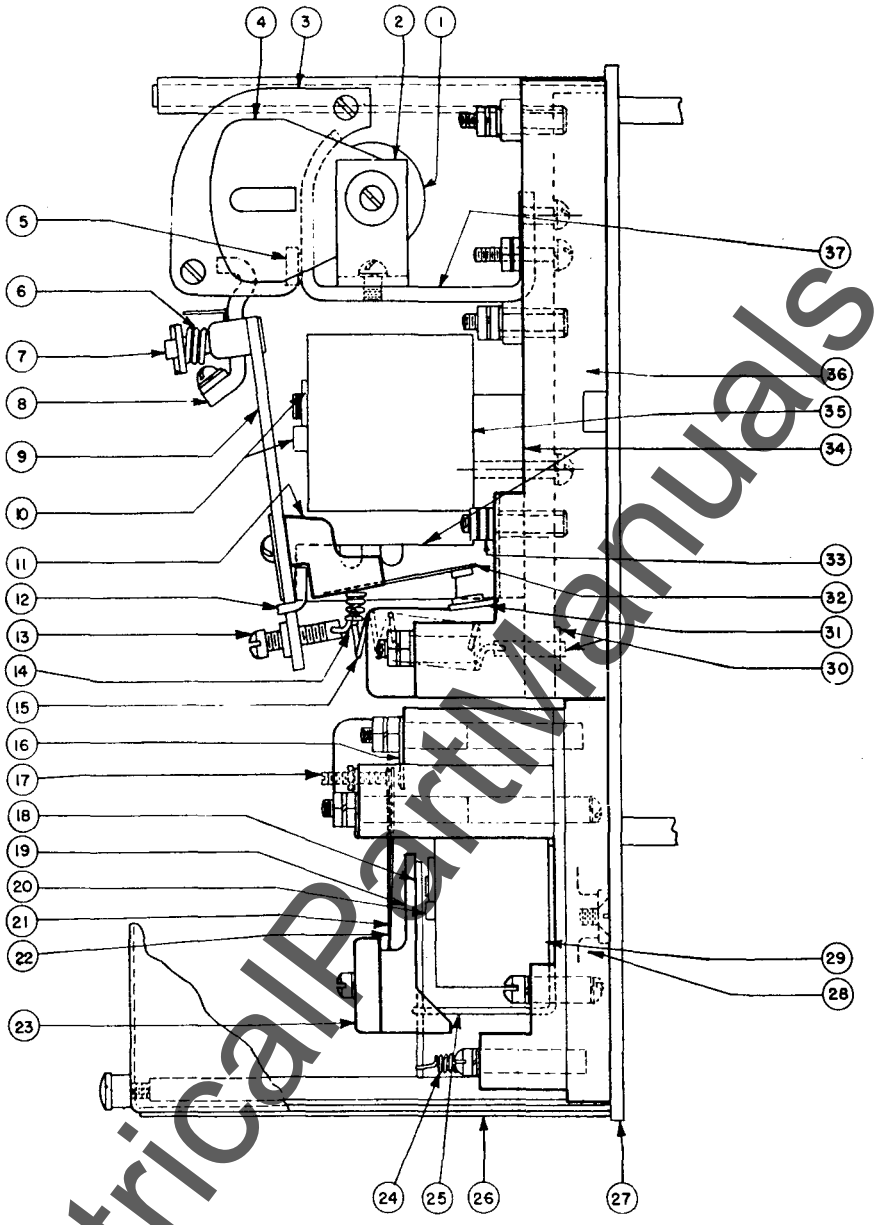
FIG. 12
MOTOR OPERATING MECHANISM



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. 13

MOTOR CONTROL RELAY

Switch". Contact M_1 is in parallel with the normally-closed contact (21) Fig. 13 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 M_2 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 M_2 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 M_1 and M_2 are opened quickly by auxiliary cam (6) Fig. 14. The opening of the contact M_1 de-energizes the upper unit of the motor control relay which, in turn, opens its contact 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. 13

The motor control relay, Fig. 13, of the AL-2-75 and AL-2-100 motor operated breakers consists of two elements with molded 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 mounting base. The upper element is the motor relay and 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. 30, which makes and breaks the motor current. A permanent magnet blow-out coil (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 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. 31. Spring (14) holds the movable contact against the composition contact block.

The lower element consists of a coil (29), a 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 movalbe contact (22). These, with corresponding stationary contacts, constitute contact switches 4-15 and 9-15 of wiring diagram, Fig. 31. Springs within the 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. 14

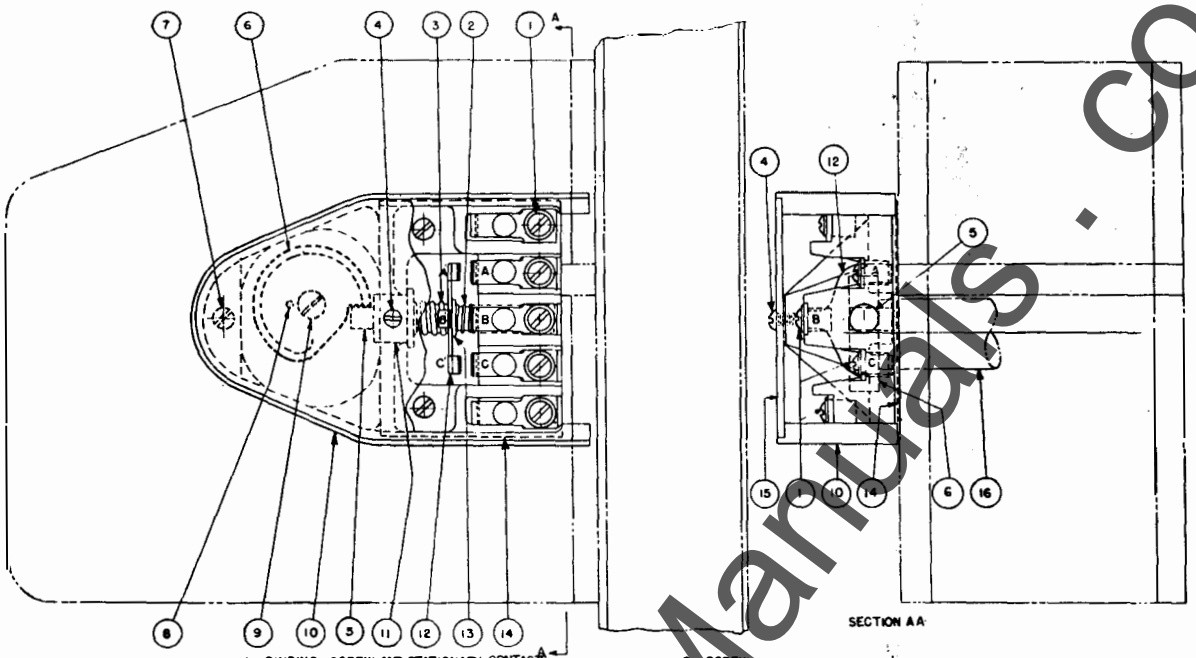
The motor cut-off switch, Fig. 14, is enclosed in a molded-composition, box-shaped base (10) on the right side of the frame which supports the drive shaft and main closing cam of the motor operating mechanism. Three round head screws (7) fasten the base to the frame. On the end of the drive shaft (16), which extends through the switch base, is fastened an auxiliary cam (6) of molded composition, 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 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 plane not parallel with the 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 counter-clockwise (looking from the right), it moves the switch shaft to the right and forces the bridging contact (12) to bridge contacts A and B, which constitutes contact switch M_1 of wiring diagram, Fig. 30. As the switch shaft is advanced farther it tilts the bridging contact (12) to close B and B' also, which constitutes contact switch M_2 of the wiring diagram. This assures that M_1 closes before M_2.

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

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

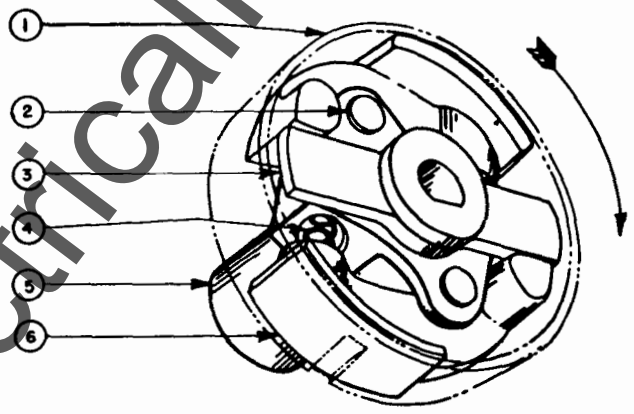
TORQUE BRAKE - FIG. 15

The torque brake of these breakers is the coupling assembly, Fig. 15, between the high speed starting motor and the worm gear 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 (8) Fig. 12. The motor



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
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. 14
MOTOR CUT-OFF SWITCH



