INSTRUCTIONS

AIR CIRCUIT BREAKER

TYPE AE-1-15

(Formerly Type AE-1A)

GENERAL ELECTRIC
SCHENECTADY, N.Y.

CONTENTS

ILLUSTRATIONS

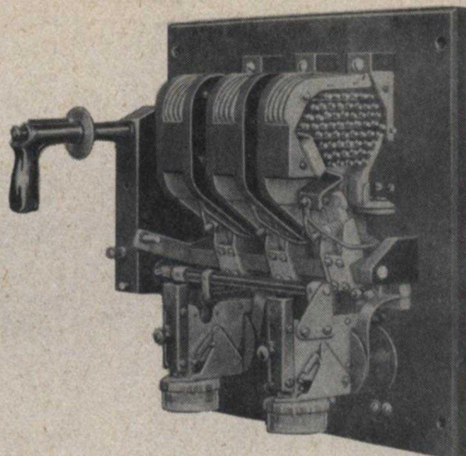


FIG. 1

TYPE AE-1-15 AIR CIRCUIT BREAKER, LIVE FRONT, MANUALLY OPERATED.

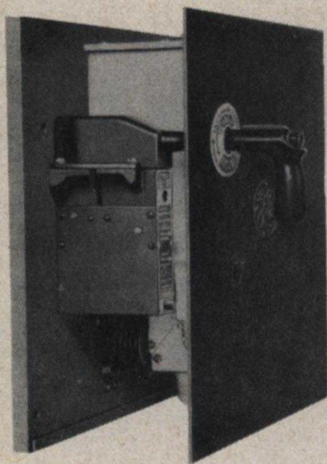


FIG. 2

TYPE AE-1-15 DEAD FRONT, MANUALLY OPERATED.

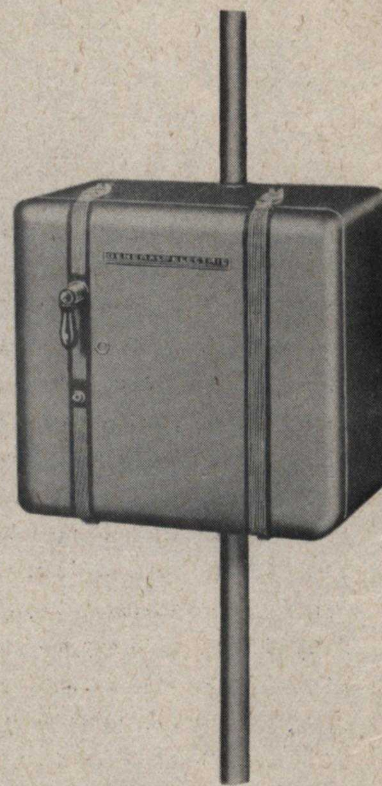


FIG. 3

TYPE AE-1-15 ENCLOSED MOUNTING, MANUALLY OPERATED.

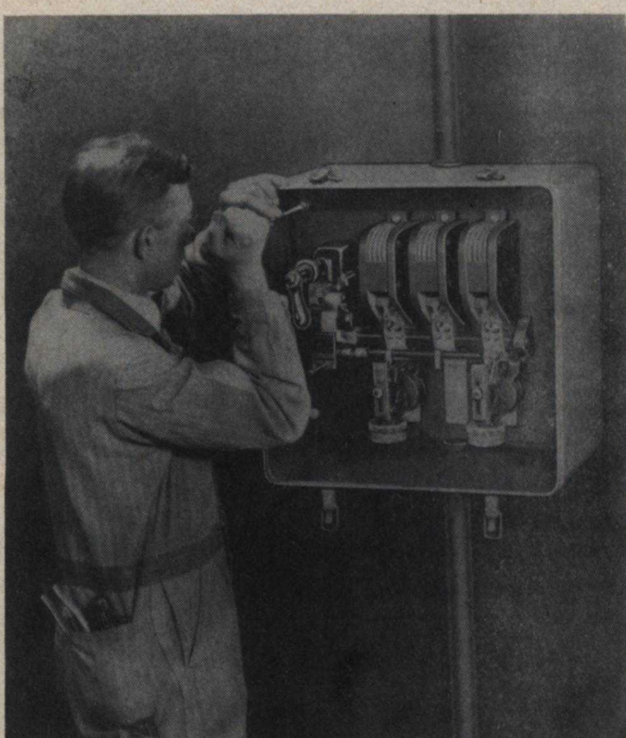


FIG. 4

TYPE AE-1-15 ENCLOSED MOUNTING. REMOVE TWO UPPER SCREWS AND TILT FORWARD TO REMOVE BREAKER.

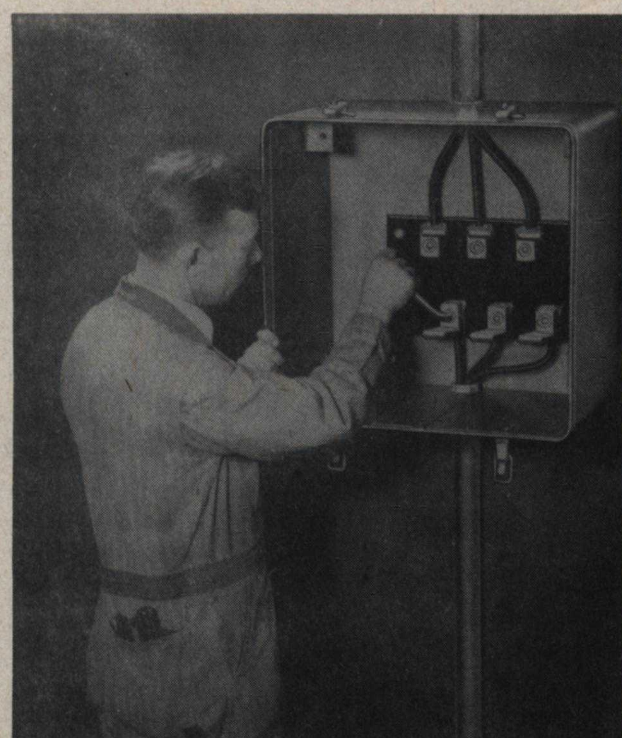


FIG. 5

TYPE AE-1-15 ENCLOSED MOUNTING TERMINALS AND SOLDERLESS CONNECTORS.

AIR CIRCUIT BREAKER

TYPE AE-1-15

GENERAL INFORMATION

This breaker was formerly designated Type AE-1A to which these instructions generally apply.

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

The type AE-1-15 air circuit breakers covered by this instruction book are generally used for the protection and control of apparatus and branch circuits, including equipment in buildings industries and power stations. Additional discussions on this breaker will be found in publication GEA-3600.

The type AE-1-15 air circuit breakers are for use on 250 volt D.C. or 600 volt A.C. circuits furnished normally with one, two, three or four poles. Their continuous current ratings are up to and including 225 amperes and maximum interrupting rating is 15,000 amperes. They can be furnished either live front (Fig. 1), dead front (Fig. 2) or enclosed (Fig. 3), either manually or electrically operated, and with various accessories. All breakers are equipped with arc quencher interrupters. Phase barriers are furnished on live front breakers and box type barriers on all dead front and enclosed breakers.

The AE-1-15 breaker is closed by a toggle mechanism operated manually or electrically against heavy springs. It is opened by these springs when a latch is released manually or by tripping devices. The breaker is trip free which assures that it cannot be held in the closed position as long as any tripping device is being operated.

The standard connection arrangement for direct current circuits is to have voltage coils connected solidly to the negative bus or line where possible. The current enters the breaker by upper stud (Pt. 6, Fig. 7), passes through stationary contact (Pt. 1), movable contact and flexible cable (Pt. 24), through series coil (Pt. 16) and out the lower stud (Pt. 12). The movable contact is attached to a main shaft (Pt. 20) which is actuated by a manually or electrically operated mechanism. On the opening of the contacts the arc is magnetically blown upward into an arc quencher (Pt. 28) and is promptly extinguished.

SHIPPING - UNPACKING - STORAGE

TRANSPORTATION DAMAGE

Immediately upon receipt of the circuit breaker an examination should be made for any damage or loss sustained during shipment. 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 circuit breaker 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 misplaced or left in the packing material. Blow out any dust or particles of packing material that may have accumulated on the circuit breakers parts. Report any shortage of material at once.

STORAGE

If the circuit breaker is not to be mounted in its permanent location at once, it should be stored in a clean, dry place and preferably placed in an upright position. It should be supported to prevent bending of the studs or damage to the breaker parts. It is best not to cover the breaker 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 and should be used if the breaker is to be stored for a considerable length of time.

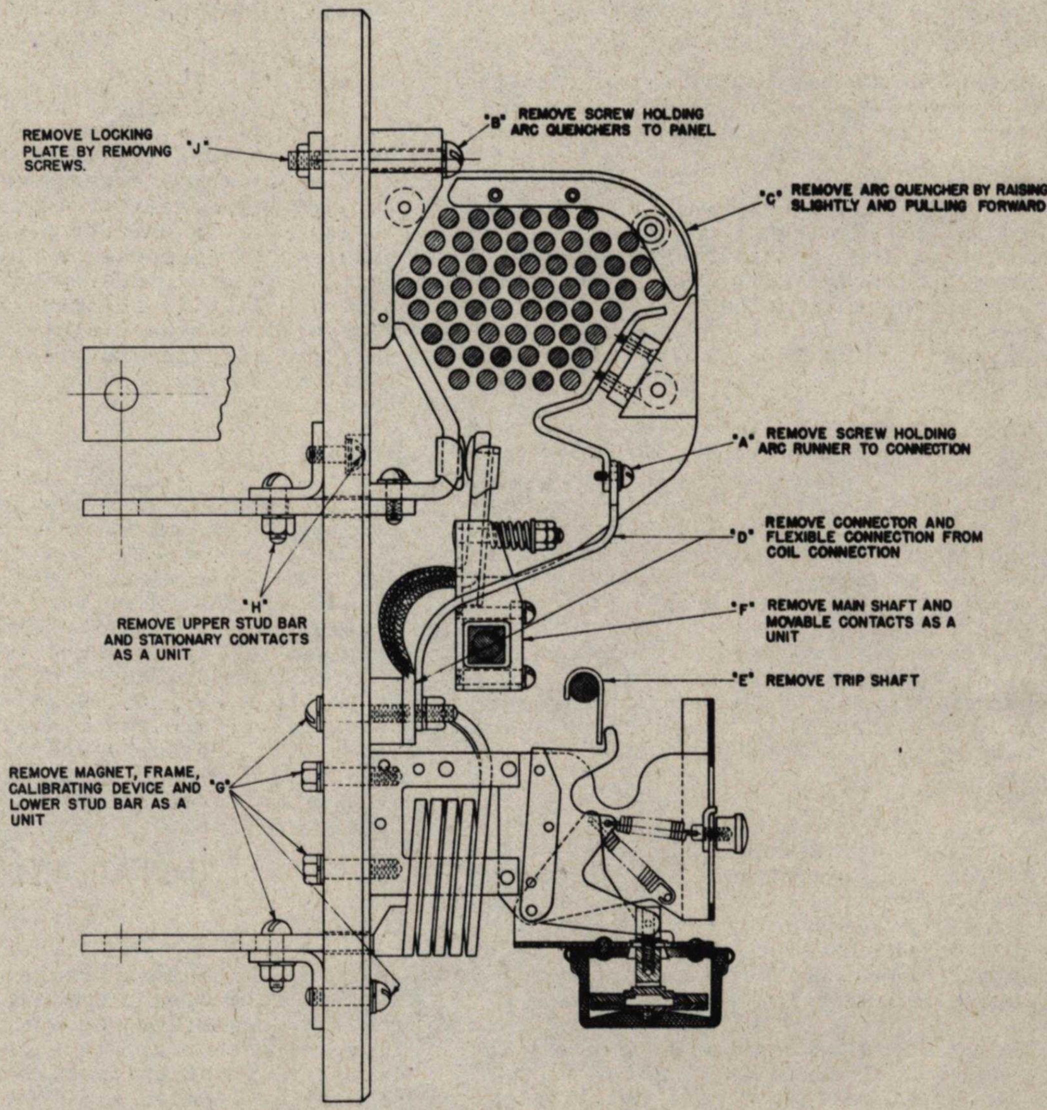
INSTALLATION

LOCATION

An air circuit breaker should be installed in a clean, dry place where it is readily accessible for operation, inspection and proper maintenance. When mounted on a live-front switchboard it should preferably be located at the top of the panel and ample head room should be provided above and in front of the breaker. Breakers mounted in special enclosures for installation in dusty, dirty, or other special locations can be furnished on request to the factory.

BREAKER CONNECTIONS

Most air circuit breakers are shipped on permanent bases or panel sections (with or without enclosures), and the installation consists simply of bolting them to the supporting framework or structure, connecting the current-carrying cables or bus bars to the breakers studs, and completing any secondary control wiring that may be required. The connections to the breaker studs should be firmly clamped or bolted in place to prevent excessive heating. The connecting cables or bus bars should have a current-



REASSEMBLE IN OPPOSITE SEQUENCE
PROGRESSIVE DISMANTLING AND REASSEMBLY INSTRUCTIONS

FIG. 6
INSTRUCTIONS FOR REMOVAL FROM TEMPORARY BASE

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carrying capacity sufficient to limit their temperature rise to that specified for the breaker. If these connecting cables or bus bars are not of sufficient size, heat will be conducted from them to the breaker and the breaker cannot be expected to carry normal rated current without exceeding the specified temperature rise. Connecting cables or bus bars should be supported so that the breaker studs will not be subjected to unnecessary strains.

DEAD FRONT BREAKERS

Breakers equipped with dead front barriers as illustrated in Fig. 2, can be installed on framework or elsewhere without removing the barriers.

ENCLOSED BREAKER

The enclosed breaker (Fig. 3) is easily installed by first removing the cover and the two top mounting bolts in the breaker base (Fig. 4). Tilt the breaker unit forward to disengage disconnects and for removal. Next, mount the box in the desired location and secure the cables in the solderless connectors of the box (Fig. 5). Finally, return the removable breaker unit to the box, and replace the two upper mounting bolts and the cover to complete the installation.

WHILE INSTALLING, OR BEFORE REMOVING THE BREAKER, IT IS IMPORTANT THAT IT SHOULD BE IN THE OPEN POSITION.

TEMPORARY BREAKER MOUNTING

It is always preferable to have an air circuit breaker shipped on a permanent base or panel section. Remounting of the 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 it is found necessary to transfer a breaker from a temporary base to a permanent base or panel, 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 necessary to effect the transfer. Sub-assemblies, such as the overcurrent devices, the operating mechanism, etc. should be transferred as units. This will help maintain adjustments and will minimize the possibility of incorrect assembly. A recommended sequence of procedure for transferring an AE-1-15 air circuit breaker given on Fig. 6. It is suggested that this procedure be followed in the order in which the operations are alphabetically arranged. After the transfer has been completed, the alignment of the contacts and the operation of all parts should be checked as described under "Operation", page 4 , and under "Contacts", page 4 .

OPERATION AND MAINTENANCE

After a breaker has been installed, slowly operate it manually several times and observe whether the contacts line up properly and make sure that all parts move freely and in the proper manner without binding.

Manually operated AE-1-15 air circuit breakers covered by these instructions are closed by first turning the operating handle in a counter-clockwise direction from the position of "handle down" to position of "handle up" to reset the mechanism latch, and then turning it in a clockwise direction to position of "handle down" to close the breaker. DO NOT ATTEMPT TO OPEN THE CIRCUIT BREAKER BY COUNTER-CLOCKWISE ROTATION OF THE OPERATING HANDLE. The circuit breaker is opened by pushing on the manual trip button to release the breaker latch.

Electrically-operated AE-1-15 air circuit breakers covered by these instructions may be closed manually by means of an emergency closing handle. To close the breaker, insert this handle in the hole provided for this purpose on the front of the operating mechanism. Push the handle down as far as it will go so that the breaker will be latched closed. The breaker is likewise opened by the trip button, and not by the emergency closing handle. When the breaker opens, it is automatically reset by the falling of the solenoid armature. AFTER CHECKING THE OPERATION MANUALLY BE SURE TO REMOVE THE EMERGENCY HANDLE.

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

INSPECTION

Periodic inspection of the breaker is recommended. The frequency of inspection will depend a great deal on local conditions but in general, an inspection should be made at least once a year. An inspection should always be made after it is known that the breaker has opened a severe short circuit. If breakers remain opened or closed for long periods at a time, it is recommended that arrangements be made to open and close them periodically several times in succession to keep the contacts and moving parts in good working condition.

