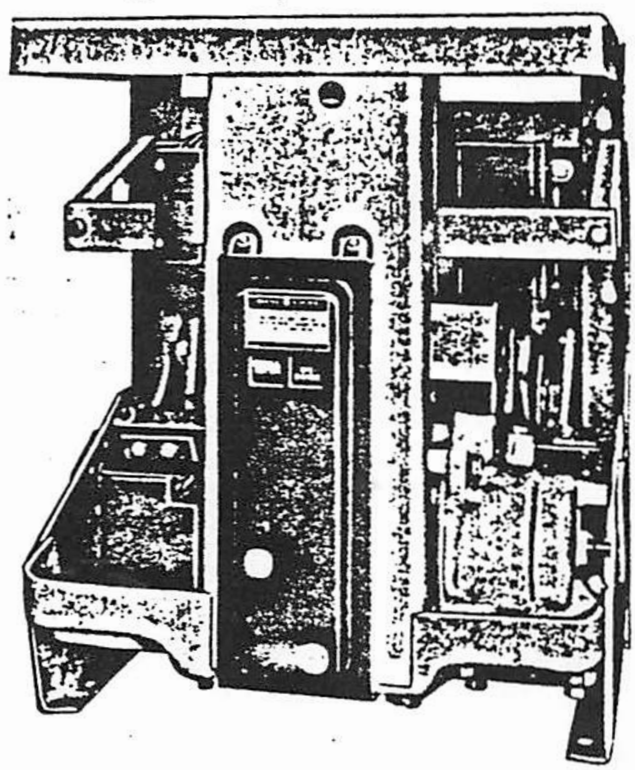
GEH-1798A

INSTRUCTIONS *Switchgear*

AIR CIRCUIT BREAKERS



Type AK-1-50
Electrically
Operated

LOW VOLTAGE SWITCHGEAR DEPARTMENT

GENERAL ELECTRIC

PHILADELPHIA, PA.

CONTENTS

AIR CIRCUIT BREAKERS
TYPE AK-1-50-1, AND AK-1-50-2
ELECTRICALLY OPERATED

INTRODUCTION

Before unpacking, installing, or attempting to operate the Type AK-1-50 Air Circuit Breaker described herein, these instructions should be thoroughly and carefully read.

The ratings for the AK-1-50 is as follows:

Continuous Current Rating	Interrupting Rating	Voltage A.C.	Voltage D.C.
RMS Amperes	RMS Amperes		
15* to 1600	50,000	600	250

*The interrupting rating is limited on the lower rated coils.

These circuit breakers are generally used for protection and control of feeder and branch circuits, including equipment in buildings, industries, power stations and for marine applications within the ratings designated.

The AK-1-50 breaker for D.C. application differs from the breaker used for A.C. applications. The difference in the D.C. breaker is an extra arcing contact per pole with corresponding difference in the upper stud and interrupter.

These instructions apply to breakers used for both D.C. and A.C. applications.

RECEIVING, HANDLING AND STORAGE

Immediately upon receipt of the circuit breaker, an examination should be made for any damage or loss sustained in transit. 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.

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. Care should be used in unpacking 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 have accumulated on the breaker parts.

If the circuit breaker is not installed at once, it should be stored in a clean dry place and preferably placed in a vertical position. It should be supported to prevent bending of studs or damage to the breaker parts. It is advisable not to cover the breaker with any packing or other material that absorbs moisture which may cause corrosion of breaker parts. A covering of paper will prevent dust from settling on the breaker parts.

INSTALLATION

LOCATION

The Air Circuit Breaker should be installed in a clean dry place where it is readily accessible for operation, inspection and proper maintenance. Special enclosures are available for the installation of circuit breakers which may be subjected to dust and moisture or other unfavorable locations.

MOUNTING

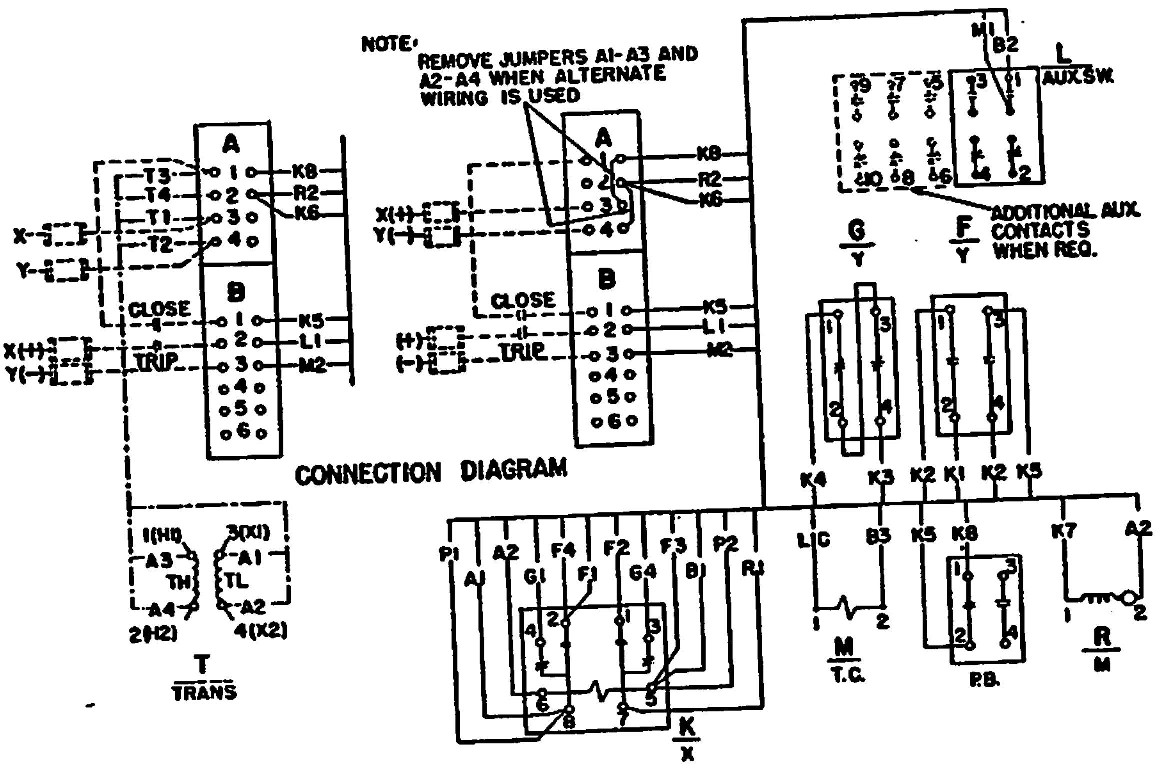
Dead front circuit breakers are designed for mounting in a switchboard or an enclosing case. The mounting of dead front breakers consists of placing the breakers within the enclosed structure and connecting the power buses or cables and making the necessary control connections. The standard mounting depth from the back surface of the breaker base to the back side of the front panel is 16". The front cover of dead front breakers consists either of a hinged door with cut-out or a plate bolted to the panel.

The structural surface to which the breaker is bolted must be flat throughout and the supporting structure must be of sufficient strength to hold the breaker firmly in place. Minimum cutout dimensions must be maintained in order to have proper electrical clearance.

CONNECTIONS

The connections to the circuit breaker studs should be firmly clamped or bolted in place to prevent excessive heating. The connecting cables or bus bars should have a current-carrying capacity specified to limit their temperature rise to that specified for the breakers. If these connecting cables or bus bars are not of sufficient size, heat will be conducted from them to the breaker so that the breaker cannot carry normal current without

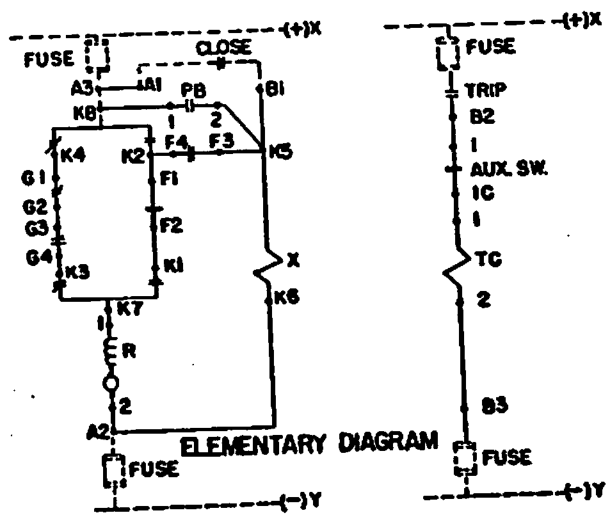
These instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently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



ALTERNATE WIRING USED WITH FOLLOWING POWER VOLTAGE RATING:

380/230 V. AC 50 ∿
460/230 V. AC 25 ∿
460/230 V. AC 50 ∿
460/230 V. AC 60 ∿
575/230 V. AC 25 ∿
575/230 V. AC 50 ∿
575/230 V. AC 60 ∿

CUSTOMER WIRING - - - - - - - - - -
FACTORY WIRING ——————
FACTORY WIRING FOR ENCLOSED BRKRS. / CUSTOMER WIRING FOR STATIONARY BRKRS. —·—·—·—



LIST OF ABBREVIATIONS

A-TERMINAL BOARD LOCATED LEFT SIDE FRONT VIEW
B-TERMINAL BOARD LOCATED LEFT SIDE FRONT VIEW
F, G-CUT OFF SWITCHES
K-CLOSING RELAY TYPE HGA (X)
L-AUXILIARY SW. "a" & "b" CONTACTS TYPE SB-12 (AUX.SW.)
M-SHUNT TRIP (T.C.)
P-PUSH BUTTON CLOSING SW. ON BRKR. (PB)
R-CLOSING SPRING CHARGING MOTOR (M)
T-AUXILIARY POWER TRANSFORMER (TRANS)

Fig. 1 Connection Diagram

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.

WIRING DIAGRAM

Fig. 1 shows the typical elementary and connection diagrams for the control system of electrically operated breakers. It shows the control circuit when the closing springs are discharged and the breaker is open. When rated voltage is applied to the control circuit, the motor will be energized through contacts K (8-4), G (1-2), G (3-4), K (3-7) to motor $\frac{52}{M}$. The motor will charge the closing springs until the motor circuit is opened by cut-off switch contacts G (1-2) and G (3-4). When the G cut-off switches open the F cut-off switches close. Operation of the breaker closing switch will energize the relay coil $\frac{52}{X}$, which in turn opens contacts K (8-4) and K (3-7) and closes contacts K (8-2) and K (1-7). The circuit thru contacts K (8-2) and F (4-3) seals in the coil $\frac{52}{X}$. The motor circuit is now energized through contacts K (8-2), F (1-2), and K (1-7). The motor will then cause the charging crank (10) Fig. 7 to travel beyond the position of right angles to the paddle (11) Fig. 7. Beyond this position the springs will discharge independently of the charging motor and the breaker will close. When the breaker closes the control circuit reverts to its original position and the above cycle can be repeated.

Operating the breaker control switch to the trip position will cause the shunt tripping device to open the breaker. An auxiliary switch "a" contact will interrupt the flow of current through the shunt trip coil.

OPERATION

MANUAL MAINTENANCE CLOSING

To observe the operation of the breaker without power, with breaker open and springs discharged, proceed as follows:

1. Charge the closing spring with the maintenance handle (1), Fig. 3, until the indicator reads "charged".
2. Continue to operate the maintenance handle until the breaker closes.
3. Open the breaker by pushing the trip button (5), Fig. 2.

ELECTRICAL

With the breaker in the open position and the closing springs discharged, as shown by their respective indicators, (3) and (8) Fig. 2, the cycle of operation is as follows:

1. The motor mechanism charges the closing springs, in the front frame, through a linkage. This pre-charging operation occurs automatically if the control circuit is energized.
2. When the closing circuit is energized, either thru a closing switch on the breaker or a remote switch, the motor mechanism drives the spring charging lever over center. This discharges the closing springs and closes the breaker. After the breaker closes, the springs will automatically be pre-charged provided the control circuit has not been opened.

NOTE: The operating mechanism may reset when the closing springs are in the pre-charged position or during the over-running section of the closing operation.

3. After the breaker is tripped, the above cycle can be repeated.

MAINTENANCE

BEFORE INSPECTION OR ANY MAINTENANCE WORK IS DONE, BE SURE THAT THE BREAKER IS IN THE OPEN POSITION. ALL ELECTRICAL POWER, BOTH PRIMARY AND CONTROL SOURCES, SHOULD ALSO BE DISCONNECTED.

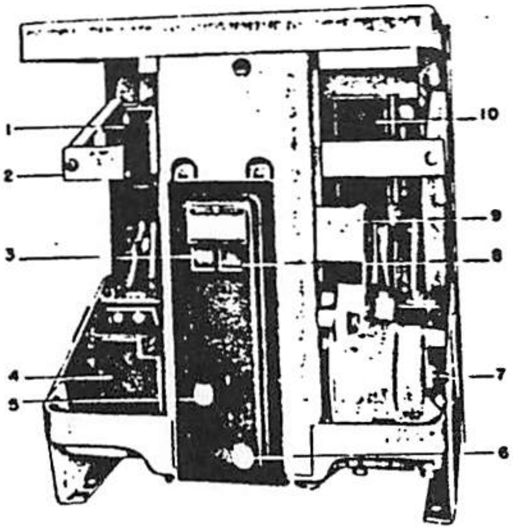
CAUTION: Care must be taken when the circuit breaker is being installed and when any inspection or maintenance work is being done so that the breaker is in the open position and the closing springs are being restrained by the safety pin. The procedure for inserting the safety pin is given below.

The closing spring should be charged with the maintenance handle (1), so that the safety pin (3) can be placed in the lower hold of the push rod (2), refer to Fig. 3. (The upper hole is used in the initial assembly of the springs). Continue to operate the maintenance handle, closing the breaker. This is done so that the safety pin takes the spring force.

Following the inspection period, the closing springs must be recharged, the safety pin removed from the push rod and the pin placed in the retaining spring clip adjacent to the push rod.

INSPECTION

Periodic inspection of the circuit breaker



1. Auxiliary Switch
2. Channel Shaped Bar
3. Position Indicator
4. Relay
5. Manual Trip Button
6. Closing Button
7. Shaft For Manual Maintenance Closing Handle
8. Spring Charged-Discharged Indicator
9. Motor Cut-Off Switches
10. Arc Quencher

Fig. 2 Front View Of Breaker

is recommended at least once a year. More frequent inspections are recommended, if severe load conditions, dust, moisture or other unfavorable conditions exist. A complete inspection of the breaker, including contacts and arc quenchers, should always be made after the breaker has interrupted a short circuit current.

After the breaker has been installed, as well as at the regular inspection periods, slowly operate it manually several times as described above and observe whether the contacts line up properly and make sure that all parts move freely without binding or excessive friction.

If the breaker remains open or closed for a period of six months or more it is recommended that arrangements be made to open and close it several times in succession, preferably under load.

If overheating, not caused by overcurrent, is observed, a complete inspection of the breaker should be made including connections, contacts and flexible connectors.

At all times it is important not to permit pencil lines, paint, oil or other foreign materials to remain on the insulating surfaces of the breaker as they may cause low resistance between points of different potential and result in eventual electrical breakdown.

The breaker should be operated several times at rated voltage to ascertain whether the control circuits are properly connected and that all electrical attachments are functioning properly.

The contacts should be inspected at the regular inspection periods and always after a known short circuit current has been interrupted, to ascertain whether the contacts are worn or pitted, in which case they should be dressed or replaced. It is necessary to remove the arc quenchers in order to properly inspect the contacts.

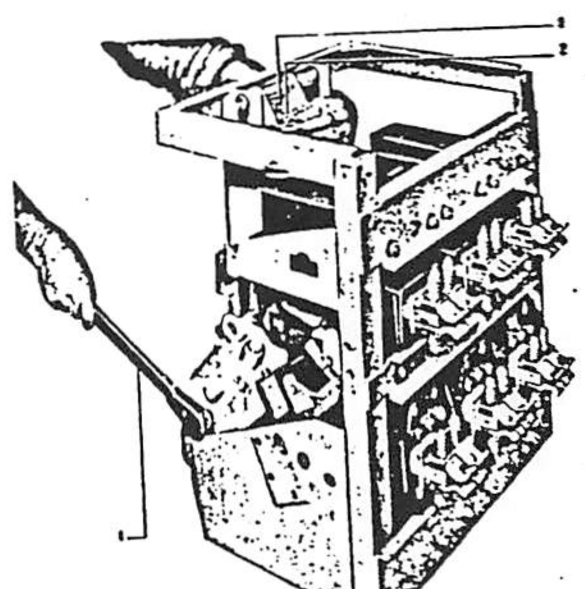
LUBRICATION

In general, the circuit breaker requires moderate lubrication. Bearing points and sliding surfaces should be lubricated at the regular inspection periods with a thin film of G.E. Lubricant D50H15. Hardened grease and dirt should be removed from latch and bearing surfaces by using kerosene. ALL EXCESS LUBRICANT SHOULD BE REMOVED WITH A CLEAN CLOTH IN ORDER TO AVOID ANY ACCUMULATION OF DIRT OR DUST.

The use of cotton waste to wipe bearing surfaces should be avoided, as the cotton ravelings might become entangled under the bearing surfaces and destroy the surface of the bearing.

REPAIR AND REPLACEMENT

In order to repair or replace contacts, operating mechanism or the overcurrent devices, the



1. Manual Maintenance Handle
2. Push Rod
3. Safety Pin

Fig. 3 View Showing Operation Of Breaker With Manual Maintenance Handle And Installation Of Safety Pin

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front frame must be separated from the back frame. To separate the two frames proceed as follows:

1. The breaker contacts must be open with the safety pin in place. (See "Maintenance").

2. Remove the two opening springs (on lower part of breaker) from the out-side pole units.

3. Remove the clevis pin (14) Fig. 5 from the center pole unit.

4. Remove the six nuts from the back frame using a socket wrench with an extension. These include the two nuts at the top of the frame.

5. Remove the operating rod (5) Fig. 10. The two frames can now be separated.

NOTE: It is recommended that the breaker be fastened to a suitable mounting base and a sling or hook hold the front frame as the bolts are being removed.

TROUBLE SHOOTING

TROUBLE	CAUSE	REMEDY
Overheating	Contacts not aligned.	Adjust contacts.
	Contacts dirty, greasy or coated with dark film.	Clean contacts.
	Contacts badly burned or pitted.	Replace contacts.
	Current carrying surfaces dirty.	Clean surfaces of current carrying parts.
	Bolts and nuts at terminal connections not tight.	Tighten, but do not exceed elastic limit of bolts or fittings.
	Current in excess of breaker rating.	Decrease load, rearrange circuit or install larger breaker.
	Excessive ambient temperature.	Provide adequate ventilation.
Failure to Trip	Travel of tripping device does not provide positive release of tripping latch.	Re-adjust or replace tripping device.
	Worn or damaged trip unit parts.	Replace trip unit.
False Tripping	Binds in overload device.	Replace overload device.
Failure to Close and Latch	Binding in attachments preventing resetting of latch.	Re-align and adjust attachments.
	Chipped or worn latch.	Replace latch.
	Latch out of adjustment.	Adjust latch.
	Latch return spring too weak or broken.	Replace spring.
	Hardened or gummy lubricant.	Clean bearing and latch surfaces.
	Safety pin left in push rod.	Remove safety pin.
	Motor burned out.	Replace motor.
	Control devices burned out.	Replace device.

BASIC BREAKER COMPONENTS

ARC QUENCHER

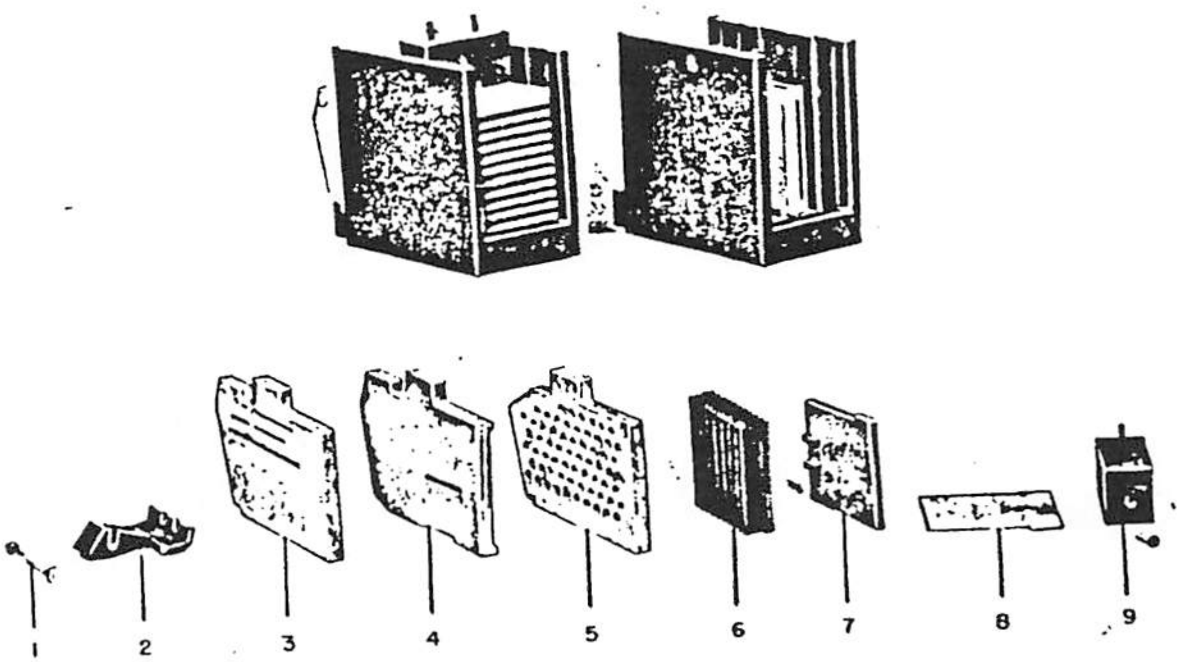
The arc quenchers should be inspected at the regular inspection period and if the barriers are cracked or eroded, they should be replaced.

REPLACEMENT

1. Remove the channel shaped retaining bar by removing two screws.
2. Lift the quencher clear of the movable arcing contacts.
3. During replacement be careful not to overtighten the screws which secure the channel shaped retaining bar. Overtightening the screws will bow the bar and leave the center arc quencher loose.

INSPECTING INNER, SLIDE, AND POCKET BARRIERS, FIG. 4

1. Remove arc quenchers (see above).
2. Remove screws holding spacer block (9).
3. Remove spacer block, steel backplate (8) and compound support (7).
4. Slide muffler (6) from slot and remove. The inner barriers (5) can now be removed for inspection.
5. Remove nut and withdraw stud (1) from cap (2).
6. Remove cap (2). The side (3) and pocket (4) barriers can now be removed.
7. Re-assemble and replace the arc quenchers in the reverse order. Tighten all fastenings after replacement.



1. Stud
2. Cap
3. Side Barrier
4. Pocket Barrier
5. Inner Barrier
6. Muffler
7. Compound Support
8. Steel Back Plate
9. Spacer Block

Fig. 4 Dis-Assembly Of Arc Quenchers To Inspect Inner, Side, And Pocket Barriers

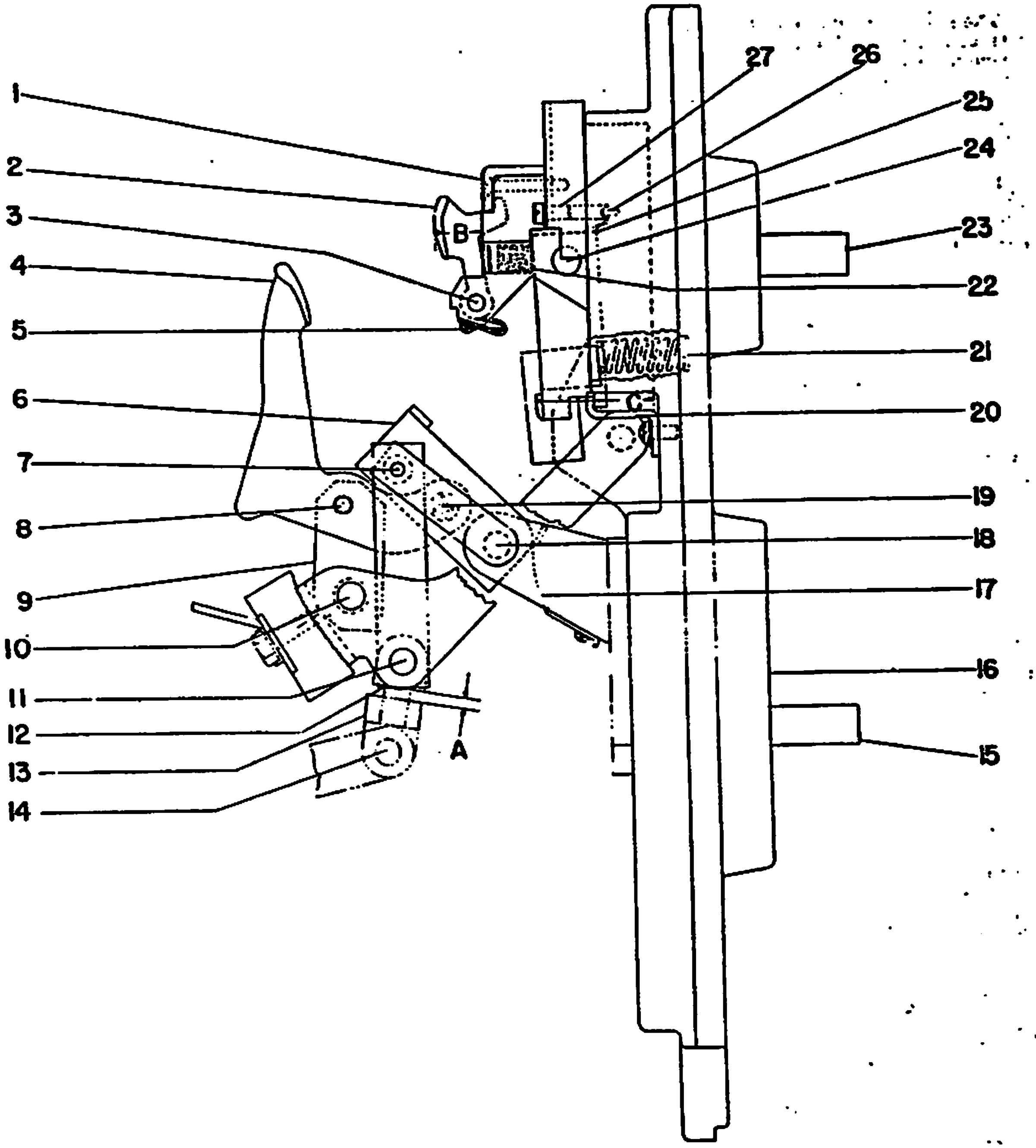
POLE UNIT ASSEMBLY

Each pole unit assembly consists of a set of arcing contacts, a set of main contacts, the operating linkage and the mounting base. See Fig. 5.