SEE SECTION "A-A" FIG. 12

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

FIG. 15

TORQUE BRAKE

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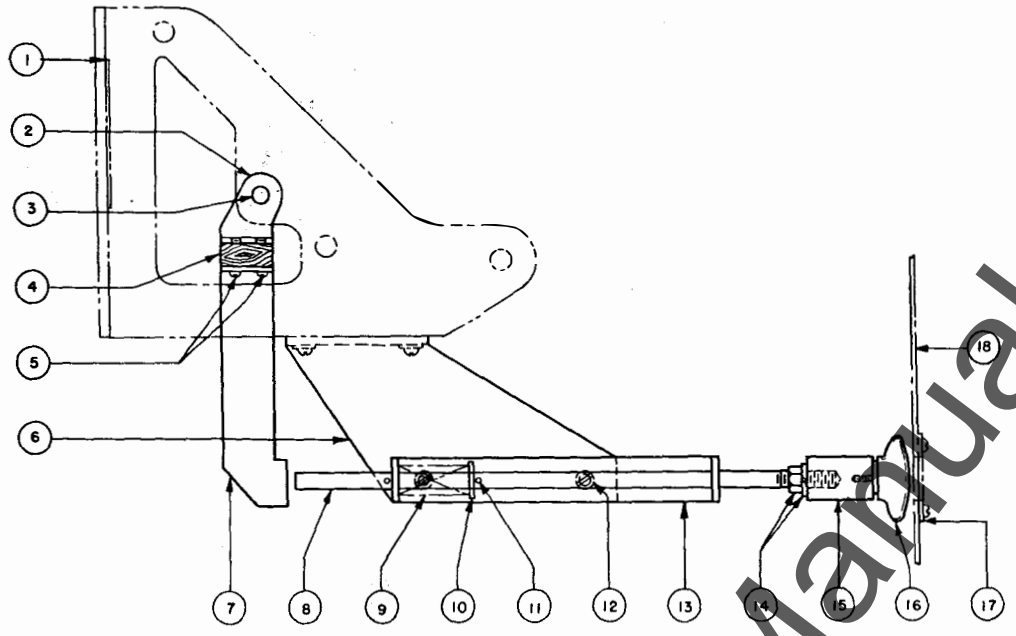
(M-6490637)

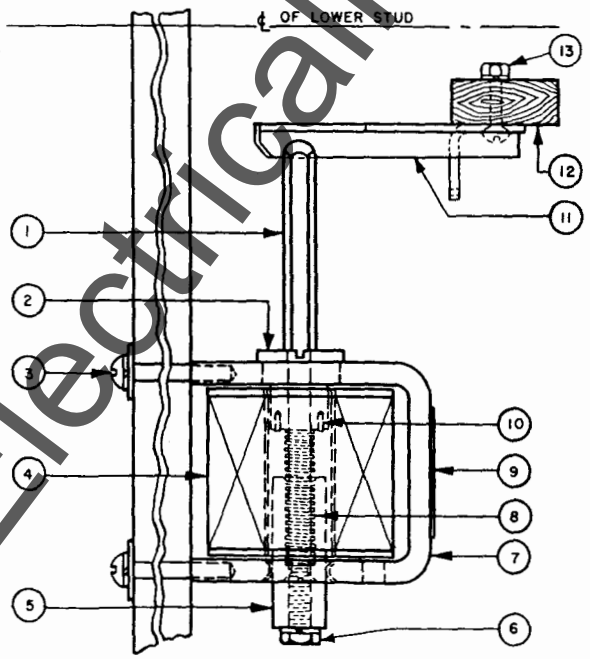


1. SIDE FRAME
2. TRIP BAR SUPPORT
3. PIN
4. TRIP BAR
5. SCREWS
6. SUPPORT
7. TRIP ARM
8. ROD
9. SPRING
10. WASHER
11. GROOV PIN
12. SCREW
13. BRACKET
14. NUT AND LOCKWASHER
15. INSULATING ROD
16. TRIP BUTTON
17. NAME PLATE
18 STEEL FRONT ENCLOSURE

FIG. 16
MANUAL TRIP DEVICE

(K-6490155)

(M-6490635)



1. TRIP PIN
2. POLE PIECE
3. SCREWS
4. COIL
5. ARMATURE
6. SCREW
7. MAGNET FRAME
8. SPRING
9. NAME PLATE
10. BRASS PINS
11. TRIP FINGER
12. TRIP BAR
13. SCREWS

FIG. 17
SHUNT TRIP DEVICE

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 ends of each brake shoe normally engage the inner surface of the brake drum (1) under pressure of spring (4) to provide friction against the brake drum which is rigidly keyed to the inside of the housing that encloses the torque brake and supports the motor as shown in Section A-A, Fig. 12. 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 the 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 gear to a stand still. The gear reduction is so great that a few revolutions of the motor will cause a very small movement of the closing cam (15) Fig. 12 which stops in the correct position for prompt closing of the breaker in a subsequent closing operation.

MANUAL TRIP DEVICE - FIG. 16

The manual trip device consists of a rod with a trip button mounted horizontally which, when pushed to the rear, will engage the trip arm attached to the trip bar thereby tripping the breaker.

The rod (8) is mounted in bracket (13) which is attached to support (6) by two screws under bottom of side frame (1) which supports the operating mechanism. The trip button is attached to an insulation rod (15) which is threaded on trip rod and held in place by means of nut and lockwasher (14). Spring (9), held in place on trip rod by means of two groove pins and washer, returns trip rod to normal position after it has been pushed to the rear to engage trip arm. The trip arm is attached to trip bar by means of two screws and the trip bar is suspended from pins in pole unit frames by means of supports (2). Thus when the lower end of the trip arm is pushed to the rear the trip bar swings to the rear and trips the breaker.

SHUNT TRIP DEVICE - FIG. 17

A shunt trip device, Fig. 17 is available for these breakers and its function is to trip the 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 connected so that the opening of the breaker 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 de-energize the coil when the breaker is open.

The device is mounted on the front of the mounting base, usually within the mechanism pole unit, below and behind the trip bar. It consists of a coil (4) and armature (5) mounted in a vertical position and when energized its armature is drawn upwards into the coil which causes trip pin (1), attached to the armature, to lift a trip finger on the trip bar and trip the breaker. When de-energized the compression spring (8) forces the armature out of the coil to allow the trip bar to return to normal position.

The armature (5) passes freely through a brass bushing in the lower magnet arm. The trip pin (1) is threaded through the armature and acts as a guide through the pole piece (2) which is threaded through the upper magnet arm. Brass pins (10) are inserted in the face of the pole piece to prevent the armature and pole piece from being held together magnetically due to residual magnetism.

HAND RESET LOCKOUT DEVICE - FIG. 18

The purpose of this device is twofold. First, it prevents the circuit breaker from being reclosed after it has been tripped automatically by any overcurrent trip device whatsoever, until the device is reset manually. Second, it closes a contact in an alarm device circuit which is opened when the device is reset. The hand reset lockout device is not affected in any way if the trip shaft of the circuit breaker is operated by any other means than by an overcurrent device, attached to the breaker.

The device consists of a trip finger (2) for each overcurrent trip device operating on trip shaft (5) which is restrained from operating by spring (19) supported by spring post (7) at one end and support (14) at the other end. Thus, when the breaker is automatically tripped, link and trigger (1) engage trip finger (2) which in turn will revolve trip shaft (5) clockwise, releasing trip latch (6) from roller (8). The lower end of link (9) is pulled forward by spring (10) and, by revolving on a pin, the upper end of the link is pushed backward releasing the plunger (17) of switch (16) and, at the same time, rod (23) engages a paddle on trip arm (3). The trip arm now holds the trip bar in a tripped position and prevents the breaker from being reclosed until the trip latch is reset. In releasing the plunger the front contacts of switch (16) are opened and the rear contacts are closed thereby sounding an alarm.

Resetting of this device is accomplished by inserting a finger through the hole in the steel front enclosure and pushing rod (13) to the rear which causes the lower end of link (9) to move backward resetting trip latch (6) on roller which is held in place by stop screw (20) and tension spring (19). The upper end of link (9) moves forward allowing the trip bar to assume the normal position when the breaker is closed and also allowing adjusting