CONTACTS

When inspecting the breaker, examine the contacts to see if there has been any severe pitting or burning of the contact

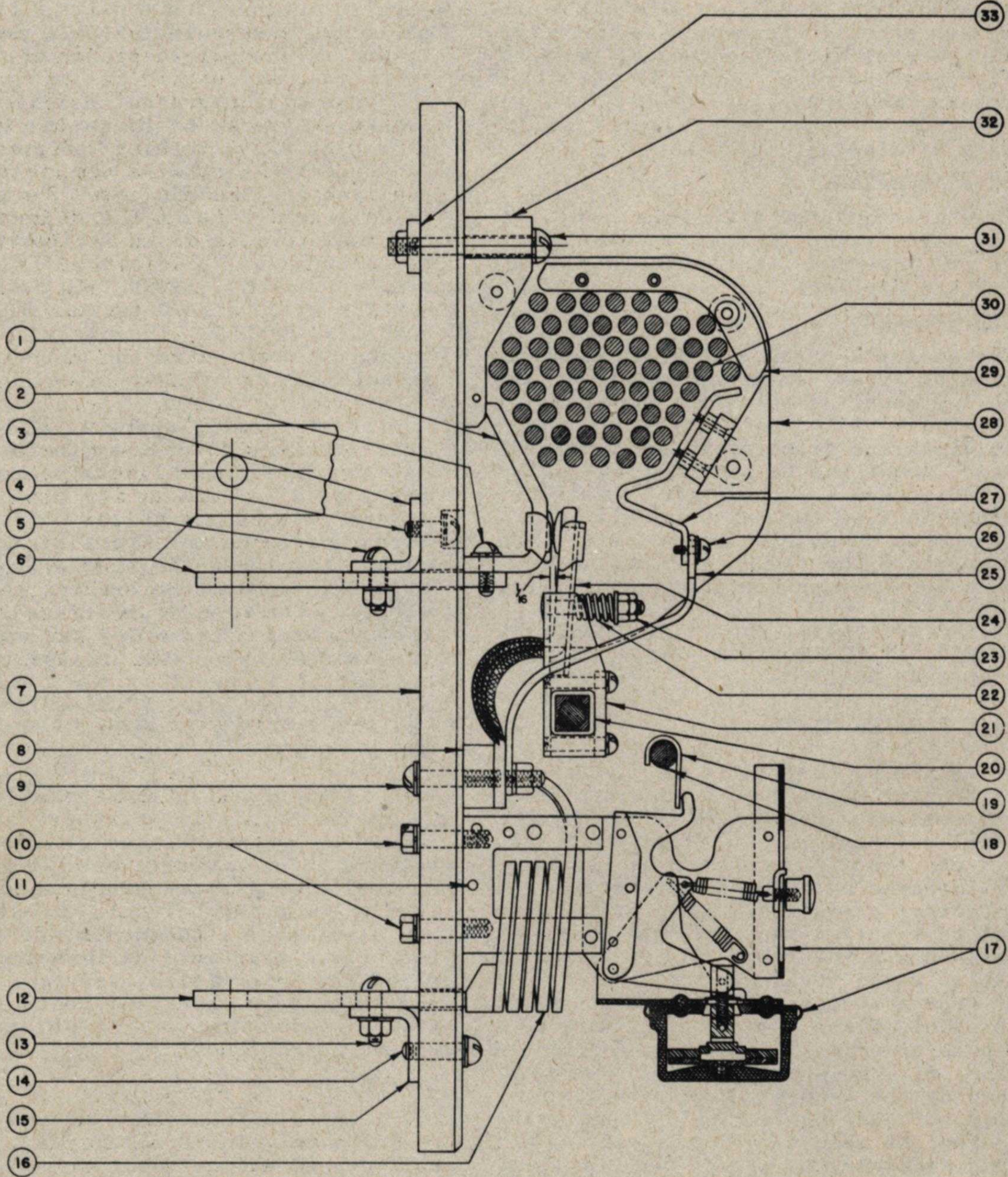

FIG 7

SIDE VIEW OF POLE UNIT

1. STATIONARY CONTACT AND ARC RUNNER
2. SCREW $\frac{1}{4}$"-20 X $\frac{5}{8}$" WITH LOCK WASHER
3. UPPER STUD BRACKET
4. SCREW R.H. $\frac{1}{4}$"-20 X $\frac{7}{8}$ WITH WASHERS
5. SCREW R.H. $\frac{1}{4}$"-20 X $\frac{3}{4}$ WITH HEX. NUT & LOCK WASHER
6. UPPER STUD
7. BREAKER BASE
8. TERMINAL, WELDED TO COIL
9. SCREW R.H. $\frac{1}{4}$-20 WITH NUT AND WASHERS
10. SCREWS HEX. HD. $\frac{1}{4}$-20 WITH WASHERS
11. MAGNET
12. LOWER STUD, WELDED TO COIL
13. SCREW R.H. $\frac{1}{4}$"-20 X $\frac{3}{4}$" WITH HEX. NUT AND WASHER
14. SCREW R.H. $\frac{1}{4}$"-20 WITH WASHERS
15. LOWER STUD BRACKET
16. SERIES CURRENT COIL
17. OIL FILM DUAL MAGNETIC OVERLOAD TRIP DEVICE (SEE FIG. 15)
18. TRIP SHAFT
19. TRIP FINGER
20. INSULATED MAIN SHAFT
21. CONTACT SUPPORT ASSEMBLY
22. ADJUSTING SPRING
23. HEX NUT $\frac{1}{4}$"-20
24. MOVEABLE CONTACT WITH FLEXIBLE COPPER BRAID
25. SHUNT CONNECTOR
26. SCREW R.H. #10-32 X $\frac{1}{2}$ AND WASHERS
27. FRONT ARC RUNNER
28. ARC QUENCHER
29. BAFFLES
30. COPPER COOLING PINS
31. SCREW R.H. $\frac{5}{16}$"-18 WITH WASHER
32. MOUNTING BLOCK
33. LOCKING PLATE WITH WELDED HEX. NUT $\frac{5}{16}$"-18 AND SELF TAPPING SCREWS #8

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surfaces. Rough or high spots should be removed with a very fine, CLEAN file or fine clean sandpaper. (Do not use emery cloth or crocus cloth). Care should be taken to maintain a line contact as much as possible. To check the amount of contact obtained, take contact impressions by holding between the contacts a piece of thin carbon paper with tissue paper on the carbon side and closing the breaker. Open the breaker and examine the impressions made 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 .001 inch feeler gauge cannot be inserted between the contacts for more than 25% of the length of the contact. See also contact pressure and adjustments under "Contacts" Page 4.

LUBRICATION

In general, the breaker operating 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 air circuit breaker mechanisms is to occasionally use a few drops of a good grade of light machine oil at bearing points, and to wipe off any excess with a clean rag.

OIL-FILM TIME DELAY

If the breaker is equipped with any type of oil-film time delay trip devices, make sure that when the breaker is installed, the oil pots of these devices are thoroughly cleaned and filled with oil to the proper level as marked on the pots. It is important that these oil pots be kept clean and properly filled with fresh oil to the proper level at regular inspection periods at least every six months, and more frequently if service is severe. A small can of oil for use in these pots is furnished with the breaker. Additional oil per General Electric Company specifications P50-HB1-A 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 pot is made.

DESCRIPTION OF COMPONENTS AND ATTACHMENTS

Although, under this heading, the adjustable features of the air circuit breaker and its attachments are given, it should be understood that the breaker has already been adjusted, inspected and tested at the factory in accordance with the information given herein. However, it is possible that unusually rough handling, transportation, and operating conditions may have resulted in some loosening or disturbance of the equipment to warrant re-checking and, in some cases, readjustment may be necessary.

CONTACTS

The current through the breaker contacts (Fig. 7) is carried by copper conductors with inserts of high conductivity and arc resistant alloy welded to their faces. To obtain a line contact, both the stationary and movable contacts (Pt. 1 and Pt. 24) are slightly rounded and the method for checking the contact engagement is described in contacts under "Operation and Maintenance". Page 4. The contact pressure is maintained by the compression springs behind the contact arm and adjustment is provided to maintain the proper contact pressure.

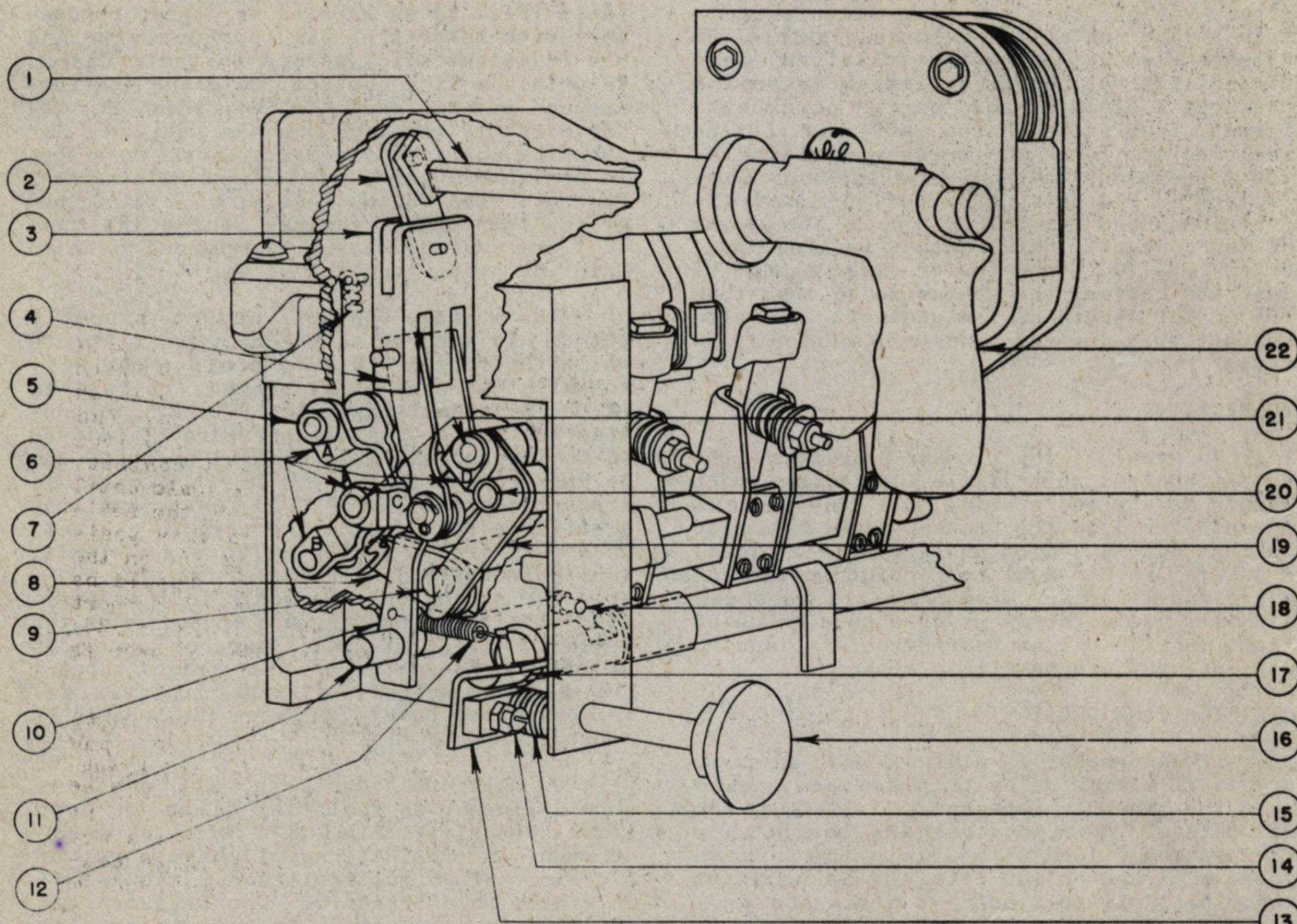
The movable contact support assembly (Pt. 21) is secured to the main shaft (Pt. 20) while the formed flexible braid (Pt. 24), to which the contact is brazed, is held in Pt. 21 by adjusting spring (Pt. 22) to provide the proper contact pressure of between 15 to 18 pounds. This contact pressure can be measured as follows: First close the breaker contacts on a .001" feeler and loop a suitable wire around the movable contact. Then pull with a spring balance scale until the pressure is just relieved from the feeler. The spring balance scale in this position will read the pressure in pounds on the contact. 1/16" minimum clearance should be provided between the movable contact support (Pt. 21) and the formed flexible braid (Pt. 24) as designated on Fig. #7, when the breaker is closed.

On multi-pole breakers, all contacts should line up so that they close or open simultaneously within 1/32". With the breaker open, the contacts should have a gap of 3/4" to 7/8" on multipole and 1" to 1-1/8" on single pole breakers. The breakers are adjusted in the factory to suit these conditions and further adjustment should not be necessary.

ARC QUENCHERS

Arc quenchers are used on live front, dead front and enclosed AE-1-15 air circuit breakers. When used on dead front on enclosed, they are covered with a box-type barrier of insulating compound.

The arc quencher as shown in Fig. 7, consists of a large number of solid copper pins supported between two molded compound sides placed vertically at each side of the breaker contacts. Molded compound baffles (Pt. 29) are used between the side above the pins. The rear arc runner of the stationary contact (Pt. 1) extends into the arc quencher behind the pins and the front arc runner is attached to an insulation block in front of the pins and is bolted to the shunt connector (Pt. 25) after the arc quencher is in place. When the contacts open, the arc is magnetically blown upward into the quencher and among the many copper pins which promptly extinguish the arc. To save burning at



1. ECCENTRIC MANUAL SHAFT
2. LINK
3. LINK
4. PAIR OF CLOSING LINKS
5. PIN MOUNTED IN FRAME
6. TOGGLE LINKS
7. SPRING (SEE FIG. 9)
8. OPERATING CRANK (SEE FIG. 9)
9. INSULATING MAIN SHAFT
10. PROP
11. PIN MOUNTED IN FRAME
12. SPRING
13. TRIP LATCH
14. ADJUSTABLE SCREW AND NUT
15. SPRING
16. TRIP BUTTOM
17. TRIP SHAFT
18. ADJUSTING SCREW RH 10-32 X $\frac{1}{2}$" AND NUT
19. TRIP ARM
20. PIN MOUNTED IN FRAME
21. RIVETED OVER PINS
22. MANUAL HANDLE

FIG 8
OPERATING MECHANISM OF TYPE AE-1-15
A.C.B. MANUALLY OPERATED IN TRIPPED POSITION

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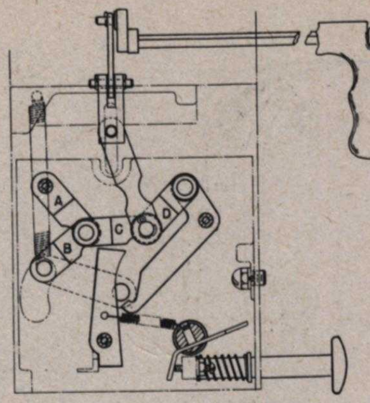


FIG. 9A
TRIPPED POSITION

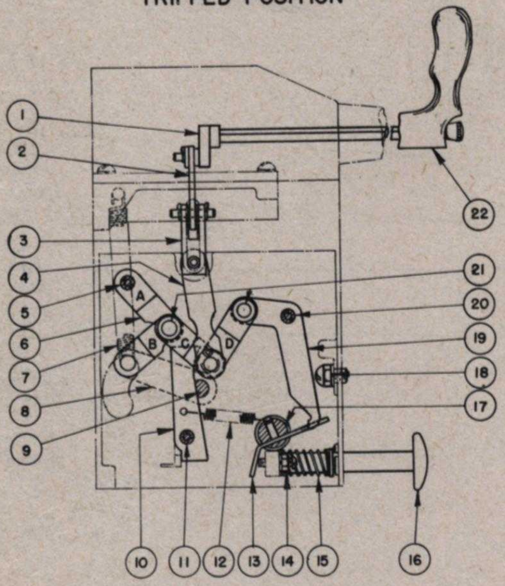


FIG. 9B
RESET POSITION

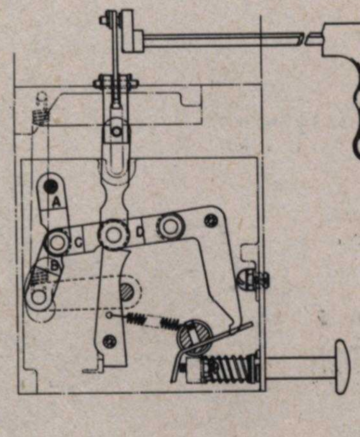


FIG. 9C
CLOSED POSITION
OPERATING POSITIONS OF OPERATING MECHANISM

the contacts, the arc is quickly transferred to the arc runners when the moving contact passes under the front arc runner. In travelling up the arc runners, the arc is lengthened, which together with the cooling effect of the pins and baffles, quickly breaks the arc.