The stationary arcing contact consists of a set of parallel contact fingers (2), pin (3), and compression springs (22), which provide continuous contact pressure for the full travel of the contacts.

Flexible braid leads shunt the pivot pin to prevent possible pitting at the pivot point when interrupting high currents.

The movable arcing contact assembly consists of parallel contact arms (4) carried on two movable pivot pins (8) and (19). The arcing contacts interleaf the main contacts and pivot with them about pin (19). This relative motion is obtained by linkages from the upper pin (7) to the breaker mechanism.



1. Screw
2. Sta. Arcing Contact
3. Pin (Sta. Arcing Cont.)
4. Movable Arcing Contact
5. Braid
6. Movable Main Cont.
7. Shouldered Pin
8. Pin (Arcing Cont. Link)
9. Insulating Link
10. Pin (Insulating Link)
11. Pin (Side Link)
12. Link
13. Clevis
14. Clevis Pin
15. Lower Stud
16. Pole Unit Base
17. Spring (Main Movable Cont.)
18. Pin (Movable Main Cont.)
19. Pin (Movable Arcing Cont.)
20. Side Link
21. Spring (Sta. Main Cont:)
22. Spring (Sta. Arcing Cont.)
23. Upper Stud
24. Pin (Sta. Main Cont.)
25. Stationary Main Contact
26. Screw
27. Screw

Fig. 5 Pole Unit Assembly

Fig. 5 (2150150)

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The stationary main contact assembly includes main contacts and intermediate contacts. The intermediate contact surface extends beyond the main contacts and will, therefore, make before the main contacts and break after the main contacts. The number of contacts for each rating is given in Table I.

The movable main contacts pivot around a stationary pin (18), which holds them to the lower block, motion is obtained from a second pin (7), connected by an insulated link (12) to the breaker mechanism. Steel springs (17) force the contacts against the pin to prevent pitting at the pivot point. The movable main contact assembly also contains main and intermediate contacts.

In order to function properly, a definite amount of contact pressure and contact wipe must exist between the movable and stationary contacts. Table I gives the figures for contact wipe and contact pressure. Both wipe and pressure should be checked during the regular inspection period.

TABLE I

	Main Contacts			Intermediate Contacts			Arcing Contacts		
Breaker Type	No. of Contacts	Pressure lbs.	Wipe in Inches	No. of Contacts	Pressure lbs.	Wipe in Inches	No. of Contacts	Pressure lbs.	Wipe in Inches
AK-1-50-1 For D.C.	3	55-65	1/16-3/32	1	55-65	*	3	25-35	5/16-7/16
AK-1-50-1 For A.C.	3	55-65	1/16-3/32	1	55-65	*	2	25-35	5/16-7/16

* The intermediate contact wipe should be at least 1/16" more than the main contact wipe.

MEASURING CONTACT PRESSURE, FIG. 5

1. Remove arc quenchers, (see replacements under "Arc Quencher").
2. With the breaker open, measure the "B" dimension of the stationary arcing contact with the spring (22) full compressed.
3. Place a push-type scale against the stationary arcing contact and push the contact backward until the "B" dimension is 1/16" more than the measurement taken in item 2. The scale should then be read.

MEASURING CONTACT WIPE, FIG. 5

1. Remove the arc quencher.
2. With the breaker open, measure the horizontal distance from the edge of the contact to the surface behind it. ("B" and "C" dimensions).
3. Close the breaker and repeat item 2. The difference between the readings in item "2 and 3" determines the wipe of the contacts. For safety reasons be extremely careful not to trip the breaker.

ADJUSTING CONTACT WIPE AND PRESSURE, FIG. 5

1. With the breaker open, measure dimension "A".
2. Remove the clevis pin (14) and increase dimension "A" to increase the wipe, and decrease dimension "A" to decrease the wipe by turning the clevis (13).

NOTE: If the proper contact pressure does not exist when the contact wipe is within its limits, the stationary contact springs should be replaced.

REPLACEMENTS, FIG. 5

Stationary Arcing Contacts (2)

1. Remove the upper plate by removing two screws (1).
2. Remove screw from braid (5).
3. Remove pin (3) allowing the stationary contacts and springs (22) to fall free.
4. Install new springs and stationary arcing contacts in reverse order.
5. Adjust contact wipe and pressure (see "Adjusting Contact Wipe and Pressure").

Movable Arcing Contacts (4)

The movable arcing contacts should be replaced when the stationary arcing contacts are replaced.

1. Separate the front frame from the pole unit frame (see "Repair and Replacement").
2. Remove pins (6) and (19) and withdraw the contacts.
3. Re-assemble parts in the reverse order.

Stationary Intermediate Contacts (9), Fig. 6

1. Remove screws (27) and remove bracket which holds pin (24) in place. See Fig. 5.
2. Remove clamp which holds lower part of stationary contact.
3. Remove pin (24) and screws (26).
4. Lift out the intermediate contacts.
5. Replace the contacts remembering to match the intermediate contacts on each pole.
6. Re-assemble in the reverse order.

Fig. 6 (8014678)

Movable Intermediate Contacts (8), Fig. 6

1. Remove the movable arcing contacts as described above.
2. Loosen spring (17). See Fig. 5.
3. Slide link (12) to the side and off of pin (7).
4. Slide pins (18) and (7) far enough to the side to allow the movable intermediate contact to be replaced.
5. Re-assemble parts in reverse order.

Always check the contact wipe and pressure following contact replacement.

OPERATING MECHANISM

The electrically operated mechanism includes a motor and a gear reduction unit, which charges the closing springs (16) Fig. 7, through a crank shaft (14) Fig. 7. The crank shaft has an arm with a roller (12) Fig. 7, which rides on the closing cam (2) Fig. 8. The position of this closing cam roller is shown in Figs. 8A, 8B, and 8C. The closing cam is connected to the center pole unit thru a clevis, and through a cross bar controls the opening and closing of the contacts on all pole units.

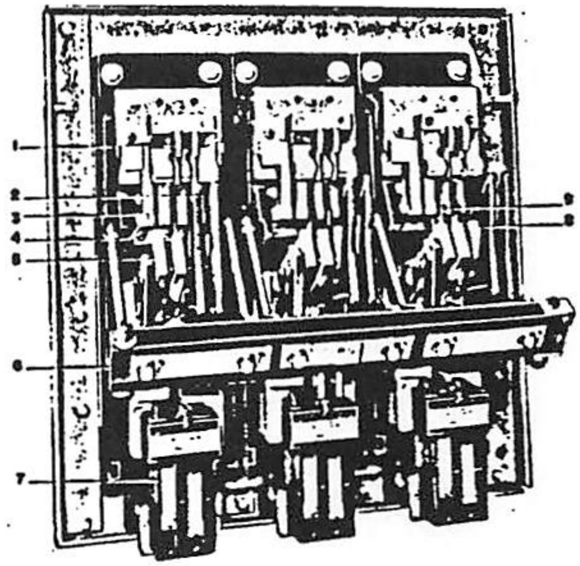
With the breaker open and the closing springs discharged, the sequence of operation is as follows:

CHARGING THE CLOSING SPRINGS, FIG. 7

1. The mechanism in position shown in Fig. 8A.
2. The motor turns the crank (10) Fig. 7, which is mounted on the output shaft of the gear reduction unit. The charging roller, which is on the face of the crank, has paddle arm (11) bearing on it.
3. As the crank turns, the roller pushes the paddle arm upward, thereby charging the closing springs through the spring charging arm (15) of the crank shaft.
4. As the charging roller approaches dead center a cut-off switch opens, de-energizing the motor circuit.
5. The breaker is now ready to close.

CLOSING THE BREAKER

1. Mechanism in reset position, closing springs charged.
2. When the closing circuit is energized, the motor rotates causing crank (10) and roller (7) to move past dead center.
3. The crank (10) is free to rotate counter-clockwise. This permits release of the charging springs, rotating the crank shaft (14).
4. Referring to Fig. 8B and Fig. 8C, rotation of the crank shaft causes the closing roller (15) to push the closing cam (2) into the position shown in Fig. 8C.
5. With the closing cam in this position, the breaker contacts are closed through a clevis and linkage.



1. Stationary Arcing Contact
2. Movable Arcing Contact
3. Stationary Main Contact
4. Clamp
5. Movable Main Contact
6. Cross Bar
7. Series Overcurrent Device
8. Movable Intermediate Contact
9. Stationary Intermediate Contact

Fig. 6 Front View Of Back Frame Assembly

6. The prop (16) engages the closing cam (2), locking it in this position until the breaker is opened.
7. The motor will continue to operate until it has recharged the closing springs (16) Fig. 7, in preparation for the next opening and closing operation.

OPENING THE BREAKER, FIG. 8

1. The rotation of the trip shaft (11) by any of the trip devices allows trip latch (10) to release the prop (5) and the forces from the contact and opening springs reposition the linkage of the operating mechanism into position shown in Fig. 8A.
2. The operating cycle can now be repeated.

ADJUSTMENTS

All adjustments should be made with the operating mechanism in the reset position as shown in Fig. 8B. (The mechanism should be reset by manual operation).

1. The gap between the trip latch (10) and the roller of the reset latch (9) should be between 1/64 to 1/32 inches. This adjustment can be obtained by turning screw (6).
2. The center line of the trip latch (10) should pass through the center of the roller (9). Form the stop (14) to make this adjustment.

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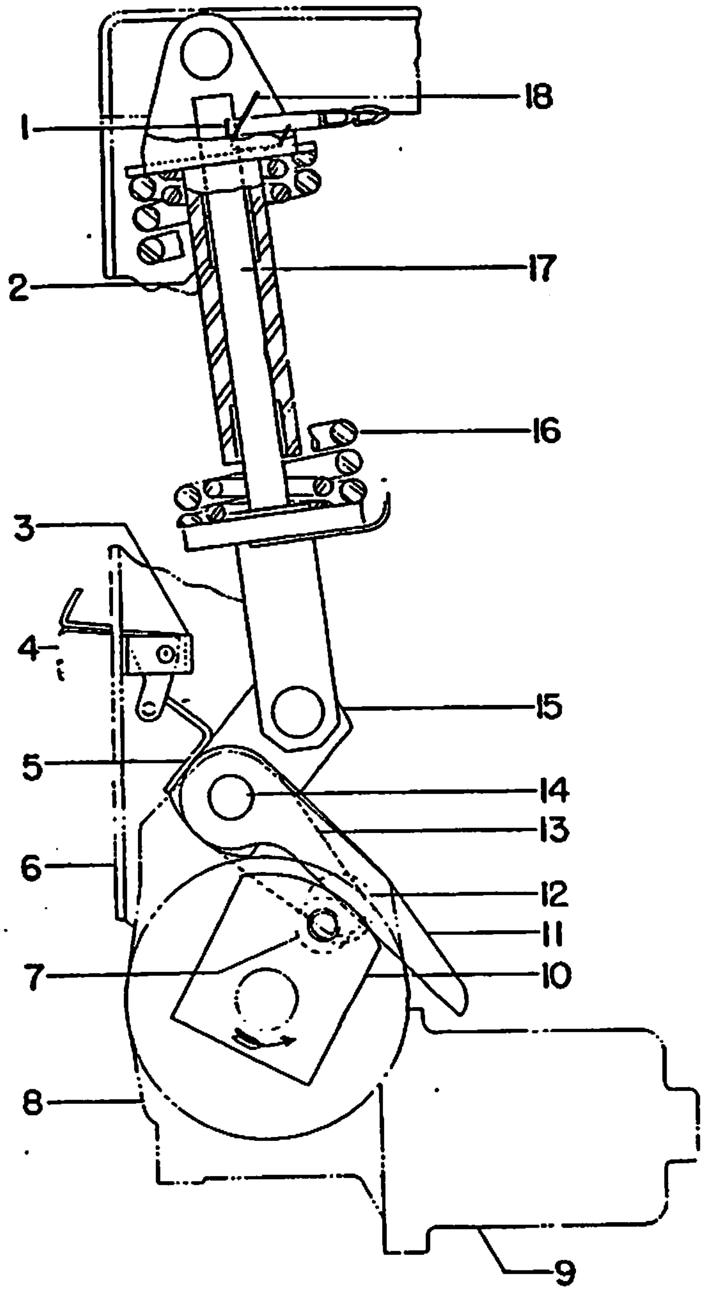

1. Pin
2. Bushing
3. Bracket
4. Indicator
5. Bracket
6. Frame
7. Crank Roller
8. Gear Reduction Unit
9. Motor
10. Crank
11. Paddle
12. Closing Cam Roller
13. Closing Cam Arm
14. Crank Shaft
15. Spring Charging Arm
16. Closing Spring
17. Push Rod
18. Clip

Fig. 7 Closing Spring And Charging Mechanism

3. The distance between the roller on link (3) and prop (5) should be 1/64 to 1/32 of an inch. To obtain this gap advance or retard the nuts on the bottom of the rod thru reset spring (4).

REPLACEMENT

1. Remove the front frame (see "Repair and Replacement" under "Maintenance").
2. Remove pins holding spring charging arms (15) Fig. 7 to closing springs.
3. Remove two bolts underneath frame and two bolts from the front of the frame.
4. Remove any wiring which is attached to the mechanism frame.
5. Note the position of the trip paddles on the trip shaft. Remove the two cotter pins which hold the sections of the trip shaft together. The mechanism is now free to be removed.
6. Re-assemble parts in reverse order. Be sure to replace the trip shaft with the trip paddles in the right position.

MOTOR AND GEAR REDUCTION UNIT

The motor is mounted on the side of the gear reduction unit and through a worm gear and a planetary gear train drives the crank (10) Fig. 7 with a reduction of 1000:1.

REPLACEMENT, FIG. 7

1. Remove front frame (see "Repair and Replacement" under "Maintenance").
2. Remove pins from closing spring charging arm (15).
3. Remove the plate from right end of crank shaft (14).
4. Slide crank shaft to right until left end of shaft clears gear unit housing.
5. Remove the buffer stop which is mounted to the side of the frame and directly over the motor.
6. Open wire connections on motor, and remove wires attached to gear unit housing.
7. Remove four bolts on bottom of front frame and the bolt at the top of the gear reduction unit. The motor and gear reduction unit can now be removed.

The gear reduction unit contains 4 to 6 ounces of oil similar to Atlantic Refining Company's Grade HFS#3. It should not be necessary to add or change oil except when the gear reduction unit and motor are dis-assembled.

AUXILIARY SWITCH

The auxiliary switch is used to make and break various control circuits as the circuit breaker is opened and closed.

The auxiliary switch, refer to Fig. 10, is mounted on the left side of the front frame. As the cross bar (4) moves, with the contacts, to the open

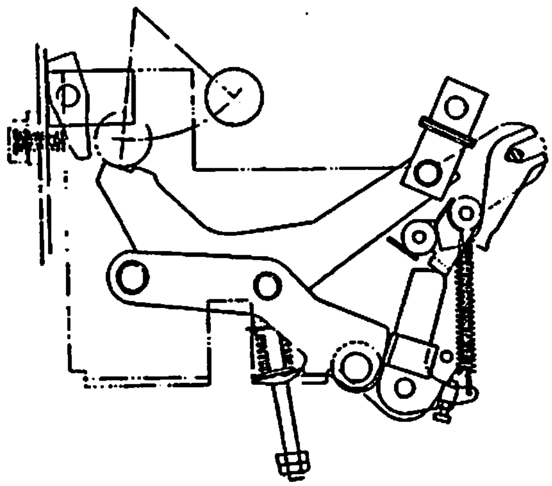

FIG-8A
MECHANISM IN MOTION BEFORE
RESETTING AS SHOWN IN FIG-8B

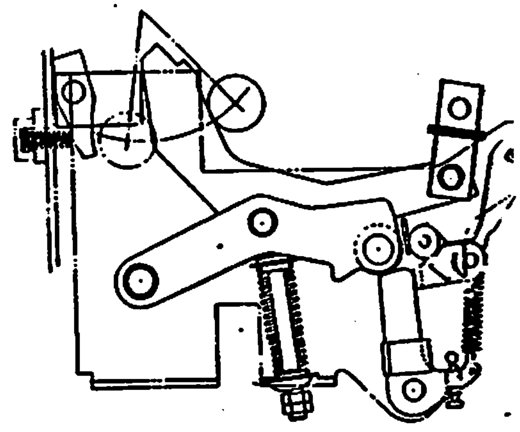

FIG.-8B
MECHANISM IN RESET POSITION
(CLOSING SPRING CHARGED)

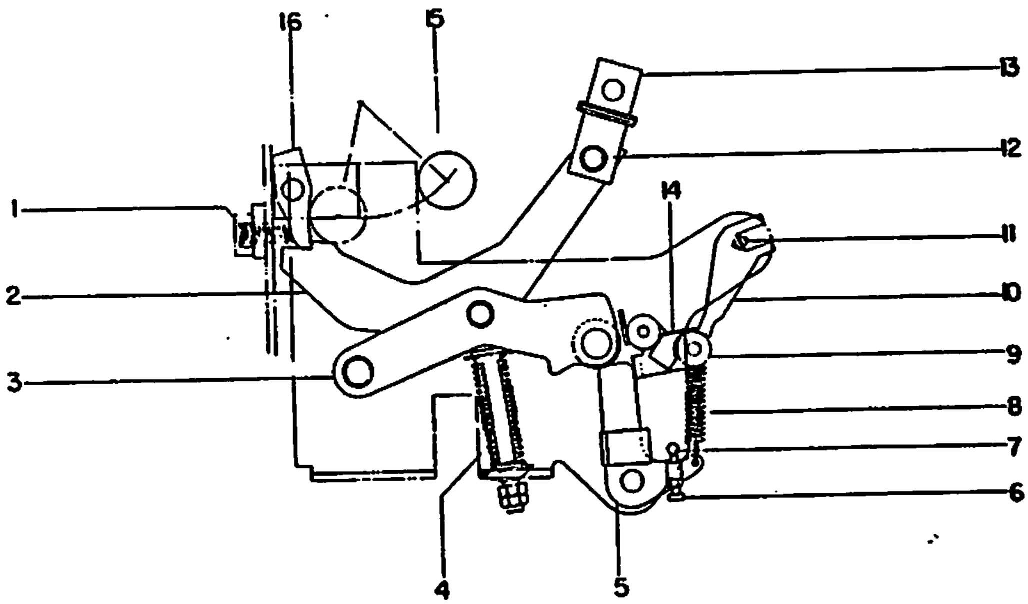

FIG.-8C
MECHANISM IN CLOSED POSITION
(CLOSING SPRING DISCHARGED)

1. Spring
2. Cam
3. Link
4. Reset Spring
5. Prop
6. Adj. Screw
7. Adj. Screw Stop Pin
8. Prop Return Spring
9. Roller
10. Latch
11. Trip Shaft
12. Clevis Pin
13. Clevis
14. Latch Stop
15. Roller
16. Prop

Fig. 8 Operating Mechanism

Fig. 8 (541E305)

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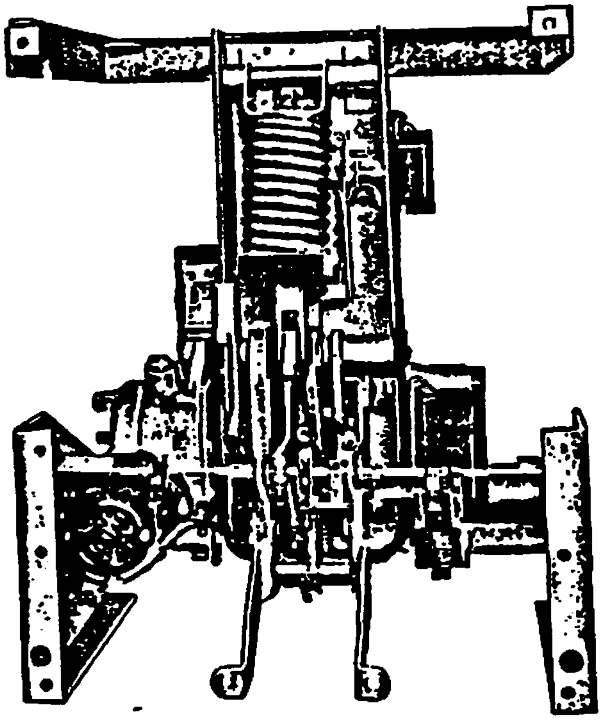
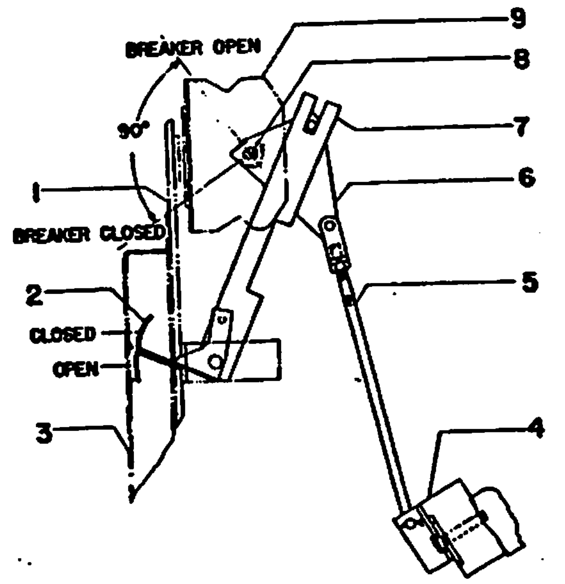
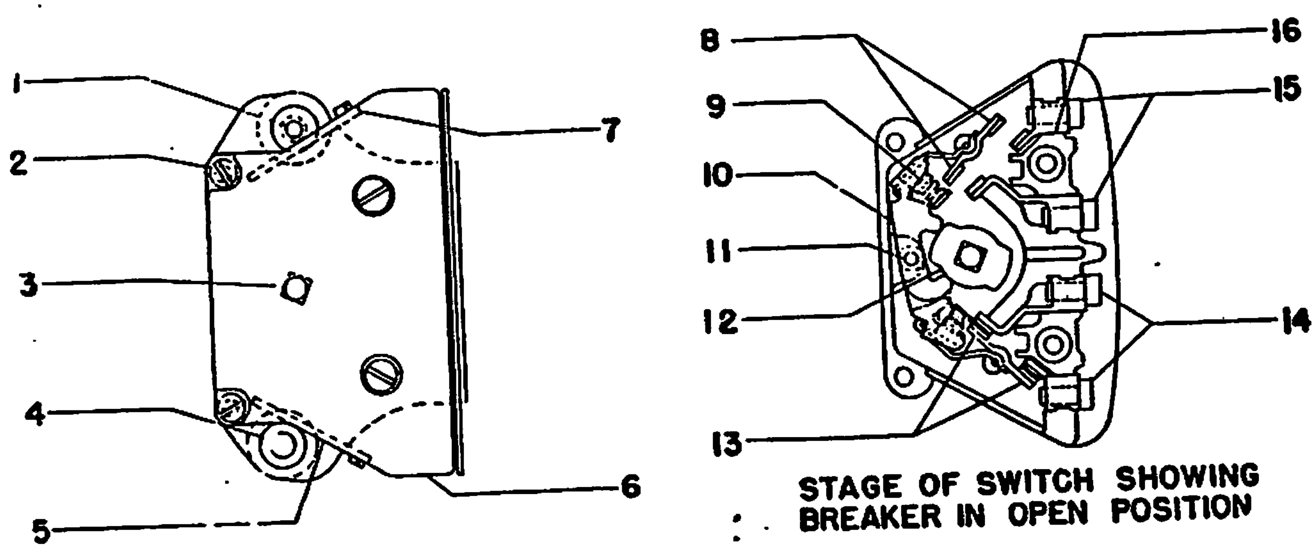


Fig. 9 Back View Of Front Frame Assembly



1. Frame
2. Open & Closed Indicator
3. Front Escutcheon
4. Cross Bar
5. Operating Rod
6. Triangular Link
7. Link
8. Operating Shaft
9. Auxiliary Shaft

Fig. 10 Open And Closed Indicator Linkage



1. Mounting Bolt
2. Tie Bolt
3. Shaft
4. Screw
5. Bottom Cover
6. End Plate
7. Top Cover
8. 'a' Contacts
9. Contact Spring
10. Rocker Arm
11. Pin
12. Cam
13. 'b' Contacts
14. 'b' Terminals
15. 'a' Terminals
16. Barrier

Fig. 11 Rotary Auxiliary Switch

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or closed position it operates a triangular link (6) through an operating rod (5). The triangular link rotates the operating shaft (8) of the auxiliary switch, which, through cams located on this shaft opens and closes the auxiliary switch contacts. The top terminals of the switch are "a" contacts (open when the breaker is open) and the bottom terminals are "b" contacts (closed when the breaker is open).