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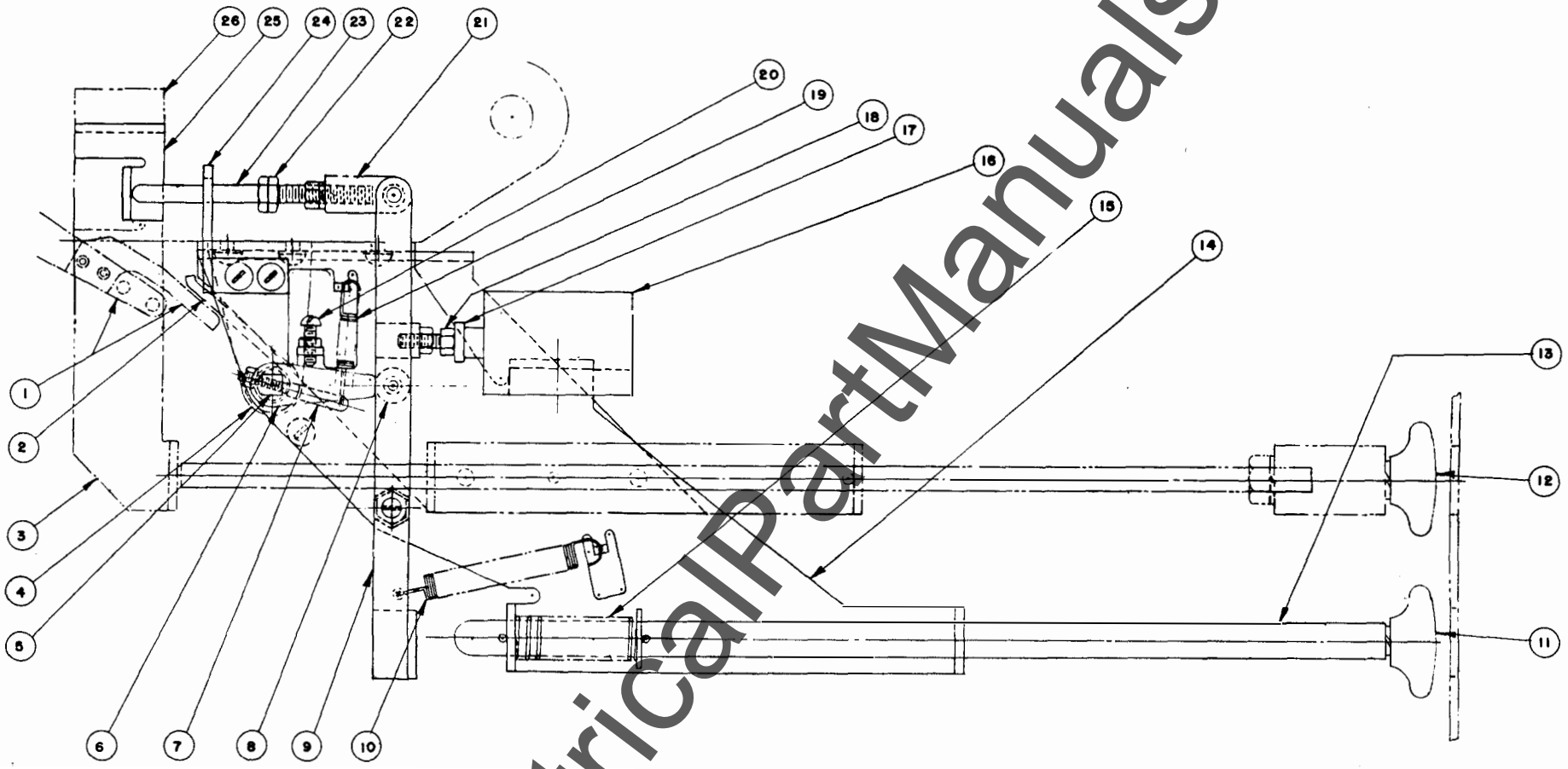
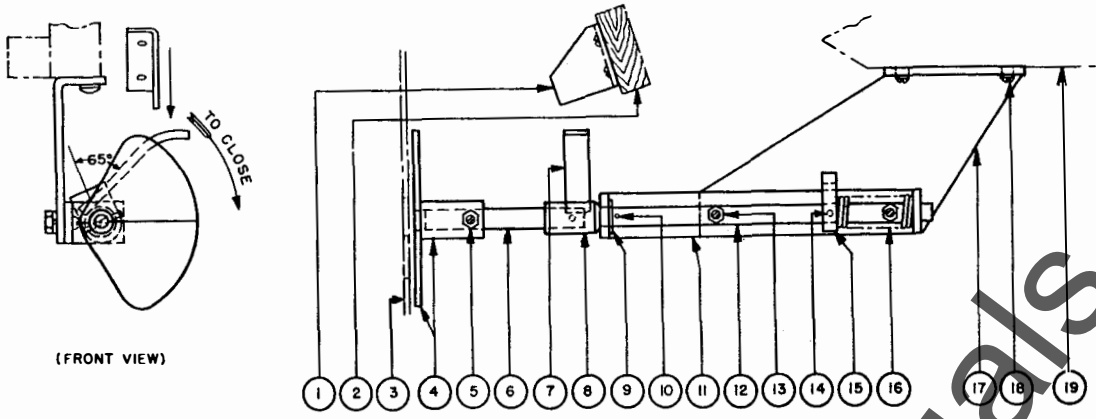


1. LINK AND TRIGGER
2. TRIP FINGER
3. TRIP ARM
4. SUPPORT
5. TRIP SHAFT
6. TRIP LATCH
7. SPRING POST
8. ROLLER
9. LINK
10. SPRING
11. RESET PUSH BUTTON
12. MANUAL TRIP BUTTON
13. ROD
14. SUPPORT
15. SPRING
16. SWITCH
17. PLUNGER
18. ADJUSTING SCREW
19. SPRING
20. STOP SCREW
21. COUPLING
22. JAM NUT
23. ROD
24. SUPPORT
25. BRACKET
26. TRIP BAR

FIG. 18

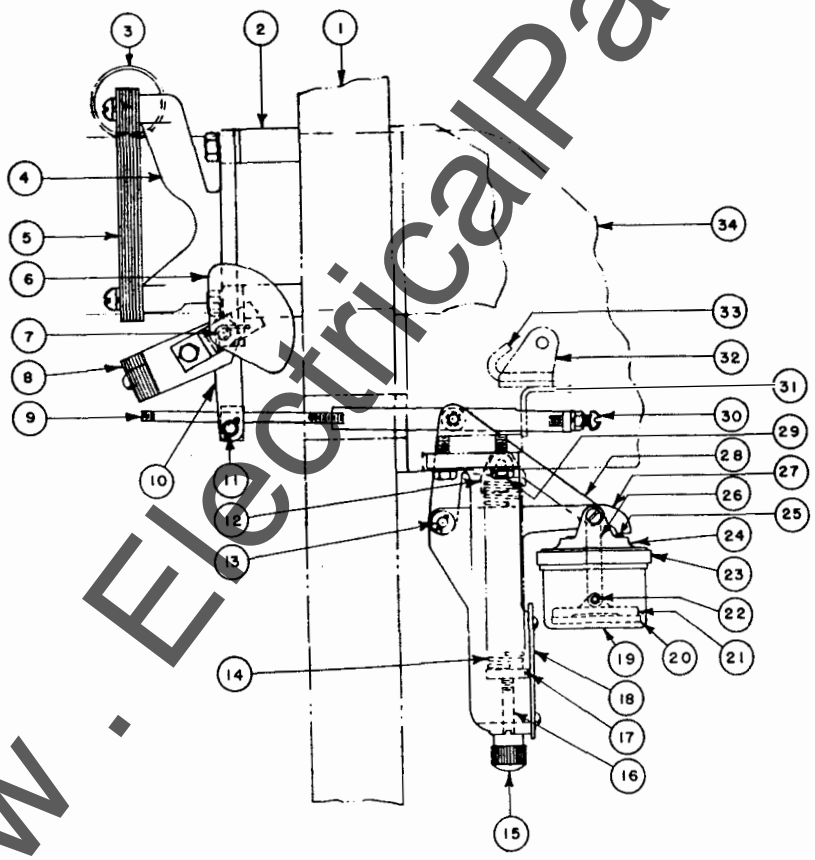
HAND RESET LOCKOUT DEVICE



1. BRACKET
2. CROSS BAR
3. STEEL FRONT ENCLOSURE
4. INDICATOR
5. SET SCREW
6. INSULATION ROD
7. LEVER
8. THIMBLE (WELDED TO ROD 12)
9. WASHER
10. COTTER PIN
11. BRACKET
12. STEEL ROD
13. SCREWS
14. SCREW
15. STOP BLOCK
16. TORSION SPRING
17. SUPPORT
18. SCREWS
19. FRAME OF OPERATING MECHANISM

FIG. 19

MECHANICAL INDICATOR



1. MOUNTING BASE
2. SPACER
3. INSULATION
4. MAGNET SUPPORT
5. MAGNET
6. WEIGHT
7. SPRING
8. ARMATURE
9. TRIP LINK
10. ARMATURE SUPPORT
11. COUPLING
12. SPRING CLIP
13. PIN AND COTTER PIN
14. CALIBRATING SPRING
15. CALIBRATING KNOB
16. CALIBRATING SCREW
17. INDEX POINTER
18. CALIBRATION PLATE
19. CUP
20. DISC PLATE
21. DISC
22. PIN AND COTTER PIN
23. CLAMPING NUT
24. COVER
25. COVER DISC
26. LINK
27. EXTENSION OF SUPPORTING FRAME
28. LINK
29. SCREW
30. ADJUSTING SCREW
31. TRIP FINGER
32. TRIP BAR SUPPORT
33. STOP
34. FRAME

FIG.20

TIME DELAY OVERCURRENT TRIP DEVICE

screw (18) to engage plunger (17). This closes the front contacts of the switch and opens the rear contacts, silencing the alarm. The breaker is now closed and can be tripped by various devices with which the breaker may be equipped.

MECHANICAL INDICATOR - FIG. 19

A mechanical indicator with red and green colors, is operated behind the steel front enclosure. When the breaker is open the indicator is in such a position that the green color is visible through a 1" hole, or when the breaker closes, the indicator is rotated so that the red color is visible.

The indicator (4) is mounted on a rod of insulating material (6) which is driven into a thimble (8) that is welded to steel rod (12). The steel rod is mounted in a bracket (11) which is attached by screws (13) to support (17) which, in turn, is attached to the bottom of frame (19) of the operating mechanism. A torsion spring (16) and stop block (15) normally hold the indicator so that the green color is visible from the front. When the breaker is closed the cross bar (2) is lowered and a bracket (1) mounted on it engages a lever (7) welded to the thimble to revolve the rod and indicator clockwise so that the red color is visible from the front. When the breaker opens, the torsion spring returns the rod and indicator to the normal open position.

For breaker installations in deeper dead front enclosures a bracket extension is attached to bracket (11) to make provision for a longer insulation rod (6).

TIME DELAY OVERCURRENT TRIP DEVICE - FIG. 20

This device automatically trips the breaker under two distinct conditions of overload; first, with inverse time delay for overcurrents slightly in excess of calibration setting; and second, with instantaneous tripping for high values of current.