MANUALLY OPERATED MECHANISM

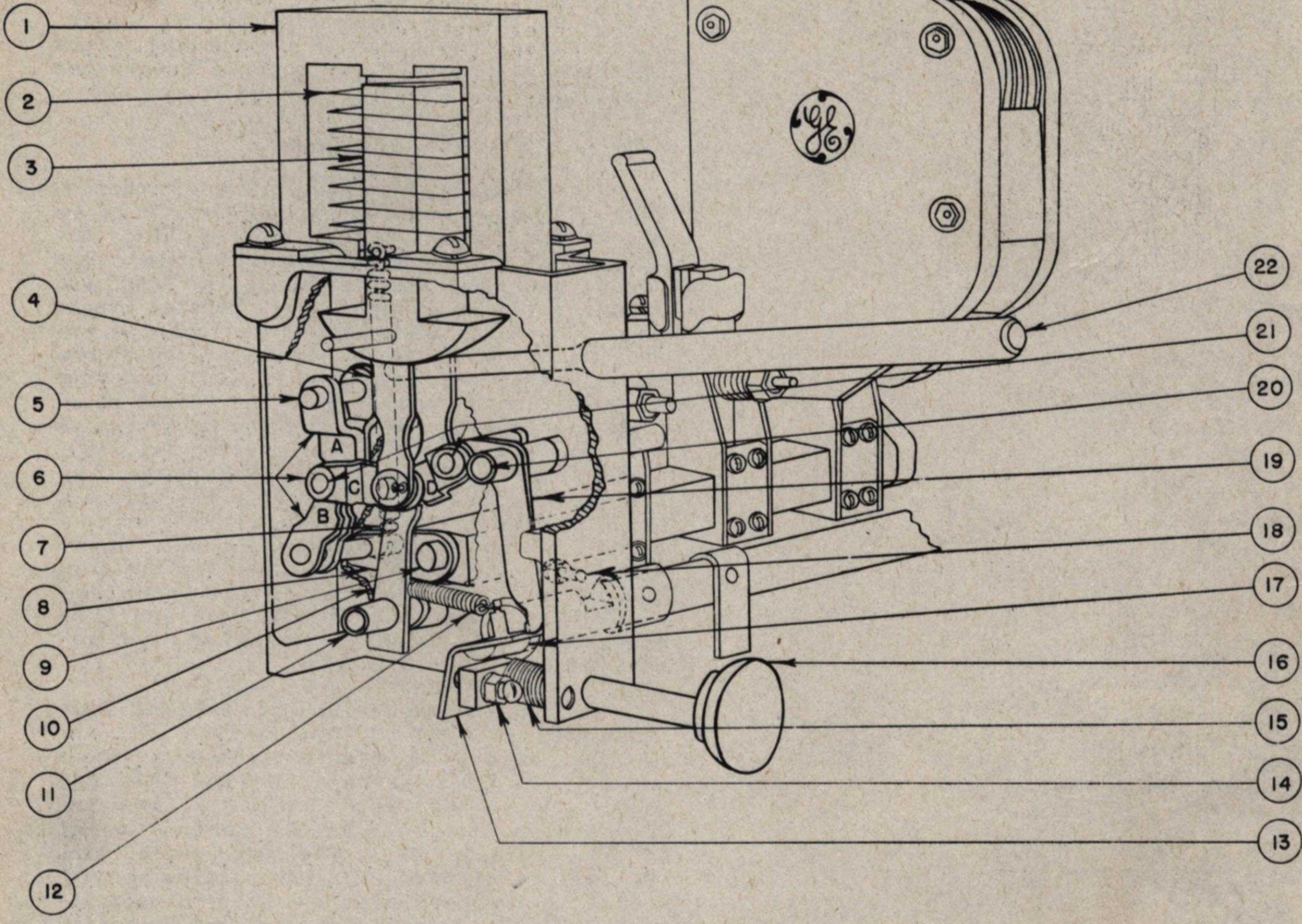
The manually operated breaker mechanism (Fig. 8) shown in the tripped position, is operated by a pistol grip handle (Pt. 22) located at the front of the mechanism. The normal position of this handle is "down" and in order to close a manually operated breaker, it must be turned counter-clockwise approximately 180° to the "reset" position which resets the trip arm (Pt. 19), and then must be turned clockwise to the "down" position to close the breaker. The mechanism is tripped manually by the trip button (Pt. 16), or by tripping devices, which revolve the trip shaft (Pt. 17), to release the trip arm (Pt. 19). 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 toggle mechanism consists of four links (Pt. 6A, 6B, 6C, 6D) and the trip arm (Pt. 19) riveted or pinned together as shown in Fig. 8. The upper end of link (Pt. 6A) is pivoted to the frame, as is the lower end of the prop (Pt. 10) and the central point of trip arm (Pt. 19). The lower end of link (Pt. 6B) is pivoted on a pin passing through a slot in the mechanism frame to the operating crank (Pt. 8) which is an arm connected at right angles to the main shaft (Pt. 9). The opening spring (Pt. 7), holds the operating crank up and maintains the contacts in the open position after the breaker is tripped.

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

<u>Tripped Position</u> - In the tripped position (Fig. 9A) the trip arm (Pt. 19) of the toggle mechanism is free of the trip latch (Pt. 13). Other links assume the positions shown. The handle is "down".

<u>Reset Position</u> - When the manual handle (Pt. 22) is turned counter-clockwise to the "reset" position with the handle up (Fig. 9B) the eccentric on the handle shaft (Pt. 1) lowers the pair of closing links (Pt. 4), collapsing the toggle links (Pts. 6C and 6D), causing the trip arm (Pt. 19) to revolve about its fixed pivot (Pt. 20) and engage the trip latch (Pt. 13), because toggle links (Pts. 6A and 6B) are held in collapsed position by spring (Pt. 7).



1. MAGNET
2. CLOSING COIL
3. ARMATURE
4. PAIR OF CLOSING LINKS
5. PIN IN FRAME
6. TOGGLE LINKS A, B, C, D
7. SPRING (SEE FIG. 9)
8. OPERATING CRANK (SEE FIG. 9)
9. INSULATING MAIN SHAFT
10. PROP
11. PIN MOUNTED IN FRAME
12. SPRING
13. TRIP LATCH
14. ADJUSTING SCREW AND NUT
15. SPRING
16. TRIP BUTTON
17. TRIP SHAFT
18. ADJUSTING SCREW RH 10-32 X $\frac{1}{2}$" AND NUT
19. TRIP ARM
20. PIN MOUNTED IN FRAME
21. RIVETED OVER PINS
22. EMERGENCY CLOSING HANDLE

FIG. 10

OPERATING MECHANISM OF TYPE AE-1A
A.C.B. SOLENOID OPERATED IN CLOSED POSITION

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Closed Position - When the manual handle (Pt. 22) is turned clockwise to the "closed" or "down" position (Fig. 9C) the closing links (Pt. 4) are raised to the vertical position extending toggle links (Pts. 6C and 6D), causing the toggle links (Pts. 6A and 6B), to be extended, forcing the operating crank (Pt. 8) downward against spring (Pt. 7) to close the breaker, because trip arm (Pt. 19) is held fixed by trip latch (Pt. 13). At the same time, the spring (Pt. 12) draws the prop (Pt. 10) under the closing links (Pt. 4) to prevent opening the breaker by counter-clockwise rotation of the closing handle.

The AE-1-15 breaker is trip free because the toggle links (Pt. 6A and Pt. 6B) cannot be extended to close the contacts by the main shaft (Pt. 9) as long as the trip shaft (Pt. 17) is held in the tripped position by any device. This prevents the trip arm (Pt. 19) from being held in position as shown in Fig. 9B and even if an attempt is made to close the breaker the trip arm simply returns to the position shown in Fig. 9A.

The latch adjusting screw (Pt. 14) should be adjusted on the trip latch (Pt. 13) to provide 1/32" minimum latch engagement with the trip arm (Pt. 19). The trip latch spring (Pt. 12) provides the proper tension between the prop (Pt. 10) and the trip latch (Pt. 13) to insure positive latching and prop seating to prevent the collapse of the toggle links (Pt. 6C and Pt. 6D). The trip arm stop screw should be adjusted to provide 1/16" clearance between it and the trip arm (Pt. 19) when the breaker is in the closed position.

SOLENOID OPERATED MECHANISM

Electric closing of the AE-1-15 breaker is accomplished by a solenoid and a closing relay as shown in Fig. 10 and Fig. 11. These parts take the place of the manual handle, the eccentric manual shaft (Pt. 1) and links (Pt. 2 and 3, Fig. 8) of the manually operated mechanism. The balance of the operating mechanism is the same for both the manually and solenoid operation, as shown in Fig. 10 with the operating mechanism in the closed position, except in reference to resetting. In solenoid operation, the resetting of the trip arm is automatic in that the weight of the falling armature, to which the closing links (Pt. 4) are directly attached, causes the collapse of toggle links (Pt. 6C and Pt. 6D) which duplicates the resetting of the manually operated mechanism.

The solenoid closing coil is designed for momentary operation and reasonable care must be exercised to avoid overheating. For this reason, a cut-off switch is recommended.

An emergency closing handle (Pt. 22) is provided, which may be inserted through a hole in the front of the mechanism frame and placed under the solenoid armature. The electrically operated breaker may be closed manually by pressing down on the emergency handle which raises the armature to allow the prop (Pt. 10) to slip under the closing links (Pt. 4) to hold the breaker closed.

Latch adjustments should be the same as given for manually operated mechanisms.

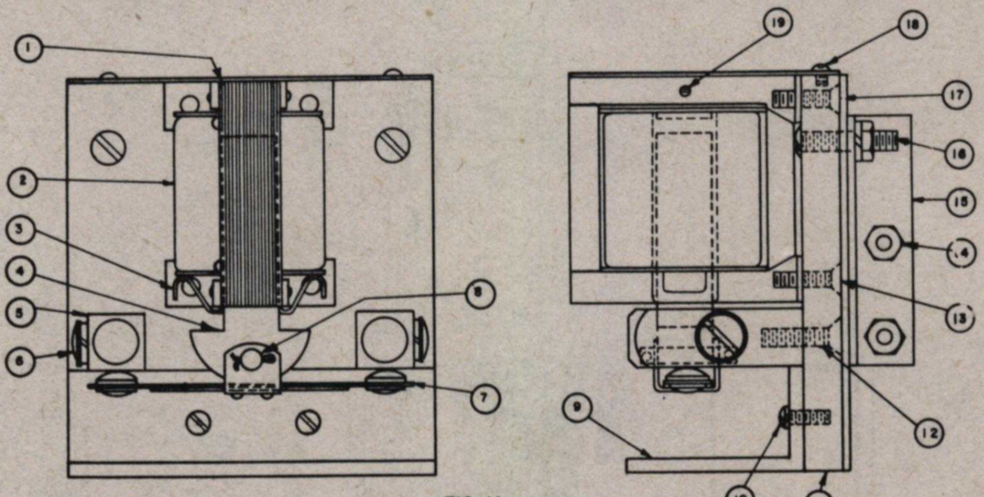

FIG. 11
CLOSING RELAY

1. MAGNET
2. COIL
3. BRASS GUIDES
4. ARMATURE
5. STATIONARY CONTACTS
6. BINDING SCREWS #10 AND LOCKWASHER
7. MOVEABLE CONTACTS ASSEMBLY
8. PIN AND COTTERS
9. INSULATION ANGLE
10. SCREW R.H. SELF TAPPING #8 x 3/8 AND LOCKWASHER
11. BASE
12. SCREW F.H. #10-32 x 3/4
13. SCREW F.H. #8-36 x 1/2
14. SCREW R.H. #8-36 x 1 3/8 LOCKWASHER AND NUTS
15. ANGLE SUPPORT
16. SCREW R.H. #10-32 x 7/8 LOCKWASHER AND NUT
17. INSULATION BARRIER
18. SCREW R.H. SELF TAPPING #6-40 x 3/16
19. SCREW R.H. SELF TAPPING #4 x 1/4

CLOSING RELAY

An electrically operated breaker is equipped with closing relay, Fig. 11, which operates to control the solenoid closing coil circuit so that the closing switch contacts will not be called upon to break the closing current. This relay is mounted directly on the front of the closing coil magnet by angle straps (Pt. 15), screwed to the magnet. No adjustments are required except to keep contacts clean.

The coil (Pt. 2) is mounted in the magnet (Pt. 1), which is screwed to a separate mounting base (Pt. 11). The coil is held by two brass guides (Pt. 3) between which the armature (Pt. 4) is free to move. The lower ends of the guides are clamped over the magnet and against the coil to keep it firmly in place, and the upper ends are fastened to the magnet by self-tapping screws (Pt. 19). When the coil is energized by the closing of a manually operated push button, or a remote switch or relay contacts, the armature is drawn up into the coil. It carries with it the movable contact strap (Pt. 7) which bridges the stationary contact blocks (Pt. 5) to energize the breaker closing coil and close the breaker. As soon as the coil is de-energized, the armature falls by its own weight and opens the breaker closing circuit at the movable contact strip.

TYPE SB-1 AUXILIARY SWITCH

An auxiliary switch (Fig. 12) is necessary for an electrically operated Type AE-1-15 air circuit breaker and for a manually operated breaker when auxiliary functions are required. It is generally placed on the mounting panel below the operating mechanism and connected to it by crank (Pt. 9) and a link (Pt. 12) attached to an index arm (Pt. 14), which is an extension of operating crank (Pt. 8, Fig. 8). The number of stages and circuits is determined by auxiliary functions desired and the characteristics of the circuits to be controlled, such as remote tripping circuit, indicating lamps, bell alarm, interlocking of breakers, etc.

The SB-1 auxiliary switch is a cam-operated, multi-pole rotary switch 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. The angular placement of the cams (Pt. 7) in steps of 15° on the shaft (Pt. 10) is important in order to make sure that certain contacts are definitely opened or closed before contacts operated by another cam are opened or closed. An "a_1" contact closes definitely before an "a" contact closes.

For detail instructions concerning the SB-1 auxiliary switch see Instruction Book GEI-18080. Each stage of the switch for AE-1-15 breakers has one cam (Pt. 7) and two sets of electrically separate switch contacts These may be wired in series for one circuit, or used for two separate circuits, depending upon the interrupting requirements of the circuits in accordance with the table in the above instruction book.

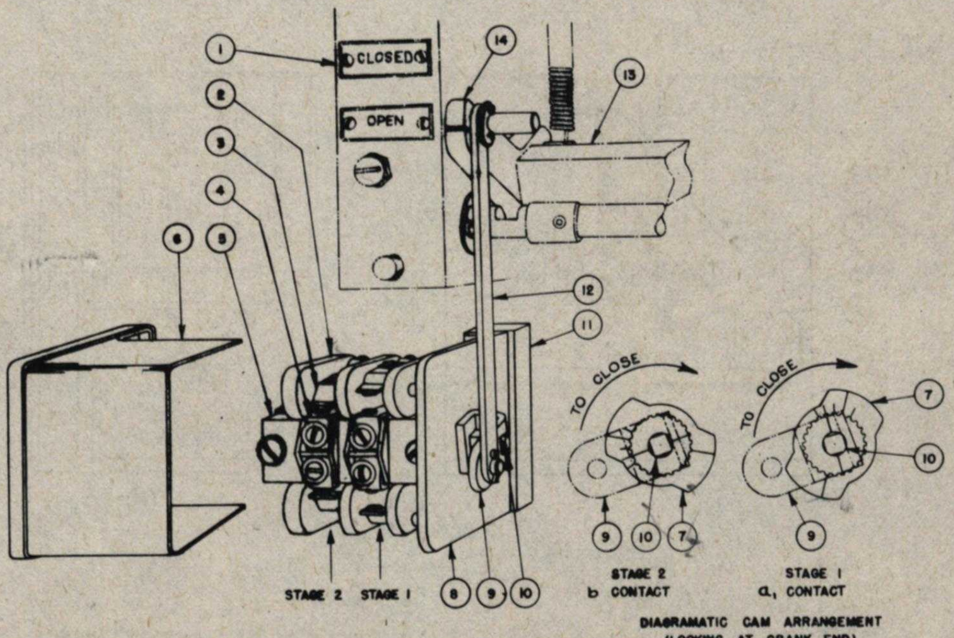

FIG. 12

TYPICAL AUXILIARY SWITCH WITH OPERATING LINKAGE

1. OPERATING MECHANISM
2. MOLDED BARRIERS
3. MOVABLE CONTACT ASSEMBLY
4. STATIONARY CONTACT ASSEMBLY
5. STATIONARY CONTACT SUPPORT
6. COVER
7. CAM, ON SHAFT (SEE DETAIL)
8. END FRAME
9. CRANK, PIN, AND COTTER
10. SHAFT (EXTENTION OF OPERATING CRANK PT.8 FIG.8)
11. MOUNTING BLOCK
12. LINK
13. MAIN SHAFT
14. INDEX ARM, PIN, AND COTTER

If changes are to be made in the control operation an approved drawing of the auxiliary switch cam arrangement involved should be optained or a careful sketch should be made of the switch in hand and the above Instruction Book GEI-18080 should be carefully followed.

By changing the position of the cam (Pt. 7) on the shaft (Pt. 10) any stage can be changed from circuit opening to circuit closing contacts.

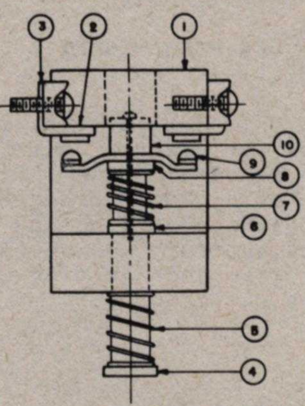

FIG. 13
MANUAL CLOSING SWITCH

1. MOLDED FRAME
2. CONTACT BRACKETS AND STATIONARY CONTACTS
3. TERMINALS AND BINDING SCREWS
4. OPERATING ROD
5. COMPRESSION SPRING
6. WASHER
7. CONTACT SPRING
8. INSULATION
9. MOVEABLE CONTACT STRIP
10. GUIDE

MANUAL CLOSING SWITCH

The manual closing switch (Fig. 13) for electrically operated breakers requires no adjustment other than to insure clean contacts. This switch is mounted on the left side or front of the mechanism and energizes the coil of the closing relay when the switch contacts are closed.