REPLACEMENT, FIG. 10

1. Disconnect all leads to auxiliary switch.
2. Remove two mounting bolts.
3. Disengage auxiliary switch shaft (8) from the triangular link (6).
4. Set arrow on new auxiliary switch shaft as shown in Fig. 10.
5. Push auxiliary switch shaft (8) into square hole in link (breaker open).
6. Replace mounting hardware and wiring.

ELECTRICAL CLOSING DEVICES AND CONTROLS

A closing switch and motor mechanism are provided for closing the breaker electrically.

CLOSING SWITCH

The closing button is mounted on the right side of the front escutcheon. When the closing button is pressed inward it engages a rod which in turn operates a switch, which is mounted on the front frame to the right of the operating mechanism.

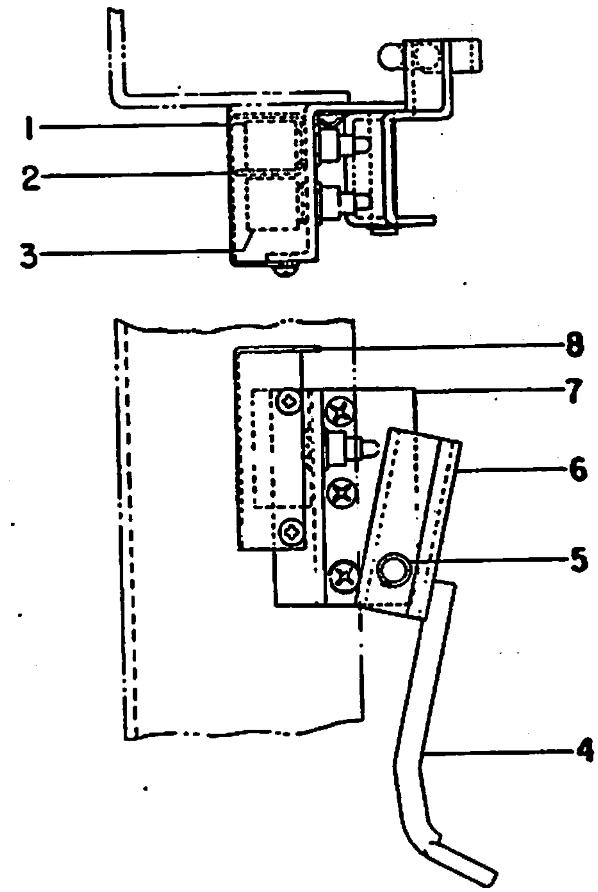
To replace the closing switch, disconnect the wiring and remove the nuts which hold the switch to its mounting bracket.

CUT-OFF SWITCHES

The motor cut-off switches are mounted on the side of the front frame as shown in Fig. 12. At the end of the charging stroke, the cut-off switch (1) opens de-energizing the motor circuit. The cut-off switch (3) closes. When the closing control circuit is energized, the motor operates to discharge the closing springs and close the breaker. After this is completed, the cut-off switch (3) opens, de-energizing the motor circuit. The cut-off switch (1) closes, and the above cycle can be repeated.

REPLACEMENT

If the switches do not function properly, they should be replaced by disconnecting the wiring and removing them from their mounting bracket.



1. "B" Switch
2. Insulation
3. "F" Switch
4. Rod
5. Retaining Ring
6. Lever Bracket
7. Mtg. Bracket
8. Cover

Fig. 12 Motor Cut-Off Switch

CONTROL RELAY

The control relay is mounted on the left side of the front frame. It is used to open and close the motor circuit. To replace remove wiring and holding screws.

PROTECTIVE DEVICES

TIME DELAY UNDERVOLTAGE TRIPPING DEVICE

This device is mounted to a bracket on the left side of the operating mechanism (looking from the front). The purpose of this device is to trip the breaker for undervoltage. For rated voltage, the armature (3) is attracted by the magnet (14). If the voltage falls below the predetermined value the magnet (14) releases the armature (3). Spring (4) then pulls armature (3) upward against the restraining force of the oil in cylinder (10); this action caused a time delay. When the spring overcomes the restraining force of the oil, the armature engages screw (20) thus rotating the trip shaft and opening the breaker. (For parts reference refer to Fig. 13).

ADJUSTMENTS, FIG. 13

An adjusting screw (20) in the trip lever is used to allow from 1/32 to 1/16 inch overtravel after tripping the breaker.

Adjusting screw (2) is used to adjust the armature so that it will pick up at 80% of normal voltage and drop out between 30% and 60% of normal voltage.

Adjusting nut (8) on connecting rod (11) is intended for a minimum amount of adjustment of the time delay setting.

From 1/4 to 3/8 inch of oil should be maintained in the cylinder at all times. In order to make an inspection of the oil, the cylinder may be unscrewed from the cap. G.E. silicone oil 9981LT40NV or similar grade should be used in the cylinder.

REPLACEMENTS

Time Delay Undervoltage Device, Fig. 13

1. Disconnect coil leads.
2. Remove two screws from bracket (1). (Bracket is omitted when instantaneous undervoltage device is used).
3. Remove four mounting screws (21) and remove device.
4. Install new device in reverse order.

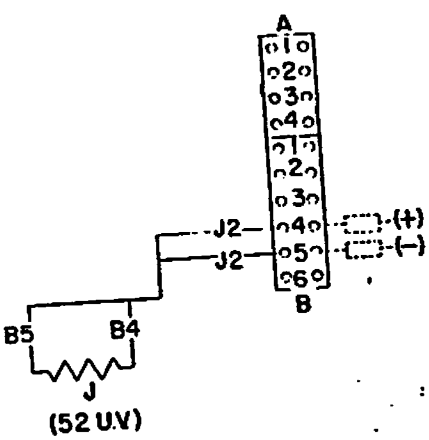
Coil 15

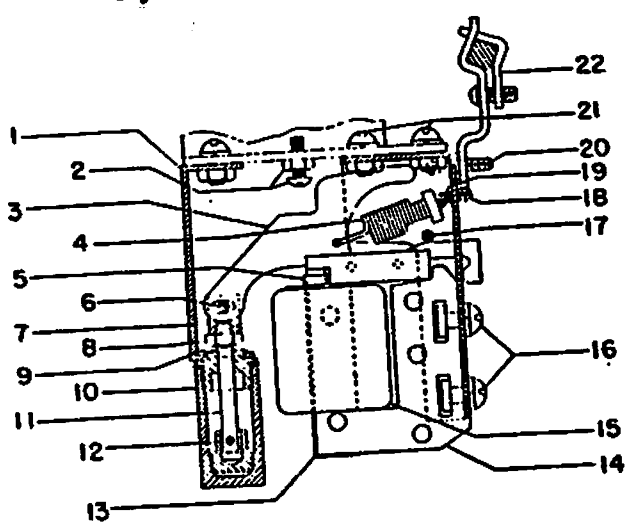
1. Disconnect leads to coil.
2. Remove two screws (16).
3. Remove magnet and coil assembly.
4. Straighten laminations around shading ring (5).
5. Remove shading ring and straighten lower end of coil clamp (13).
6. Remove coil. Install new coil in reverse order.

INSTANTANEOUS UNDER-VOLTAGE TRIPPING DEVICE

The undervoltage tripping device is constructed similarly to the time delay undervoltage tripping device with the exception that the cylinder (10), plunger (12), connecting rod (11), clevis (7), bracket (1), and adjusting nut (8), as shown in Fig. 13, are omitted.

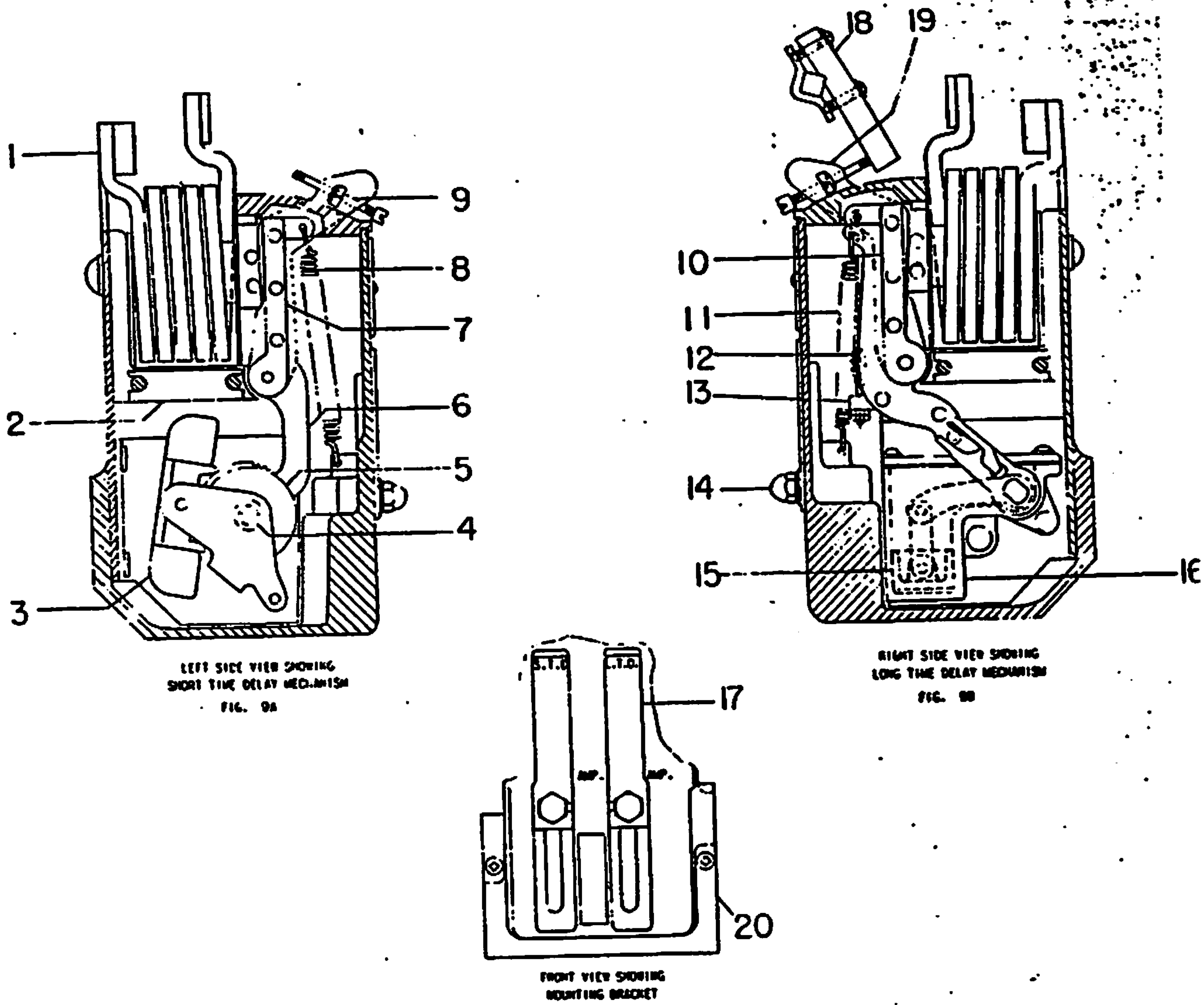
The adjustments and replacements for this device are also the same as those for the time delay undervoltage tripping device.





1. Bracket
2. Adjusting Screw & Nut
3. Armature
4. Spring
5. Shading Ring
6. Pin
7. Clevis
8. Adjusting Nut
9. Cap
10. Cylinder
11. Connection Rod
12. Plunger
13. Clamp
14. Magnet
15. Coil
16. Screws
17. Pin
18. Adjusting Screw
19. Locking Wire
20. Adjusting Screws
21. Mounting Screws
22. Trip Paddle & Clamp

Fig. 13 Time Delay Undervoltage Tripping Device



1. Series Coil
2. Magnet
3. Pallet
4. Pinion
5. Escape Wheel
6. Driving Segment
7. S.T.D. Armature
8. S.T.D. Calibration Spring
9. Trip Arm
10. L.T.D. Armature
11. L.T.D. Calibration Spring
12. Instantaneous Trip Spring
13. Spring Holder
14. Calibration Clamp Nut
15. Plunger
16. Cylinder
17. Calibration Plate
18. Trip Paddle
19. Trip Paddle Adjusting Screw
20. Clamping Bracket

Fig. 14 Series Overcurrent Tripping Device

SERIES OVERCURRENT TRIPPING DEVICE

Each series overcurrent tripping device is enclosed in a molded case and mounted by three screws and a bracket to the lower part of the pole unit base.

The device can be provided with the following tripping combinations:

1. Long time delay, short time delay and instantaneous tripping.
2. Long time and short time delay tripping only.
3. Long time delay and instantaneous tripping.
4. Short time delay and instantaneous tripping.
5. Short time delay tripping only.
6. Instantaneous tripping.
   (a) Adjustable
   (b) Non-adjustable

SHORT TIME DELAY TRIPPING, FIG. 14

The armature (7) is retained by calibrating spring (8). After the magnetic force, produced by an overcurrent condition, overcomes this restraining force, the armature movement is further retarded by an escapement mechanism which produces an inverse time delay characteristic. The mechanism is shown on Fig. 14a.

LONG TIME DELAY TRIPPING, FIG. 14

The armature (10) is retained by the calibration spring (11). After the magnetic force, produced by an overcurrent condition, overcomes this restraining force, the armature movement is further retarded by the flow of silicone oil in a dashpot, which produces an inverse time delay characteristic. The mechanism is shown on Fig. 14b.

INSTANTANEOUS TRIPPING, FIG. 14

(a) Adjustable instantaneous tripping takes place after the magnetic force produced by an overcurrent condition, overcomes the restraining force of the calibration spring which can be adjusted by the calibration clamp nut (14).

(b) Non-adjustable instantaneous tripping takes place after the magnetic force produced by an overcurrent condition overcomes the restraining force of a non-adjustable spring.

Selective tripping is obtained when the breakers in the electrical distribution system are arranged on the basis of a progressive series of time and current pickup. This will allow the breaker having the shorter time setting and the lower pickup to trip before the breaker having the longer time setting and the higher current pickup, provided the fault is on the part of the line protected by the breaker having the lower setting. Hence, if a fault occurs in any part of the electrical system, only the breaker nearest the fault will trip.

In order to reduce the possibility of damaging the equipment and to provide maximum safety to the operator, the overload caused by a fault is removed in a minimum amount of time by selective tripping. Overloads producing current up to 5 or 10 times the breaker rating are removed in a matter of a few seconds while currents in excess of this value are removed in a fraction of a second.

For the exact characteristics and setting of each breaker in a selective system, reference should be made to the coordination chart furnished for the particular system.

ADJUSTMENTS, FIG. 14

Calibration clamping nuts (14) are used to set the desired pickup for the adjustable elements.

To adjust for approximately 1/32" overtravel of trip arm (9) after tripping:

1. Check trip latch engagement. See "Adjustments - Operating Mechanism".
2. Loosen the locknut and turn the adjusting screw (19) on the trip arm (9). The screw should not touch the trip paddle when the breaker is "open" and the latch is reset, but should have a clearance not exceeding 1/32".
3. Tighten the adjusting screw locknut on the trip arm.

REPLACEMENT

1. Remove front frame (See "Repair and Replacement").
2. Remove the bolts holding the coil to the lower stud.
3. Remove bracket and mounting screws.

Fig. 15 Checking Travel Distance Of Series Overcurrent Tripping Device

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4. Before installing a new device, check the travel of the trip arm with a rod or wire and push the armature solidly against the magnet (see Fig. 15). The trip arm should move at least 5/32". If there appears to be insufficient movement of the trip arm, or if the armature appears to be binding, the device should not be used.
5. Replace new device in reverse order.
6. Adjust device as described above.

NOTE: No component parts of the overcurrent tripping devices are replaced. It will be necessary to install a new device when parts are worn or damaged.

REVERSE CURRENT TRIPPING DEVICE

The device is enclosed in a molded case and is mounted on the right pole base similarly to the series overcurrent tripping device.

The reverse current tripping device (see Fig. 17) consists of a series coil (2) with an iron core mounted between two pole pieces (9), also a potential coil (7) connected across a constant source of voltage and mounted around a rotary-type armature (10). Calibration spring (6) determines the armature pick-up when a reversal of current occurs.

As long as the flow of current through the breaker is in the normal direction, the magnetic flux of the series coil and the magnetic flux of the potential coil produce a torque which tends to rotate the armature counter-clockwise. The calibration spring also tends to rotate the armature in the same direction. This torque causes the armature to rest against the stop screw (12) attached to a bearing plate on the right side of the device.

If the current through the series coil (2) is reversed, the armature (10) tends to move in the clockwise direction against the restraint of the

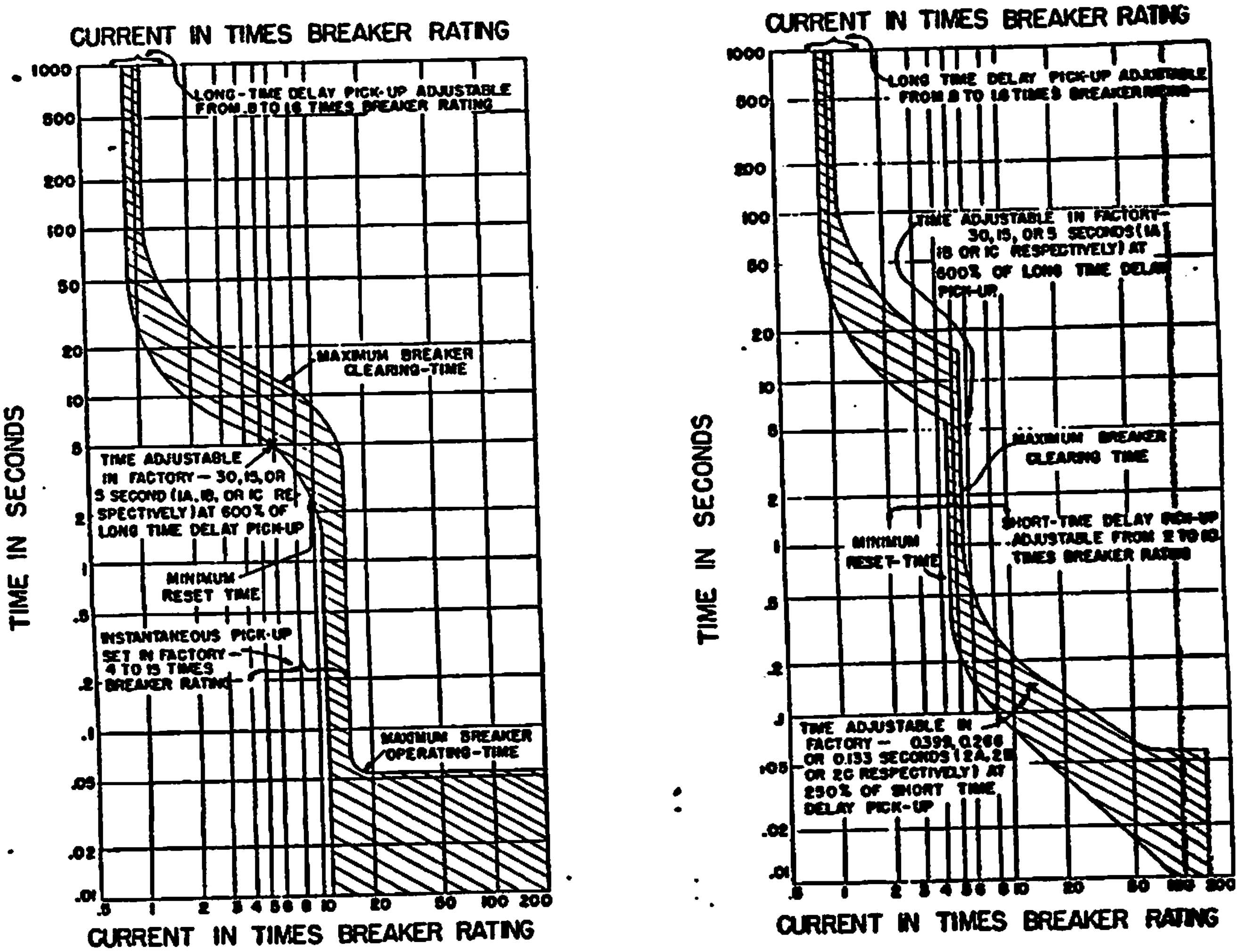

Fig. 16 Typical Time-Current Characteristic

Fig. 16 (2150180)

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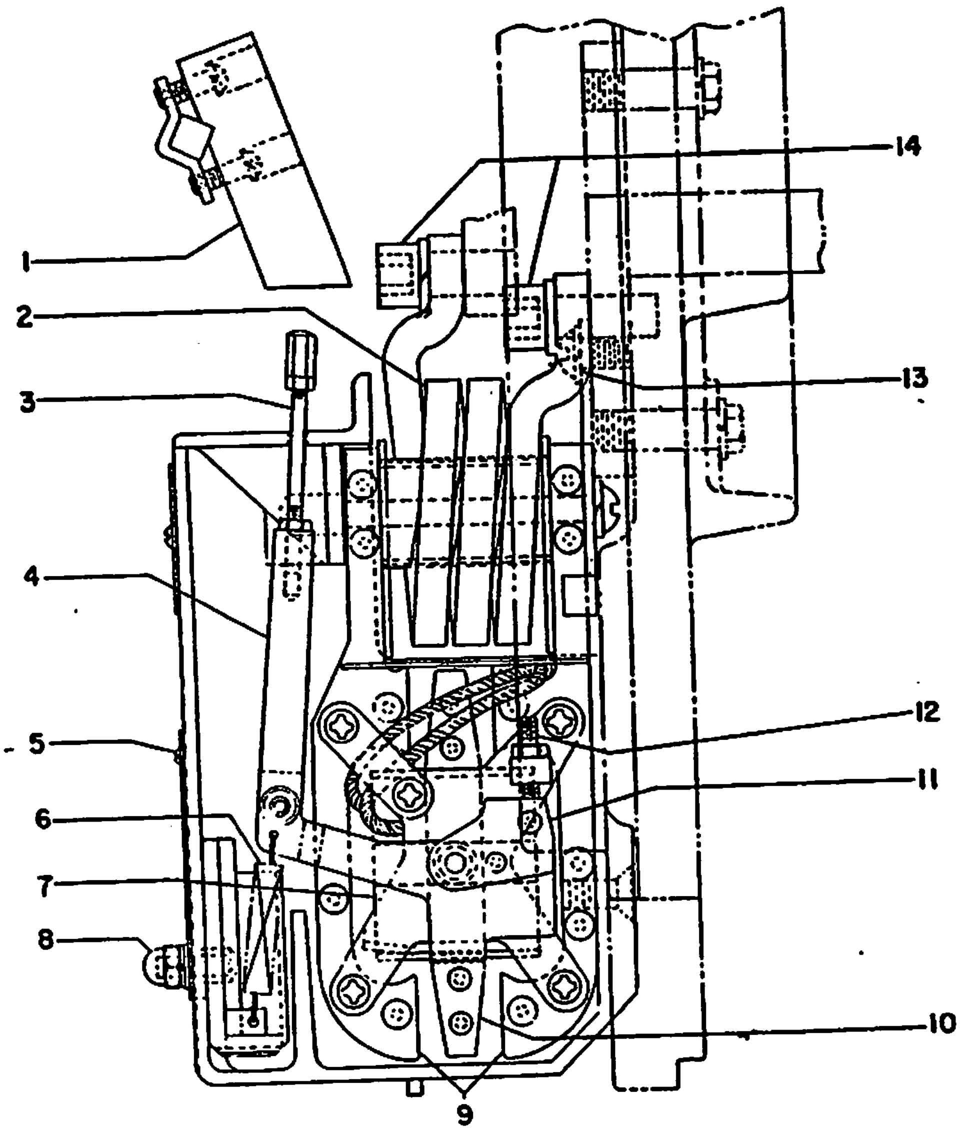
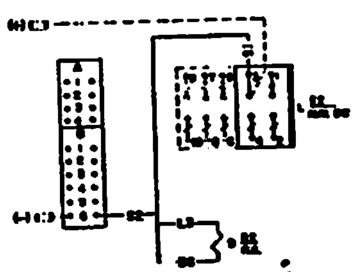




1. Trip Paddle
2. Series Coil
3. Trip Rod
4. Trip Crank
5. Setting Sealing Screw
6. Spring
7. Potential Coil
8. Calibration Nut
9. Pole Pieces
10. Armature
11. Counter Weight
12. Stop Screw
13. Mounting Screw
14. Screw

Fig. 17 Reverse Current Tripping Device

calibration spring (6). When the current reversal exceeds the calibration setting, the armature revolves clockwise causing the trip rod (3) to move upward engaging the trip paddle (1), thereby tripping the breaker.

ADJUSTMENTS, FIG. 17

No adjustments should be made in the field with the exception of checking for overtravel of the trip rod. Proper overtravel of the trip rod is provided, if the trip rod advances the trip paddle between 1/32" to 3/64" beyond the point where the breaker trips. To adjust for this amount of overtravel, lift the trip rod as high as possible after backing off the adjusting nut on the trip rod (3) so that it will not touch the trip paddle (1). Advance adjusting nut on the trip rod until you can just tri the breaker by lifting the trip rod (3) as far as · will go. Then advance this same adjusting nut a additional 1-1/2 turns, thereby assuring positiv tripping. Lock adjusting nut.

Be extremely cautious not to have hands nea moving parts of the breaker when making this ad justment.

REPLACEMENT

After removing the wiring for the potenti: coil the reverse current device can be remove and replaced by following the procedure outline for replacing the series overcurrent device. Fc wiring, see Fig. 17.

MISCELLANEOUS

SHUNT TRIPPING DEVICE

The shunt tripping device (refer to Fig. 18) is mounted on a bracket attached to the left side of the operating mechanism (looking from the front).