To accomplish inverse tripping the overload current creates magnetic force to attract armature (8), which is pivoted on magnet support (4), toward magnet (5). Trip link (9) which engages trip finger (31) is operated by the armature by means of coupling (11) into which it is threaded and which is attached by a pin to armature support (10). The armature is restrained by calibration spring (14) and also by a thin oil film between disc plate (20) and disc (21) in oil cup (19). For currents below the calibration setting as shown by index pointer (17), the calibration spring prevents the armature from picking up and no force is exerted to separate the disc in the oil pot. For currents in excess of the calibration setting the magnetic pull on the armature exceeds the pull of the calibration spring (14) and the excess force tends to pull the two flat discs (20) and (21) apart by rupturing the oil film between them. The time required to rupture the oil film varies inversely with current passing through the breaker. If the overcurrent falls below the calibration setting before the oil film has been ruptured, the breaker will not trip. However, the breaker trips immediately without any delay from the pull of the oil film for high values.

The oil cup (19) is suspended from extensions of supporting frame (27). Links (26) and (28) are attached to trip link (9) and also to disc (21). The tripping mechanism is held taut by torsion spring (7) and calibration spring (14). Proper tripping is obtained by adjusting screw (30) on the end of the trip link. This screw should be adjusted to just trip the breaker when a 1/32 inch thick shim is placed in the air gap between armature and magnet. For general feeder applications, the calibration setting should not be less than 125 per cent of the actual current carried by the breaker.

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 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".

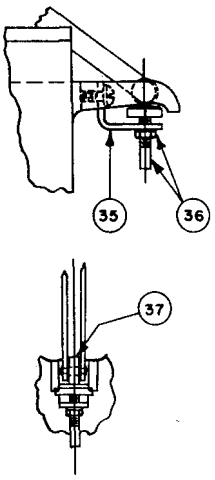
The air gap should not be changed in the field unless facilities are available for recalibrating the overcurrent trip devices.

INSTANTANEOUS OVERCURRENT TRIP DEVICE - FIG. 21

This device is similar to the time delay overcurrent trip device without the time delay assembly as shown in Fig. 20. It is designed to trip the breaker instantaneously if the current through the breaker exceeds the calibration setting. A stop and adjusting nut (36) with bracket (35) constitute the support for spacer (37) which is attached to the end of link (28) which link is restrained by calibration spring (14) exactly in the same manner as in the time delay assembly. If the magnetic pull on the armature exceeds the pull on this calibration spring the breaker will trip instantaneously.

INSTANTANEOUS SHORT CIRCUIT TRIP DEVICE - FIG. 22

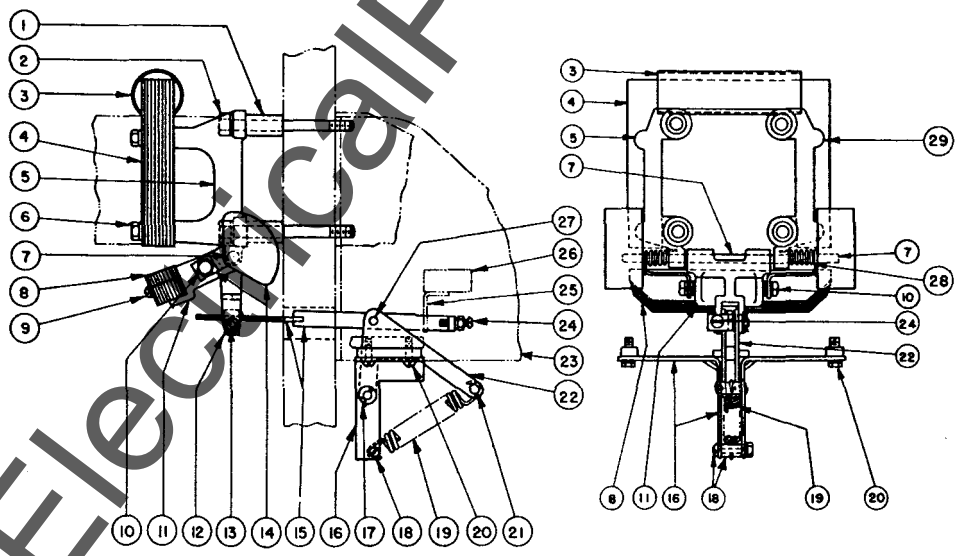
This device is magnetically operated to trip the breaker instantaneously and directly by current through the breaker when it exceeds the calibration setting. It consists of an electro-magnet placed around the lower stud behind the mounting base. The armature is connected by linkage, which extends through the base, to engage a trip finger on the



35. BRACKET
36. STOP AND ADJUSTING NUT
37. SPACER

(NOTE - FOR THE COMPLETION OF FIG. 21. ADD PARTS 1 TO 18 AND 27 TO 34 OF FIG. 20.)

FIG. 21
INSTANTANEOUS OVERCURRENT TRIP DEVICE



1. SPACER
2. SCREW
3. INSULATION
4. MAGNET
5. MAGNET SUPPORT, LEFT HAND
6. SCREW
7. PIN
8. ARMATURE
9. SCREW
10. SCREW
11. ARMATURE SUPPORT
12. COUPLING
13. PIN AND COTTER PINS
14. COUNTERWEIGHTS AND BRACKETS
15. TRIP LINK
16. SUPPORT
17. PIN AND COTTER PINS
18. SCREW WITH SPACER, LOCKWASHER AND NUT
19. SPRING
20. SCREWS
21. RIVET AND SPACER
22. CRANK
23. FRAME
24. ADJUSTING SCREW WITH LOCKWASHER AND NUT
25. TRIP FINGER
26. TRIP BAR
27. RIVETED OVER PIN
28. SPRINGS, RIGHT AND LEFT
29. MAGNET SUPPORT, RIGHT HAND

FIG. 22
INSTANTANEOUS SHORT CIRCUIT TRIP DEVICE

(I-6496-d)

(I-6496-d)

1. TRIP BAR
2. TRIP FINGER
3. TRIP ARM
4. MOUNTING BASE
5. COIL
6. MAGNET FRAME
7. LINK
8. NUT
9. CORE
10. COUPLING
11. CRANK
12. MAGNET FRAME EXTENSION
13. SPRINGS
14. ROLLER AND SUPPORT
15. TOGGLE KICK-OFF LEVER
16. KICK-OFF SCREW
17. PIN
18. LEVER
19. TOGGLE AND STOP PIN
20. POLE PIECE
21. COUPLING
22. ARMATURE
23. SPRING
24. SLOT AND PIN
25. SUPPORT AND PIN
26. PLUNGER, ROD AND LINK
27. CRANK
28. PIN
29. SET SCREW
30. PIN

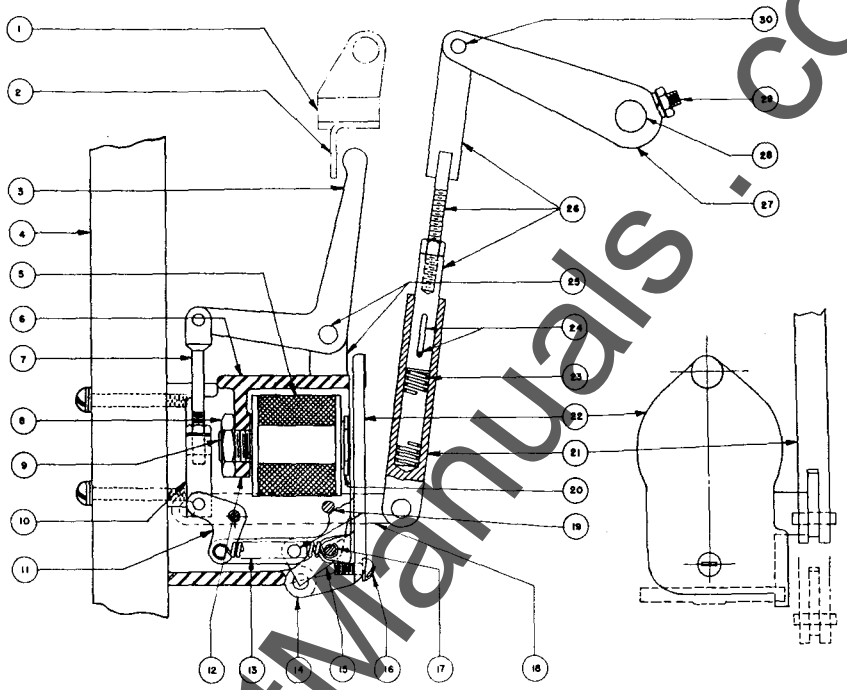


FIG. 23

INSTANTANEOUS UNDERVOLTAGE TRIP DEVICE

trip bar. The armature movement is restrained by a heavy spring as described below.

The magnet (4) is attached to right and left hand magnet supports (5 and 29) by screws (6) and the supports are attached to the mounting base, through spacers (1) by screws (2). A tubular shaped insulation (3) is placed over the upper arm of the magnet. The armature (8) is attached by screws (9) to armature support (11) which is hinged on pin (7) through lugs on the bottom of the magnet supports. The trip link (15) passes through the mounting base and is connected to an extension of the armature support by threaded coupling (12) and pin (13). An adjustable screw (24) on the front end of the trip link engages a trip finger (25) on the trip bar (26). The pick up of the armature is restrained by tension spring (19) connected to the lower end of support (16) by pin (17). The support (16) is attached by screws (20) to the bottom of the side frames of the pole unit. Right and left hand torsion springs (28) are mounted over pin (7).

Fig. 22 illustrates the 3000-ampere trip device. The magnet, armature, magnet support and armature support for other ratings are essentially the same.

INSTANTANEOUS UNDERVOLTAGE TRIP DEVICE - FIG. 23

The function of this device is to trip the breaker when the voltage drops below a predetermined value. As long as the required voltage is impressed on the coil the armature is attracted to the coil and the breaker is not affected in any way by the device. But when the voltage drops to approximately 50 per cent of normal the magnetic flux is weakened and the armature falls away from the coil and trips the breaker through a toggle and spring mechanism. As the breaker opens, a lever resets the armature so that when normal voltage is restored, the armature is held up and the breaker can be closed.