The switch consists of a molded frame (Pt. 1) which supports an operating rod (Pt. 4) on which rides a movable contact strip (Pt. 9) and also contact brackets (Pt. 2) which carry the stationary contacts and terminals with binding screws (Pt. 3). A compression spring (Pt. 5) normally holds the rod and movable contact strip in the open position. Contact spring (Pt. 7) holds the contact strip against the stationary contacts when in the closed position.

CUT-OFF SWITCH

The cut-off switch, Fig. 14, is located on the left side of breaker mechanism housing (Pt. 2) and is actuated by pin (Pt. 4) of solenoid operated breakers to close its contacts while the breaker is in the closed

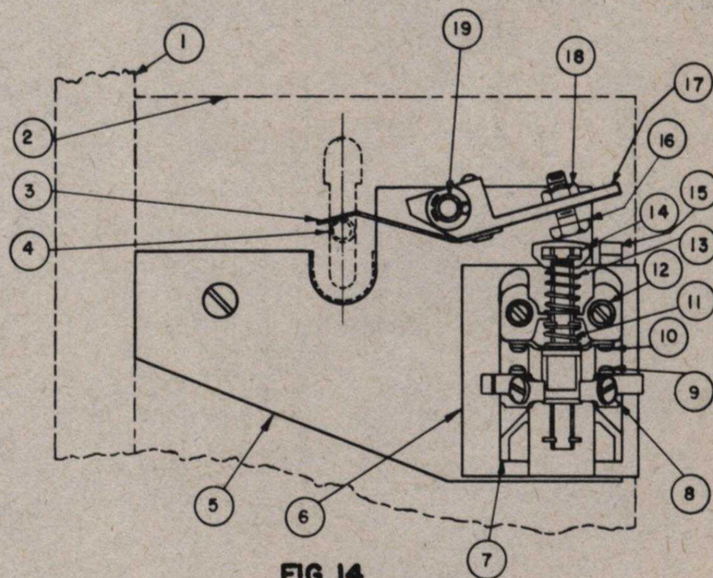

FIG. 14
CUT-OFF SWITCH
WITH BREAKER IN OPEN POSITION

1. MOUNTING BASE
2. OPERATING MECHANISM HOUSING
3. SPRING
4. PIN OF BREAKER CLOSING LINK
5. SUPPORT PLATE
6. INSULATION
7. MOLDED FRAME
8. BINDING SCREWS
9. STATIONARY CONTACTS
10. MOVEABLE CONTACT STRIP
11. CONTACT SPRING
12. MOUNTING SCREWS #6-40 X $\frac{1}{2}$
13. COMPRESSION SPRING
14. OPERATING ROD
15. STOP
16. ADJUSTING SCREW
17. OPERATING LEVER
18. LOCK NUT
19. PIN

position. The purpose of this switch is to provide a circuit to de-energize the solenoid closing coil as described below and prevent damage if the control switch is held in the closed position too long. The contacts of this switch should not close too soon in the closing stroke of the breaker which would de-energize the coil too soon to close the breaker. A cut-off relay with open and closed contacts, not provided with the breaker, must be used with this switch. See wiring diagrams, Fig. 30 and 31.

The switch is mounted on a support plate (Pt. 5) with a sheet of insulating material (Pt. 6) between the switch and the plate and consists of a molded frame (Pt. 7) which supports an operating rod (Pt. 14) on which rides a movable contact strip (Pt. 10). The molded frame also supports brackets which carry stationary contacts (Pt. 9) and binding screws (Pt. 8). A compression spring (Pt. 13) normally holds the rod and moving contact strip in the open position. A contact spring (Pt. 11) holds the contact strip against the stationary contacts when in the closed position. The operating lever (Pt. 17) is pivoted at a middle point to the same support (Pt. 5) by pin (Pt. 19) and carries a flat spring (Pt. 3) which bears against the top of pin (Pt. 4) of the breaker operating mechanism. When the breaker closes, the raising of this pin lowers the adjusting screw (Pt. 16), attached to the operating lever, and forces the cut-off switch into the closed position. This closes a circuit which energizes a cut-off relay which, in turn, de-energizes the closing relay, thus cutting off current from the solenoid coil to prevent damage.

DUAL OIL-FILM MAGNETIC OVERCURRENT TRIP DEVICE.

This device (Fig. 15) 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 over-loads exceeding ten times rated current.

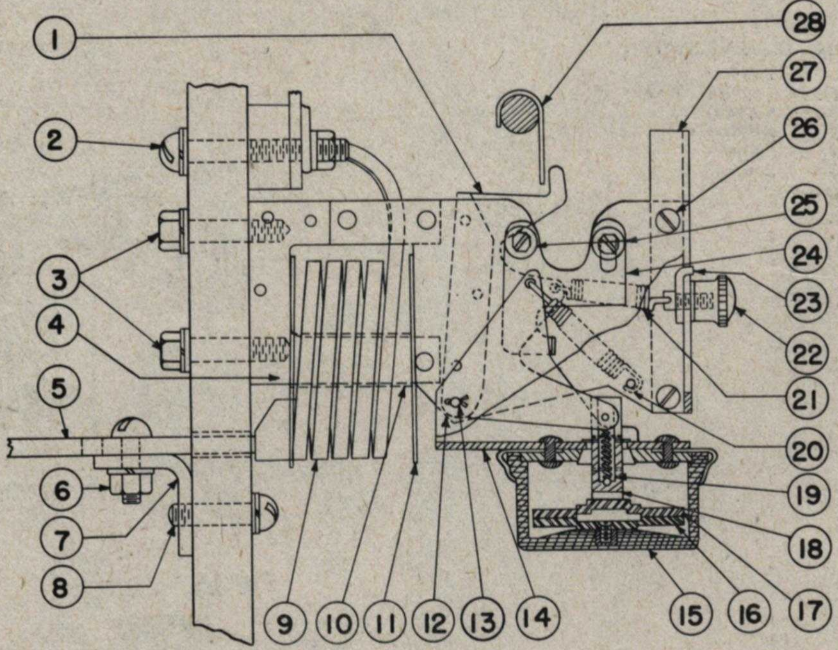

FIG. 15

DUAL OIL FILM MAGNETIC OVERCURRENT TRIP DEVICE

1. ARMATURE ASSEMBLY
2. SCREW R.H. 1/4-20, NUT AND WASHERS
3. SCREW HEX. HD. 1/4-20, AND WASHERS
4. MAGNET
5. LOWER STUD (WELDED TO COIL)
6. SCREW R.H. 1/4-20 X 3/4, NUT AND WASHER
7. LOWER STUD BRACKET
8. SCREW R.H. 1/4-20 AND WASHERS
9. SERIES OVERCURRENT COIL WITH UPPER TERMINAL
10. INSULATING TUBE
11. INSULATING WASHERS
12. FRAME
13. PIN & COTTERS
14. PIVOTED COVER & SUPPORT
15. OIL POT
16. LOWER DISC
17. UPPER DISC
18. SHANK
19. SPRING
20. INSTANTANEOUS TRIP SPRING
21. CALIBRATION SPRING
22. CALIBRATION ADJUSTING KNOB
23. CALIBRATION INDEX & SCREW
24. ADJUSTING STOP
25. SCREWS HEX. HD. 10-32 X 1/2 NUT AND WASHERS
26. SCREWS R.H. 8-36 X 1/4 AND WASHER
27. CALIBRATION PLATE
28. TRIP FINGER

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To accomplish inverse time tripping the current in the series coil (Pt. 9) sets up a magnetic circuit which tends pick up armature (Pt. 1) pivoted on pin (Pt. 13), and operate the trip finger (Pt. 28) on breaker trip shaft. The armature (Pt. 1) is restrained by a calibrating spring (Pt. 21) held under tension between the armature assembly and the calibration index (Pt. 23) and also by a thin oil film between upper disc (Pt. 17) which is pivoted to the armature assembly, and the lower disc (Pt. 16) attached to the bottom of oil pot (Pt. 15) which holds the oil in which both discs are immersed. For currents below the calibration setting, the calibrating 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 restraining force of the calibration spring (Pt. 21) and the excess force tends to pull the two flat disc surfaces (Pt. 16 and Pt. 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 open.

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

Calibration settings for 100, 125, 150, 175, and 200 per-cent of breaker normal current rating are marked in amperes on the calibration plate (Pt. 27). For general feeder applications, the calibration setting used should be not less than 125 per-cent of the 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 (Pt. 15) to different time delay settings, which increases or decreases the area of disc surfaces separated by oil film. The smaller the area, the shorter will be the time delay obtained.

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

To check the adjustment of this device for positive tripping, pick the armature up manually; the breaker should trip when approximately 1/32" air gap remains between the armature and magnet. To obtain this adjustment, bend the trip finger attached to the trip shaft so that the armature engages this finger sooner or later as required.

It is important that the facing surfaces of the discs be clean and smoothe, otherwise the calibration will be affected. If these surfaces are damaged or affected in any way, they should be relapped or made smoothe by rubbing over crocus cloth backed up by a smoothe flat surface.

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

A typical time-current tripping curve for this device is shown by Fig. 16. This curve is approximate and considerable variation in time delay may be expected depending on the cleanliness of the oil forming the film, the time allowed for resetting, the ambient temperature, etc.

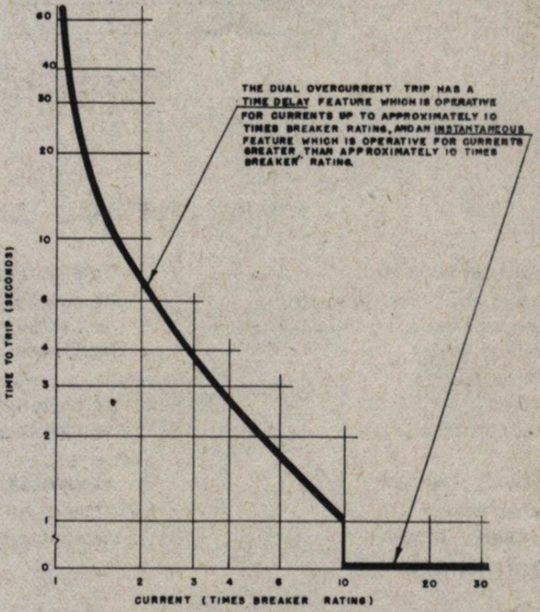

FIG. 16

APPROXIMATE TIME — CURRENT CHARACTERISTIC OF DUAL MAGNETIC OVERCURRENT TRIP DEVICE

(100 % CALIBRATION SETTING - MAXIMUM TIME DELAY SETTING)

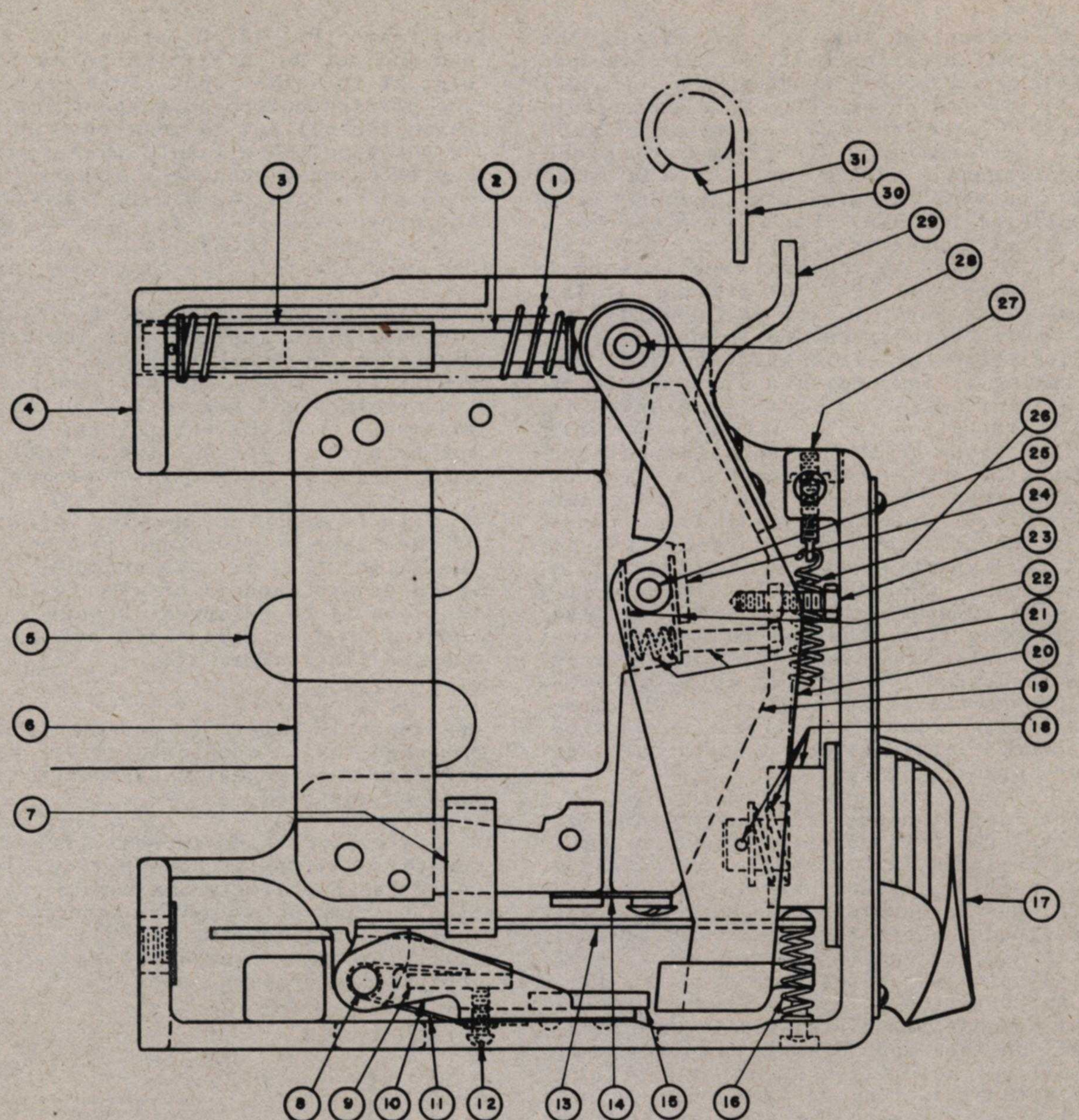

FIG. 17
DUAL THERMAL MAGNETIC OVERCURRENT TRIP DEVICE

1. SHORT CIRCUIT SPRING
2. SPRING GUIDE AND LOCK NUT
3. TUBULAR SPRING GUIDÉ AND COTTER
4. MOLDED FRAME
5. SERIES COIL
6. MAGNET
7. INDUCTION RING
8. PIN
9. THERMAL TRIP ARM
10. LATCH SUPPORT
11. TORSION SPRING
12. ADJUSTING SCREW
13. BIMETALLIC STRIP
14. SPRING HINGE
15. LATCH PLATE
16. SPRING FOR THERMAL TRIP ARM
17. CALIBRATING KNOB
18. CALIBRATING CAM, SPRING, AND COTTER
19. ARMATURE
20. YOKE
21. ADJUSTING SCREW AND SPRING
22. FLAT BUFFER SPRING
23. ARMATURE ADJUSTING SCREW AND NUT
24. LEATHER BUFFER
25. YOKE AND ARAMTURE PIN
26. RESET SPRING FOR YOKE
27. ADJUSTING SCREW
28. PIN
29. TRIP ARM
30. TRIP FINGER
31. TRIP SHAFT

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DUAL THERMAL MAGNETIC OVERCURRENT TRIP DEVICE

This device (Fig. 17) also automatically trips the breaker under two distinct conditions of overcurrent; first, with inverse time delay when the current exceeds the value of calibrations setting and is less than 12 to 15 times rated current, the inverse time element being obtained by the time required to heat and flex a bimetallic strip, and second, instantaneously when the current exceeds 12 to 15 times the normal breaker rating. It operates on alternating current only, and is principally used for motor protection. The unit is enclosed in a molded frame.

Current in the series coil (Pt. 5) sets up a magnetic circuit which tends to pick up the armature (Pt. 19) and operate the trip finger (Pt. 30) on the trip shaft (Pt. 31). The armature is attached to the lower member of the magnet (Pt. 6) by a spring hinge (Pt. 14) and is restrained by a yoke (Pt. 20) which is pivoted to the center of the armature by pin (Pt. 25) between two flat buffer springs (Pt. 22). The yoke is restrained at the bottom by the latch plate (Pt. 15) and also at the top by two heavy compression short circuit springs (Pt. 1). Current in the series coil induces current in the short circuited ring (Pt. 7), mounted around the lower magnet member, generating heat which is conducted to the bimetallic strip (Pt. 13) which is riveted at one end to the thermal trip arm (Pt. 9) and held at the other end between the calibrating cam (Pt. 18) and the spring (Pt. 16). The thermal trip arm (Pt. 9) is pivoted to the frame on pin (Pt. 8). When sufficient heat has been developed to cause the bimetallic strip (Pt. 13) to bend, with the convex surface downward, the thermal trip arm will tend to revolve about the pin (Pt. 8) and bear against an adjusting screw (Pt. 12) set in the latch support (Pt. 10). also pivoted on the pin (Pt. 8), to cause the latch plate (Pt. 15) to disengage the yoke (Pt. 20) at the lower end and allow the armature to be picked up and trip the breaker. A torsion spring (Pt. 11) is mounted on pin (Pt. 8) to hold the thermal trip arm (Pt. 9) and the latch support (Pt. 10) together against the adjusting screw (Pt. 12). 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 yoke will cause the short circuit spring (Pt. 1), supported between pin (Pt. 28) in the yoke and the frame, to be compressed. This allows the armature to be picked up and trip the breaker immediately without waiting for the release of latch plate (Pt. 15) by the heating of the bimetallic strip (Pt. 13) as described above.