A remote switch or relay contacts are used to close the circuit of the device causing the armature (9) to engage the trip paddle (11), thereby tripping the breaker. The spring (2) is used to return the armature to the neutral position after the breaker trips.

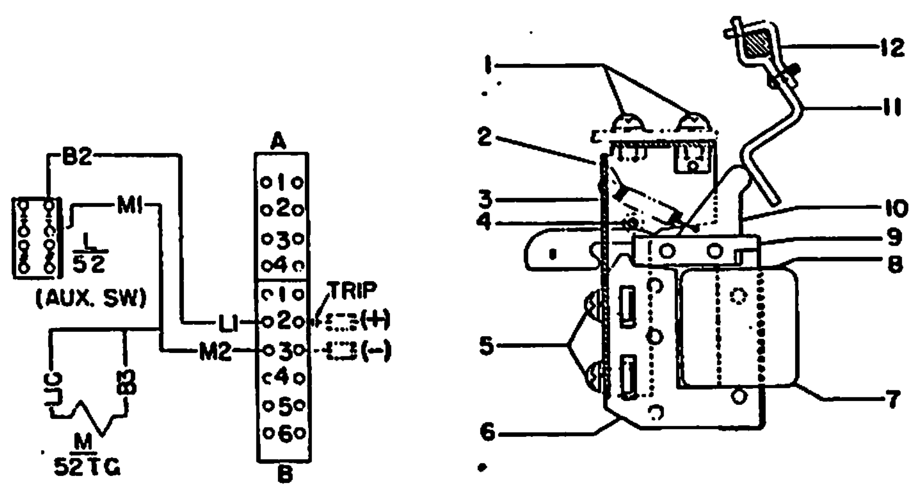
To prevent overheating, the coil (7) is cut off by contacts of the auxiliary switch which are open when the breaker is open.

ADJUSTMENTS

From 1/32" to 1/16" overtravel of the armatur is required when the breaker is tripped. If an adjustment is necessary to provide this amount c overtravel, the trip lever is bent in or out ac cordingly.

REPLACEMENT - COIL (7), FIG. 18

1. Disconnect leads to coil.
2. Remove magnet (6) and coil from frame (3
3. Bend lower end of clamp (8) straight an remove.
4. Remove coil and install new coil in re verse order.



1. Screws
2. Spring
3. Frame
4. Pin
5. Screws
6. Magnet
7. Coil
8. Clamp
9. Armature
10. Armature Arm
11. Trip Paddle
12. Clamp

Fig. 18 Shunt Tripping Device

Fig. 18 (2150176)
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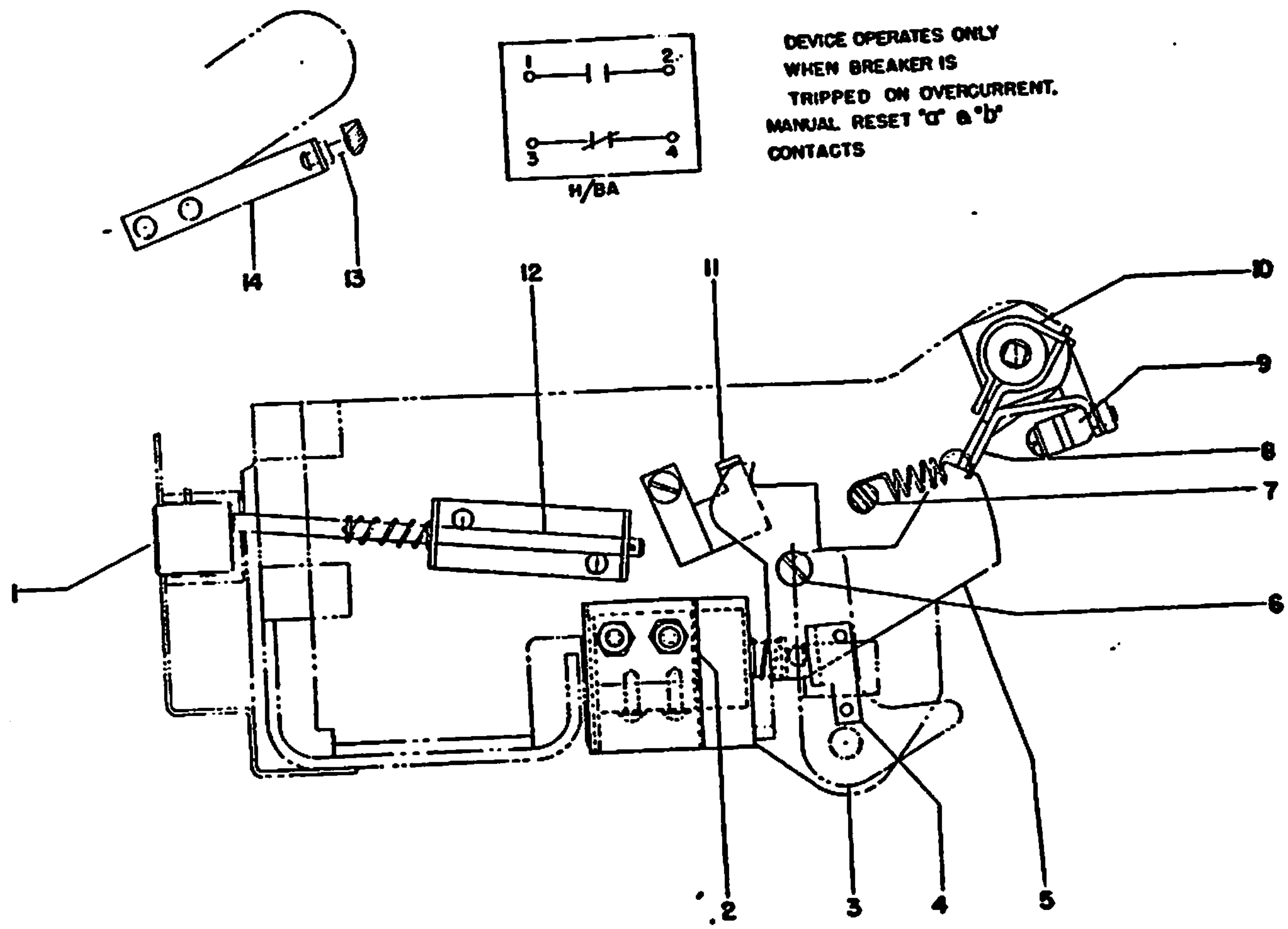
BELL ALARM AND LOCKOUT DEVICE

Refer to Fig. 19. When the breaker is tripped by an overload device, auxiliary shaft (9) rotates counter clockwise causing latch (8) to move off of latch arm (5). The breaker opens causing prop (3) to rotate clockwise allowing switch (2) to close. The switch then rotates latch arm (5), which, in turn allows catch (11) to move downward thereby locking latch arm (5) in the rotated position. When in the rotated position the latch arm keeps the trip shaft and prop (3) in the trip-free position, thus keeping the breaker from being closed until the lockout mechanism is reset by means of reset button (1). When the switch is closed it sounds an alarm. If the breaker is tripped by any device other than an overload device, latch (8) keeps latch arm (5) from rotating and therefore stops the bell alarm and lockout device mechanism from operating.

ADJUSTMENTS

1. With the breaker mechanism and lockout mechanism in the reset position adjusting screw (13) should be set so that auxiliary shaft (9) clears the overload paddles on the trip shaft by 1/32" to 3/32".

2. With the front frame assembled to the back frame the adjusting screws in the series overcurrent tripping devices should be adjusted so that there is approximately 1/32" overtravel after the overload device trips the breaker. See item 4 under "Series Overcurrent Device," "Replacements."



1. Reset Button
2. Switch
3. Prop
4. Paddle
5. Latch Arm
6. Pin
7. Pin
8. Latch
9. Auxiliary Shaft
10. Clamp
11. Catch
12. Reset Rod
13. Adjusting Screw
14. Bracket

Fig. 19 Bell Alarm And Lockout Device

Fig. 20 (267

DISCONNECTS

The disconnects are attached to the circuit breaker studs at the rear of the breaker.

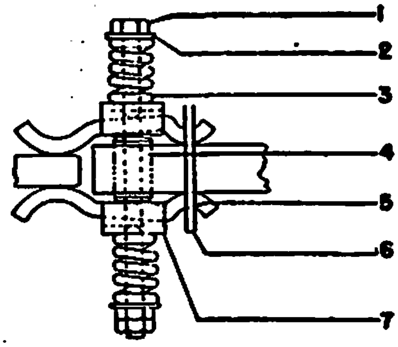
Each disconnect consists of eight contact fingers (5), four retainers (7), two spacers (4), two screws (1), one retaining ring (6), four washers (2) and four springs (3). The parts are assembled as shown in Fig. 20.

ADJUSTMENTS, FIG. 20

Tighten the nuts on screw (1) compressing springs (3) so that the spring length from retainer to washer does not exceed 1-1/32 inches.

LUBRICATION

Grease contact fingers (5) with General Electric Company grease specification D50H28.



1. Screw 2. Washer 3. Spring 4. Spacer 5. Contact Finger 6. Retaining Ring 7. Retainer

Fig. 20 Secondary Disconnect

RENEWAL PARTS

When ordering renewal parts, address the nearest Sales Office of the General Electric Company, specifying the quantity required. The parts should be described and the complete nameplate data of the breaker should be given.

Renewal parts, which are furnished, may not be identical with the original parts since improvements are made from time to time. Parts which are furnished will be interchangeable.

G.E. - VOLUME 1 - TYPE "A K" L.V. BREAKERS

TAB #	CATALOG SECTION	DESCRIPTION	CONTENTS
1		AK Breakers with Stored Energy	
2	GEK-7302B GEK-7302	Instructions / Installation / Operation Manual	AK-2/3/2A/3A-15 AK-2/3/2A/3A-25 AK-2/3/4/5/2A/3A/4A/5A-50/50S AK-2/3/2A/3A-75/75S AK-2/3/2A/3A-100/100S AKT-2/3/50/50S AKU-2/3/2A/3A-25 AKU-2/3/4/5/2A/3A/4A/5A-50/50S AKF-2/2A-25 AKF-2C/2D/2E
3	GEH-2021D GEH-2021C GEH-2021	Instructions / Installation / Operation Manual	AK-1-15/25/50/75/100 AK-2-15/25/50/75/100 AK-1A-25 AK-2A-15/25/50/75/100 AK-2-50S/75S/100S AK-2A-50S/75S/100S AKF-1A-25 AKF-1B/1C/2C/1D/2D AKU-2-25/50/50S AKU-2A-25/50
4	GEI-74603 GEI-74602 GEI-23989	Instructions / Maintenance Manual	AK-1-15 AK-1-25
5	GEI-74624	Instructions / Maintenance Manual	AKF-1B-3 to 10
6	GEF-3506E	Renewal Parts	AK-1-15 and AK-1-25 AKF-1B

GEAKV1.XLS

7	GEI-50299E GEI-50299D GEI-50299A	Maintenance / Instructions Manual	AK-2/2A-15 AK-2/3/2A/3A-25 AKU-2/3/2A/3A-25
8	GEI-93863A	Instructions Manual	AKF-2/2A-25
9	GEF-4149G GEF-4149E	Renewal Parts Data	AK-2/2A-15 AK-2/3/2A/3A-25 AKU-2/3/2A/3A-25 AKF-2/2A-25

Stored energy provides positive, high-speed closing of General Electric Type AK low voltage breakers

All frame sizes of General Electric low voltage power circuit breakers employ spring-operated, stored-energy mechanisms for manual or electrical operation. The stored-energy principle provides a quick-make, quick-break operating mechanism that assures positive high-speed closing of breaker, independent of the operating force. Positive, controlled closing prevents unnecessary arcing between movable and stationary contacts. This results in longer contact and breaker life.

Type AK-2A and AK-3A breakers are rugged switching and overload and short-circuit protective devices for main, tie or feeder circuits. They provide a means for switching circuits and equipment, disconnecting circuits for maintenance and construction and provide short-circuit protection. They also perform a wide variety of control functions such as motor starting and automatic throw-over.

ELECTRICALLY OPERATED STORED ENERGY

Electrical stored-energy breakers are operated by a motor or solenoid. In the smaller, more compact frame sizes (225-600 amp) a solenoid is used to conserve space. In the large frame sizes (1600-4000 amp) an a-c/d-c motor is used to keep control power requirements low (4 amp at 230 volts).

When the solenoid is energized, it charges the closing springs and drives the mechanism over center in one continuous motion. Motor-operated mechanisms are designed to automatically pre-charge the closing springs to a predetermined level. At the closing impulse, the springs are released and close the breaker. The motor or solenoid does *not* aid in the closing stroke; the springs supply all actual closing power. There is sufficient stored-energy in the charged springs to close the contacts under short-circuit conditions.

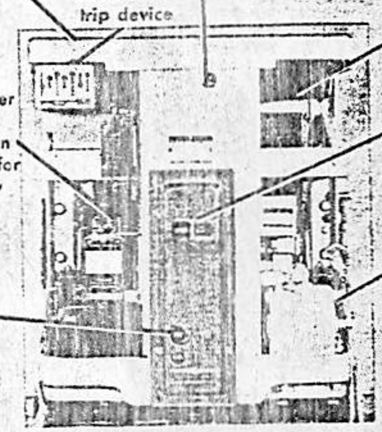
A second set of springs opens the contacts when the breaker receives a trip impulse. The breaker can be operated manually for maintenance by means of a detachable handle.

MANUALLY OPERATED STORED ENERGY

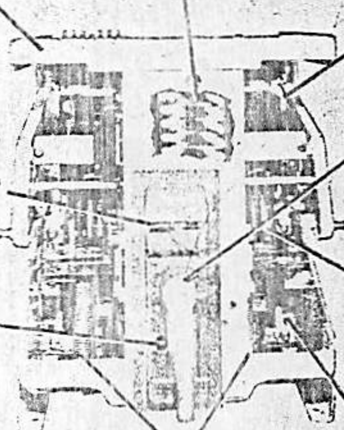
Manual stored-energy breakers are charged and closed by the operation of an insulated handle. In the AK-2A-15 and 25 breakers, charging of the closing springs takes place during the upward (CCW) and part of the downward strokes of the handle. At a predetermined point in the downward stroke near the vertical position of the handle, the springs become fully charged and are released to close the contacts.

In the AK-2A-50, 75 and 100 breakers, charging of the closing springs takes place during four upward and downward strokes of the handle. During the fourth downward stroke the springs are released to discharge and close the contacts. Until the springs are released in either of the mechanisms, there is no motion of the contacts. When the springs are released, the contacts move at a speed determined by the spring force and therefore independent of the operator. Upon receiving a tripping impulse, the breaker contacts are opened by separate opening springs.

Type AK-3A-50 electrically-operated power circuit breaker.



Type AK-2A-50 manually-operated power circuit breaker.



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INSTRUCTIONS

GEK-7302B
Supersedes GEH-2021D

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AK LOW VOLTAGE POWER CIRCUIT BREAKERS

Installation and Operation

Types

AK-2/3/2A/3A-15
AK-2/3/2A/3A-25
AK-2/3/4/5/2A/3A/4A/5A-50/50S
AK-2/3/2A/3A-75/75S
AK-2/3/2A/3A-100/100S
AKT-2/3/50/50S
AKU-2/3/2A/3A-25
AKU-2/3/4/5/2A/3A/4A/5A-50/50S
AKF-2/2A-25
AKF-2C/2D/2E

SWITCHGEAR PRODUCTS DEPARTMENT

GENERAL ELECTRIC

PHILADELPHIA, PA.

TAB 13

AUXILIARY DEVICES SPECIFICATIONS

TYPE LOAD OR P. F.	VOLTAGE		INTERRUPTING RATING (AMPS)		
	Nominal	Range	Auxiliary Switch	Bell Alarm Switch	EC-1 Switchette
Resistance	48 DC	41-56	25.00	-	-
	125 DC	106-140	11.00	2.5	0.30
	250 DC	210-280	2.00	0.9	0.15
	600 DC	508-672	0.45	0.3	-
Electro-Magnet	48 DC	41-56	15.00	-	-
	125 DC	106-140	6.25	2.5	0.30
	250 DC	210-280	1.75	0.9	0.15
	600 DC	508-672	0.35	0.3	-
75 - 85% Lagging	120 AC	104-127	75.0	30.0	-
	240 AC	208-254	50.0	15.0	10.0
	480 AC	416-508	25.0	7.0	10.0
	600 AC	520-635	12.0	5.0	-
30 - 35% Lagging	120 AC	104-127	50.0	30.0	-
	240 AC	208-254	25.0	15.0	10.0
	480 AC	416-508	12.0	7.0	10.0
	600 AC	520-635	8.0	5.0	-
Continuous Rating (Amps)			*20.0	*10.0	*10.0
Closing Rating (Amps) 30-35% P F or resistive			50.0	30.0	**

* Limited to 5.0 A continuous rating of #16 GA. wire on Drawout Breakers.

** Adequate for use with AK Breaker Shunt Trip Coils of the voltage ratings listed in above table. (Maximum current of 12.3A for the 120 V. AC coil)

INSTALLATION AND OPERATION OF TYPE AK POWER CIRCUIT BREAKER

RECEIVING, HANDLING AND STORAGE

Before installing, or operating these circuit breakers, make a careful reading of the sections of these instructions which are pertinent to the anticipated work.

Upon receipt of a circuit breaker, immediately make an examination for any damage or loss sustained in shipment. If injury, loss or rough handling is evident, file a damage claim at once with the transportation company and notify the nearest General Electric Sales Office.

Unpack the circuit breaker as soon as possible after it has been received. Exercise care in the unpacking to avoid damage to the breaker parts. Be sure that no loose parts are missing or left in the packaging material. Blow out any dirt or loose particles of packaging material remaining on/or in the breaker.

If the circuit breaker is not to be placed in service at once, store it in a clean, dry location in an upright position. Support it to prevent bending of the studs or damage to any of the breaker parts. Do not cover the breaker with any packing or other material which absorbs moisture, that may cause corrosion of breaker parts. A covering of kraft or other non-absorbent paper will prevent dust from settling on the breaker.

INSTALLATION

LOCATION

In choosing a location for the installation of an AK Circuit Breaker, there are two factors to be considered. The first of these is the effect of the location on the breaker itself. Much better performance and longer life may be expected if the area is clean, dry, dust-free, and well ventilated, than if the opposites to these conditions exist. The second consideration is convenience for operation and maintenance. The breaker should be easily accessible to the operator, and there should be sufficient space allowed for maintenance work to be done if this becomes necessary.

MOUNTING

AK Circuit Breakers are designed to be mounted in any one of three ways. These are dead front mounting, individual mounting with the enclosure being provided, and drawout mounting in which the breaker is designed for insertion into a cubicle in drawout equipment such as a substation or control board.

DEAD FRONT BREAKERS

These breakers are designed for mounting in a switchboard or enclosing case of the customer's design and construction. Mounting in this instance consists of bolting the breaker frame to a supporting structure within the switchboard or enclosure, connecting the power buses or cables, and making any necessary control connections. The front cover of the breaker enclosure may be a hinged door or a plate bolted to the panel. In either case, it should have a section cut out, through which the front escutcheon of the breaker may protrude. Outline drawing numbers giving the dimensions needed for preparing a suitable enclosure or cubicle for the various types of AK breakers are given below. These are for standard 2 or 3 pole breakers.

Breaker	Typical Outline Drawing No.
AK-2-15 and 25	695C116
AK-3-15 and 25	121C7570
AK-2-50 Man. Oper.	845C281
AK-2-50 Elec. Oper.	238C123
AK-3-50 Man. Oper.	121C7553
AK-3-50 Elec. Oper.	121C7555
AKT-2-50 Man. Oper.	102C3650
AKT-2-50 Elec. Oper.	102C3651
AKT-3-50 Man. Oper.	121C7589
AKT-3-50 Elec. Oper.	121C7590
AK-2-75 Man. Oper.	845C284
AK-2-75 Elec. Oper	269C225
AK-3-75 Man. Oper	121C7583
AK-3-75 Elec. Oper.	121C7557
AK-2-100 Man. Oper.	845C290
AK-2-100 Elec. Oper.	269C227
AK-3-100 Man. Oper.	121C7585
AK-3-100 Elec. Oper.	121C7559
AK-4-50 Man. Oper.	134C2600
AK-4-50 Elec. Oper.	134C2601
AK-5-50 Man. Oper.	134C2610
AK-5-50 Elec. Oper.	134C2611

The surface on which the breaker is mounted must be flat throughout in order not to impose any internal distortion on the breaker unit. The supporting structure must be rigid enough to avoid any possibility of the breaker studs supporting the weight of the breaker. Minimum cutout dimensions, as given by the appropriate outline drawing, must be maintained to provide adequate electrical clearance.

INDIVIDUALLY ENCLOSED BREAKERS

Individually enclosed breakers are supplied with several types of enclosures, most common is the general purpose type or the weather resistant type. The former is used for favorable indoor locations and the latter for outdoor locations or indoor locations that may be subject to unfavorable conditions. All of the enclosures are provided with suitable means for mounting on walls or supporting framework. Removable cover plates are supplied with the enclosures which may be drilled or machined to accommodate the entrance of bus ducts, conduits or cables. Steps in the procedure for installing enclosed breakers follow:

1. If the breaker is an AK-15, AK-25 or an AK-50, remove it from the enclosure. With AK-50 breakers, a handle and cam arrangement is used for that part of the breaker movement that involves the disengagement or engagement of the primary disconnect. AK-75 and AK-100 breakers are bolted solidly to the enclosure frame and need not be removed from the enclosure.

2. Remove cover plates of enclosure and prepare them to accommodate whatever power entrance means is used.

3. Mount enclosing case to supporting structure.

4. Replace cover plate and make power connections to stationary terminals in enclosure.

5. If the breaker is a type AK-15, AK-25 or AK-50 and has been removed from the enclosure, it may now be replaced. Control power connections to the terminal board should be made as required. (See CONNECTIONS).

6. Before energizing the power circuit, operate the breaker several times to be sure that it is functioning properly. (See OPERATION).

AK-4/5-50 breakers which are individually enclosed will have enclosures of the AKD5 drawout type. These breakers will be straight drawout breakers, types AK-4A-50 and AK-5A-50. (See instructions in this book under the heading, "Drawout Breakers AKD5 Equipment")

DRAWOUT BREAKERS AKD EQUIPMENT

Mounting drawout breakers consists of simply placing the breaker in the proper position with respect to its enclosure, sliding or rolling it to a stop position, and, by means of a racking handle and mechanism, racking it through the last part of its movement during which the stationary and movable halves of the disconnects engage.

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.

Large drawout breakers are fastened to a telescoping tray which extends out from the enclosure to receive the breaker. Small breakers have guides on their side plates which slide in channels in the enclosures. Both large and small breakers have a test position in which the secondary disconnects are engaged, but the primary disconnects are not. In this position, the breaker may be operated electrically without energizing the load cable or bus.

Use D50H47 lubricant on the disconnect terminals to reduce the force required to insert the breaker.

Inserting Breaker AK-15 and 25

1. Trip the breaker.

2. Raise the breaker until the guides on the sides of the breaker are level with their mating supporting channels in the enclosure, and slide the breaker part way into its enclosure. (Note - The breaker will be obstructed by a position stop at the bottom of the enclosure after the breaker has traveled only a short distance into the cubicle. Lift the position stop handle, located at the bottom right of the enclosure, which will release the position stop and allow the breaker to travel further into the cubicle).

3. Raise the rackout handle forward and up as far as its travel will permit and push the breaker into the enclosure until the rackout pins on the handle assembly bear against the housing rackout cams on the side of the enclosing case.

4. Push downward on the rackout handle forcing the pins on the handle up into the slot in the stationary cam plate. This action forces the breaker through a final short portion of its movement into the enclosure and allows the operator to provide the force necessary to make the primary disconnects engage the stationary studs in the enclosure. In performing this operation, make sure that the handle is rotated downwards as far as its free travel will permit and then pull the racking handle down to be sure the trip interlock is released. (Note - When the racking handle is in any position other than completely down, the breaker cannot be operated and is held trip-free by the trip interlock. This applies to the "fully in" and "test" positions.)

Withdrawing Breaker AK-15 and 25

1. Trip the breaker open. If the breaker is not open, the interlock lever of the drawout mechanism will not permit operation of the rackout handle.

2. Pull the racking handle up and forward as far as it will travel, disengaging the primary disconnects.

3. Slide the breaker out until the position stop engages in the front slot in the bottom of the breaker carriage. The breaker is now in the "test" position, where its primary disconnects are safely disconnected from the line and load terminals of the enclosure. (Note - Refer to section describing "Test Position" in these instructions.)

4. To remove the breaker from its enclosure, lift the position stop handle and slide the breaker forward until the position stop engages the rear slot in the bottom of the breaker carriage. This is the safety position stop where both the primary and secondary contacts are disengaged. Again lift the position stop handle. Slide the breaker slightly forward to remove it from the enclosure.

Inserting Breaker AK-50, 75 and 100

1. Lift the breaker to a position approximately six inches above the height of the compartment tray.

2. Pull the drawout tray out under the breaker as far as the tray will travel. NOTE - When installing an individual skeleton housing for a drawout AK-50 or 75, locate a bolt head over the two front bottom mounting holes of the housing to provide a limit stop for the drawout tray.

3. Lower the breaker about 1/2" above the dowel pins on the tray and push the breaker back into its compartment so that the rear bottom angle of the breaker is against the guides on the tray directly back of the dowel pins.

4. Slowly lower the breaker onto the tray and at the same time guide it so that the holes in the rear angle of the breaker fit over the two dowel pins on the tray. If the breaker is correctly positioned on the dowels, its rear and side bottom frame angles will all sit firmly on the tray.