The device is mounted on the front of the mounting base (4) either to the left of the left pole unit or the right of the right pole unit, and directly below the trip bar (1). It consists of a magnet frame (6) and coil (5) which is energized by a source of voltage. Tripping and resetting mechanisms also constitute integral parts of this device.

The coil (5) contains a core (9) which is threaded at one end and is inserted into an extension (12) from the magnet frame (6) and made secure by lock nut (8). The other end of the core has a pole piece (20) attached to it which attracts the armature (22) when the coil is sufficiently energized. The lower end of the armature is attached to the magnet frame by a pin (17) on which the armature revolves. Also, to this lower end of the armature is attached a toggle mechanism (19) which is kept slightly over center by two springs (13). In the event the magnetic flux is weakened to such an extent that the weight of the armature

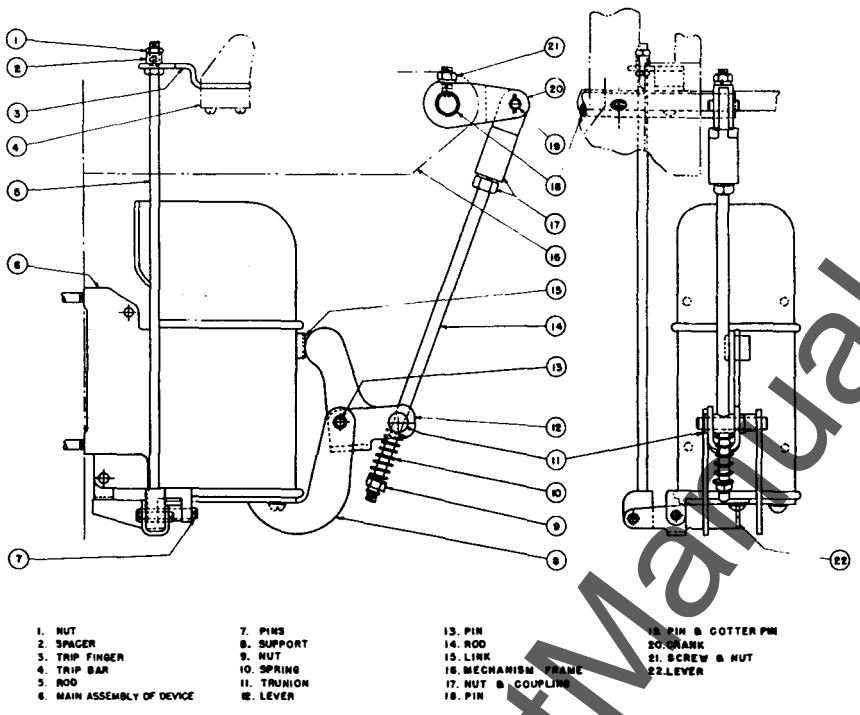


FIG. 24
TIME DELAY UNDERVOLTAGE TRIP DEVICE

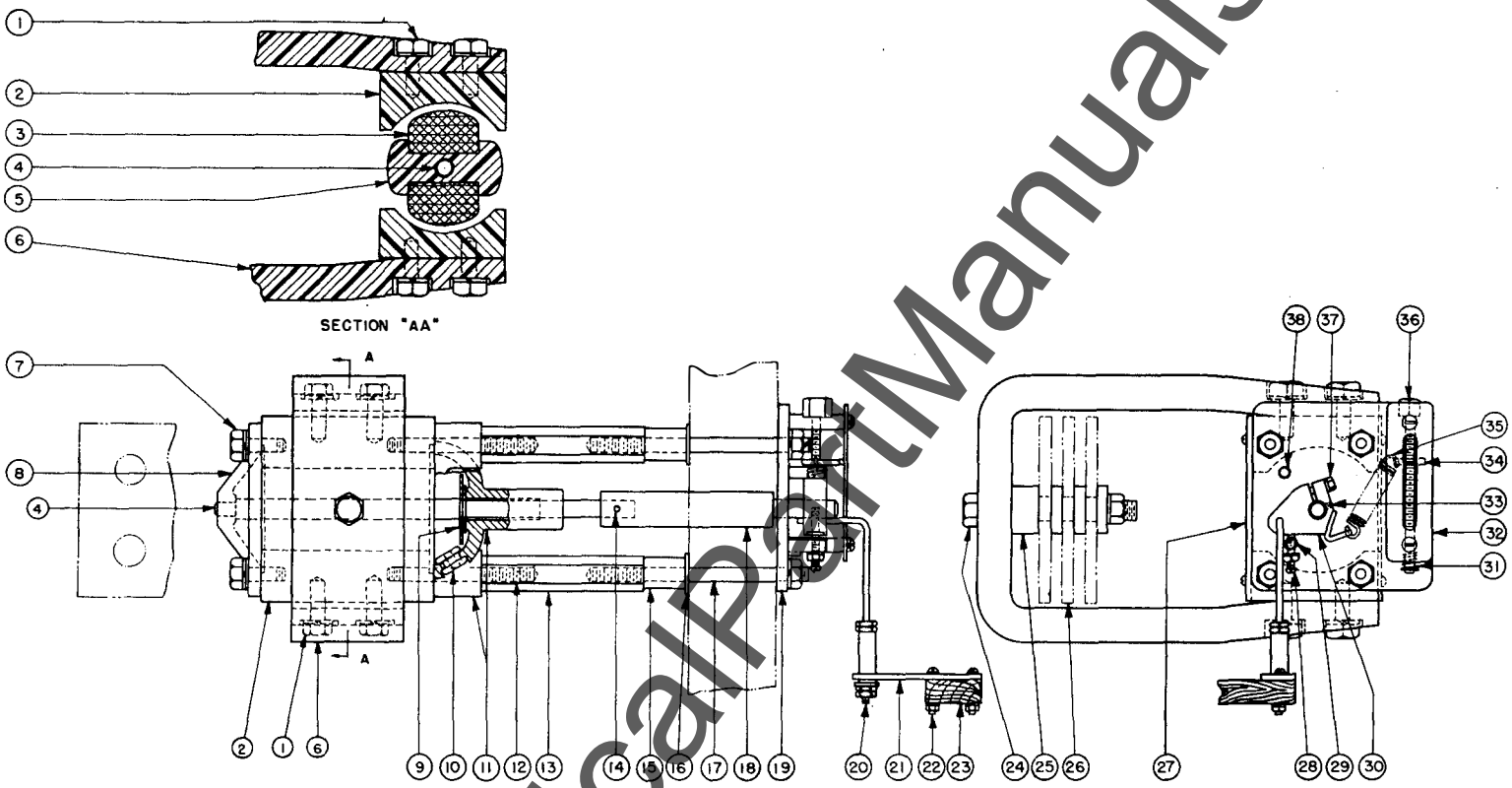
overcomes the attraction of the pole piece, the armature is released so that screw strikes the toggle link and springs (13) drawing link (7) and coupling (10) downward by crank (11) which moves counter-clockwise. This causes the upper end of the trip arm (3) to move forward on pin through support (25) engaging trip finger (2) attached to trip bar (1) and thereby tripping the breaker.

After the device has operated, the pull of the magnetic flux is not adequate to attract the armature which drops to a level almost even with the bottom of the magnet frame unless the armature is mechanically reset. Hence a reset mechanism has been devised to revolve the armature in the direction of the pole piece on pin (17) until the armature is raised and reset. The reset mechanism is set into operation by means of crank (27) which is attached to pin (28) and held firm by set screw (29). The other end of the crank is attached to a coupling and a plunger (26) by pin and cotter pin (30). These move downward when pin (28), which operates in conjunction with the main shaft of the breaker mechanism, is set into motion by the tripping of the breaker, and engage a lever (18) pressing it down on a roller and roller support (14) attached to an extension from the lower end of the armature. This pressure causes the armature to revolve on pin (17) pushing the armature in the direction of the pole piece thereby placing the breaker in the reset position. Then when the voltage is restored to the predetermined value the breaker will be in a position to be closed since the pull in the coil will now be sufficient to attract the armature and close the breaker.

TIME DELAY UNDERVOLTAGE TRIP DEVICE - FIG. 24

This device is constructed as shown in Fig. 24 and operates in a similar manner as the instantaneous trip device. However, an air bellows and orifice time delay attachment furnishes time delay between the loss of voltage and tripping. Lever (22) moves on pin (7) so that when the right end of the lever is pushed downward by the operation of the device the left end of the lever moves upward pushing trip rod (5) in the same direction and tripping the breaker. Thus when the coil is de-energized by the loss or reduction of voltage the armature is free to move away from the pole piece but is restrained by the air bellows. After a brief time delay, the armature moves away from the pole piece and operates a toggle linkage lever (22) causing the breaker to trip. If normal voltage is restored before the device has operated, the breaker will remain in the closed position.