The lock nut on spring guide (Pt. 2) controls the compression of the short circuit springs which are adjusted in the factory to provide instantaneous tripping when the current exceeds approximately 12 to 15 times normal breaker rating. The adjustable stop screw (Pt. 23) is secured to the armature (Pt. 19) and provides a stop against the molded case to control the clearance of 1/16" to 3/32" between the latch surface on the yoke and latch plate (Pt. 15) to insure positive reset. The reset spring (Pt. 26) provides the proper tension to yoke (Pt. 20) to insure positive resetting after a tripping operation. The adjusting screw (Pt. 12) controls the latch plate (Pt. 15) engagement and calibration time for a given current by varying the distance through which the thermal strip (Pt. 13) must bend before releasing the latch to trip the breaker.

The calibration adjustment knob (Pt. 17) can be turned to indications as marked on the nameplate to change the calibration range from 80 to 120 per-cent of the breaker rating.

To check the adjustment of this device for positive tripping, pick the armature up manually; the breaker should trip when approximately 1/32" air gap remains between the armature and magnet. To obtain this adjustment, bend the trip finger attached to the trip shaft so that the armature engages this finger sooner or later as required.

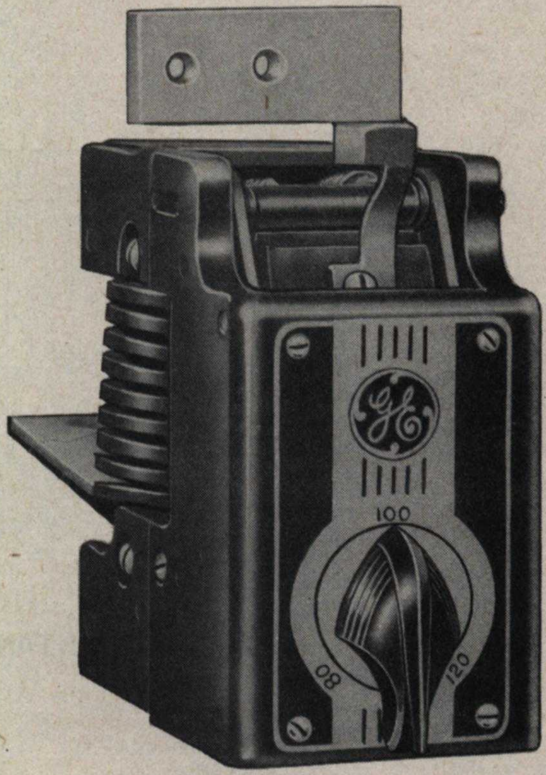

FIG. 18

DUAL THERMAL MAGNETIC OVERCURRENT TRIP DEVICE. EXTERNAL VIEW

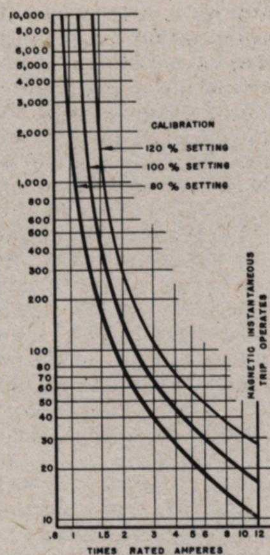

FIG. 19
APPROXIMATE TIME-CURRENT CHARACTERISTIC
OF THERMAL MAGNETIC OVERCURRENT TRIP DEVICE
(STARTING COLD IN 24° CAMBIENT)

There are available other special accessories that can be attached to the extension of the thermal trip (Pt. 9) to perform special functions when the bimetallic strip flexes. These are special and information concerning them should be obtained from the nearest sales office of the company.

A typical time-current tripping curve for this device is shown by Fig. 19. This curve is approximate and variations in time delay may be expected depending on the ambient temperature, the time required for resetting, etc.

INSTANTANEOUS OVERCURRENT TRIP DEVICE (FIG.20)

This device is magnetically operated to trip the breaker instantaneously by the current through the breaker when this current exceeds the value of the calibration setting. 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 applications, the calibration setting used should be not less than 125 per-cent of the normal load.

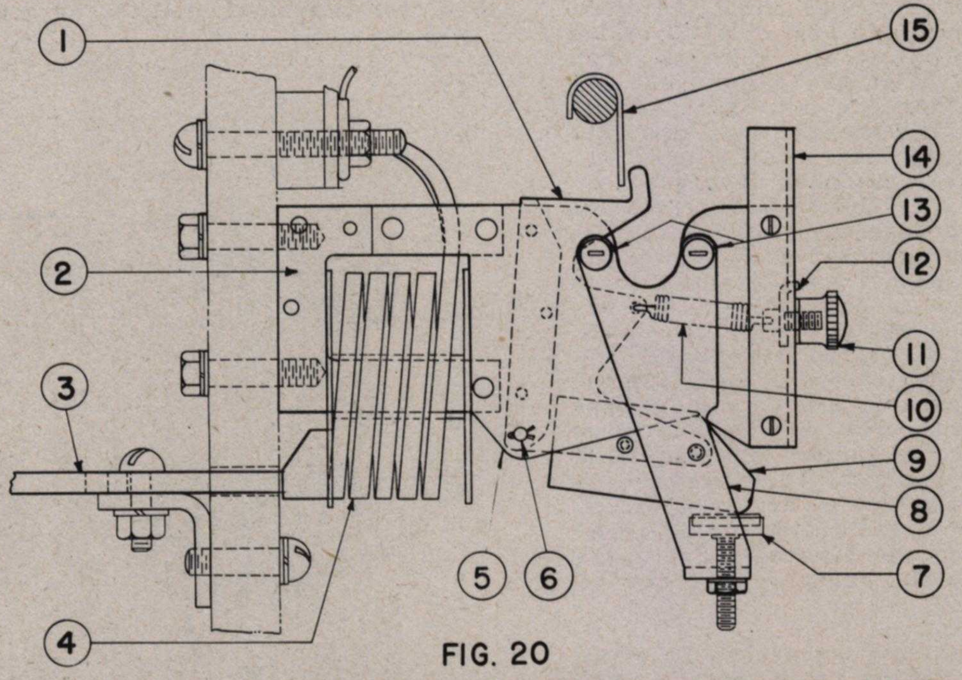

FIG. 20
INSTANTANEOUS OVERCURRENT TRIP DEVICE

1 ARMATURE
2. MAGNET
3. LOWER STUD
4. SERIES COIL
5. FRAME
6. PIN AND COTTER
7. STOP AND HEX NUT
8. SUPPORT FOR STOP
9. STOP PLATE, RIVETED TO ARMATURE ASSEMBLY
10. CALIBRATION SPRING
11. CALIBRATION ADJUSTING KNOB
12. CALIBRATION INDEX
13. SCREW R.H. #10-32 X 1/2"
14. CALIBRATION PLATE
15. TRIP FINGER

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This device is similar to the dual oil film magnetic overcurrent trip device without the time delay assembly and support and the heavy instantaneous trip springs. As shown in Fig. 20, the armature has a stop plate or weight (Pt. 9) riveted to it and is pivoted on the pin (Pt. 6) set in the frame (Pt. 5). It is restrained by the calibration spring (Pt. 10) only. The armature air gap is adjusted by raising or lowering the stop (Pt. 7) set in support (Pt. 8) which is attached to the frame (Pt. 5) by screws (Pt. 13).

INSTANTANEOUS SHORT-CIRCUIT TRIP DEVICE (FIG. 21)

According to NEMA standards, all air circuit breakers shall be inherently automatic. Hence, if the type AE-1-15 air circuit breaker is not equipped with time delay or instantaneous overcurrent trip device, it will be furnished with the instantaneous short-circuit trip device. For the type AE-1-15 air circuit breaker, this device is set to operate at 3375 amperes. No adjustment for changing this setting is provided.

The instantaneous short-circuit trip device, Fig. 21, is mounted on the upright portion of the lower stud on the front of the mounting base. It consists of a U shaped magnet (Pt. 5) attached to the stud by flat head screws (Pt. 4) through a spacer (Pt. 2) and a brass plate (Pt. 3) to which is attached a brass rod (Pt. 11). This rod supports the armature assembly (Pt. 9) which includes a guide rod (Pt. 8), the trip arm (Pt. 12) and a brass guide tube (Pt. 13) which slides over the rod (Pt. 11). A compression spring (Pt. 14) sits over this tube in a brass cup (Pt. 15) at one end and against the armature at the other end to force the armature against the calibration nuts (Pt. 10) on the rod (Pt. 11). Guides (Pt. 7) are screwed to the magnet by screws (Pt. 6). Current in the lower stud sets up a magnetic field which picks up the armature and trips the breaker when the tripping value is exceeded.

UNDERVOLTAGE TRIP DEVICE

A direct-acting undervoltage trip device is located on lower right hand side of the breaker base and is available for the type AE-1-15 air circuit breakers covered by these instructions. This undervoltage trip device may be either the instantaneous type (Fig. 22A) or the time-delay type (Fig. 22B). Both types are mechanically reset by the opening of the breaker and their construction is such that they do not release to trip the breaker latch until the voltage has dropped to some value below 50% of the normal voltage rating. For the time-delay type tripping does not occur until approximately three seconds or more after loss of voltage, thus preventing tripping on undervoltages of short duration. See Fig. 29 for typical connection diagram.

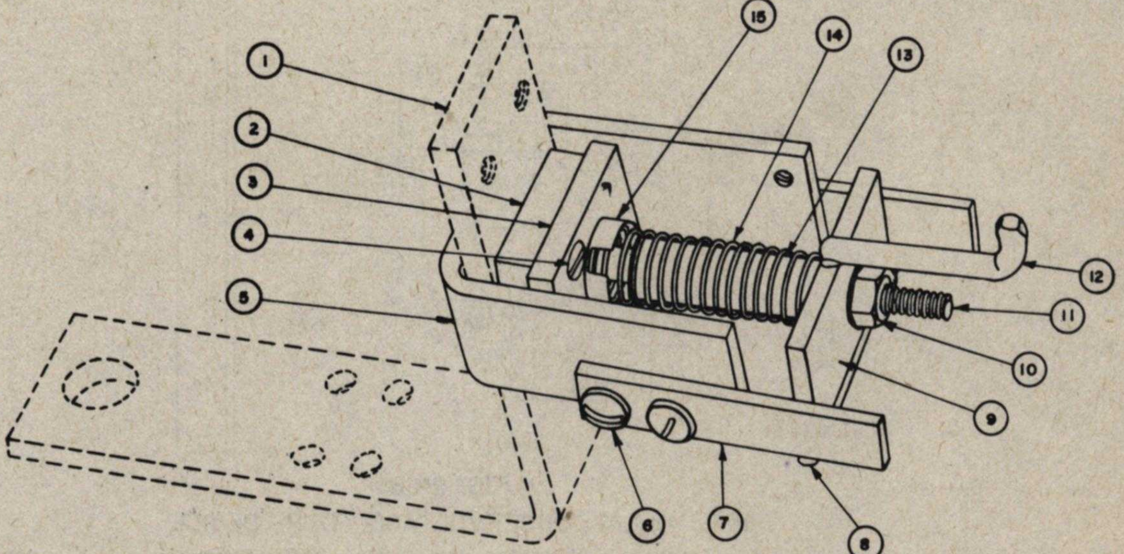


FIG. 21
INSTANTANEOUS SHORT-CIRCUIT TRIP DEVICE

1. LOWER STUD
2. SPACER (IF NEEDED)
3. BRASS PLATE, BRAZED TO 11
4. SCREWS, F.H. 10-32 X 1
5. MAGNET
6. SCREWS, R.H. 10-32 X 7/16 AND LOCKWASHER
7. BRASS GUIDES
8. GUIDE ROD, WELDED TO 9
9. ARMATURE
10. NUTS 1/4-20
11. BRASS ROD, BRAZED TO 3
12. TRIP ARM
13. BRASS TUBE
14. COMPRESSION SPRING
15. BRASS CUP

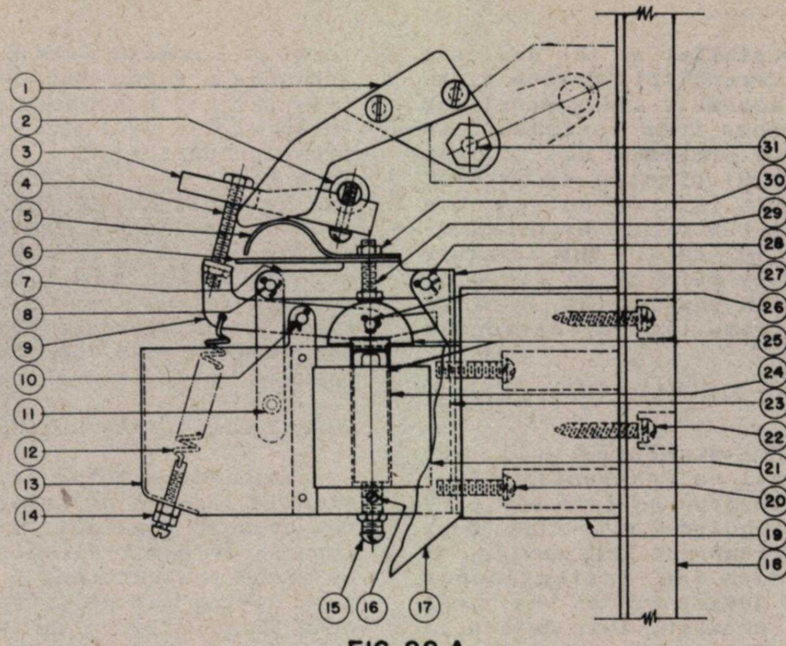


FIG. 22 A

INSTANTANEOUS UNDERVOLTAGE TRIP DEVICE
WITH BREAKER IN OPEN POSITION

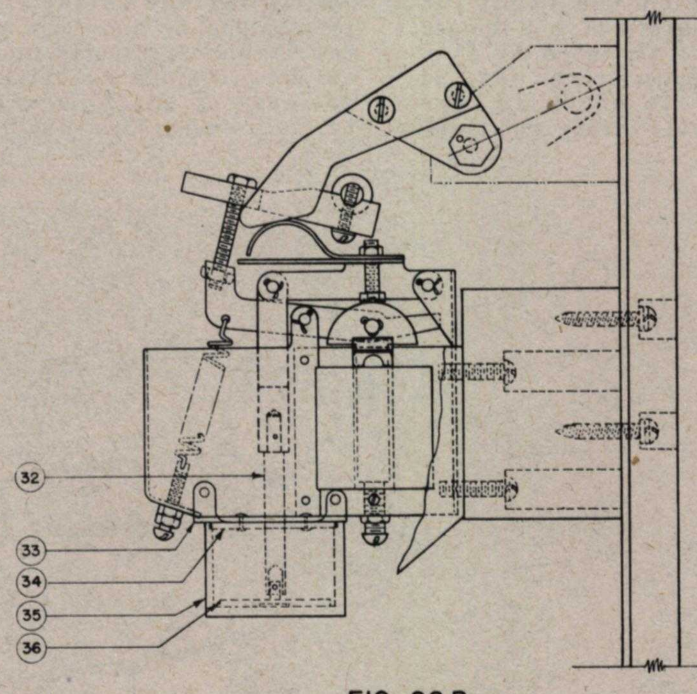


FIG. 22 B

TIME DELAY UNDERVOLTAGE TRIP DEVICE
WITH BREAKER IN OPEN POSITION

1. RESETTING ARM
2. BREAKER TRIP SHAFT
3. COMPOSITION TRIP ARM
4. TRIP ADJUSTING SCREW HEX. HD. #10 - 32 X 1 3/8" AND NUTS
5. BUFFER SPRING
6. FLAT SPRING
7. RESET LINK
8. PIN AND COTTER PINS
9. TRIP LEVER
10. PIN AND COTTER PINS
11. STOP LINK
12. SPRING
13. FRAME
14. SPRING ADJUSTING SCREW R.HD. #10 - 32 X 1 1/2"
15. STOP SCREW R.HD. 1/4 - 20 X 5/8" WITH HEX NUT (DIRECT CURRENT ONLY)
16. SCREW R.HD. SELF TAPPING #4 X 1/4"
17. BARRIER
18. MOUNTING BASE
19. COMPOSITION SPACING BLOCK
20. SCREW R.HD. #10 - 32 X 1 3/4" AND LOCKWASHER
21. COIL
22. SCREW R.HD. SELF-TAPPING #10 WITH WASHER AND LOCKWASHER
23. MAGNET
24. BRASS GUIDES
25. ARMATURE
26. PIN AND COTTER PINS
27. SUPPORT
28. PIN AND COTTER PINS
29. RESET ADJUSTING SCREW HEX HD. #10 - 32 X 3/8"
30. HEX NUT #10-32
31. MAIN SHAFT
32. PLUNGER
33. FRAME
34. COVER
35. OIL DASH POT
36. DISC

INSTANTANEOUS UNDERVOLTAGE TRIP DEVICE

The function of this device is to trip the breaker when the voltage drops below a predetermined value. As long as this voltage, or greater, is impressed on the coil the armature is held down into the coil and the device has no effect upon closing or tripping of the breaker in any way, but when it drops to approximately 50% of normal, or less, the magnet is weakened and a strong spring causes the breaker to trip. The breaker cannot be reclosed until the necessary voltage returns.