5. Insert two 3/8 inch hex. head screws through the holes in the front of the side angles on the breaker and thread them part way into the tapped holes in the tray. Do not tighten screws firmly. This provides better alignment of the primary stationary studs and the primary disconnects for the subsequent racking operation.

6. Push the breaker into the compartment until the "test" position stop engages to prevent further travel. (Note - Refer to section describing "Test Position" in these instructions.)

7. Release the test position stop by depressing its lever and push the breaker back into the compartment until the racking pins on the housing butt against the outer surface of the racking cam. In this position, the racking pin has lifted the locking arm on the cam which allows the racking handle to be lifted enough to allow the pawl to engage the first notch on the cam.

8. When the pawl engages the first notch on the cam, push the handle down again to its normal position. This causes the cam to rotate about the racking pin. Repeat this operation five times to rack the breaker into its final operating position. Interlocks hold the breaker trip free until it is racked into the fully contacted position. The fifth stroke of the handle is only a partial stroke and does not result in any further movement of the breaker. It does serve three useful purposes: it positions the cam so that it cannot rotate and allow the breaker to back out under short circuit stresses; the partial stroke signals that the racking operation is complete, and it releases the trip interlock which was engaged by the racking pin during the previous four pumps of the racking arm. NOTE: Once a racking operation has been started, it must be completed, as the breaker cannot be reversed until the racking operation is completed.

9. After completing the fifth racking stroke, lift the handle as high as it will go and allow it to drop to its normal position. NOTE: Any strokes beyond this point will cause the breaker to be trip free. Tighten the 3/8 inch hex head screws inserted in the front holes of the drawout tray during step 5 of this operation. The breaker is now in the operating position.

Withdrawing Breaker AK-50, 75 and 100

1. Trip the breaker to release the positive racking interlock.

2. Lift the racking handle as far as it will go.

This operation will re-engage the trip interlock to hold the breaker trip-free for the remainder of the racking operation. Note that here the cam is rotated by lifting the handle, whereas in racking the breaker in, the operation is performer as a result of pushing the handle down.

3. Reset the handle to its lowered position and lift it again. This operation must be performed 5 times to completely disengage the cams from their racking pins. After the fifth lifting stroke let the handle drop to its normal position.

4. Pull the breaker out of its compartment until the test position stop engages to hold the breaker in the "test" position.

5. Depress the test position stop handle and pull the breaker out of its compartment as far as the drawout tray will travel.

6. Remove the two 3/8 hex. head screws which hold the breaker on the tray.

7. Attach a lifting device to the top frame of the breaker.

8. Lift the breaker approximately 1/2 inch off the dowel pins on the tray and then pull the breaker forward until its primary contacts clear the compartment.

9. Push the tray all the way back into its compartment. The breaker is now free from its compartment.

TEST POSITION

The "Test Position", as referred to in the previous instructions, is that breaker position where the primary power disconnect contacts are safely disengaged but the secondary control disconnects are engaged. In this position, the breaker may be tested or operated, manually or electrically without energizing the primary power circuit, provided the racking handle has been moved to the completely down position, thus releasing the trip interlock.

For a more complete description of drawout mechanisms and enclosures see AKD DRAWOUT EQUIPMENT INSTRUCTIONS, GEH-1830 and AKD5 Drawout Equipment Instructions GEI-90890.

DRAWOUT BREAKERS AKD5 EQUIPMENT

NOTE: AKD5 breakers are identified by letter "A" appearing after breaker number - example, "AK-2A-15".

Drawout Mechanism Operation - There are four positions of the drawout mechanism:

1. The Connected Position - the breaker in the operating position, both primary and secondary contacts made and the door may be closed.

2. The Test Position - the primary (power) contacts not made but the secondary (control) contacts are made. Any breaker test not involving power may be made in this position. The door may be closed in this position.

3. Disconnect Position - neither the primary nor the secondary contacts made. The door may be closed.

4. Fully Withdrawn Position - the breaker completely out of its compartment ready for removal from the inner housing. The door must be open in this position.

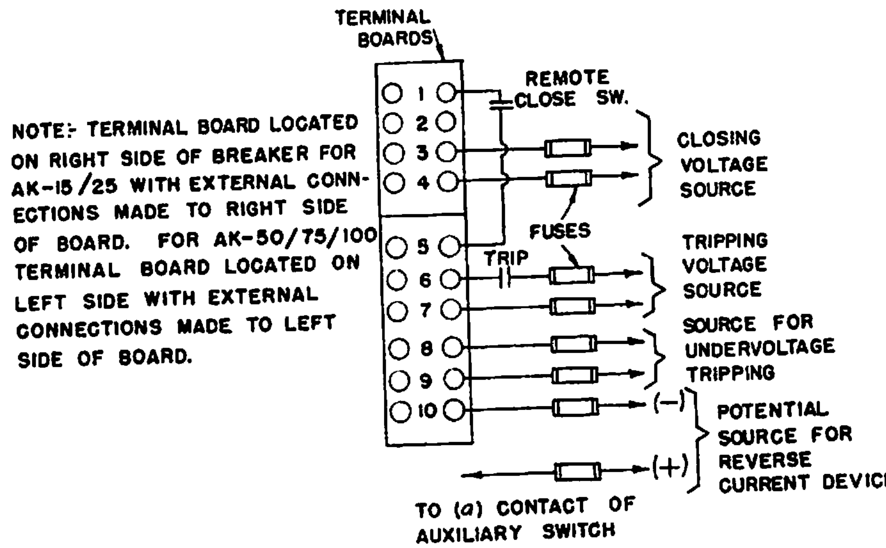


Fig. 1 (Front View)

<u>Breaker Insertion AK-2A/3A</u> - With the inner housing in the connected position proceed as follows:

1. Insert handle on jackscrew shaft located on left hand side of compartment right above indicator.
2. Rotate handle counter clockwise until jackscrew is stopped. (Indicator should read DISC).
3. Remove handle and open compartment door.
4. Rotate the two track lock links and pull the right track to the limit of its travel.
5. Using a lifting device, raise the breaker until the breakers mounting pins are approximately one inch above the tracks.
6. Pull the remaining track out to the limit of its travel and lower breaker so the breaker mounting pins drop into the slots in the track. Remove the lifting device.
7. Push the breaker in against the track stops. Rotate the two track lock links to lock the breaker in place. Close the compartment door.

NOTE: When moving a breaker from one position to another, be sure breaker is tripped open.

8. Insert handle on jackscrew shaft and rotate clockwise to move breaker into the compartment. Breaker is in connected position when jackscrew can no longer be rotated. (Indicator should read CONN).

<u>Breaker Insertion AK-4A/5A</u> - With the inner housing in the connected position, proceed as follows:

1. Open door and remove wooden wedge in the lower guide slot of the inner housing.
2. Pull inner housing forward as far as possible.

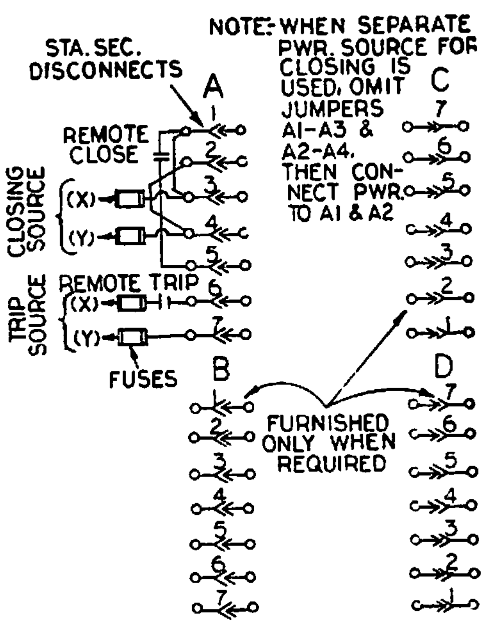


Fig. 2 Front View AK-15 and 25 Breaker Compartment

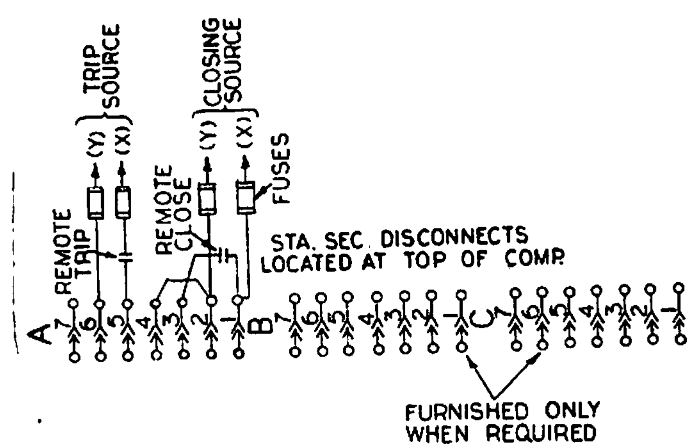


Fig. 3 Front View AK-50, 75, 100 Breaker Compartment

3. Rotate the two track lock links, and pull the right track all the way forward.

4. Using a lifting device and the spreader provided for these breakers, raise the breaker and position it so that the mounting pins on the side of the breaker line up with the slots in the track and are about 2 inches above the track.

5. Pull the left track out and lower the breaker so that the mounting pins engage the slots in the tracks.

6. Engage the racking handle. This is done by pushing the trip button in the breaker escutcheon, sliding the cover below it to the right, and inserting the handle on the jackshaft.

7. Turn the handle counterclockwise as far as it will go, (if it will move in that direction) and remove the handle.

8. Push the breaker in against the track stops, and lock the track links.

9. Close the compartment door. Again engage the handle as in step 6, and rotate the handle clockwise as far as it will go. Towards the end, a high force requirement will be felt as the disconnect fingers on the breaker engage the stationary studs. A couple of turns later, and the stop will be encountered. The position indicator will now show "CONN."

Breaker Removal AK-2A/3A

1. Trip the breaker.

2. Move the breaker and inner housing to the fully withdrawn position. (See Breaker Insertion, Steps 1, 2 and 3).

3. Rotate the two track lock links and pull the breaker out to the limit of the track travel. Attach lifting device and lift breaker up and away from compartment until primary disconnects clear the compartment.

4. Move the inner housing to the connected position by pushing the tracks back against the track stops and then follow Steps 7 and 8 under Breaker Insertion. The inner housing is now in the connected position and the breaker is free from its compartment.

Breaker Removal AK-4A/5A

1. Trip the breaker.

2. Engage the handle and rotate it counterclockwise. If the breaker closing spring is fully charged, it will be discharged automatically a couple of turns before the end of the action.

3. Open the door, unlock the track locks, and pull the breaker all the way forward. The breaker may now be lifted from the tracks.

NOTE: The installation of AK-2/3-50S/75S/100S/AKF2C/2D and breakers equipped with the quick-closing mechanism is the same as the other breakers described in this book. The only difference occurs with drawout breakers. The compartments that house the quick-close breakers will be equipped with an interlock that prevents the manual discharging of the closing springs while the breaker is in the racked in (connected position). This interlock, when requested, will be provided with both AKD and AKD5 equipment that require quick close breakers

CONNECTIONS

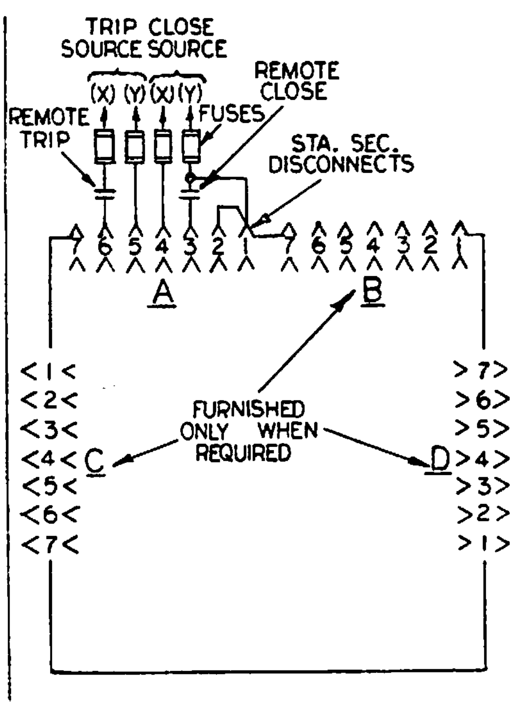
All electrical connections should be made to assure good conductivity. Mating surfaces should be parallel and firmly bolted or clamped together. Contact surfaces should be clean and have a smooth finish. The bus or cable connecting to the breaker should have adequate current-carrying capacity to prevent excessive heating. Control circuit connections should be made according to the wiring diagram which applies to each breaker specifically. Depending on the breaker type, those connections are made either to a terminal board on the breaker or to the stationary parts of the secondary disconnects.

INDIVIDUALLY ENCLOSED AND STATIONARY BREAKERS

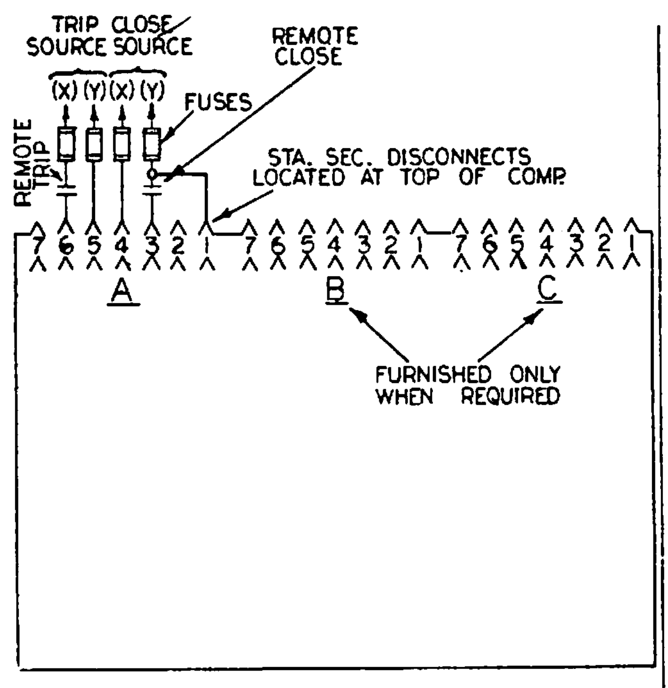
The customers external connections for operation of breaker control components and accessories are shown in Fig. 1.

DRAWOUT BREAKERS

The customers external control connections to these breakers are made to the stationary secondary disconnected located in the breaker compartment as shown in Figs. 2 and 3, AKD Equipment and Figs. 4 and 5 AKD5 Equipment. (Note - If the breaker is used in a General Electric Company, Drawout Switchgear Equipment, all external connections must be made to terminal blocks located in the rear vertical wiring trough of the equipment.)



FRONT VIEW AK - 1A-15, 25 & AK-2A-15, 25
BREAKER COMPARTMENT



FRONT VIEW AK-2A-50, 75, 100
BREAKER COMPARTMENT

Figs. 4 & 5 (0156A2377)

TYPICAL WIRING DIAGRAMS

Fig. 4 Fig. 5

OPERATION

MANUAL CLOSING

AK-15/25 manually operated breakers are closed by turning the handle 90 degrees counterclockwise and then clockwise 90 degrees back to the original position. The initial counterclockwise movement resets the closing mechanism. The clockwise movement closes the breaker.

The closing mechanism of the AK-2/3 50/75/100 manual breakers is a spring charged mechanism similar to the one used on AK-2/3-50/75/100 electrically operated breakers. AK-2/3-50/75/100 manual breakers are closed by rotating the closing handle counterclockwise through approximately 120 degrees, and then clockwise back through 120 degrees to the normal handle position. Four such complete movements of the handle are required to close the breaker. During the four counterclockwise movements and the first three clockwise movements of the handle, the springs are charged. After approximately 70 degrees travel of the fourth clockwise handle movement, the spring charged mechanism is driven over-center and the breaker closes. A charge-indicator, numbered 1 to 4, viewed through the breaker front escutcheon, moves with each complete handle movement and indicates the number of complete handle movements that have been performed.

AK-4/5-50 manual breakers are also closed by means of energy released through the discharge of a closing spring. The charging of the spring is done by a single stroke of the breaker handle. This involves raising the handle counterclockwise from the vertical position until a stop is encountered after about 140 degrees of rotation. The spring is then extended to its fully charged position as the handle is returned to its normal vertical position. Release of the spring, and resultant closing of the breaker, occurs when the "close" button in the escutcheon is pushed. (The breaker will close only if the racking mechanism is in the "CONN" or "TEST" position.)

ELECTRICAL CLOSING
(Figures 6 and 7)

STANDARD BREAKERS

AK-15 and AK-25 electrically operated breakers are closed by a solenoid coil. The armature of the solenoid is linked to the breaker mechanism and its movement, operating through the mechanism, closes the breaker. The closing solenoid circuit may be operated by a push button closing switch on the breaker or by a remote switch or relay, depending on the individual arrangements desired. When a closing signal is given, the X relay coil is energized and it in turn closes its contacts. One of these seals in the X coil circuit; the other three, which are arranged in series, energize the solenoid closing coil. As the breaker closes, a mechanically operated switch opens one pair of its contacts (bb) and closes another (aa). The contacts which open cut out the X relay coil. The contacts which close energize the Y relay coil, whose contacts now seal in the Y coil and hold open the X relay coil circuit. This prevents another closing operation if one of the protective devices operates to trip the breaker before contact at the closing switch is released.

Large AK breakers (AK-50/75/100) are closed by the discharge of a closing spring. This rotates a crankshaft which, by means of an attached roller, operates a closing cam, forcing the movable breaker contacts against the stationary contacts. The closing spring is charged through the operation of a motor and gear reduction unit.

The electrical control system is comprised of an X relay, two double contact mechanically operated switches (F and G), a push button closing switch and any means for remote closing which the user may incorporate into the system. When voltage is first applied to the breaker, (before any closing signal is given) the motor is energized through two of the X relay contacts and the two G switch contacts. The motor then compresses the closing springs to the "pre-charged" position at which point the mechanically operated F and G switches are operated. This opens the G contacts, stopping the motor, and closes the F contacts, which readies the system for the actual closing of the breaker. When the push button or remote switch signals for a closing operation, the X relay coil is energized, operating the X contacts. This seals in the X relay and energizes the motor once again and the closing operation takes place.

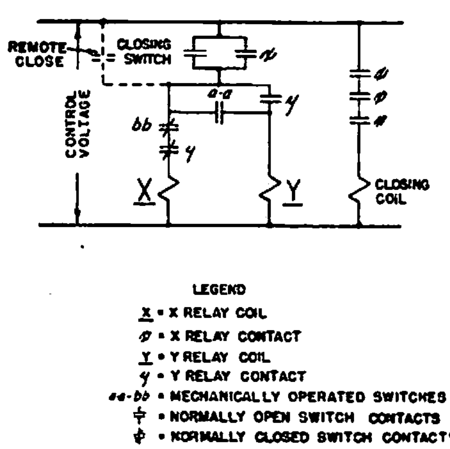


Fig. 6 Simplified Elementary Diagram Internal Wiring AK-15 and 25

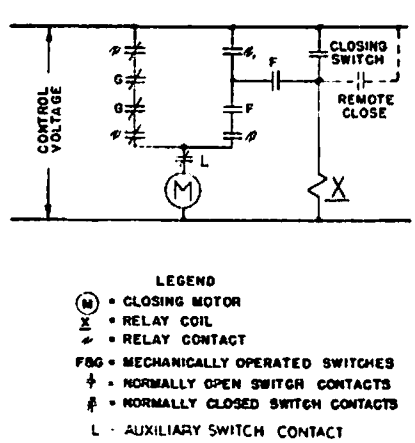


Fig. 7 Simplified Elementary Diagram Internal Wiring AK-50, 75 and 100

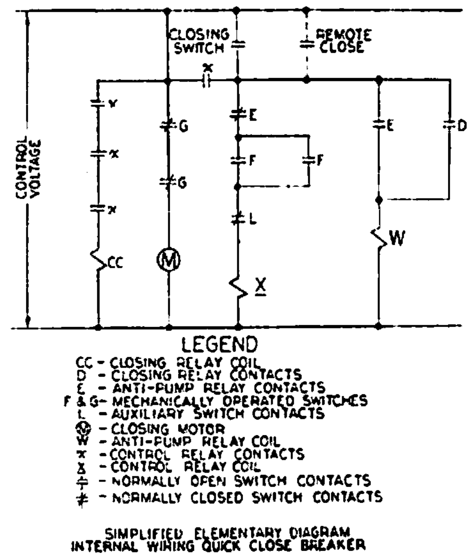


Fig. 8

QUICK CLOSE BREAKERS
(Figure 8)

Functionally, the quick close mechanism differs from the standard electrical mechanism in that the pre-charge operation is extended to completely charge the closing springs. At the end of the charging operation, which takes approximately 5 seconds, (2 seconds for AK-4/5-50 breakers) a latch plate engages the prop roller to prevent the closing springs from discharging.

With the closing springs fully charged the breaker is ready for a closing operation upon release of the prop roller. This may be accomplished either manually, by depressing the closing lever on the breaker, or electrically by closing the remote closing switch. Upon the release of the prop roller the closing springs discharge and close the breaker in the same manner as on the standard electrical breaker. AK-4/5-50 breakers are closed through a remote switch or the close button in the escutcheon, (if the breaker is equipped with a push button closing switch).

With control voltage applied, the motor is energized through the G switch contacts, and charges the closing springs. When the springs reach the fully charged position, the mechanically operated switches operate, reversing their contacts. Upon operation of these switches the motor is stopped by the opening of the G switch. The closing of the F switch prepares the breaker for a closing operation.

Fig. 6 (457A685)

Fig. 7 (457A684)

Fig. 8 (0156A2395)

A closing signal now given energizes the control relay X whose contacts close and complete the circuit through the closing relay coil. With the closing relay coil energized the breaker closes as described above. At the same time the closing relay contact closes to energize the anti-pump relay causing its contacts to reverse providing the anti-pump feature.

When the breaker closes, the mechanical operated G switches close to energize the motor again and the F switches open and de-energize the control relay. The auxiliary switch contact opens preventing the control relay from being energized until the breaker is tripped open. With the G switches closed, the motor charges the closing springs ready for the next closing operation.

MANUAL OR MAINTENANCE CLOSING OF ELECTRICAL BREAKERS

All electrical breakers may be closed manually by means of the maintenance handle furnished with the breaker or switchgear.

To close AK-15/25 breakers:

1. Place the two small hooks of the handle into the two slots located in the lower portion of the front escutcheon.
2. Rotation of the long end of the handle downwards forces the shorter end of the handle upwards against the bottom of the solenoid armature, and closes the breaker's contacts.

To close AK-2/3-50/75/100 breakers:

1. Place the ratchet type maintenance handle on the shaft that protrudes from the gear reduction unit.
2. Operate handle until the spring charge indicator reads charged.
3. Continue to operate handle until the closing springs discharge and close the contacts.

To close AK-50S/75S/100S, AKF2C, 2D breakers and breakers equipped with the quick closing mechanism:

NOTE: All AKD, or AKD-5 drawout type breakers equipped with the quick closing mechanism cannot normally be closed manually when in the racked in (connected position), due to mechanical designed interference between the enclosure and the spring discharge lever on the breaker. If manual closing is desired with the breaker racked in, the interference feature must be removed, otherwise the breaker can be manually closed in the test position or fully racked out position only.

1. With the ratchet type maintenance handle applied to the gear box shaft, operate the handle until the springs are fully charged. The fully charged position is indicated by the spring charge indicator and by solid resistance to any further handle operation.
2. Push down on the push to close lever to release the energy stored in the closing springs which closes the breaker's contacts.

To close AK-4/5-50 breakers:

NOTE: AK-4A and AK-5A drawout breakers will be "trip-free" if the racking mechanism is in any position other than the "TEST" or "CONN" position. If the breaker is on a workbench or on the extended rails, and it is to be closed with the maintenance handle, operate the drawout mechanism as far as it will go in a clockwise direction. This will put the mechanism in the "connected" position, and the breaker may be closed. If this is done, the mechanism will have to be reset to the "disconnected" position before it can be reinserted into the breaker compartment in the enclosure.

1. Place the maintenance handle on the end of the camshaft below the motor.

2. Operate the handle until the closing spring goes over center and the breaker closes. If the breaker is a "quick-close" breaker, type AK-4/5-50S, the spring will not release upon going over center, but will be held off by a blocking link. This can be released by pulling forward on the closing solenoid armature located beneath the mechanism. This can be done safely, since no moving parts are located in this space.

TRIPPING

The breaker is tripped open by the displacement of a mechanism latch, which allows a toggle linkage supporting the movable contacts in the closed position to collapse. This trip latch is fastened rigidly to a trip shaft which runs horizontally from left to right through the breaker. All of the means provided for tripping the breaker operate through striker arms which displace the mechanism trip latch by moving against trip paddles fastened on the trip shaft. Looking at the breaker from the right, counterclockwise rotation of the trip shaft causes the breaker to trip; clockwise movement resets the mechanism latch. The manual trip button, overload devices, shunt trip, undervoltage tripping device, and reverse current trip all operate in this fashion to trip the breaker. The movement of the striker arms of all of these, when activated, should move from 1/32 to 1/16 inch beyond the point at which tripping occurs. This is what is meant by the expression, "positive tripping".

NOTE: BEFORE MAKING ANY ADJUSTMENTS TO TRIP DEVICE SETTINGS, THE BREAKER SHOULD BE IN THE OPEN POSITION AND CONTROL POWER REMOVED.

Most AK-2 and AK-4 air circuit breakers are equipped with series overcurrent trip devices either of the dual magnetic type (instantaneous and time delay tripping) or instantaneous alone. Breakers are designed to carry up to 100% of the continuous current rating of their trip devices. Any attempt to carry higher currents for a prolonged period will cause overheating and possible damage.