The reset mechanism is likewise similar to that of the instantaneous undervoltage trip device. The opening motion of the breaker rotates a crank (20) attached to a pin in the breaker mechanism by means of



1. SCREW
2. POLE SHOE
3. POTENTIAL COIL
4. ARMATURE SHAFT
5. ARMATURE
6. MAGNET
7. BOLT
8. REAR BEARING
9. THRUST WASHER AND INSULATION WASHER
10. GROMMET
11. FRONT BEARING
12. STUD
13. SPACERS FOR STUDS
14. GROVE PIN
15. SPACER
16. WASHER
17. STUD
18. EXTENSION FOR ARMATURE SHAFT
19. ESCUTCHEON PLATE
20. TRIP ROD
21. TRIP FINGER
22. SCREW
23. SPECIAL CROSS TRIP BAR, REPLACES REGULAR TRIP BAR
24. BOLT
25. SPACER
26. SPECIAL LOWER STUD, REPLACES REGULAR BREAKER STUD
27. DUST COVERS AND WASHERS
28. ADJUSTING SCREW LOCKWASHER AND NUT
29. POST FOR ADJUSTING SCREW
30. TRIP LEVER
31. SPRING
32. CALIBRATION PLATE
33. SET SCREW
34. INDEX POINTER
35. CALIBRATION SPRING
36. CALIBRATION SCREW
37. SCREW
38. STOP POST FOR REVERSE ROTATION

FIG. 25

REVERSE CURRENT TRIP DEVICE

screw (18) and moves reset rod (14) upward. This rod passes through a pin in lever (12) making a connection (11) at this point in the form of a trunion. The reset rod operates lever (12) through spring (10) and adjusting nut (9). Lever (12) pushes against link (15) and resets the armature. As soon as normal voltage is now restored the breaker may be closed.

REVERSE CURRENT TRIP DEVICE - FIG. 25

A direct acting reverse current trip device of the rotor type Fig. 25 is available for these breakers for direct current application which will trip the breaker when the reversed current exceeds the calibration setting. The device is constructed similar to a bipolor motor with stationary poles excited from a magnet frame which encloses the lower stud, 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 breaker load current in the normal direction, produces a torque which tends to rotate the armature in a direction to prevent tripping. However, when the breaker current is reversed the torque is reversed to cause reverse rotation which trips the breaker.

As shown in Fig. 25, the motor element is mounted on the rear of the mounting base by studs (17) and spacers (15) through the base. The magnet frame (6) is supported on the lower stud of the breaker by spacers, and is attached to the motor element by screws (1). An extension (18) of the armature shaft (4) passes through to the front to operate the tripping equipment.

The armature shaft (4) is supported in bronze bearings (8 and 11) which are fastened to the pole shoes (2) by bolts (7) and studs (12). An escutcheon plate (19) is mounted on the front of the mounting base by studs (17) and to it are riveted two posts for the calibration plate (32) and two stop posts, one of which has an adjusting screw (28) threaded through it to adjust the travel of the armature in the normal position. The trip lever (30) is clamped firmly by screw (37) and set screw (33) to the extended armature shaft (18) and supports the trip rod (20). A trip finger (21) is screwed to special trip bar (23) which replaces the regular trip bar, and is free to move over the lower end of the trip rod between properly spaced lock nuts to permit sufficient travel when the breaker is tripped by other devices.

When current passes through the lower stud in the normal direction the armature will tend to revolve counter-clockwise (looking from the front) to force the trip lever (30) against the adjusting screw (28). The calibration spring (35) also normally holds the trip lever against the adjusting screw. But when the current passes through the lower stud in the reverse direction the armature will tend to rotate clockwise, away from the adjusting screw, and when the calibration setting is reached it will rotate in the reverse direction and lift the trip rod to trip the breaker. The stop post (38) limits the reverse rotation travel. A calibration plate (32) is mounted on posts on the escutcheon plate. The calibration screw (36) passes through these posts and is threaded through the index pointer (34) which is attached to the calibration spring (35). By turning the hexagonal head of the calibration screw against the compression spring (31) the reverse current setting can be changed.

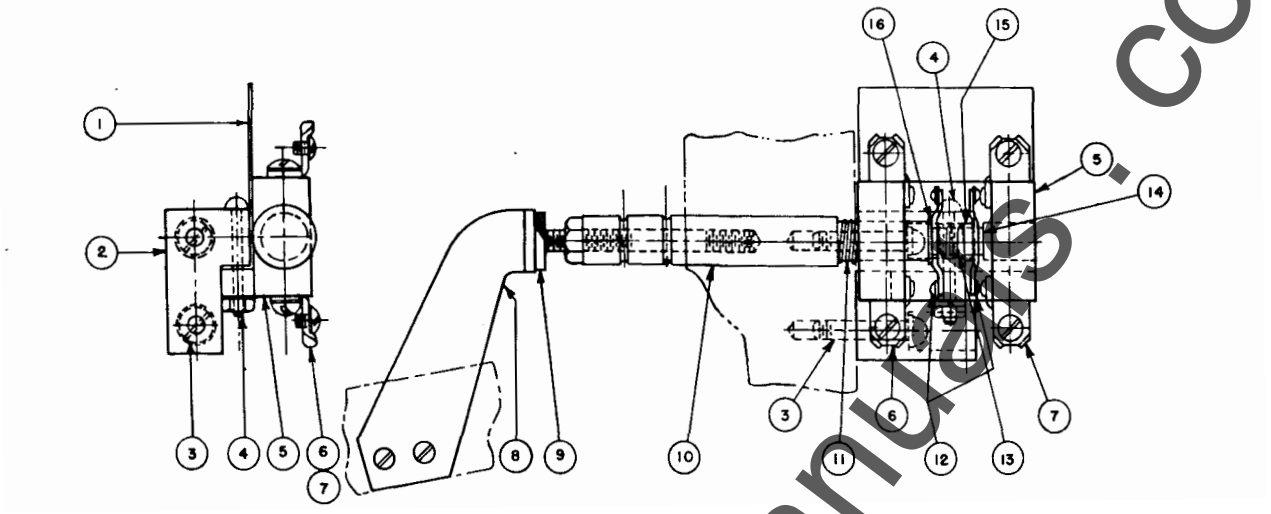
The trip lever (30) is clamped to the armature shaft so that the potential coil (3) will be located approximately in the vertical position with a somewhat larger air gap on the trip side when the lever resets against the adjusting screw (28), extended approximately 1/16" to 3/32" beyond the post. When 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 any movement is detected, back off slightly on the adjusting screw to increase the air gap to the pole piece on the trip side. Adjust the jam nuts on trip rod so that the breaker will trip with 1/32" overtravel of the trip finger, measured at the trip rod. Slight variations of these adjustments may be necessary to improve the operation of the device.

Any change in the adjusting screw (28) and the tripping lever (30) will affect the calibration of the reverse current device, Thus the settings 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.

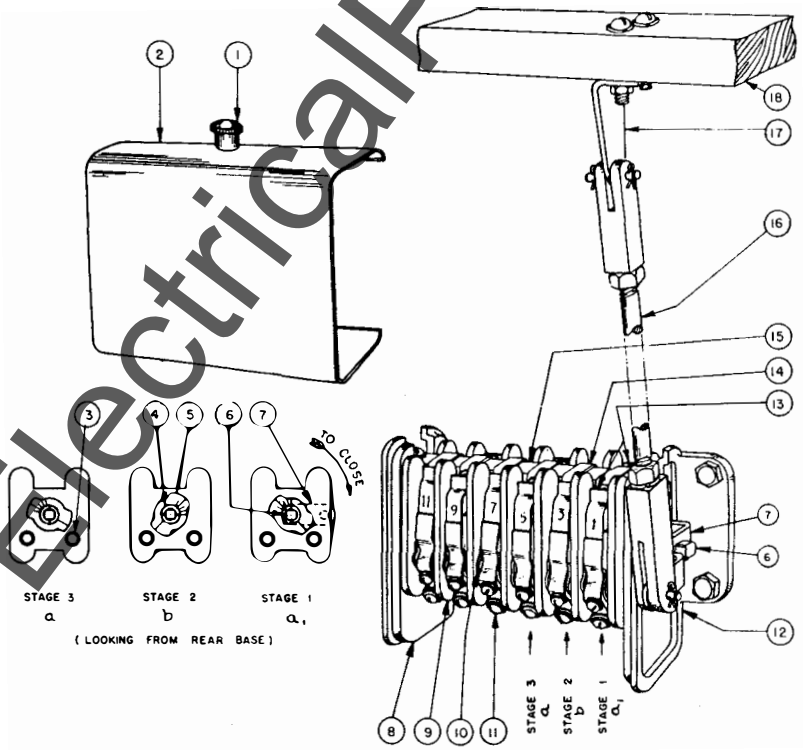
PUSH TYPE AUXILIARY SWITCH - FIG. 26

To give light indications for open and closed positions of the manually operated breaker a push type auxiliary switch, shown in Fig. 26, is generally mounted on the rear of the breaker base to the right and above the lower stud of the right hand pole unit. A limited number of other operating functions may be accomodated by similar auxiliary switches, similarly located with reference to the lower stud of other pole units. A plunger (10) of insulating material extends through the breaker base and engages a bracket attached to link (30) Fig. 10. One normally closed and one normally open set of contacts are provided, (one to show the green light when the breaker is open, and the other to show the red light when the breaker is closed). Fig. 26 shows the switch in the closed position of the breaker.



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. FINGER
9. SCREW
10. COMPOSITION PLUNGER
11. COMPRESSION SPRING FOR PLUNGER
12. MOVEABLE CONTACT STRIPS
13. CONTACT SPRING
14. GUIDE
15. INSULATION WASHER
16. INSULATION WASHER

FIG. 26
PUSH TYPE AUXILIARY SWITCH
SHOWN IN CLOSED POSITION OF BREAKER



1. INSULATED NUTS
2. COVER OF INSULATION
3. THROUGH BOLT HEX. HD. ¼"-20 WITH LOCKWASHER
4. CAM BUSHING
5. CAM
6. SHAFT
7. CRANK
8. REAR BASE
9. MOLDED BARRIER
10. MOVABLE CONTACT SUPPORT
11. BINDING POST
12. FRONT BASE (CRANK END)
13. MOVABLE CONTACT FINGER
14. STATIONARY CONTACT ASSEMBLY
15. STATIONARY CONTACT SUPPORT
16. ROD AND COUPLING
17. LEVER
18. CROSS BAR

FIG. 27
ROTARY TYPE AUXILARY SWITCH
IN OPEN POSITION OF 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 part of the base and a guide (14), screwed to the end of the plunger, passes through the other part of the base. Two movable contact strips (12) move over the 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 open position of the breaker.