The device (Fig. 22A) is mounted under the trip shaft to the right of breaker poles and on an insulation spacer block (Pt. 19) by screws (Pt. 20) which pass through an insulating barrier (Pt. 17), partly cut away and a support (Pt. 27) into the magnet (Pt. 23). The spacer block is mounted on the front of the mounting base by screws (Pt. 22). The coil (Pt. 21) is mounted in the magnet by two brass guides (Pt. 24) between which the armature (Pt. 25) is free to move. The upper ends of the guides are clamped over the magnet and lower ends fastened by screws (Pt. 16). A trip lever (Pt. 9) is pivoted at a central point to frame (Pt. 13) by pin (Pt. 10) and also attached by tension spring (Pt. 12) to the same frame which is riveted to the magnet. A trip adjusting screw (Pt. 4) connects the trip lever to a trip arm (Pt. 3) which is attached to the breaker trip shaft (Pt. 2). When the voltage fails, or drops below the predetermined value, the spring (Pt. 12) draws the trip arm (Pt. 3) down and at the same time raises the armature out of the coil to exert a hammer blow to trip the breaker. The trip lever is stopped by pin (Pt. 28). As soon as the breaker opens, however, a reset arm (Pt. 1), attached to the breaker main shaft (Pt. 31), is forced downward against the buffer spring (Pt. 5), attached to the reset link (Pt. 7), pivoted to the base (Pt. 27) by pin (Pt. 28), which causes the adjusting screw (Pt. 29) to drive the armature firmly down against the bottom member of the magnet in the case of alternating current application or against set screw (Pt. 15) in direct current application. This resetting is necessary as the pull of the magnet, at 50% to 100% of normal voltage, may not be sufficient to draw the armature down against the spring (Pt. 12). To prevent the trip link (Pt. 7) from springing upward to a vertical position and remaining there on tripping, a stop link (Pt. 11) is hooked under trip lever (Pt. 9) and is attached to the reset link (Pt. 7) by pin (Pt. 8).

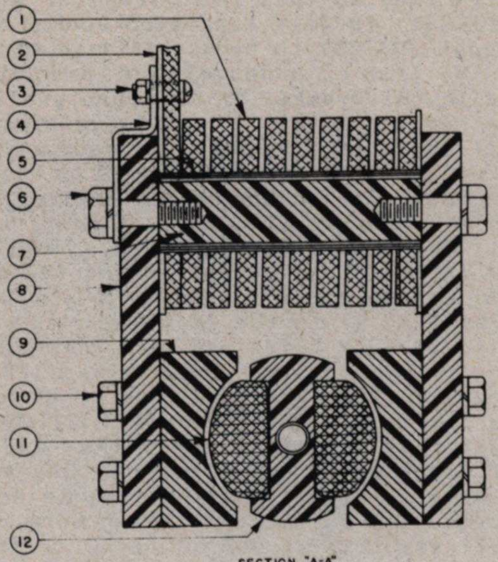
For direct current application, the adjusting brass screw and lock nut (Pt. 15) through the lower member of the magnet are necessary to slightly separate the armature from the magnet to break residual magnetism and allow tripping.

Adjustments consist first, in direct current application, in setting the stop screw (Pt. 15) so that the bottom of armature (Pt. 25) is just separated enough from the magnet (Pt. 23) to breakeresidual magnetism at the time of undervoltage tripping. Then, with the breaker in the open position and the reset arm (Pt. 1) in the reset position, as shown in Fig. 22A, the reset adjusting screw (Pt. 29) should be set to allow 1/32" to 1/8" between the buffer spring (Pt. 5) and the flat spring (Pt. 6) and then lock nut (Pt. 30) should be tightened. With the breaker in the closed position and the coil (Pt. 21) de-energized, turn the trip adjusting screw (Pt. 4) in the trip lever (Pt. 9) until the breaker trips and then continue to turn the trip adjusting screw between 1/2 and 3/4 of a turn more and then lock it in position by lock nut. The spring (Pt. 12) should be adjusted by adjusting screw (Pt. 14) to prevent drop out of armature (Pt. 25) when the breaker is closed and the coil is energized by 50% of normal voltage or more, but to positively trip at 50% of normal or less.

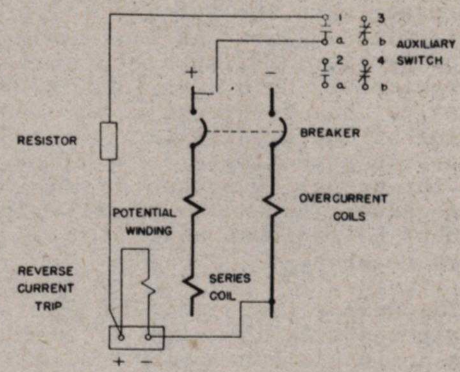
TIME DELAY UNDERVOLTAGE TRIP DEVICE

This device (Fig. 22B) is constructed and operates in the same manner as the instantaneous undervoltage trip device with the addition of the oil film time delay attachment and the omission of the reset link stop (Pt. 11). The time delay attachment consists of disc (Pt. 36) immersed in oil in an oil dash pot (Pt. 35) which is screwed to a cover (Pt. 34) which, in turn, is riveted to its own frame (Pt. 33) and fastened by screws to the frame (Pt. 13) and magnet (Pt. 23). The disc is connected to the reset link (Pt. 7) by plunger assembly (Pt. 32) to delay the tripping of the breaker until the oil film, between the lapped surfaces of the disc and bottom of the dash pot, ruptures. Thus, if normal voltage is restored before the oil film ruptures, the breaker will not open.

First adjust, in direct current application, the clearance of bottom of armature from the magnet by stop screw (Pt. 15) as described in instantaneous undervoltage trip device adjustment. Then, with the breaker in the closed position and the coil (Pt. 21) de-energized, push the armature (Pt. 25) down into the coil to lower the reset link (Pt. 7) and the disc (Pt. 36). Now screw the dash pot cup on the cover (Pt. 34) until the reset link (Pt. 7) begins to lift and then turn it another half turn which should make the cup tight against its seat. If not seated by about a half turn, then turn the adjusting screw (Pt. 29) and repeat until this condition is obtained. Now, when the breaker is opened and the reset arm (Pt. 1) is down, the disc should be pressed firmly against the bottom of the oil dash pot by the buffer spring (Pt. 5) which should now be about 1/32" to 1/8" from the flat spring (Pt. 6). If not, the buffer spring will have to be bent to secure these adjustments. The adjustment of trip adjustment screw (Pt. 4) and the spring (Pt. 12) will be the same as in the instantaneous undervoltage trip device.



SECTION "A-A"



WIRING DIAGRAM (REAR VIEW)
STANDARD METHOD OF CONNECTION.
IF BREAKER POLARITY IS REVERSED, POLARITY OF REVERSE CURRENT POTENTIAL COIL MUST ALSO BE REVERSED.

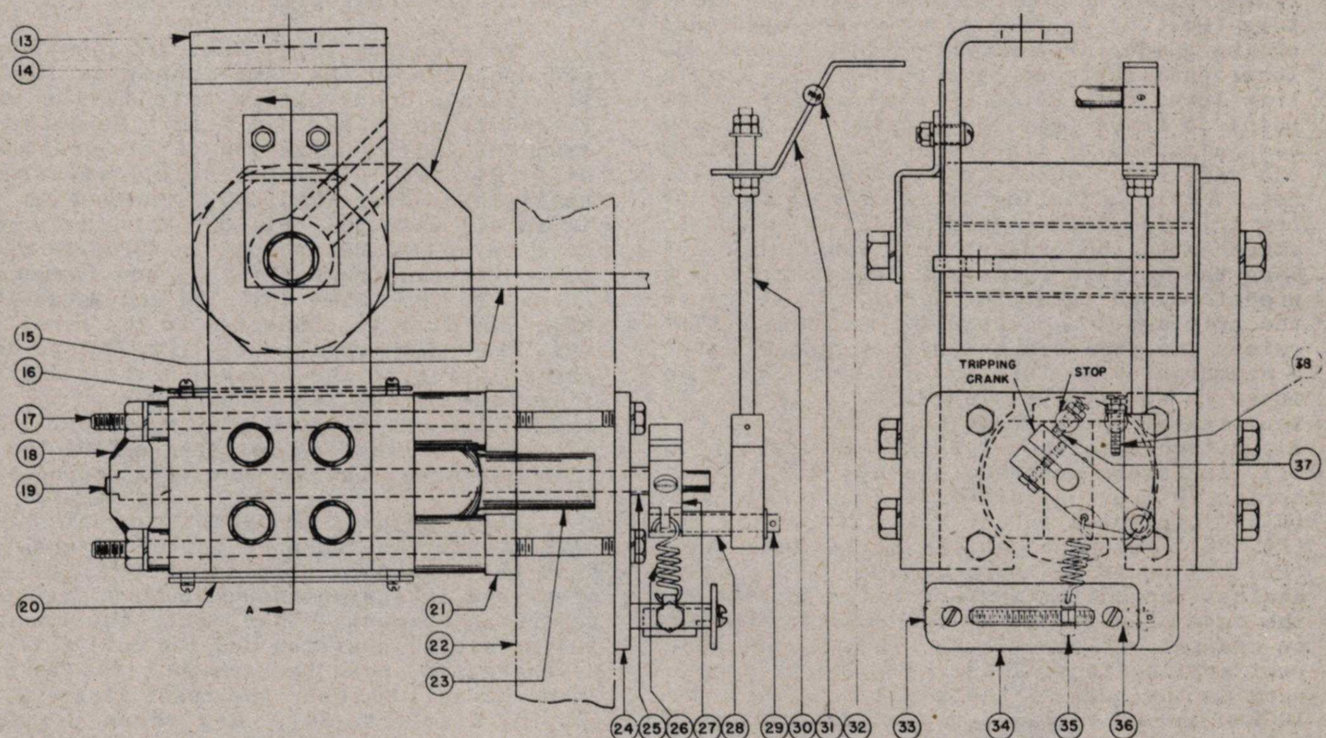


FIG. 23

REVERSE CURRENT TRIP DEVICE (ROTOR TYPE) FOR AIR CIRCUIT BREAKER TYPE AE-1-15

1. COIL AND SLOTTED CONNECTION STRAPS
2. INSULATION WASHER
3. SCREW R.H. $\frac{1}{4}$"-20 X $\frac{3}{4}$" WITH INSULATION BUSHING, WASHERS AND NUT
4. CONNECTION STRAP SUPPORT
5. INSULATION TUBE
6. BOLT, HEX HD. $\frac{3}{8}$-16 X 1$\frac{1}{4}$" AND WASHER
7. CORE
8. SUPPORT
9. POLE SHOES
10. BOLT, HEX HD $\frac{5}{16}$"-18 X 1$\frac{1}{4}$" AND LOCKWASHERS
11. ARMATURE COIL
12. ARMATURE
13. UPPER CONNECTION STRAP OF COIL
14. SIDE CONNECTION STRAP OF COIL
15. LOWER STUD
16. UPPER DUST COVER
17. STUD, $\frac{5}{16}$"-18 X 9" WITH NUTS AND LOCKWASHERS
18. REAR BEARING, BRONZE
19. ARMATURE SHAFT
20. LOWER DUST COVER
21. SPACER
22. REAR OF BREAKER BASE
23. FRONT BEARING, BRONZE
24. ESCUTCHEON PLATE
25. SPACER
26. CALIBRATION SPRING
27. TRIPPING CRANK
28. SPACER
29. PIN
30. TRIP ROD #10-32 AND ASSEMBLY
31. TRIP LEVER
32. TRIP SHAFT
33. CALIBRATION SCREW, HEX HD. WASHER AND COTTER PIN
34. CALIBRATION PLATE
35. CALIBRATION INDEX
36. COMPRESSION SPRING
37. STOP SCREW, FOR RESET POSITION
38. STOP SCREW, FOR TRIP POSITION

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REVERSE CURRENT TRIP DEVICE (ROTOR TYPE)

A direct-acting reverse current trip device of the rotor type is available for AE-1-15 breakers for direct current application which will trip the breaker when the reverse current exceeds the calibration setting. This device is constructed similar to a bipolar motor with stationary pole pieces, on 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 current in the potential coil together with the field set up by the breaker 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, if the current in the series coil is reversed, the torque is reversed to cause reverse rotation which trips the breaker.

As shown in Fig. 23, the motor element is mounted on the back of the breaker base by studs (Pt. 17). The potential coil should be connected to "a" contacts of the auxiliary switch to open the potential circuit when the breaker is open. The armature shaft, (Pt. 19) extends through to the front to operate the tripping equipment. The series coil (Pt. 1) has welded to it an upper connecting strap, (Pt. 13) diagonally slotted, for connection to external load, a welded lateral connecting strap (Pt. 14), also diagonally slotted and a horizontal bar, welded to it, for connection to the lower stud (Pt. 15) of the breaker. The armature shaft (Pt. 19) is supported in bronze bearing castings (Pt. 18 and Pt. 23) which are fastened to the pole shoes (Pt. 9) by studs (Pt. 17). An escutcheon plate (Pt. 24) is mounted on the front of the breaker base by the same studs (Pt. 17) and to it are riveted two posts to support the calibrating plate (Pt. 34), and also two posts to support the stop screws (Pt. 37 and Pt. 38). A tripping crank (Pt. 27) of insulating material is clamped to the extended armature shaft and supports the trip arm assembly (Pt. 30) on pin (Pt. 29). The trip lever (Pt. 31) is fastened by a screw to the trip shaft (Pt. 32) and is free to move over the upper end of the trip rod between properly spaced 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 clockwise (looking from the front) to force the trip crank (Pt. 27) against the stop screw (Pt. 37). The calibrating spring (Pt. 26) also normally holds the tripping crank against this same screw. But when current passes through the series coil in the reverse direction, the armature will tend to rotate counter-clockwise away from the stop screw and after the calibration setting is reached, the reverse rotation of the armature will raise the trip rod (Pt. 30) and trip the breaker. Stop screw (Pt. 38) stops the reverse rotation. A calibration plate (Pt. 34) is mounted on posts of the escutcheon plate. The calibration screw (Pt. 33) passes through these posts and carries a threaded calibration index (Pt. 35) attached to the calibration spring (Pt. 26). By turning the hexagon head of the calibration screw against the compression spring (Pt. 36) the reverse current setting can be changed.

The tripping crank (Pt. 27) is clamped to the armature shaft so that the potential coil will be located on the horizontal center line of the pole pieces when the crank is resting against stop screw (Pt. 37) which should project approximately 1/16" to 3/32" from its support. When rated voltage is applied to the potential coils and the calibration spring (Pt. 26) 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 (Pt. 37) to increase the air gap to pole piece on the trip side. After this adjustment has been completed, the adjusting screw (Pt. 38) can be set to limit the travel of the armature (Pt. 12) so that the tripping crank (Pt. 27) will be stopped slightly above horizontal. In this position, the trip rod (Pt. 30) should trip the breaker with 1/32" overtravel. Slight variations of these adjustments may be necessary to improve the operation of this device.

The adjustment of stop screw (Pt. 37) and tripping crank (Pt. 27) will affect the calibration of the reverse current device, so their 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, preferably to a station battery bus, if possible.

REVERSE CURRENT TRIP DEVICE - (MAGNET TYPE)

A direct acting reverse current trip device of the magnet and hinged armature type is available for AE-1-15 breakers for direct current applications. It will operate to trip the breaker when reverse current exceeds the calibration setting. The principle of operation is shown diagrammatically by Fig. 24. The device consists of a composite magnet with a series coil on the middle core, which carries the breaker current, and a potential coil on the bottom core. An air gap in the upper leg of the magnet is bridged by an armature which is attracted to the magnet and held by flux from the potential coil alone, or more firmly by potential coil flux plus series coil flux due to current through the breaker in the normal direction. When current passes through the breaker in the reverse direction, the two fluxes are no longer cumulative and the flux across the air gap is weakened sufficiently to allow a spring to pull the armature away and trip the breaker.

The details of the device are shown in Fig. 25A and 25B. The series coil (Pt. 4) is in the same location as the standard overcurrent coil between the lower stud of the breaker and the connection to the movable contact on the front of the breaker base. It is mounted on the middle core of the composite magnet (Pt. 2 and Pt. 6) while the potential coil (Pt. 8) is mounted on the bottom core. The magnet is provided with two thin non-magnetic spacers to provide two small magnetic gaps so placed to cause the greater part of both fluxes to flow through the upper leg of the magnet. The armature (Pt. 10) pivots on pin (Pt. 9) which passes through the supporting frames (Pt. 11). It is held to the magnet when the potential coil is energized and is held more firmly when the magnetic force is increased by breaker current in the normal direction.