All AK-3 and AK-5 type air circuit breakers will be equipped with Power Sensor* overcurrent trip devices. The time current band as well as the pickup settings of this device are adjustable. A single captive thumb screw adjusts all three phases for any particular characteristic or setting. Should a thumb screw be inadvertently left loose the Power Sensor* will revert to the "minimum" pickup settings or "maximum" time delay bands accordingly. If after installation, nuisance tripping occurs, check the Power Sensor* for proper settings as required for the specific application and tighten all the thumb screws on the Power Sensor*.

For a more detailed discussion of the construction, operation, and application of overcurrent trip devices refer to the following publications:

1. Maintenance manual for specific breaker involved (see "Maintenance").

2. "Selection and Application of Power Circuit Breakers" GET-1113.

TYPE AKU AND BREAKERS WITH FUSE-BREAKER COMBINATIONS

Open Fuse Lockout Device

This device may be furnished with any of the above type breakers. The open fuse lockout device consists of 3 separately operated devices (one per breaker pole) each wired in parallel to corresponding breaker fuses. These devices are mounted on the left hand side of the breaker (looking from front). The purpose of this device is to trip the breaker upon the blowing of any one of the breaker fuses. This energizes the coil of the device causing the armature to engage the trip paddle, thereby tripping the breaker. Once operated, the armature is latched in the closed air gap position allowing the reset button to extend forward indicating which fuse has blown, and simultaneously holding the breaker in the trip-free position until the latch closed armature is released by the operating of the manual reset button.

MAINTENANCE INSTRUCTIONS

INSPECTION

BEFORE INSPECTION OR ANY MAINTENANCE WORK IS DONE, BE SURE THAT THE BREAKER IS IN THE OPEN POSITION. ALL ELECTRICAL POWER, BOTH PRIMARY AND CONTROL SOURCES SHOULD ALSO BE DISCONNECTED.

Periodic inspection of the circuit breaker is recommended at least once a year. More frequent inspections are recommended, if severe load conditions, dust, moisture, or other unfavorable conditions exist.

Always inspect the breaker after a short circuit current has been interrupted.

At the time of inspection, the following checks should be made after the breaker has been de-energized.

1. Manually operate the breaker several times, checking for obstructions or excessive friction.

2. Electrically operate the breaker several times (if breaker has electrical control) to ascertain whether the electrical attachments are functioning properly.

3. Remove the arc quenchers by removing the channel shaped retaining bar.

4. Inspect arc quenchers and contacts for breakage or excessive burning.

Should arc quencher barriers or contacts be eroded to half their original thickness they should be replaced.

LUBRICATION

In general, the circuit breaker requires moderate lumbrication. Bearing points and sliding surfaces should be lubricated at the regular inspection periods with a thin film of GE Lubricant D50H15. Before lubricating remove any hardened grease and dirt from latch and bearing surfaces with kerosene. ALL EXCESS LUBRICANT WHOULD BE REMOVED WITH A CLEAN CLOTH TO AVOID ANY ACCUMULATION OF DORT OR DUST.

On drawout breakers, the contact surface of the disconnect studs should be cleaned and greased with GE Grease Specification D50H47.

These instructions have as their purpose the imparting of information of a general nature concerning the installation and operation of Type AK power circuit breakers. If more complete and specific information is required, such as might be needed for overhauling the breaker, trouble shorting, or replacing parts of the breaker, refer to the complete instruction for the particular breaker type involved. These are:

Maintenance Manual	Breaker Type
GEI-50299	AK-2/2A/3/3A-15125, AK U-2/2A/3/3A-25
GEI-93863	AKF-2/2A-25
GEK-7303	AK-2/2A/3/3A-50/75/100, AKU-2/2A/3/3A-50 AK-2/2A/3/3A-50S/75S/ 100S, AKF-2C/2D/2E
GEK-7301	Power Sensor Solid State Test Instructions
GEK-7310	AK/AKU-4/5-50/50S
GEK-7309	Test Instructions for Installation or service of Power Sensor Equipped AK breakers

Renewal parts bulletins for the various types of breakers are:

Bulletin	Breaker Type
GEF-4149	AK-2-15/25
GEF-4150	AK-2-50
GEF-4151	AK-2-75/100
GEF-4527	AK-4/5-50

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INSTRUCTIONS

GEK-7302
SUPERSEDES GEH-2021D

AK LOW VOLTAGE POWER CIRCUIT BREAKERS

INSTALLATION AND OPERATION

Types

AK-2/3/2A/3A-15
AK-2/3/2A/3A-25
AK-2/3/2A/3A-50/50S
AK-2/3/2A/3A-75/75S
AK-2/3/2A/3A-100/100S
AKT-2/3/50/50S
AKU-2/3/2A/3A-25
AKU-2/3/2A/3A-50/50S
AKF-2/2A-25
AKF-2C/2D/2E

SWITCHGEAR DEPARTMENT
GENERAL ELECTRIC
PHILADELPHIA, PA.

INSTALLATION AND OPERATION OF TYPE AK POWER CIRCUIT BREAKER

RECEIVING, HANDLING AND STORAGE

Before installing, or operating these circuit breakers, make a careful reading of the sections of these instructions which are pertinent to the anticipated work.

Upon receipt of a circuit breaker, immediately make an examination for any damage or loss sustained in shipment. If injury, loss or rough handling is evident, file a damage claim at once with the transportation company and notify the nearest General Electric Sales Office.

Unpack the circuit breaker as soon as possible after it has been received. Exercise care in the unpacking to avoid damage to the breaker parts. Be sure that no loose parts are missing or left in the packaging material. Blow out any dirt or loose particles of packaging material remaining on/or in the breaker.

If the circuit breaker is not to be placed in service at once, store it in a clean, dry location in an upright position. Support it to prevent bending of the studs or damage to any of the breaker parts. Do not cover the breaker with any packing or other material which absorbs moisture, that may cause corrosion of breaker parts. A covering of kraft or other non-absorbent paper will prevent dust from settling on the breaker.

INSTALLATION

LOCATION

In choosing a location for the installation of an AK Circuit Breaker, there are two factors to be considered. The first of these is the effect of the location on the breaker itself. Much better performance and longer life may be expected if the area is clean, dry, dust-free, and well ventilated, than if the opposites to these conditions exist. The second consideration is convenience for operation and maintenance. The breaker should be easily accessible to the operator, and there should be sufficient space allowed for maintenance work to be done if this becomes necessary.

MOUNTING

AK Circuit Breakers are designed to be mounted in any one of three ways. These are dead front mounting, individual mounting with the enclosure being provided, and drawout mounting in which the breaker is designed for insertion into a cubicle in drawout equipment such as a substation or control board.

DEAD FRONT BREAKERS

These breakers are designed for mounting in a switchboard or enclosing case of the customer's design and construction. Mounting in this instance consists of bolting the breaker frame to a supporting structure within the switchboard or enclosure, connecting the power buses or cables, and making any necessary control connections. The front cover of the breaker enclosure may be a hinged door or a plate bolted to the panel. In either case, it should have a section cut out, through which the front escutcheon of the breaker may protrude. Outline drawing numbers giving the dimensions needed for preparing a suitable enclosure or cubicle for the various types of AK breakers are given below. These are for standard 2 or 3 pole breakers.

Breaker	Typical Outline Drawing No.
AK-2-15 and 25	695C116
AK-3-15 and 25	121C7570
AK-2-50 Man. Oper.	845C281
AK-2-50 Elec. Oper.	238C123
AK-3-50 Man. Oper.	121C7553
AK-3-50 Elec. Oper.	121C7555
AKT-2-50 Man. Oper.	102C3650
AKT-2-50 Elec. Oper.	102C3651
AKT-3-50 Man. Oper.	121C7589
AKT-3-50 Elec. Oper.	121C7590
AK-2-75 Man. Oper.	845C284
AK-2-75 Elec. Oper	269C225
AK-3-75 Man. Oper	121C7583
AK-3-75 Elec. Oper.	121C7557
AK-2-100 Man. Oper.	845C290
AK-2-100 Elec. Oper.	269C227
AK-3-100 Man. Oper.	121C7585
AK-3-100 Elec. Oper.	121C7559

The surface on which the breaker is mounted must be flat throughout in order not to impose any internal distortion on the breaker unit. The supporting structure must be rigid enough to avoid any possibility of the breaker studs supporting the weight of the breaker. Minimum cutout dimensions, as given by the appropriate outline drawing, must be maintained to provide adequate electrical clearance.

INDIVIDUALLY ENCLOSED BREAKERS

Individually enclosed breakers are supplied with several types of enclosures, most common is the general purpose type or the weather resistant type. The former is used for favorable indoor locations and the latter for outdoor locations or indoor locations that may be subject to unfavorable conditions. All of the enclosures are provided with suitable means for mounting on walls or supporting framework. Removable cover plates are supplied with the enclosures which may be drilled or machined to accommodate the entrance of bus ducts, conduits or cables. Steps in the procedure for installing enclosed breakers follow:

1. If the breaker is an AK-15, AK-25 or an AK-50, remove it from the enclosure. With AK-50 breakers, a handle and cam arrangement is used for that part of the breaker movement that involves the disengagement or engagement of the primary disconnect. AK-75 and AK-100 breakers are bolted solidly to the enclosure frame and need not be removed from the enclosure.

2. Remove cover plates of enclosure and prepare them to accommodate whatever power entrance means is used.

3. Mount enclosing case to supporting structure.

4. Replace cover plate and make power connections to stationary terminals in enclosure.

5. If the breaker is a type AK-15, AK-25 or AK-50 and has been removed from the enclosure, it may now be replaced. Control power connections to the terminal board should be made as required. (See CONNECTIONS).

6. Before energizing the power circuit, operate the breaker several times to be sure that it is functioning properly. (See OPERATION).

DRAWOUT BREAKERS AND EQUIPMENT

Mounting drawout breakers consists of simply placing the breaker in the proper position with respect to its enclosure, sliding or rolling it to a stop position, and, by means of a racking handle and mechanism, racking it through the last part of its movement during which the stationary and movable halves of the disconnects engage. Large drawout breakers are fastened to a telescoping tray which extends out from the enclosure to receive the breaker. Small breakers have guides on their side plates which slide in channels in the enclosures. Both large and small breakers have a test position in which the secondary disconnects are engaged, but the primary disconnects are not. In this position, the breaker may be operated electrically without energizing the load cable or bus.

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.

Use D50H47 lubricant on the disconnect terminals to reduce the force required to insert the breaker.

The procedure for inserting and withdrawing a drawout breaker from its enclosure is as follows:

Inserting Breaker AK-15 and 25

1. Trip the breaker.

2. Raise the breaker until the guides on the sides of the breaker are level with their mating supporting channels in the enclosure, and slide the breaker part way into its enclosure. (Note - The breaker will be obstructed by a position stop at the bottom of the enclosure after the breaker has traveled only a short distance into the cubicle. Lift the position stop handle, located at the bottom right of the enclosure, which will release the position stop and allow the breaker to travel further into the cubicle).

3. Raise the rackout handle forward and up as far as its travel will permit and push the breaker into the enclosure until the rackout pins on the handle assembly bear against the housing rackout cams on the side of the enclosing case.

4. Push downward on the rackout handle forcing the pins on the handle up into the slot in the stationary cam plate. This action forces the breaker through a final short portion of its movement into the enclosure and allows the operator to provide the force necessary to make the primary disconnects engage the stationary studs in the enclosure. In performing this operation, make sure that the handle is rotated downwards as far as its free travel will permit and then pull the racking handle down to be sure the trip interlock is released. (Note - When the racking handle is in any position other than completely down, the breaker cannot be operated and is held trip-free by the trip interlock. This applies to the "fully in" and "test" positions.)

Withdrawing Breaker AK-15 and 25

1. Trip the breaker open. If the breaker is not open, the interlock lever of the drawout mechanism will not permit operation of the rackout handle.

2. Pull the racking handle up and forward as far as it will travel, disengaging the primary disconnects.

3. Slide the breaker out until the position stop engages in the front slot in the bottom of the breaker carriage. The breaker is now in the "test" position, where its primary disconnects are safely disconnected from the line and load terminals of the enclosure. (Note - Refer to section describing "Test Position" in these instructions.)

4. To remove the breaker from its enclosure, lift the position stop handle and slide the breaker forward until the position stop engages the rear slot in the bottom of the breaker carriage. This is the safety position stop where both the primary and secondary contacts are disengaged. Again lift the position stop handle. Slide the breaker slightly forward to remove it from the enclosure.

Inserting Breaker AK-50, 75 and 100

1. Lift the breaker to a position approximately six inches above the height of the compartment tray.

2. Pull the drawout tray out under the breaker as far as the tray will travel. NOTE - When installing an individual skeleton housing for a drawout AK-50 or 75, locate a bolt head over the two front bottom mounting holes of the housing to provide a limit stop for the drawout tray.

3. Lower the breaker about 1/2" above the dowel pins on the tray and push the breaker back into its compartment so that the rear bottom angle of the breaker is against the guides on the tray directly back of the dowel pins.

4. Slowly lower the breaker onto the tray and at the same time guide it so that the holes in the rear angle of the breaker fit over the two dowel pins on the tray. If the breaker is correctly positioned on the dowels, its rear and side bottom frame angles will all sit firmly on the tray.

5. Insert two 3/8 inch hex. head screws through the holes in the front of the side angles on the breaker and thread them part way into the tapped holes in the tray. Do not tighten screws firmly. This provides better alignment of the primary stationary studs and the primary disconnects for the subsequent racking operation.

6. Push the breaker into the compartment until the "test" position stop engages to prevent further travel. (Note - Refer to section describing "Test Position" in these instructions.)

7. Release the test position stop by depressing its lever and push the breaker back into the compartment until the racking pins on the housing butt against the outer surface of the racking cam. In this position, the racking pin has lifted the locking arm on the cam which allows the racking handle to be lifted enough to allow the pawl to engage the first notch on the cam.

8. When the pawl engages the first notch on the cam, push the handle down again to its normal position. This causes the cam to rotate about the racking pin. Repeat this operation five times to rack the breaker into its final operating position. Interlocks hold the breaker trip free until it is racked into the fully contacted position. The fifth stroke of the handle is only a partial stroke and does not result in any further movement of the breaker. It does serve three useful purposes: it positions the cam so that it cannot rotate and allow the breaker to back out under short circuit stresses; the partial stroke signals that the racking operation is complete, and it releases the trip interlock which was engaged by the racking pin during the previous four pumps of the racking arm. NOTE: Once a racking operation has been started, it must be completed, as the breaker cannot be reversed until the racking operation is completed.

9. After completing the fifth racking stroke, lift the handle as high as it will go and allow it to drop to its normal position. NOTE: Any strokes beyond this point will cause the breaker to be trip free. Tighten the 3/8 inch hex head screws inserted in the front holes of the drawout tray during s[illegible] 5 of this operation. The breaker is no[illegible] the operating position.

Withdrawing Breaker AK-50, 75 and 100

1. Trip the breaker to release the positive racking interlock.

2. Lift the racking handle as far as it will go.

This operation will re-engage the trip interlock to hold the breaker trip-free for the remainder of the racking operation. Note that here the cam is rotated by lifting the handle, whereas in racking the breaker in, the operation is performer as a result of pushing the handle down.

3. Reset the handle to its lowered position and lift it again. This operation must be performed 5 times to completely disengage the cams from their racking pins. After the fifth lifting stroke let the handle drop to its normal position.

4. Pull the breaker out of its compartment until the test position stop engages to hold the breaker in the "test" position.

5. Depress the test position stop handle and pull the breaker out of its compartment as far as the drawout tray will travel.

6. Remove the two 3/8 hex. head screws which hold the breaker on the tray.

7. Attach a lifting device to the to[illegible] frame of the breaker.

8. Lift the breaker approximately 1/[illegible] inch off the dowel pins on the tray and then pull the breaker forward until its primary contacts clear the compartment.

9. Push the tray all the way back into its compartment. The breaker is now free from its compartment.

TEST POSITION

The "Test Position", as referred to in the previous instructions, is that breaker position where the primary power disconnect contacts are safely disengaged but the secondary control disconnects are engaged. In this position, the breaker may be tested or operated, manually or electrically without energizing the primary power circuit, provided the racking handle has been moved to the completely down position, thus releasing the trip interlock.

For a more complete description of drawout mechanisms and enclosures see AKD DRAWOUT EQUIPMENT INSTRUCTIONS, GEH-1830 and AKD5 Drawout Equipment Instructions GEI-90890.

DRAWOUT BREAKERS AKD5 EQUIPMENT

NOTE: AKD5 breakers are identified by letter "A" appearing after breaker number - example, "AK-2A-15".

Drawout Mechanism Operation - There four positions of the drawout mechanis

1. **The Connected Position** - the breaker in the operating position, both primary and secondary contacts made and the door may be closed.

   The Test Position - the primary (power) contacts not made but the secondary (control) contacts are made. Any breaker test not involving power may be made in this position. The door may be closed in this position.

3. **Disconnect Position** - neither the primary nor the secondary contacts made. The door may be closed.

4. **Fully Withdrawn Position** - the breaker completely out of its compartment ready for removal from the inner housing. The door must be open in this position.

NOTE: The mechanism is designed to reverse automatically in the connect and fully disconnected position. Once an operation is started it must be completed. Completion of an operation is indicated by the red knob retracting to its original position.

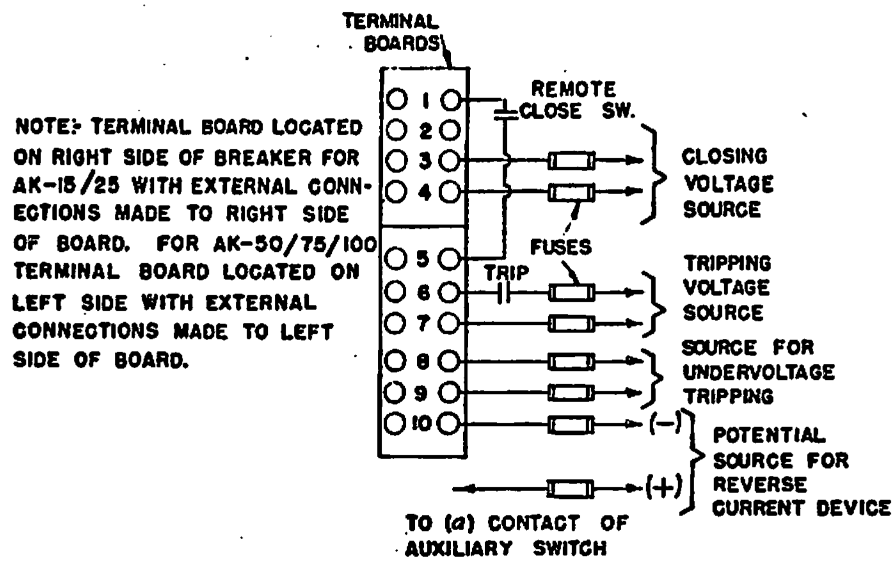


Fig. 1 (Front View)

Fig. 1 (457A683)

<u>Breaker Insertion AK-2A/3A</u> - With the inner housing in the connected position proceed as follows:

1. Insert handle on jackscrew shaft located on left hand side of compartment right above indicator.
2. Rotate handle counter clockwise until jackscrew is stopped. (Indicator should read DISC).
3. Remove handle and open compartment door.
4. Rotate the two track lock links and pull the right track to the limit of its travel.
5. Using a lifting device, raise the breaker until the breakers mounting pins are approximately one inch above the tracks.
6. Pull the remaining track out to the limit of its travel and lower breaker so the breaker mounting pins drop into the slots in the track. Remove the lifting device.
7. Push the breaker in against the track stops. Rotate the two track lock links to lock the breaker in place. Close the compartment door.

NOTE: When moving a breaker from one position to another, be sure breaker is tripped open.

8. Insert handle on jackscrew shaft and rotate clockwise to move breaker into the compartment. Breaker is in connected position when jackscrew can no longer be rotated. (Indicator should read CONN).

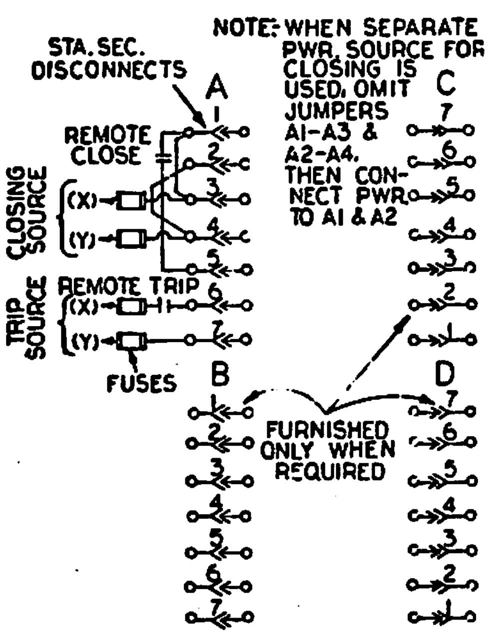


Fig. 2 Front View AK-15 and 25 Breaker Compartment

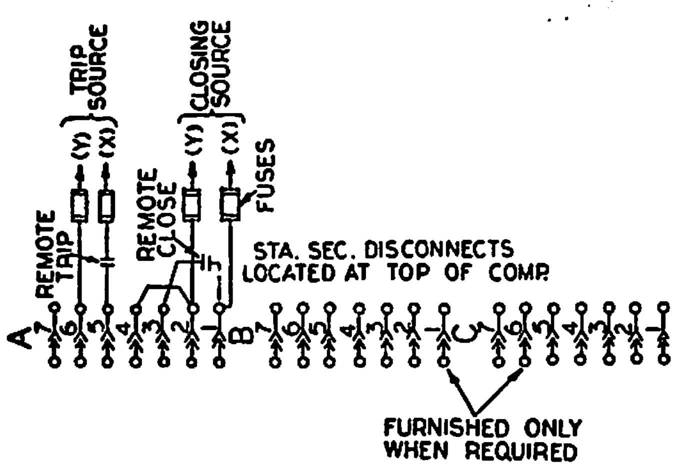


Fig. 3 Front View AK-50, 75, 100 Breaker Compartment

Figs. 2 & 3 (127A613)

Breaker Removal AK-2A/3A

1. Trip the breaker.

Move the breaker and inner housing to the fully withdrawn position. (See Breaker Insertion, Steps 1, 2 and 3).

3. Rotate the two track lock links and pull the breaker out to the limit of the track travel. Attach lifting device and lift breaker up and away from compartment until primary disconnects clear the compartment.

4. Move the inner housing to the connected position by pushing the tracks back against the track stops and then follow Steps 7 and 8 under Breaker Insertion. The inner housing is now in the connected position and the breaker is free from its compartment.

NOTE: The installation of AK50S/75S/100S/AKF2C/2D and breakers equipped with the quick-closing mechanism is the same as the other breakers described in this book. The only difference occurs with drawout breakers. The compartments that house the quick-close breakers will be equipped with an interlock that prevents the manual discharging of the closing springs while the breaker is in the racked in (connected position). This interlock will be provided with both AKD and AKD5 equipment that require quick-close breakers.

CONNECTIONS

All electrical connections should be made to assure good conductivity. Mating surfaces should be parallel and firmly bolted or clamped together. Contact surfaces should be clean and have a smooth finish. The bus or cable connecting to the breaker should have adequate current-carrying capacity to prevent excessive heating. Control circuit connections should be made according to the wiring diagram which applies to each breaker specifically. Depending on the breaker type, those connections are made either to a terminal board on the breaker or to the stationary parts of the secondary disconnects.

INDIVIDUALLY ENCLOSED AND STATIONARY BREAKERS

The customers external connections for operation of breaker control components and accessories are shown in Fig. 1.

DRAWOUT BREAKERS

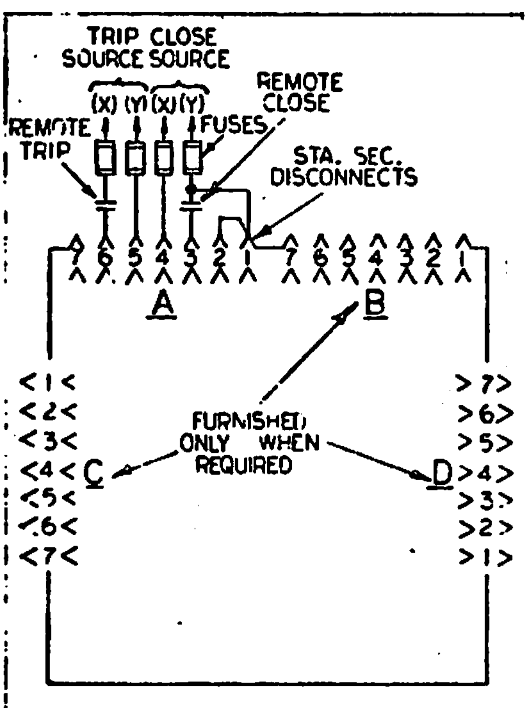
The customers external control connections to these breakers are made to the stationary secondary disconnected located in the breaker compartment as shown in Figs. 2 and 3, AKD Equipment and Figs. 4 and 5 AKD5 Equipment. (Note - If the breaker is used in a General Electric Company, Drawout Switchgear Equipment, all external connections must be made to terminal blocks located in the rear vertical wiring trough of the equipment.)