The molded base (5) is attached to the bracket (2) by screws (4) and the bracket is attached to the breaker base by 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. - 27

The rotary type auxiliary switch is a type SB-1 switch and is used on electrically operated breakers and on manually operated breakers when more auxiliary functions are required than can be taken care of by one or more push type auxiliary switches and where space is available for mounting a rotary switch. It is generally mounted on the front of the breaker base directly below the operating mechanism and is connected to a lever (17) on the cross bar by a rod and crank on the right hand side of the switch as shown in Fig. 27. The number and arrangement of stages are determined by the auxiliary functions desired and character of circuits to be controlled, such as remote tripping, indicating lamps, bell alarm, control circuits, interlocking of breakers, etc.

This auxiliary switch is a cam operated multi-circuit rotary switch with a cover of insulating material provided with insulating nuts. It is provided with "a" and "b" contacts, an "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. An intermediate "a1" position, which closes before the regular "a" contact closes, is necessary in order that these particular contacts close before the main contacts of the breaker are closed. The angular placement of the cams on the shaft, in steps of 15^0, is important to obtain the proper sequence for breaker operation.

For details of construction and maintenance of the rotary type auxiliary switch see Instruction Book GEI-18080. In general a square shaft (6) extends through the unit, the length depending upon the number of stages used. Each stage of the switch has one cam (5) and two sets of switch contacts, assembled at right angles of the shaft. The cam simultaneously opens or closes both switch contacts of each stage. Both sets of switch contacts are in series to provide two breaks in each circuit controlled. The cam bushing (4) fits over the squared shaft (6) and has 24 external teeth which fit into corresponding 24 internal teeth of cam (5) to allow steps of 15^0 placement with reference to its setting on the shaft.

In Fig. 27, with the switch in the open position of the breaker, the crank (7) is approximately in the horizontal position. Stage 1, next to the crank end, has its contacts open which are designated "a1" because its cam is advanced 15^0 ahead of the cam of the regular "a" stage in closing. Stage 2 has closed contacts which are designated "b". Stage 3 has its contacts open which are regular "a". When the breaker closes the crank is rotated 60^0 counterclockwise (looking at the crank end) and the contacts take the opposite position.

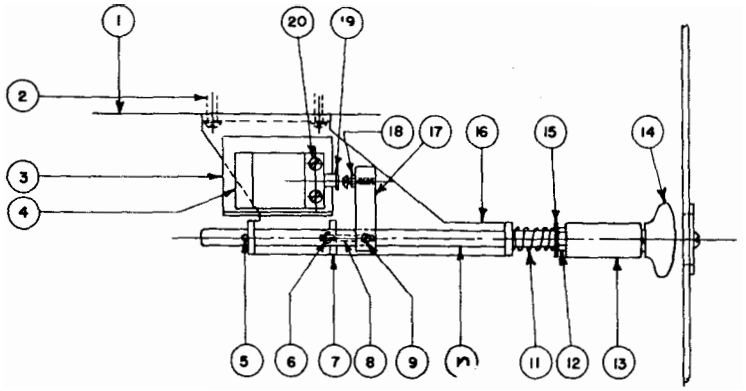
By changing the position of the cam (5) on the cam bushing (4), which fits over the square shaft, any stage can be changed from "a" to "b" or any desired intermediate position. However, if changes are required in the operating sequence of the auxiliary switch refer to the section of Instruction Book GEI-18080 headed "Adjustment" for details of procedure. The cam arrangement is given in Fig. 27 but if the switch is to be dismantled a sketch should be made showing the cam position of each stage before it is removed.

BELL ALARM DEVICE - FIG. 28

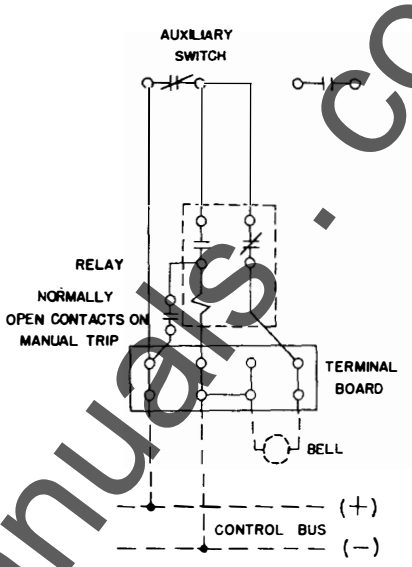
This device uses a push type switch operated by the hand trip rod on the breaker, an HGA relay, and a "b" contact on the breaker auxiliary switch. It is designed to provide a means of silencing the bell alarm whenever the breaker is automatically tripped and to prevent the bell from ringing when the breaker is manually tripped. It is mounted on a flanged support (16) which is attached to the left side of the left pole unit frame by screws (2) in the same location as the "Manual Trip" Fig. 16. A wiring diagram is also shown in Fig. 28.

When the breaker is tripped automatically a "b" contact of the auxiliary switch is closed, which rings 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



PUSH TYPE SWITCH



WIRING DIAGRAM

1. OPERATING FRAME
2. SCREWS
3. INSULATION
4. SWITCH
5. GROOV PIN
6. NUT
7. STOP
8. GUIDE
9. SCREW
10. ROD
11. SPRING
12. NUT
13. INSULATED ROD
14. PUSH BUTTON
15. WASHER
16. SUPPORT
17. BLOCK
18. ADJUSTING NUT
19. PLUNGER
20. SCREWS

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FIG 28
BELL ALARM DEVICE

closed as above so as to energize and 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.

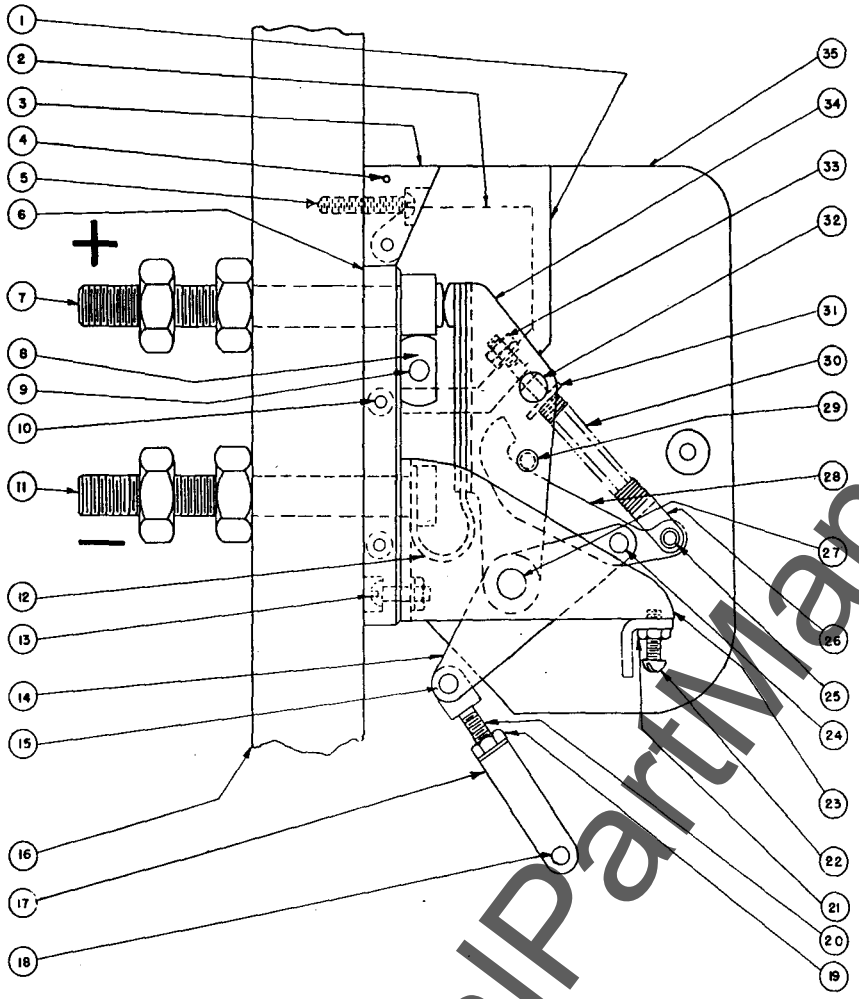
A two circuit push type switch (4) is attached by screws (20) to a flanged support (16). A plunger (19) is attached to the switch which closes the normally open contacts when push button (14) is operated by finger pressure through a hole in the steel front enclosure. An adjusting screw (18) in block (17) which is attached to rod (10) regulates the distance the plunger is moved in order to properly close the aforesaid contacts. A stop (7) is welded to the support (16) to prevent too much movement of the rod when the push botton is operated. Spring (11) will bring the rod and push botton to the normal position after being pressed to the rear in operating the push type switch. A similar spring pushes the plunger forward after pressure on the push button is released and the bell has been silenced or when current has been prevented from reaching the bell in the event the breaker is tripped manually.