When the current in the series coil reverses, the magnetic pull on the armature decreases, and when the reverse current exceeds the calibration setting, the pull is not enough to overcome the pull of the tension spring (Pt. 14) which moves the armature away from the magnet. When the armature is pulled away, it strikes a trigger (Pt. 17) attached to a shaft (Pt. 18) mounted in a bearing plate (Pt. 19). Another trigger (Pt. 20) on this shaft engages a trip finger (Pt. 21) on the trip shaft (Pt. 22) which trips the breaker.

As soon as the breaker opens, however, the armature is at once reset against the magnet by a linkage consisting of a crank (Pt. 24) which is attached to the main shaft (Pt. 23), an insulation link (Pt. 25), and a link (Pt. 26) which rotates on pin (Pt. 27). A torsion spring (Pt. 28) on this pin holds link (Pt. 26) and reset lever (Pt. 29) together by pressure against lugs on each. When the breaker opens, the above linkage at once draws the reset lever (Pt. 29) against the armature (Pt. 10) and forces it against the magnet where it is held by the magnetic pull of the potential coil. The potential coil must be connected in the circuit so that it is continuously energized in order to hold the armature against the magnet when the breaker is open, so that the breaker will not be tripped when an attempt is made to close it. When the breaker is closed the reset linkage moves the resetting arm (Pt. 29) away from the armature so that it will not retard the armature when released by reversed current.

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

When all the poles of a breaker require series coils for overcurrent or other purposes, it is necessary to place the reverse current trip device "off pole", in the location of an additional pole to the right of the regular poles. In this case, the series coil of this device is placed in series with the series coil at the adjoining pole by placing a connection bar between the lower studs back of the mounting base. An upper stud is supplied for connection to the source or the load, as desired. An extension of the main shaft is provided to make provision for the resetting links. In such installations, the current in the series coil will be in the opposite direction from the standard practice in which case it will be important that the potential coil should also be reversed.

For correct operation, the armature and magnet faces must be kept clean. The armature should make line contact with the top leg of the magnet and have an air gap of not over .005" at the lower leg. If adjustments are made to the reverse current device, the calibration should be checked after the adjustments are made.

HEAVY ARROWS DESIGNATE LOAD CURRENT FLUX
LIGHT ARROWS DESIGNATE POTENTIAL CURRENT FLUX

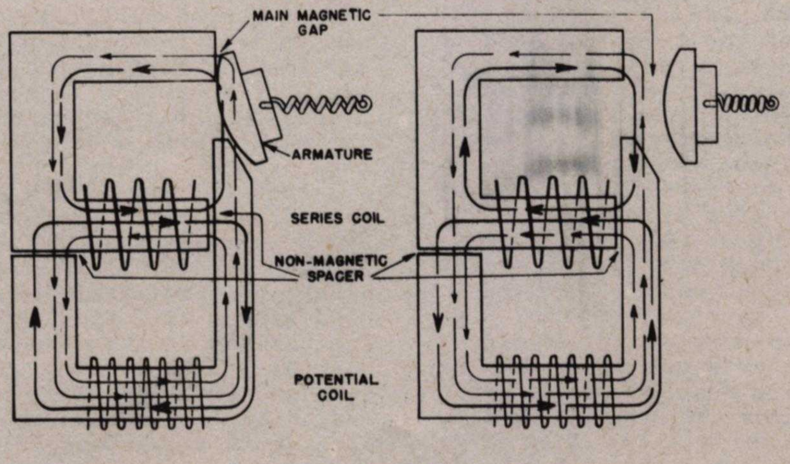

FIG. 24
REVERSE CURRENT TRIP DEVICE (MAGNET TYPE)
DIAGRAMATIC MAGNETIC CIRCUITS

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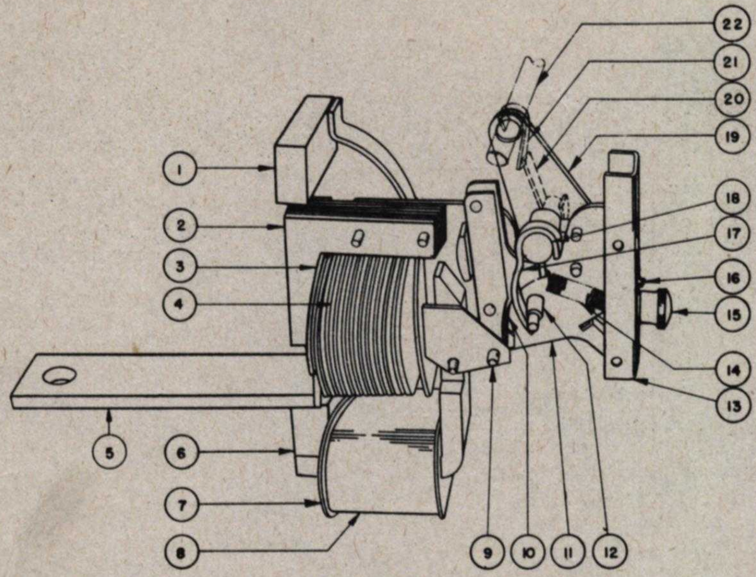
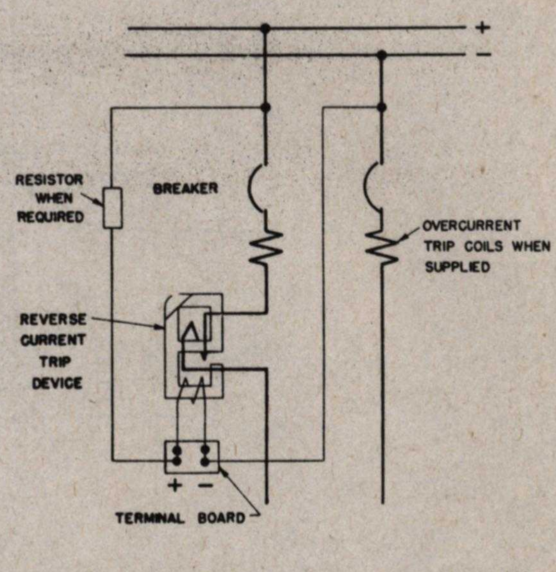


FIG. 25 A
TRIPPED POSITION
(WITH LEFT COVER AND RESET MECHANISM REMOVED)



WIRING DIAGRAM
(BACK VIEW)

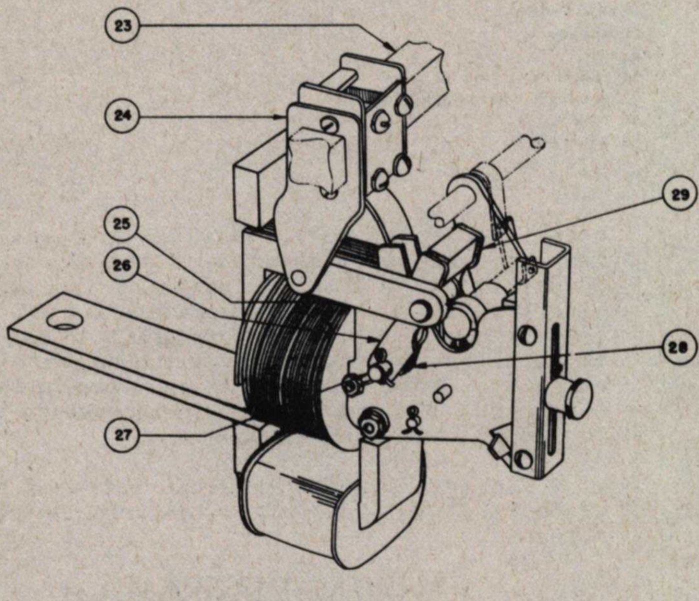


FIG. 25 B
POTENTIAL COIL ENERGIZED AND
BREAKER IN CLOSED POSITION

REVERSE CURRENT TRIP DEVICE (MAGNET TYPE)

1. TERMINAL OF SERIES COIL
2. LAMINATED SECTION OF MAGNET
3. INSULATION
4. SERIES COIL
5. LOWER STUD
6. SOLID SECTION OF MAGNET
7. INSULATION
8. POTENTIAL COIL
9. PIN AND COTTER FOR ARMATURE
10. ARMATURE ASSEMBLY
11. FRAMES
12. STOP PIN
13. CALIBRATION PLATE
14. CALIBRATION SPRING
15. CALIBRATION KNOB
16. CALIBRATION INDEX AND SCREW
17. TRIGGER
18. TRIGGER SHAFT
19. BEARING PLATE
20. TRIGGER
21. TRIP FINGER
22. TRIP SHAFT
23. MAIN SHAFT
24. RESET CRANK
25. INSULATION LINK
26. LINK
27. PIN AND COTTER FOR LINK AND RESET LEVER
28. TORSION SPRING
29. RESET LEVER

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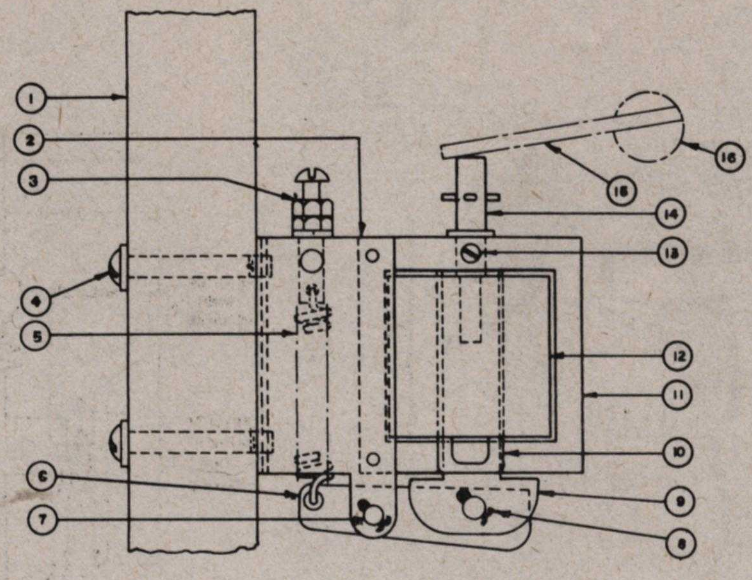

FIG. 26

SHUNT TRIP DEVICE
IN ENERGIZED POSITION

1. BREAKER BASE
2. FRAME
3. ADJUSTING SCREW R.H. 10-32 WITH LOCKNUTS AND WASHER
4. SCREWS R.H. 10-32 AND WASHER
5. ADJUSTING SPRING
6. PIVOT LINK
7. PIN AND COTTERS
8. PIN AND COTTERS
9. ARMATURE
10. BRASS GUIDES
11. MAGNET
12. COIL
13. SCREW SELFTAPPING 4 x $\frac{1}{4}$
14. PLUNGER, COTTER, AND WASHER
15. TRIP LEVER
16. TRIP SHAFT

SHUNT TRIP DEVICE

The function of the shunt trip device (Fig. 26) is to trip the circuit breaker when its coil is energized by the closing of a switch or relay contacts at some remote point. The coil is designed to remain in the circuit only momentarily, hence it should be connected so that the opening of the air circuit breaker contacts will immediately disconnect it from the circuit. Whenever this is impossible, the shunt trip coil should be connected to "a" contacts of an auxiliary switch which will open when the breaker is open.

The device is mounted on the breaker base by screws (Pt. 4) to the right of the operating mechanism and below the trip shaft. The coil (Pt. 12) is mounted in the magnet (Pt. 11), which is riveted to the frame (Pt. 2), and is held in place by two brass guides (Pt. 10) between which the armature (Pt. 9) is free to move. The lower ends of the guides are clamped over the magnet and against the coil to hold it firmly in place and the upper ends are fastened to the magnet by self-tapping screws (Pt. 13). When the coil is energized, the armature is drawn upward into the coil and the trip plunger (Pt. 14), which is fastened to the armature and passes freely through the magnet, is lifted to engage the trip lever (Pt. 15) attached to the trip shaft (Pt. 16) which trips the breaker. When the coil is de-energized, the adjusting spring (Pt. 5), which is fastened to the frame by adjusting screw (Pt. 3), pulls on the pivot link (Pt. 6) to draw the armature out of the coil, thus allowing the trip shaft to return to normal position. An insulation barrier extends on both sides of the device and is supported by the mounting screws between the device and the breaker base.

The trip plunger should overtravel between 1/64" to 1/32" after the trip lever is released.

WIRING DIAGRAM

Fig. 27 shows schematic wiring diagram and Fig. 29 shows complete typical wiring diagram for the control of electrically operated AE-1-15 air circuit breakers without cut-off switch and cut-off relay. Similarly Fig. 28 shows schematic wiring diagram and Fig. 30 shows the complete typical wiring diagram with cut-off switch and cut-off relay with direct current control, while Fig. 31 shows the same as Fig. 30 except with alternating current control.

When an undervoltage trip device is provided with the breaker, tripping can be accomplished by opening the potential circuit rather than energizing a shunt trip device from the control circuit.

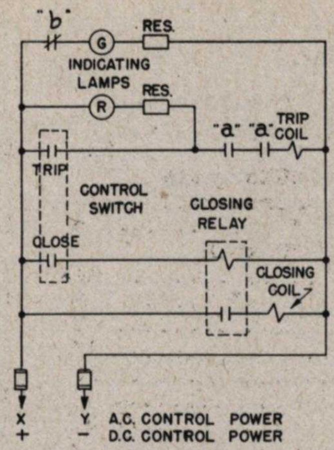

FIG. 27
SCHEMATIC WIRING
FOR SOLENOID OPERATED BREAKER WITH MOMENTARY-CONTACT CONTROL

"a"- AUX. SW. OPEN WHEN BREAKER IS OPEN.
"b"- AUX. SW. CLOSED WHEN BREAKER IS OPEN.
'CUT-OFF'- AUX. SW. OPEN WHEN BREAKER CLOSING MECHANISM IS IN NON-OPERATED POSITION.
⊣⊢- CONTACT OPEN WHEN DEVICE IS IN THE DE-ENERGIZED OR NON-OPERATED POSITION.
⊣/⊢- CONTACT CLOSED WHEN DEVICE IS IN THE DE-ENERGIZED OR NON-OPERATED POSITION.

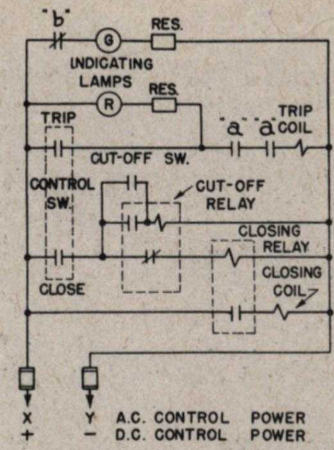

FIG. 28
SCHEMATIC WIRING
FOR SOLENOID OPERATED BREAKER WITH MAINTAINED-CONTACT CONTROL

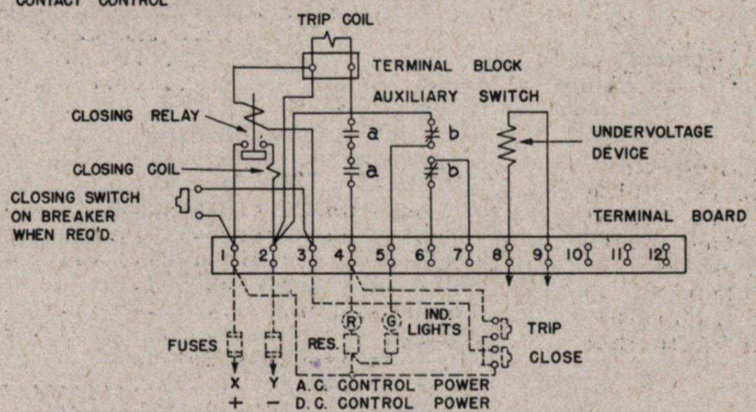

FIG. 29
TYPICAL WIRING DIAGRAM
FOR SOLENOID OPERATED BREAKER WITH MOMENTARY-CONTACT CONTROL

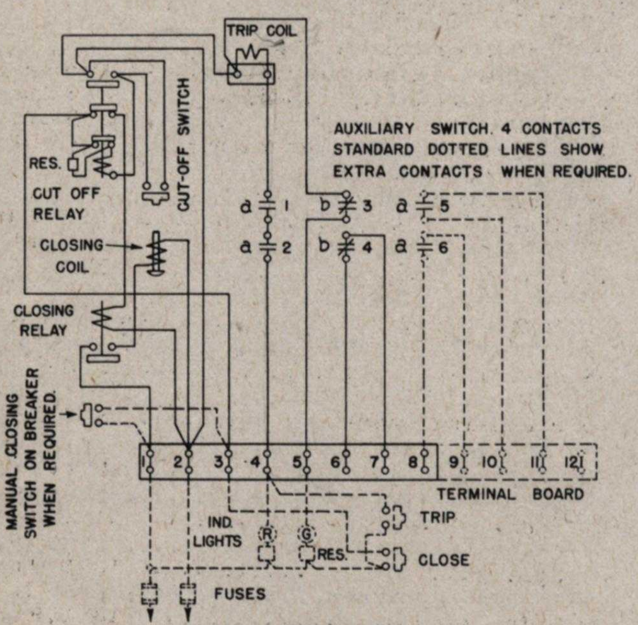

FIG. 30
TYPICAL WIRING DIAGRAM
FOR SOLENOID OPERATED BREAKER WITH MAINTAINED-CONTACT CONTROL

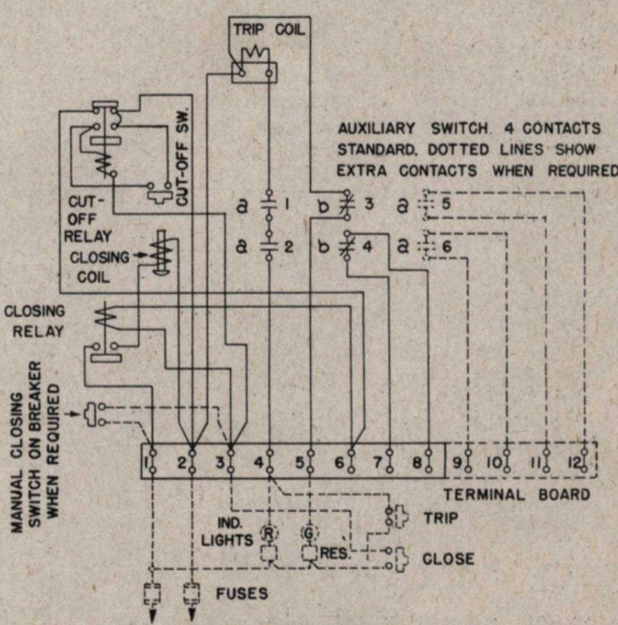

FIG. 31
TYPICAL WIRING DIAGRAM
FOR SOLENOID OPERATED BREAKER WITH MAINTAINED-CONTACT CONTROL

RENEWAL PARTS

Spare parts should be ordered from the nearest Sales Office of the General Electric Company by giving the complete breaker name plate information and the name of the part. Reference should be made to the instruction book giving its number, the piece and figure number of the part desired. If possible, give the General Electric Company's requisition number on which the breaker was purchased.