OPERATION

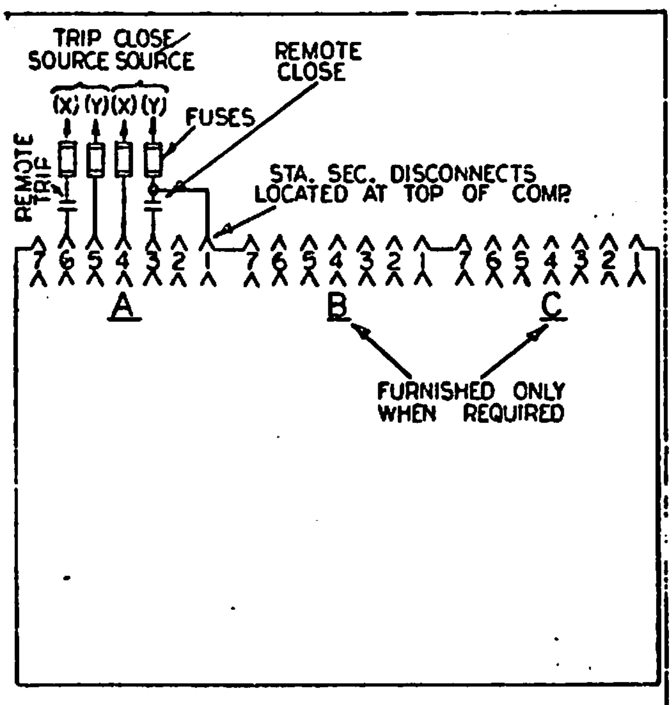
MANUAL CLOSING

AK-15/25 manually operated breakers are closed by turning the handle 90 degrees counterclockwise and then clockwise 90 degrees back to the original position. The initial counterclockwise movement resets the closing mechanism. The clockwise movement closes the breaker.

The closing mechanism of the AK-50/75/100 manual breakers is a spring



FRONT VIEW AK-1A-15, 25 & AK-2A-15, 25
BREAKER COMPARTMENT



FRONT VIEW AK-2A-50, 75, 100
BREAKER COMPARTMENT

Figs. 4 & 5 (0156A2377)

Fig.

Fig. 5

charged mechanism similar to the one used on AK-50/75/100 electrically operated breakers. AK-50/75/100 manual breakers are closed by rotating the closing handle counterclockwise through approximately 120 degrees, and then clockwise back through 120 degrees to the normal handle position. Four such complete movements of the handle are required to close the breaker. During the four counterclockwise movements and the first three clockwise movements of the handle, the springs are charged. After approximately 70 degrees travel of the fourth clockwise handle movement, the spring charged mechanism is driven over-center and the breaker closes. A charge-indicator, numbered 1 to 4, viewed through the breaker front escutcheon, moves with each complete handle movement and indicates the number of complete handle movements that have been performed.

ELECTRICAL CLOSING
(Figures 6 and 7)

STANDARD BREAKERS

AK-15 and AK-25 electrically operated breakers are closed by a solenoid coil. The armature of the solenoid is linked to the breaker mechanism and its movement, operating through the mechanism, closes the breaker. The closing solenoid circuit may be operated by a push button closing switch on the breaker or by a remote switch or relay, depending on the individual arrangements desired. When a closing signal is given, the X relay coil is energized and it in turn closes its contacts. One of these seals in the X coil circuit; the other three, which are arranged in series, energize the solenoid closing coil. As the breaker closes, a mechanically operated switch opens one pair of its contacts (bb) and closes another (aa). The contacts which open cut out the X relay coil. The contacts which close energize the Y relay coil, whose contacts now seal in the Y coil and hold open the X relay coil circuit. This prevents another closing operation if one of the protective devices operates to trip the breaker before contact at the closing switch is released.

Large AK breakers (AK-50/75/100) are closed by the discharge of a closing spring. This rotates a crankshaft which, by means of an attached roller, operates a closing cam, forcing the movable breaker contacts against the stationary contacts. The closing spring is charged through the operation of a motor and gear reduction unit.

The electrical control system is comprised of an X relay, two double contact mechanically operated switches (F and G), a push button closing switch and any means for remote closing which the user may incorporate into the system. When voltage is first applied to the breaker, (before any closing signal is given) the motor is energized through two of the X relay contacts and the two G switch contacts. The motor then compresses the closing springs to the "pre-charged" position at which point the mechanically operated F and G switches are operated. This opens the G contacts, stopping the motor, and closes the F contacts, which readies the system for the final closing of the breaker. When the push button or remote switch signals for a closing operation, the X relay coil is energized, operating the X contacts. This seals in the X relay and energizes the motor once again and the closing operation takes place.

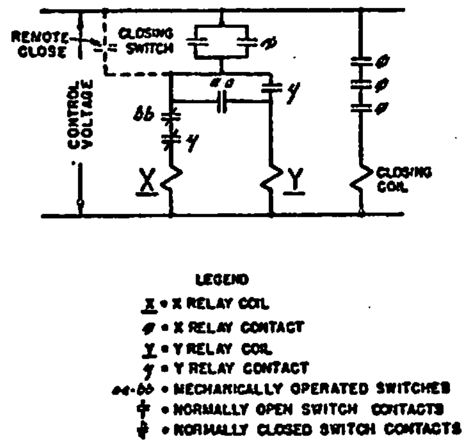


Fig. 6 Simplified Elementary Diagram Internal Wiring AK-15 and 25

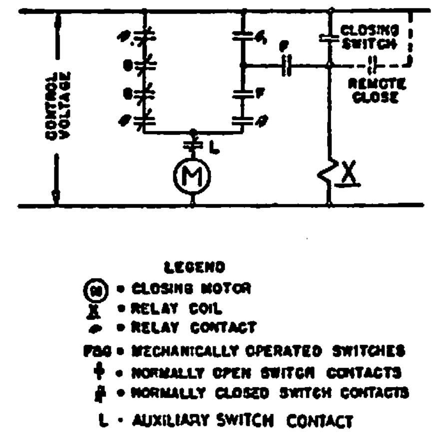


Fig. 7 Simplified Elementary Diagram Internal Wiring AK-50, 75 and 100

QUICK CLOSE BREAKERS
(Figure 8)

Functionally, the quick close mechanism differs from the standard electrical mechanism in that the pre-charge operation is extended to completely charge the closing springs. At the end of the charging operation, which takes approximately 5 seconds, a latch plate engages the prop roller to prevent the closing springs from discharging.

With the closing springs fully charged the breaker is ready for a closing operation upon release of the prop roller. This may be accomplished either manually, by depressing the closing lever on the breaker, or electrically by closing the remote closing switch. Upon the release of the prop roller the closing springs discharge and close the breaker in the same manner as on the standard electrical breaker.

With control voltage applied, the motor is energized through the G switch contacts, and charges the closing springs. When the springs reach the fully charged position, the mechanically operated switches operate, reversing their contacts. Upon operation of these switches the motor is stopped by the opening of the G switch. The closing of the F switch prepares the breaker for a closing operation.

A closing signal now given energizes the control relay X whose contacts close and complete the circuit through the closing relay coil. With the closing relay coil energized the breaker closes as described above. At the same time the closing relay contact closes to energize the anti-pump relay causing its contacts to reverse providing the anti-pump feature.

When the breaker closes, the mechanical operated G switches close to energize the motor again and the F switches open and de-energize the control relay. The auxiliary switch contact opens preventing the control relay from being energized until the breaker is tripped open. With the G switches closed, the motor charges the closing springs ready for the next closing operation.

MANUAL OR MAINTENANCE CLOSING OF ELECTRICAL BREAKERS

All electrical breakers may be closed manually by means of the maintenance handle furnished with the breaker or switchgear.

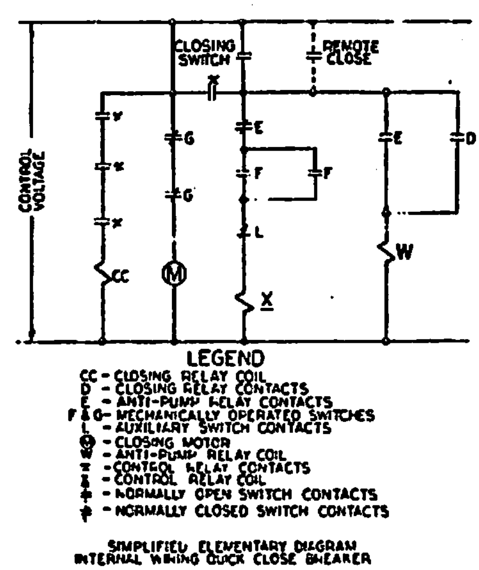


Fig. 8

To close AK-15/25 breakers:

1. Place the two small hooks of the handle into the two slots located in the lower portion of the front escutcheon.

   Rotation of the long end of the handle downwards forces the shorter end of the handle upwards against the bottom of the solenoid armature, and closes the breaker's contacts.

To close AK-50/75/100 breakers:

1. Place the ratchet type maintenance handle on the shaft that protrudes from the gear reduction unit.
2. Operate handle until the spring charge indicator reads charged.
3. Continue to operate handle until the closing springs discharge and close the contacts.

To close AK-50S/75S/100S, AKF2C, 2D breakers and breakers equipped with the quick closing mechanism:

NOTE: All AKD, or AKD-5 drawout type breakers equipped with the quick closing mechanism cannot normally be closed manually when in the racked in (connected position), due to mechanical designed interference between the enclosure and the spring discharge lever on the breaker. If manual closing is desired with the breaker racked in, the interference feature must be removed, otherwise the breaker can be manually closed in the test position or fully racked out position only.

1. With the ratchet type maintenance handle applied to the gear box shaft, operate the handle until the springs are fully charged. The fully charged position is indicated by the spring charge indicator and by solid resistance to any further handle operation.
2. Push down on the push to close lever to release the energy stored in the closing springs which closes the breaker's contacts.

TRIPPING

The breaker is tripped open by the displacement of a mechanism latch, which allows a toggle linkage supporting the movable contacts in the closed position to collapse. This trip latch is fastened rigidly to a trip shaft which runs horizontally from left to right through the breaker. All of the means provided for tripping the breaker operate through striker arms which displace the mechanism trip latch by moving against trip paddles fastened on the trip shaft. Looking at the breaker from the right, counterclockwise rotation of the trip shaft causes the breaker to trip; clockwise movement resets the mechanism latch. The manual trip button, overload devices, shunt trip, undervoltage tripping device, and reverse current trip all operate in this fashion to trip the breaker. The movement of the striker arms of all of these, when activated, should move from 1/32 to 1/16 inch beyond the point at which tripping occurs. This is what is meant by the expression, "positive tripping".

NOTE: BEFORE MAKING ANY ADJUSTMENTS TO TRIP DEVICE SETTINGS, THE BREAKER SHOULD BE IN THE OPEN POSITION AND CONTROL POWER REMOVED.

Most AK-2 air circuit breakers are equipped with series overcurrent trip devices either of the dual magnetic type (instantaneous and time delay tripping) or instantaneous alone. Breakers are designed to carry up to 100% of the continuous current rating of their trip devices. Any attempt to carry higher currents for a prolonged period will cause overheating and possible damage.

All AK-3 type air circuit breakers will be equipped with Power Sensor* overcurrent trip devices. The time current band as well as the pickup settings of this device are adjustable. A single captive thumb screw adjusts all three phases for any particular characteristic or setting. Should a thumb screw be inadvertently left loose the Power Sensor* will revert to the "minimum" pickup settings or "maximum" time delay bands accordingly. If after installation, nuisance tripping occurs, check the Power Sensor* for proper settings as required for the specific application and tighten all the thumb screws on the Power Sensor*.

For a more detailed discussion of the construction, operation, and application of overcurrent trip devices refer to the following publications:

1. Maintenance manual for specific breaker involved (see "Maintenance").

2. "Selection and Application of Power Circuit Breakers" GET-1113.

TYPE AKU AND BREAKERS WITH FUSE-BREAKER COMBINATIONS

Open Fuse Lockout Device

This device may be furnished with any of the above type breakers. The open fuse lockout device consists of 3 separately operated devices (one per breaker pole) each wired in parallel to corresponding breaker fuses. These devices are mounted on the left hand side of the breaker (looking from front). The purpose of this device is to trip the breaker upon the blowing of any one of the breaker fuses. This energizes the coil of the device causing the armature to engage the trip paddle, thereby tripping the breaker. Once operated, the armature is latched in the closed air gap position allowing the reset button to extend forward indicating which fuse has blown, and simultaneously holding the breaker in the trip-free position until the latch closed armature is released by the operating of the manual reset button.

MAINTENANCE INSTRUCTIONS

INSPECTION

BEFORE INSPECTION OR ANY MAINTENANCE WORK IS DONE, BE SURE THAT THE BREAKER IS IN THE OPEN POSITION. ALL ELECTRICAL POWER, BOTH PRIMARY AND CONTROL SOURCES SHOULD ALSO BE DISCONNECTED.

Periodic inspection of the circuit breaker is recommended at least once a year. More frequent inspections are recommended, if severe load conditions, dust, moisture, or other unfavorable conditions exist.

Always inspect the breaker after a short circuit current has been interrupted.

At the time of inspection, the following checks should be made after the breaker has been de-energized.

1. Manually operate the breaker several times, checking for obstructions or excessive friction.

2. Electrically operate the breaker several times (if breaker has electrical control) to ascertain whether the electrical attachments are functioning properly.

3. Remove the arc quenchers by removing the channel shaped retaining bar.

4. Inspect arc quenchers and contacts for breakage or excessive burning.

Should arc quencher barriers or contacts be eroded to half their original thickness they should be replaced.

LUBRICATION

In general, the circuit breaker requires moderate lumbrication. Bearing points and sliding surfaces should be lubricated at the regular inspection periods with a thin film of GE Lubricant D50H15. Before lubricating remove any hardened grease and dirt from latch and bearing surfaces with kerosene. ALL EXCESS LUBRICANT WHOULD BE REMOVED WITH A CLEAN CLOTH TO AVOID ANY ACCUMULATION OF DORT OR DUST.

On drawout breakers, the contact surface of the disconnect studs should be cleaned and greased with GE Grease Specification D50H47.

These instructions have as their purpose the imparting of information of a general nature concerning the installation and operation of Type AK power circuit breakers. If more complete and specific information is required, such as might be needed for overhauling the breaker, trouble shorting, or replacing parts of the breaker, refer to the complete instruction for the particular breaker type involved. These are:

Maintenance Manual	Breaker Type
GEI-50299	AK-2/2A/3/3A-15125, AK U-2/2A/3/3A-25
GEI-93863	AKF-2/2A-25
GEK-7303	AK-2/2A/3/3A-50/75/100, AKU-2/2A/3/3A-50 AK-2/2A/3/3A-50S/75S/100S, AKF-2C/2D/2E
GEK-7301	Power Sensor Solid State Test Instructions

Renewal parts bulletins for the various types of breakers are:

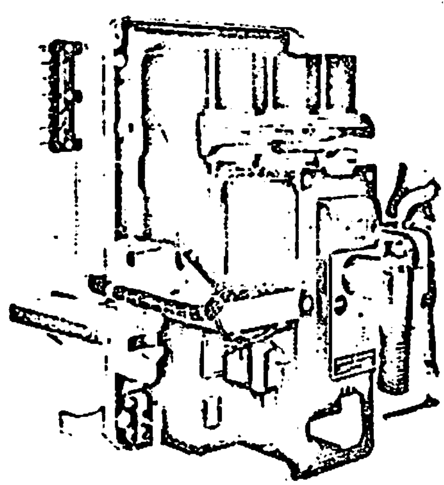
Bulletin	Breaker Type
GEF-4149	AK-2-15/25
GEF-4150	AK-2-50
GEF-4151	AK-2-75/100

*Trade-Mark of General Electric Company

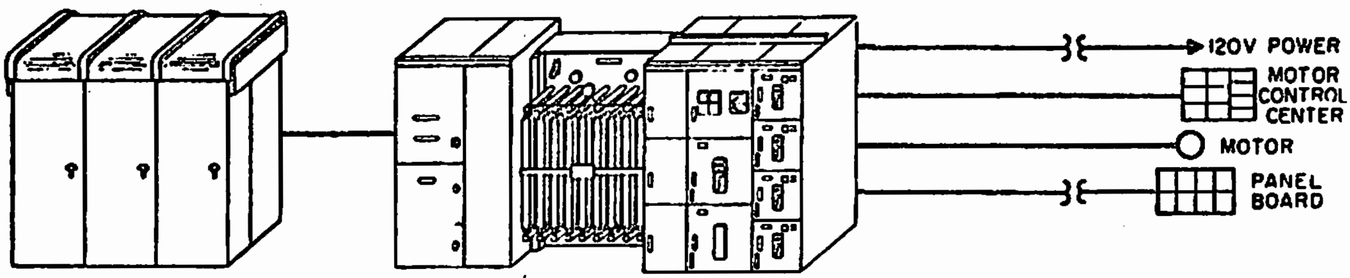
SELECTION AND APPLICATION

of

Low Voltage Power Circuit Breakers



GENERAL ELECTRIC



Co-ordinated system provides best possible combination of continuous power, continuous protection

The highest degree of service reliability can be secured by the careful selection of main and feeder circuit breaker time-current characteristics with proper relation to one another. This is what is meant by circuit breaker co-ordination.

Electrical distribution systems—no matter how carefully constructed and thoroughly insulated—can have faults. With proper co-ordination, it is possible to protect the system from unnecessary downtime caused by faults. This is achieved by matching the characteristics of protective devices from the power source to utilization in order to achieve the highest degree of service reliability. This co-ordination is provided in addition to proper mechanical design of the equipment, insulation levels, thermal capacity and short-circuit bracing. Co-ordinated, the system provides the most desirable combination of continuous power and continuous protection.

TABLE OF CONTENTS

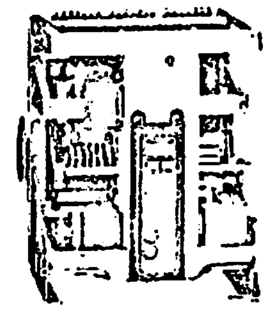
Application Information

FOREWORD

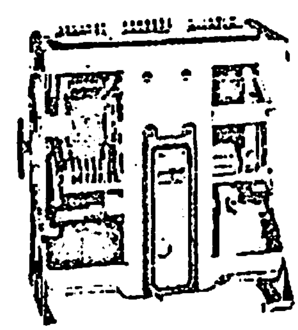
The selection of power circuit breakers for the protection of low-voltage circuits is similar to the problem of selecting other types of electrical equipment. To be properly applied, a circuit breaker should be suited to the power system on which it is to be used; it should be able to withstand the service conditions to be encountered, and should provide the necessary overcurrent protection either by itself or in co-ordination with other protective devices.

Most of the factors pertaining to the characteristics of the power system and the service conditions under which the breakers will operate will be obvious by inspection. One exception to this is the value of the maximum available short-circuit current which the breakers must interrupt. This must be determined either by calculation or with assistance from the local power company. The characteristics of the load to be supplied and the co-ordination required with other breakers in the system, dictate the type of overcurrent trip devices which should be selected for a particular breaker.

The material in this section is intended to assist in the selection of general-purpose low-voltage power circuit breakers and their trip devices as recommended by the NEMA Standards. A summary of breaker types and ratings is given in Table I.



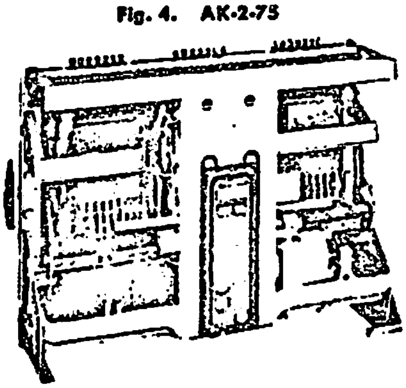
(Photo 8017150)
Fig. 3. AK-2-50



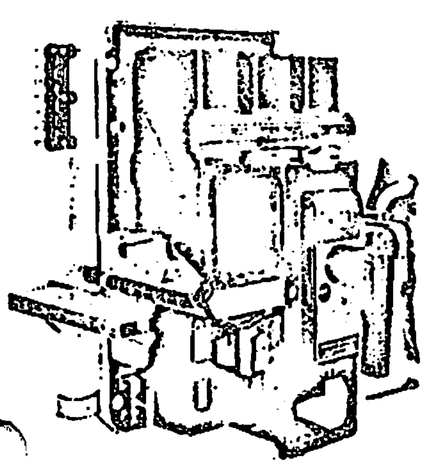
(Photo 8017150)
Fig. 4. AK-2-75

TABLE I—Summary of Breaker Types, Ratings

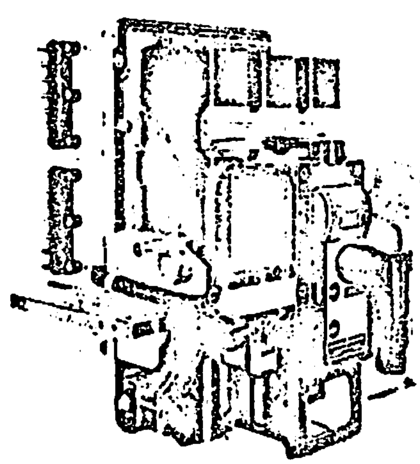
▲ G-E Breaker Type	Voltage Rating 60 Cycles A-c	Interrupting Rating in Amperes, RMS Symmetrical: With Inst. Trips	Interrupting Rating in Amperes, RMS Symmetrical: Without Inst. Trips	Overcurrent Trip Device Rating: Min. with Instantaneous Characteristic	Overcurrent Trip Device Rating: Min. with 2C Short-time Characteristic	Overcurrent Trip Device Rating: Min. with 2B Short-time Characteristic	Overcurrent Trip Device Rating: Min. with 2A Short-time Characteristic	Overcurrent Trip Device Rating: Max. Breaker Rating	Short-time Rating Symmetrical Amperes	Short Circuit Limit for 2-step Cascade Operation Amperes RMS Symmetrical
15		14,000	9,000	15	100	125	150	225	9,000	25,000
25		22,000	22,000	40	175	200	250	600	22,000	42,000
..50	600	42,000	42,000	200	350	400	500	1600	42,000	85,000
AK-75		65,000	65,000	2000	2000	2000	2000	3000	65,000	85,000
AK-100		85,000	85,000	2000	2000	2000	2000	4000	85,000	85,000
AK-15		22,000	9,000	20	100	125	150	225	9,000	42,000
AK-25		30,000	22,000	100	175	200	250	600	22,000	60,000
AK-50	480	50,000	50,000	400	350	400	500	1600	50,000	85,000
AK-75		65,000	65,000	2000	2000	2000	2000	3000	65,000	85,000
AK-100		85,000	85,000	2000	2000	2000	2000	4000	85,000	85,000
AK-15		25,000	9,000	30	100	125	150	225	9,000	50,000
AK-25		42,000	22,000	150	175	200	250	600	22,000	85,000
AK-50	240	65,000	50,000	600	350	400	500	1600	50,000	100,000
AK-75		85,000	65,000	2000	2000	2000	2000	3000	65,000	130,000
AK-100		130,000	85,000	2000	2000	2000	2000	4000	85,000	130,000



(Photo 8017150)
Fig. 5. AK-2-100



(Photo 8024100)
Fig. 1. AK-2-15



(Photo 8024132)
Fig. 2. AK-2-25

APPLICATION FACTORS

In selecting power circuit breakers, the following factors relating to the characteristics of the power system to which the breakers are to be applied and the conditions under which they will operate should be considered.

1. Circuit voltage.
2. Circuit-load current.
3. Available short-circuit current.
4. System frequency.
5. The ambient temperature.
6. Frequency of operation.
7. Altitude.
8. Local electrical codes.
9. Unusual service conditions.
10. Special duty cycles.

These factors should be given the consideration indicated in the following paragraphs. Note, when reference to the Company is indicated, inquiry should be made to the nearest Apparatus Sales Office for referral to the Low Voltage Switchgear Marketing Section, Philadelphia.

1. Circuit Voltage

The voltage rating of the circuit breaker should equal or exceed the nominal voltage of the circuit to which it is to be applied.

2. Circuit-load Current

The continuous current rating of a circuit breaker should equal or exceed the maximum-load current which the circuit will carry as established by the overload or thermal ratings of the apparatus serviced by the circuit. In this connection attention is directed to the following quotation which is a paragraph under Section SG3-3.03 of NEMA Low-voltage Power Circuit Breaker Standards, Pub. No. SG3-1958.

"NOTE: Circuit breakers are rated upon a maximum basis. They are circuit interrupters and protective devices and, as such, may be called upon at any time successfully to remove from service other equipment or circuits. Furthermore, after such a circuit interruption, their current-carrying ability may be materially reduced. Because of these conditions which differ from those for generators, motors, transformers, and similar apparatus, it is not practical to establish standard overload or thermal ratings."

3. Available Short-circuit Current

The available short-circuit current at a given point in a power system is the maximum current which the power system, when operating with maximum generating capacity and connected motor load can deliver to zero impedance short circuits simultaneously applied from all phases or polarities to ground. For a-c systems the calculated value of the short-circuit current available must be less than the interrupting rating of the circuit breaker. For d-c systems the maximum steady-state current should be less than the interrupting rating of the circuit breaker.

For a discussion of the interrupting ratings of G-E breakers, refer to pages 3 and 4.

4. System Frequency

The frequency rating of the circuit breaker should agree with the nominal frequency of the power system. Standard G-E circuit breakers are rated for frequencies of 60–25 cycles or d-c. Special recommendations should be requested from the Company for applications of circuit breakers to circuits of higher frequencies or circuits on which higher order harmonics are present, such as capacitors, rectifiers, or induction furnaces.

5. Ambient Temperature

General Electric power circuit breakers are designed in accordance with NEMA Standards to carry rated current without exceeding allowable temperature rises when operated in an ambient temperature of 40 C. When the circuit breakers are mounted in enclosures the average ambient temperature inside the enclosure may be not more than 15 degrees higher than the standard ambient temperature of 40 C outside the enclosure. Applications requiring operation in ambient temperatures in excess of 40 C should be referred to the Company with complete information relative to temperature and ventilation conditions at the proposed site of installation.

6. Frequency of Operation

Power circuit breakers may be applied to most of the more commonly encountered power circuits such as generator, transformer, and feeder circuits without normally questioning the frequency of operation. Where repetitive operations are involved such as on circuits feeding industrial process motors, furnaces, etc., the application should be considered in light of the published information on page 23, Table XII.