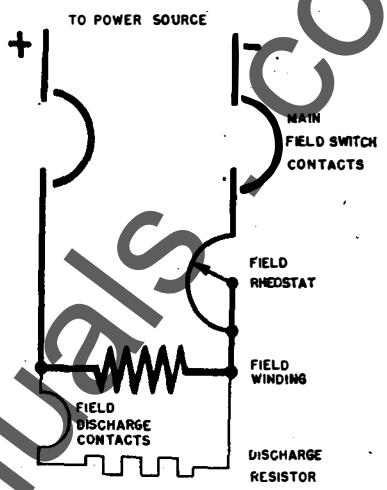
TYPE ALF-2 FIELD SWITCH WITH DISCHARGE CONTACTS

The type ALF-2 field switch with discharge contacts, Fig. 29, is used for the control of generator shunt field circuits. It consists of a regular non-automatic two pole type AL-2-75 or AL-2-100 with field discharge contacts 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.

FIELD DISCHARGE CONTACTS - FIG. 29

The field discharge contacts, Fig. 29, 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 contacts, 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 (20) and coupling (17) which are connected by pin (18) with the operating mechanism. Thus





TYPICAL CONNECTION DIAGRAM

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. BREAKER BASE
17. COUPLING
18. PIN
19. NUT
20. ROD
21. NUT
22. KICK-OFF SCREW
23. FRAME
24. RIVET AND WASHERS
25. RIVET
26. SPRING ROD
27. PIN, COTTER AND SPACER
28. CATCH
29. RIVET
30. COMPRESSION SPRING
31. WASHER
32. PIN
33. LOCKNUTS AND LOCKWASHER
34. CONTACT LEVER
35. BARRIER

FIG. 29

FIELD DISCHARGE CONTACTS

WITH FIELD SWITCH IN OPEN POSITION

when the mechanism operates to open the field circuit the discharge contacts will positively close before the contacts of the field switch open. 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. 29 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. 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).

The first adjustment consists of lenening 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.

DIAGRAMS - FIGS. 30 and 31

Figs. 30 and 31 show typical diagrams for electrically operated AL-2-75 and AL-2-100 breakers.

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

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.

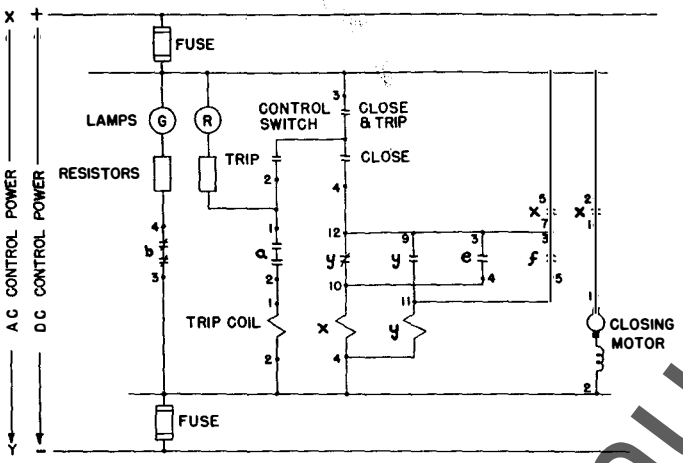


FIG. 30
TYPICAL ELEMENTARY DIAGRAM
FOR MOTOR OPERATED BREAKER

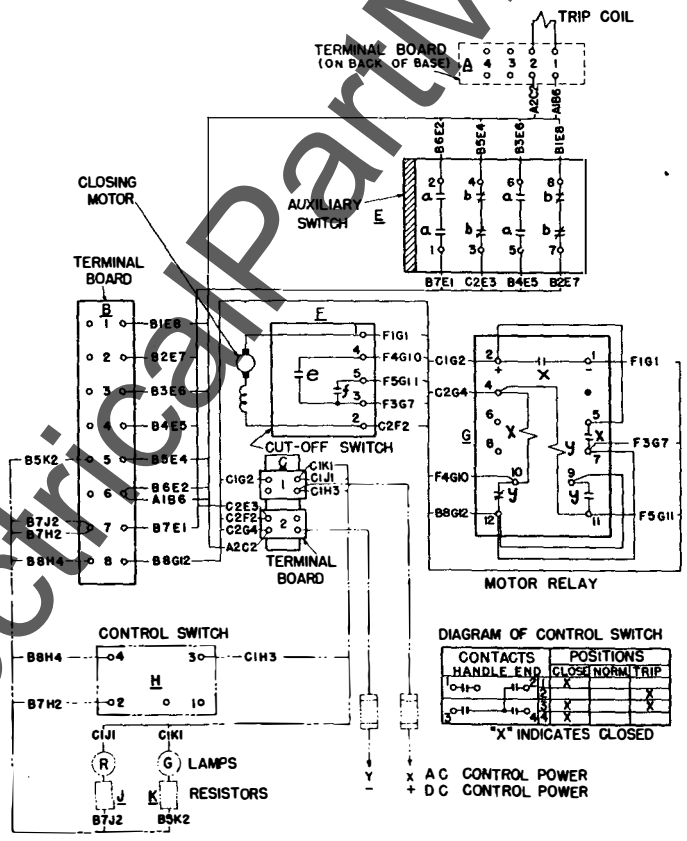


FIG. 31
TYPICAL CONNECTION DIAGRAM
FOR MOTOR OPERATED BREAKER
FRONT VIEW

LIST OF ABREVIATIONS

a - AUX. SW. CONTACTS OPEN WHEN BREAKER CONTACTS ARE OPEN.
b - AUX. SW. CONTACTS CLOSED WHEN BREAKER CONTACTS ARE OPEN.
e & f - CUT-OFF SWITCH CONTACTS CLOSED BY CLOSING MECHANISM ("e" CLOSES BEFORE "f") OPENED SIMULTANEOUSLY WHEN MECHANISM IS FULLY CLOSED.
X - CLOSING RELAY.
y - CUT-OFF DEVICE.

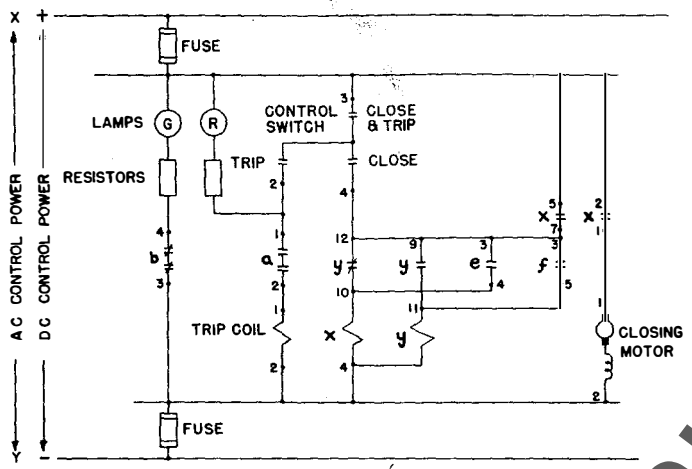


FIG. 30
TYPICAL ELEMENTARY DIAGRAM
FOR MOTOR OPERATED BREAKER

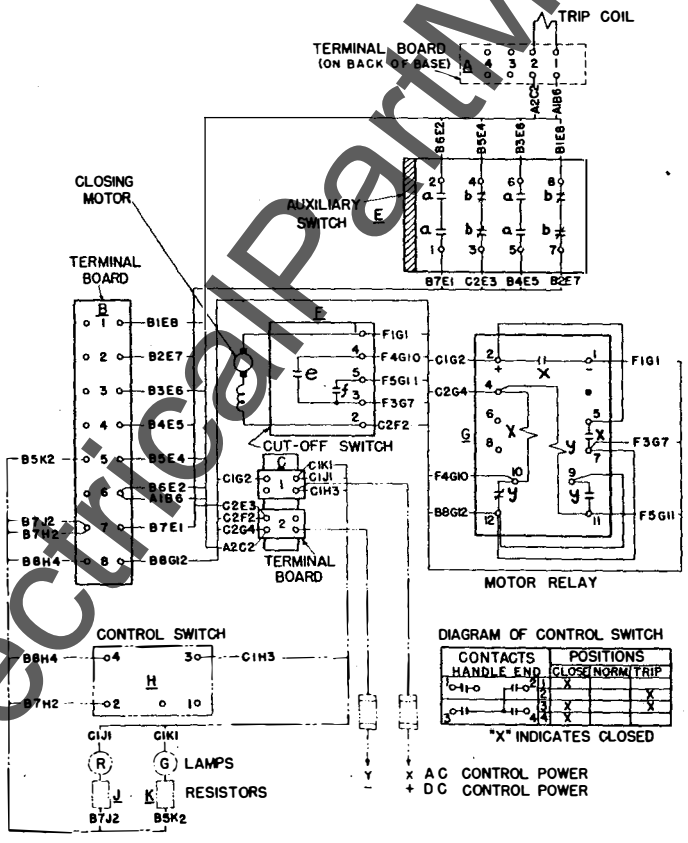


FIG. 31
TYPICAL CONNECTION DIAGRAM
FOR MOTOR OPERATED BREAKER
FRONT VIEW

LIST OF ABREVIATIONS

a- AUX. SW. CONTACTS OPEN WHEN BREAKER CONTACTS ARE OPEN.
b - AUX. SW. CONTACTS CLOSED WHEN BREAKER CONTACTS ARE OPEN.
e & f - CUT-OFF SWITCH CONTACTS CLOSED BY CLOSING MECHANISM ("e" CLOSES BEFORE "f") OPENED SIMULTANEOUSLY WHEN MECHANISM IS FULLY CLOSED.
X - CLOSING RELAY.
y - CUT - OFF DEVICE.

ATTN FRANK AUDSLEY
304-342-7786

(W-6490517)