If several parts are desired as an assembly, reference should be made to each part and instructions included to ship assembled. If the part has not been given a number in any of the figures in the instruction book, it should be referred to as 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 original parts since changes and improvements are made from time to time. However parts which are furnished will be interchangeable with original parts with very little or no extra work beyond that required to install a part identical to the original. If parts identical to original parts are required, the order must state that they are to be identical.

Contacts, Stud and Pole Unit Assembly

Item		Part	Fig.
1	Stationary Contact and Arc Runner	1	7
2	Movable Contact and Flexible Braid	24	7
3	Upper Stud	6	7
4	Screw, R.H.-1/4"-20 X 5/8 with Lockwasher	2	7
5	Upper Stud Bracket	3	7
6	Screw, R.H. - 1/4" - 20 with Washers	4	7
7	Screw, R.H.-1/4"-20 X 3/4" with Hex. Nuts and Washers	5	7
8	Insulated Main Shaft	20	7
	" " "	9	8
	" " "	9	9
	" " "	9	10
	" " "	13	12
	" " "	31	22
	" " "	23	25A-B
9	Contact Support Assembly	21	7
10	Adjusting Spring	22	7
11	Hex. Nut - 1/4" - 20	23	7
12	Screw, R.H.- 1/4" - 20 with Nut and Washer	9	7
	" " "	2	15
13	Screws, Hex.Hd. 1/4" - 20 with Washers	10	7
	" "	3	15
14	Lower Stud (Welded to Series Coil)	12	7
	" " " "	5	15
	" " " "	3	20
	" " " "	15	23
	" " (Welded to Series Coil)	5	25A-B
15	Lower Stud Bracket	15	7
	" " "	7	15
16	Screw, R.H.-1/4"-20X3/4 with Hex. Nut and Washers	13	7
	" " " "	6	15
17	Screw, R.H.-1/4"-20 with Washers	14	7
	" " " " "	8	15
18	Trip Shaft	18	7
	" "	17	8
	" "	17	9
	" "	17	10
	" "	31	17
	" "	2	22
	" "	32	23
	" "	22	25A-B
	" "	16	26
19	Trip Finger	19	7
	" "	28	15
	" "	30	17
	" "	15	20
	" "	21	25A-B

Arc Quencher

Item		Part	Fig.
20	Copper Cooling Pins	30	7
21	Front Arc Runner	27	7
22	Shunt Connector	25	7
23	Screw, R.H. #10-32 X 1/2 with Washer	26	7
24	Baffles	29	7
25	Molded Asbestos Shields and Spacer	28	7
26	Mounting Block	32	7
27	Screw, R.H. 5/16" - 18 with Washer	31	7
28	Locking Plate with Clinch Nut	33	7

Operating Mechanism

Item		Part	Fig.
29	Eccentric Manual Shaft (Manual Operated)	1	8 and 9
30	Link (Manual Operated)	2	8 and 9
31	Link " "	3	8 and 9
32	Magnet (Solenoid Operated)	1	10
33	Closing Coil " "	2	10
34	Armature " "	3	10
35	Closing Links	4	8,9 and 10
36	Pin in Frame	5	8,9 and 10
37	Toggle Links	6A-B C-D	8,9 and 10
38	Spring	7	8,9 and 10
39	Operating Crank	8	8,9 and 10
40	Prop	10	8,9 and 10
41	Pin in Frame	11	8,9 and 10
42	Spring	12	8,9 and 10
43	Trip Latch	13	8,9 and 10
44	Adjusting Screw	14	8,9 and 10
45	Spring	15	8,9 and 10
46	Trip Button and Rod	16	8,9 and 10

Item		Part	Fig.
47	Trip Shaft....................	17	8,9,10
48	Adjusting Screw R.H. 10-32 X 1/2 and Nut..................	18	8,9,10
49	Trip Arm.....................	19	8,9,10
50	Pin in Frame.................	20	8,9,10
51	Riveted Over Pins............	21	8,9,10
52	Manual Handle (Manual Operated).....	22	8, 9
52A	Emergency Closing Handle (Solenoid Operated)..........	22	10

Closing Relay

Item		Part	Fig.
53	Magnet.......................	1	11
54	Coil.........................	2	11
55	Brass Guides.................	3	11
56	Armature.....................	4	11
57	Stationary Contacts..........	5	11
58	Binding Screws and Washers...	6	11
59	Movable Contact Assembly.....	7	11
60	Pin and Cotters..............	8	11
61	Insulation Angle.............	9	11
62	Screws, R.H. #8 X 3/4 Self Tapping and Lockwashers......	10	11
63	Base.........................	11	11
64	Screws, F.H. #10-32 X 3/4....	12	11
65	Screws, F.H. #8-36 X 1/2.....	13	11
66	Screws, R.H. #8-36 X 1-3/8 Lockwashers and Nuts.........	14	11
67	Angle Support................	15	11
68	Screws, R.H. #10-32 X 7/8 Lockwashers and Nuts.........	16	11
69	Insulation Barrier...........	17	11
70	Screws, R.H. Self Tapping #6-40 X 3/16.................	18	11
71	Screw, R.H. Self Tapping #4 X 1/4.....................	19	11

Auxiliary Switch

Item		Part	Fig.
72	End Frame....................	8	12
73	Mounting Block...............	11	12
74	Cover........................	6	12
75	Movable Contact Assembly.....	3	12
76	Stationary Contact Assembly..	4	12
77	Molded Contact Support.......	5	12
78	Molded Barriers..............	2	12
79	Shaft........................	10	12
80	Cams on Shaft................	7	12
81	Crank with Pin and Cotter....	9	12
82	Link.........................	12	12
83	Index Arm, with Pin and Cotter (Extension of operating Crank Pt. 8, Fig. 8).....	14	12

Manual Closing Switch

Item		Part	Fig.
84	Molded Frame.................	1	13
85	Contact Brackets and Stationary Contacts..........	2	13
86	Terminals and Binding Screws .	3	13
87	Operating Rod................	4	13
88	Compression Spring...........	5	13
89	Washer.......................	6	13
90	Contact Spring...............	7	13
91	Insulation...................	8	13
92	Movable Contact Strip........	9	13
93	Guide........................	10	13

Cut-Off Switch

Item		Part	Fig.
94	Molded Frame.................	7	14
95	Mounting Screws, R.H. #6-40 X 1/2.................	12	14
96	Operating Rod................	14	14
97	Compression Spring...........	13	14
98	Contact Spring...............	11	14
99	Movable Contact Strip........	10	14
100	Stationary Contacts..........	9	14
101	Binding Screws...............	8	14
102	Stop.........................	15	14
103	Operating Lever..............	17	14
104	Adjusting Screw..............	16	14
105	Lock Nut.....................	18	14
106	Pin and Cotter...............	19	14
107	Flat Spring..................	3	14
108	Insulation...................	6	14
109	Support Plate................	5	14
110	Pin of Breaker Closing Links.	4	14

Dual Oil Film Magnetic Overcurrent Trip Device

Item		Part	Fig.
111	Magnet.......................	4	15
	"	11	7
	"	2	20
112	Series Coil with Upper Terminal and Lower Stud.........	9	15
	" " " "	16	7
	" " " "	4	20
	" " " "	4	25A-B
113	Insulation Tube..............	10	15
114	Insulation Washer............	11	15
	" "	3	25A-B
115	Armature Assembly............	1	15
	" "	1	20
116	Frame........................	12	15
	"	5	20
	"	11	25A-B
117	Pin and Cotters..............	13	15
	" " "	6	20
	" " "	9	25A-B
118	Pivoted Cover and Support ...	14	15
119	Oil Pot......................	15	15
120	Lower Disc...................	16	15
121	Upper Disc...................	17	15
122	Shank........................	18	15
123	Spring.......................	19	15
124	Instantaneous Spring.........	20	15
125	Calibration Spring...........	21	15
	" "	10	20
	" "	14	25A-B
126	Calibration Adjusting Knob and Screw..................	22	15
	" " " " " ...	11	20
	" " " " " ...	15	25A-B
127	Calibration Index............	23	15
	" "	12	20
	" "	16	25A-B
128	Screws, Hex.Hd. #20 - 32 X 1/2 with Nuts and Washers........	25	15
	" " " " "	13	20
129	Screws, R.H. #8 - 36 X 1/4 with Washers.................	26	15
130	Calibration Plate............	27	15
	" "	14	20
	" "	13	25A-B
131	Adjusting Stop...............	24	15

Dual Thermal Magnetic Overcurrent Trip Device

Item		Part	Fig.
132	Molded Frame	4	17
133	Magnet Assembly	6	17
134	Series Coil	5	17
135	Induction Ring	7	17
136	Armature	19	17
137	Spring Hinge	14	17
138	Yoke	20	17
139	Pin for Yoke and Armature	25	17
140	Adjusting Screw and Spring	21	17
141	Flat Buffer Springs	22	17
142	Leather Buffer	24	17
143	Armature Adjusting Screw and Nut	23	17
144	Reset Spring for Yoke	26	17
145	Adjusting Screw	27	17
146	Trip Arm	29	17
147	Bimetallic Strip	13	17
148	Thermal Trip Arm	9	17
149	Pin	8	17
150	Latch Support	10	17
151	Adjusting Screw	12	17
152	Latch Plate	15	17
153	Torsion Spring	11	17
154	Spring for Thermal Trip Arm	16	17
155	Calibration Knob	17	17
156	Calibration Cam, Spring And Cotter	18	17
157	Short Circuit Spring	1	17
158	Spring Guide and Lock Nut	2	17
159	Tubular Spring Guide And Cotter	3	17
160	Pin	28	17

Instantaneous Overcurrent Trip Device

Item		Part	Fig.
161	Stop and Hex. Nut	7	20
162	Support for Stop	8	20
163	Trip Plate, riveted to Armature Assembly	9	20

Instantaneous Short Circuit Trip Device

Item		Part	Fig.
164	Lower Stud	1	21
165	Spacer (if needed)	2	21
166	Brass Plate	3	21
167	Screw, F.H. #10-32 X 1"	4	21
168	Magnet	5	21
169	Screws, R.H. #10-32 X 7/16 With Lockwasher	6	21
170	Brass Guides	7	21
171	Guide Rod, Welded to Armature	8	21
172	Armature	9	21
173	Nuts, 1/4" - 20	10	21
174	Brass Rod, brazed to Brass Plate	11	21
175	Trip Arm	12	21
176	Brass Tube	13	21
177	Compression Spring	14	21
178	Brass Cup	15	21

Undervoltage Trip Device

Item		Part	Fig.
179	Composition Spacing Block	19	22
180	Screws R.H. #10 Self Tapping with Washers	22	22
181	Magnet	23	22
182	Screws, R.H. #10 - 32 X 1-3/4 and Lockwasher	20	22
183	Support	27	22
184	Barrier	17	22
185	Brass Guides	24	22
186	Screws, #4 X 1/4 Self Tapping	16	22
187	Armature	25	22
188	Pin and Cotters	26	22
189	Stop Screw, R.H. 1/4" - 20 X 5/8 with Hex. Nut (For Direct Current Only	15	22
190	Potential Coil	21	22
191	Trip Lever	9	22
192	Pin and Cotters	10	22
193	Stop Link(Instantaneous Only)	11	22
194	Pin and Cotters	8	22
195	Spring	12	22
196	Spring Adjusting Screw #10 - 32 X 1-1/2 with Locknuts	14	22
197	Frame	13	22
198	Trip Adjusting Screw, Hex. Hd. #10-32 X 1-3/8 with Nuts	4	22
199	Composition Trip Arm	3	22
200	Reset Arm	1	22
201	Reset Link	7	22
202	Flat Spring	6	22
203	Buffer Spring	5	22
204	Pin and Cotters	28	22
205	Reset Adjusting Screw Hex. Hd. #10 - 32X5/8	29	22
206	Hex. Nut #10 - 32	30	22
207	Plunger (Time Delay Only)	32	22
208	Frame " " "	33	22
209	Cover " " "	34	22
210	Oil Dash Pot " "	35	22
211	Disc " "	36	22

Reverse Current Trip Device (Rotor Type).

Item		Part	Fig.
212	Series Coil with slotted Connection Straps	1	23
213	Magnet Core	7	23
214	Magnet Supports	8	23
215	Pole Shoes	9	23
216	Armature	12	23
217	Armature Coil	11	23
218	Connection Strap Support	4	23
219	Insulation Washer	2	23
220	Screws, R.H. 1/4" X 20 X 3/4" with insulation Bushings, Washers and Nuts	3	23
221	Insulation Tube	5	23
222	Bolts, Hex. Hds. 3/8 - 16 X 1-1/4 with Lockwashers	6	23
223	Bolts, Hex. Hds. 5/16 - 18 X 1-1/4 with Lockwashers	10	23
224	Upper Connection Strap of Coil	13	23
225	Side Connection Strap of Coil	14	23
226	Studs 5/16" - 18 X 9" with Nuts and Washers	17	23
227	Rear Armature Bearing	18	23
228	Front Armature Bearing	23	23
229	Armature Shaft	19	23
230	Upper Dust Cover	16	23

Item		Part	Fig.
231	Lower Dust Cover............	20	23
232	Spacer......................	21	23
233	Escutcheon Plate............	24	23
234	Spacer......................	25	23
235	Calibration Spring..........	26	23
236	Trip Crank..................	27	23
237	Spacer......................	28	23
238	Pin.........................	29	23
239	Trip Rod #10 - 32 and Assembly	30	23
240	Trip Lever..................	31	23
241	Calibration Screw, Hex.Hd. with Washer and Cotter......	33	23
242	Calibration Plate...........	34	23
243	Calibration Index...........	35	23
244	Compression Spring..........	36	23
245	Stop Screw for Normal Rotation....................	37	23
246	Stop Screw for Reverse Rotation....................	38	23

Reverse Current Trip Device (Magnet Type)

247	Laminated Section of Magnet..	2	25A-B
248	Solid Section of Magnet.....	6	25A-B
249	Insulation..................	7	25A-B
250	Potential Coil..............	8	25A-B
251	Armature Assembly...........	10	25A-B
252	Stop Pin....................	12	25A-B

Item		Part	Fig.
253	Trigger.....................	17	25A-B
254	Trigger Shaft...............	18	25A-B
255	Bearing Plate...............	19	25A-B
256	Trigger.....................	20	25A-B
257	Reset Crank.................	24	25B
258	Insulation Link.............	25	25B
259	Link........................	26	25B
260	Pin and Cotters.............	27	25B
261	Torsion Spring..............	28	25B
262	Reset Lever.................	29	25B

Shunt Trip Device

263	Frame.......................	2	26
264	Adjusting Screw, R.H. #10 - 32. with Locknuts and Washer.....	3	26
265	Mounting Screws, R.H. #10 - 32 with Washers........	4	26
266	Adjusting spring............	5	26
267	Pivot Link..................	6	26
268	Pin and Cotters.............	7	26
269	Pin and Cotters.............	8	26
270	Armature....................	9	26
271	Brass Guides................	10	26
272	Magnet......................	11	26
273	Coil........................	12	26
274	Screws, #4-1/4 Self Tapping..	13	26
275	Plunger with Washer and Cotters.....................	14	26
276	Trip Lever..................	15	26