7. Altitude

In the rarefied air above 3300-ft altitude, both insulation and current-carrying capacity are affected, and for such applications the published ratings of power circuit breakers are modified by multiplying the ratings by the following factors established in ASA, AIEE, and NEMA standards:

Altitude in Feet	Correction Factors	
	Voltage	Current
3300	1.00	1.00
4000	0.98	0.996
5000	0.95	0.99
10000	0.80	0.96

8. Local Electrical Codes

All G-E standard power circuit breakers are built to conform to applicable provisions of the ASA and NEMA standards. Requirements for breakers having special characteristics in order to meet certain city, state, or other electrical codes should be referred to the Company.

9. Unusual Service Conditions

It is recommended that, wherever possible, steps should be taken at the site of installation to control unusual service conditions so that standard equipment can be installed. When such steps are not practical or standard equipments such as dust-tight, watertight, dripproof, or explosion-proof enclosures adaptable to the unusual condition are not listed, recommendations for special features necessary to adapt the equipment to the unusual conditions should be obtained from the Company in advance of placing the order. Among such unusual conditions are the following:

1. Exposure to damaging fumes or vapor.
2. Exposure to steam.
3. Exposure to salt air.
4. Exposure to oil vapors.
5. Exposure to hot and humid climate.
6. Exposure to dust, abrasive dus* magnetic dust, or metallic dust.
7. Exposure to dripping water c. falling dirt.
8. Exposure to explosive mixtures of dust or gases.
9. Exposure to abnormal vibration, shock, or tilting.
10. Seasonal or infrequent use.
11. Unusual insulation requirements.
12. Exposure to extreme temperatures or sudden changes in temperature.
13. Unusual space limitations affecting use or installation.
14. Unusual configuration of enclosing rooms causing hot air pockets, rooms not having normal ventilation, or rooms containing large amounts of magnetic material.
15. Unusual operating duty, frequency of operation, or difficulty of maintenance.
16. Unusual or special operating requirements.

10. Special Duty Cycles

Breakers are used occasionally on special duty cycles, including currents above the normal rating for short periods, followed by rest periods, etc. Under these conditions it may be necessary to integrate the combined effect of the various load currents at different parts of the dut cycle as far as heating effect is concerne. It is seldom necessary to use a breaker of

Application Information

rating corresponding to the highest current of the duty cycle. Recommendations for such applications should be requested from the Company.

INTERRUPTING RATINGS

Modern design circuit interrupters such as are used on General Electric low-voltage power circuit breakers have interrupting capabilities which are a function of voltage. This is reflected in the differences in interrupting ratings assigned to circuit breakers with instantaneous trip devices at the three voltage levels of 600, 480, and 240 volts. Table I indicates these ratings, as well as the interrupting ratings without instantaneous trips, which are not a function of voltage. The latter ratings are to be used when breakers are applied without instantaneous trips, as they would be when equipped with selective trips or when direct-acting overcurrent trips are omitted—for example, when separate overcurrent relays are used.

The rated interrupting current is the maximum current at the rated voltage which a circuit breaker is required to interrupt under the operating duty specified and with a normal frequency recovery voltage not less than the rated voltage.

Interrupting ratings of General Electric power circuit breakers are based on the test procedure, applicable operating duty (duty cycle), performance and conditions given in paragraphs SG3-3.08 and SG3-3.19 of the NEMA Standard for low-voltage power circuit breakers. The latter paragraph reads as follows.

DETERMINATION OF INTERRUPTING RATING

The test procedure and characteristics of the test circuit to be used for verifying the ability of the circuit breaker to interrupt the total rms amperes given by the interrupting rating for the applicable operating duty shall be as follows:

A. RMS Total Amperes

The rms total amperes shall be determined by measuring the current flow as follows:

The circuit breaker shall be short circuited or omitted.

The symmetrical current shall be measured at an instant one-half cycle after the short circuit occurs and shall be calculated in accordance with the American Standard Methods for Determining RMS Value of a Sinusoidal Current Wave and a Normal-Frequency Recovery Voltage, C37.5-1953. The degree of asymmetry for the asymmetrical tests shall be determined on the basis of a test circuit with an X/R ratio of not less than 6.6.*

* Copies are available from the American Standards Association, Inc., 70 East 45th Street, New York 17, N. Y.

The circuit breaker shall be able to interrupt the rms symmetrical current rating as well as every degree of asymmetry up to an X/R ratio of not less than 6.6. Verification of breaker interruption rating shall be made by:

1. *A single-phase test with line-to-line voltage across the circuit-breaker pole with the alternating-current component of current equal to or greater than 86.7 percent of the symmetrical rating, and*
2. *A single-phase test with maximum degree of asymmetry associated with par. 1 and with line-to-line voltage across the breaker pole, and*
3. *A three-phase test at rated voltage with the 3-phase average asymmetrical current not less than 1.17 times the symmetrical rating.*

The transient characteristics of the testing circuit shall be such that the 3-phase average alternating-current component of current at the end of 30 cycles (based on a 60-cycle frequency) shall be not less than 85 percent of the average alternating-current component of current at the end of the first half-cycle.

B. Operating Duty for Determining the Interrupting Rating (Duty Cycle)

The operating duty for determining the interrupting rating of circuit breakers with instantaneous overcurrent trip devices for fault currents shall consist of an opening operation, followed after a 15-second interval by a close-open operation.

The operating duty for determining the interrupting rating of circuit breakers with delayed overcurrent trip devices for fault currents shall consist of an opening operation, followed after a 15-second interval by a close-open operation, the tripping being delayed by the associated tripping devices.

C. Performance

At the end of any performance at or within its interrupting rating, the circuit breaker shall be in the following condition:

1. *Mechanical—The circuit breaker shall be in substantially the same mechanical condition as at the beginning.*
2. *Electrical—The circuit breaker shall be capable of withstanding rated voltage in the open position and of carrying rated continuous current at rated voltage for a limited time but not necessarily without exceeding the rated temperature rise.*

After a performance at or near its interrupting rating, it is not to be inferred that the circuit breaker can again meet its interrupting rating without being inspected and, if necessary, repaired.

D. Conditions

The conditions which are assumed in assigning an interrupting rating to a circuit breaker include the stored electrostatic and magnetic energy of the system, the re-establishment of an arc under transient voltage conditions, the decrement of the system and other variable conditions. These conditions are considered as not differing widely in average systems and are to be taken into account in the factor of safety employed in the rating of the circuit breaker.

SHORT-TIME RATINGS

The short-time rating of a circuit breaker must be taken into account when the breaker is applied without direct-acting overcurrent trips.

The rated short-time current is the maximum current which a circuit breaker will carry without injury for specified short-time intervals. The rating recognizes the limitations imposed by both thermal and electromagnetic effects.

Short-time ratings of General Electric air circuit breakers are based on the test procedure, operating duty (duty cycle), performance, and conditions given in paragraphs SG3-3.10 and SG3-3.16 of the NEMA Standard for low-voltage power circuit breakers. This paragraph reads as follows:

DETERMINATION OF SHORT-TIME RATING

The test procedure for determining the short-time current rating shall be as follows:

A. RMS Total Amperes

Determined same as for interrupting rating.

B. Operating Duty (Standard Duty Cycle)

The short-time duty cycle shall consist of maintaining rated short-time current for two periods of one-half second each, with a 15-second interval of zero current between the one-half second periods.

C. Performance

At the end of any performance at or within its short-time rating, the circuit breaker shall be capable of carrying rated continuous current without exceeding the rated temperature rise of its various parts and shall be capable of meeting its interrupting rating.

Application Information

A-C POWER SYSTEM APPLICATION

NUMBER OF POLES AND TRIPS REQUIRED

The following data gives the correct power circuit breaker for protection of the more commonly used circuits.

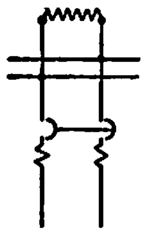


Fig. 6. Single-phase, two-wire, ungrounded

One 2-pole breaker with two overcurrent trips

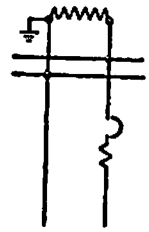


Fig. 7. Single-phase, two-wire, grounded

¶ One 1-pole breaker with overcurrent trip

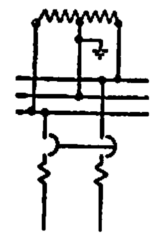


Fig. 8. Single-phase, two-wire, grounded

One 2-pole breaker with two overcurrent trips

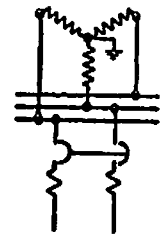


Fig. 9. Single-phase, two-wire, grounded

One 2-pole breaker with two overcurrent trips

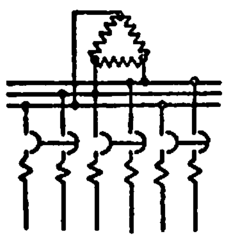


Fig. 10. Single-phase, two-wire, ungrounded

One 2-pole breaker with two overcurrent trips

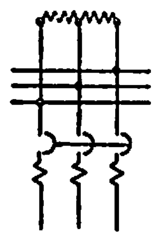


Fig. 11. Single-phase, three-wire, ungrounded

One 3-pole breaker with three overcurrent trips

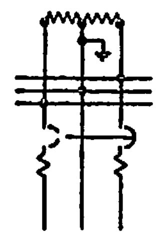


Fig. 12. Single-phase, three-wire, grounded

¶ One 2-pole breaker with two overcurrent trips (one in each conductor, except neutral)

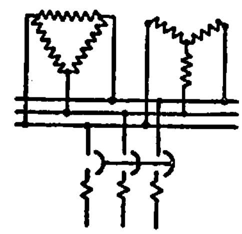


Fig. 13. Three-phase, three-wire, ungrounded

One 3-pole breaker with three overcurrent trips

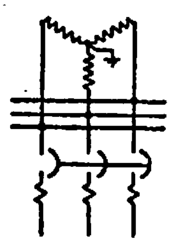


Fig. 14. Three-phase, three-wire, grounded

One 3-pole breaker with three overcurrent trips

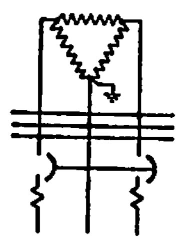


Fig. 15. Three-phase, three-wire, grounded

One 2-pole breaker with two overcurrent trips (one in each ungrounded conductor)

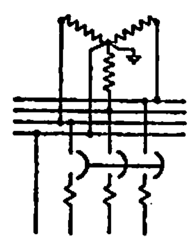


Fig. 16. Three-phase, four-wire, grounded

¶ One 3-pole breaker with three overcurrent trips

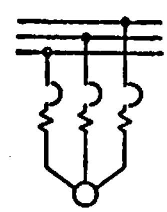


Fig. 17. Three-phase, a-c generator

One 3-pole breaker with three overcurrent trips. ‡ See note below.

¶ On incoming service lines, where the Underwriters' rules apply, provide some means of disconnecting the grounded neutral in accordance with the following requirements: 230-70 (i) of the National Electrical Code: "If the switch or circuit breaker does not interrupt the grounded conductor, other means shall be provided in the service cabinet or on the switchboard for disconnecting the grounded conductor from the interior wiring."

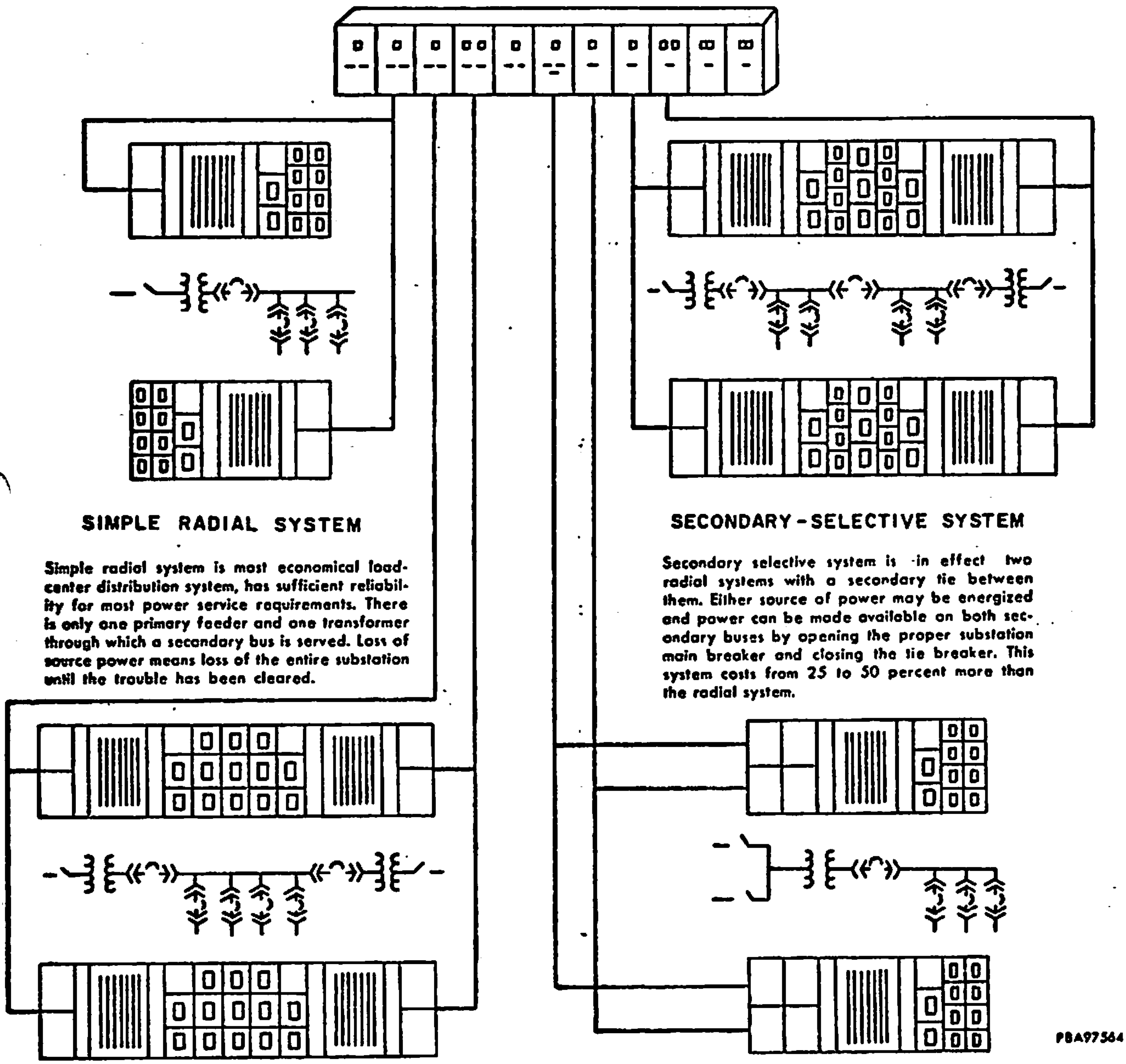
‡ Provides overcurrent and short-circuit protection only. Switchgear relays can be furnished to give reverse power, undervoltage, phase sequence, ground-current protection, etc. Such application should be referred to the Company.

Application Information

A-C POWER SYSTEM APPLICATION

Four basic circuits for power distribution have evolved from the many possible types and variations of substations and circuit arrangements.

The load center philosophy of power distribution—that is, the use of substations located in or near the load area—is basic to all of these arrangements providing good design at minimum cost. Power is supplied to the load center unit substations at the primary voltage level, stepped down to utilization voltage, and distributed to utilization devices on relatively short, low-voltage feeders. Selective co-ordination of protective devices is recommended where processes require continuous power. G-E load centers can be provided for any of these arrangements. Combinations of the various systems may be utilized.



SIMPLE RADIAL SYSTEM

Simple radial system is most economical load-center distribution system, has sufficient reliability for most power service requirements. There is only one primary feeder and one transformer through which a secondary bus is served. Loss of source power means loss of the entire substation until the trouble has been cleared.

SECONDARY-SELECTIVE SYSTEM

Secondary selective system is—in effect—two radial systems with a secondary tie between them. Either source of power may be energized and power can be made available on both secondary buses by opening the proper substation main breaker and closing the tie breaker. This system costs from 25 to 50 percent more than the radial system.

SPOT-NETWORK SYSTEM

Spot network system parallels the transformer secondaries to provide continuous service for an outage of one primary circuit. Failure of transformer or primary feeder results in automatic removal of the faulty equipment. This system costs from 20 to 50 percent more than the radial system.

PRIMARY-SELECTIVE SYSTEM

Primary selective system provides an alternate supply to the primary of each transformer. If a primary fault occurs, the associated primary breaker opens and interrupts service to half of the load area. The de-energized transformers . . . out of service . . . are manually switched to the other feeder. Cost is 15 to 40 percent more than radial systems.

Application Information

A-C POWER SYSTEM APPLICATION

TRANSFORMER SECONDARY BREAKER

A transformer secondary breaker is recommended for one or more of the following purposes:

1. To provide a fast method of removing all load from the transformer. Article 230-70 (g) of the NEC specifies that the disconnecting means for service conductors may consist of *not more* than six circuit breakers;
2. To provide required transformer secondary overcurrent protection in accordance with NEC Article 450-3;
3. To provide protection for faults on the main bus;
4. To provide a disconnect for maintenance purposes;
5. To provide for throwover, automatic or manual, to an alternate source in the case of failure of a primary feeder or transformer (Secondary selective circuit arrangement);
6. To back-up lower rated cascaded feeder breakers;
7. To simplify key interlocking schemes when the number of feeder breakers exceeds the practical limit.

Selection of the rating of the transformer secondary breaker should be based on the fact that forced cooling may be applied at some future time to increase the transformer rating as much as 33 percent.

GENERAL PURPOSE FEEDERS

For a-c circuits, there should be one breaker pole with overcurrent trip in each ungrounded conductor. For polyphase circuits, it is essential that all phases be disconnected simultaneously; therefore multipole breakers are used.

The dual-magnetic trip (Long time-instantaneous) with a 1B long time-delay characteristic is commonly used for general purpose a-c feeders. Instantaneous trip settings should be determined on the basis of the type of load and the type of protection desired. For instance, where arcing fault protection is a consideration, as low a setting as is consistent with the inrush characteristic of the load should be used.

A-C MOTOR STARTING AND FEEDER BREAKERS

Low-voltage power circuit breakers may be applied in motor branch circuits. They are particularly suited both economically and from good system design viewpoint for motors rated above 100 hp.

A motor branch circuit is a circuit including a single motor and a single breaker. A motor feeder circuit is a circuit including a breaker which supplies more than one motor branch circuit. Circuit breakers may also be used for motor-running overcurrent protection and as the motor controller for starting. The elements of a motor branch circuit are shown below.

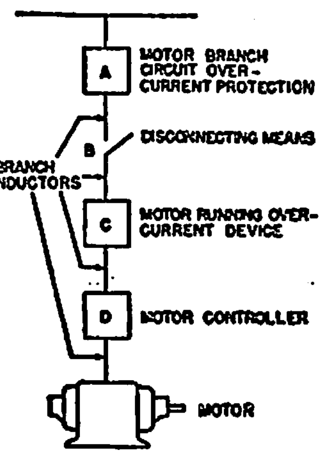


Fig. 18. Elements of a motor-branch circuit

A circuit breaker with its accessories will provide some or all of the elements of a motor circuit shown in NEC 430-1, either in itself or in combination with a motor controller. Because of the high inrush current associated with motor starting, only breakers with either an electrically or manually operated stored-energy mechanism should be used.

In single-motor circuits where the breaker is providing either branch circuit or motor-running overcurrent protection the breaker and its trip devices must have the following characteristics:

1. Continuous current-carrying capacity at least 115 per cent of motor full-load current. (Enclosed motors may have other service factors.) See table below for the selection of the continuous current rating.
2. Interrupting capacity sufficient for available short-circuit current.
3. Sufficient time delay in the overload trip to ride over the starting current of the motor.

The breaker ratings indicated in the table below, when equipped with a 1B-3 trip characteristic, are satisfactory for starting normal motors and their loads with locked rotor currents up to 6 times motor full-load current.

4. Instantaneous tripping for protection of the motor and its circuit, set low enough to protect, and not so low that tripping occurs on transient inrush. A

TABLE II—Application of Power Circuit Breakers to Full-voltage Starting and Running Duty of 3-phase, 60-cycle, 40 C Rise Induction Motors

Horsepower Rating of 3-phase Alternating-current Motors			Trip Coil Rating of Circuit Breaker Amperes	Motor Full-load Current Amp		Max. Permissible Locked-rotor Cur. 60 Cycles Amperes*
Induction Motors						
220 Volts	440 Volts	550 Volts		Min.	Max.	
3	7.5	7.5, 10	15	9.6	13	120
5	10	15	20	13	17	160
7.5	15,20	20, 25	30	19	26	240
10	25	30	40	26	35	320
15	30	40	50	32	44	400
20	40	50, 60	70	45	61	560
25, 30	50, 60	75	90	58	78	720
40	75	100	125	80	109	1000
50	100	125	150	96	131	1200
60	.....	150	175	112	152	1400
....	125	....	200	128	174	1600
75	150	200	225	144	196	1800
....	.....	....	250	160	218	2000
100	200	250	300	192	261	2400
....	250	300	350	224	304	2800
125	.....	350	400	256	348	3200
150	300, 350	400, 450	500	320	435	4000
200	400	500	600	384	522	4800
250	450, 500	600, 700	800	512	696	6400
300, 350	600, 700	800, 900	1000	640	870	8000
400	800	1000	1200	768	1044	9600
450, 500	900, 1000	....	1600	1023	1392	12800

* Locked-rotor currents are based upon motors having NEC code letters "a" through "j" inclusive. If the locked-rotor current exceeds this value, select the circuit breaker having the next higher continuous current rating, provided there is a calibration point on the breaker which is less than 140 percent of the motor full-load current.

Application Information

A-C POWER SYSTEM APPLICATION

setting of 2 times the locked rotor current is considered adequate for most conditions.

NUMBER OF OPERATIONS

In applications where the AK low-voltage power circuit is performing the function of motor controller as well as motor branch circuit protection, the number of operations which the breaker can perform without maintenance should be considered. Based on closing currents up to 600% of the frame size rating and opening currents equal to the frame size rating, AK breakers can be expected to perform at least the number of operations without inspection and servicing, indicated in Table III.

Frequently, a particular frame size of breaker will be used to control a motor considerably smaller in size than those shown under the column headed "Maximum HP at 440 Volts." In these cases the number of operations which the breaker can successfully perform between inspection and possible servicing will increase appreciably.

[illegible]ERENT MOTOR PROTECTION— [illegible] THERMO-TECTOR®

Additional protection for the motor may be obtained through the use of separate thermal relays or Thermo-tectors built into G-E motors. Either of these protective devices can be used to trip the breaker in response to abnormal conditions.

A Thermo-tector device is a specially designed heat-sensing switch embedded in the stator windings of some G-E motors. It is responsive to rate-of-rise of temperature as well as actual temperature. It will protect for locked rotor, overload, high-ambient, loss of ventilation, and single phase operating conditions; in fact, any short- or long-time abnormal condition that can raise the temperature of a winding to a dangerous degree.

Each Thermo-tector (there are at least three) has a single normally closed contact (circuit opening on rising temperature) that must be connected in the coil circuit of the motor controller. When using Type AK Power Circuit Breakers as motor controllers, the control will be arranged so that the Thermo-tector trips the circuit breaker by opening the undervoltage device or by dropping out an auxiliary relay to trip the breaker by means of the shunt trip device.

The branch circuit breaker for motors with inherent thermal protection should be provided with the usual instantaneous overcurrent trips set at twice locked rotor current and with long-time overcurrent trips for cable and for back-up protection and with sufficient delay to allow motor to start. Since the breaker long-time trip element is not being depended upon for motor running overcurrent, or stalled rotor protection, the long-time trips can be set somewhat higher than usual for motor circuits, usually 150-200 percent of motor rating depending on the cable size.

GENERATOR CIRCUITS

The power circuit breaker for a generator should be fast closing for synchronizing and should have a continuous current rating of about 125 percent of the maximum current rating of the generator. Each pole of the breaker should be provided with overcurrent trip devices having the following characteristics:

1. Long time, set for about 125 percent of the generator continuous current rating and for maximum time, for continued moderate overcurrent protection of the generator.

2. Short time, set at about 2.5 times generator continuous current rating, or as required for selectivity with feeder breakers, for protection against bus faults.

3. Instantaneous, set at 10 to 12 times generator continuous current rating, for generator circuit protection on internal faults fed from other sources in system.

The generator breaker must have an interrupting rating equal to or greater than the available short-circuit current at the breaker location from all power sources on the system, including motors. The initial value of short-circuit current calculated from the generator sub-transient reactance should be used in determining the interrupting rating required. This current may be 7 to 15 times the continuous current rating of the generator.

The short-circuit current from a generator is the large value determined by the sub-transient reactance. This current decays with time until it reaches a lower sustained value that is dependent on machine synchronous reactance and excitation system characteristics. The actual sustained value may be any value between substantially zero and about three times generator continuous current rating.

The plotted values of generator output current and time under short-circuit conditions is called the decrement curve. It determines the settings and time-current characteristics required on the generator and feeder breakers in a selective system. The decrement curve of a particular generator may not be available, but the two most important points, the initial value and the sustained value of short-circuit current, can be obtained from the manufacturer.

Self-excited generators (generator field or exciter field energized from generator voltage) require special consideration because of the rapid decrement of short-circuit current to zero. Proper tripping of the generator breaker, and selectivity between the generator and feeder breakers, can be obtained with such generators only if provision is made in the excitation system for forcing the generator to sustain short-circuit current of sufficient magnitude and duration to operate the overcurrent trip devices.

For better protection of the generator, induction type overcurrent relays with voltage restraint, type IJCV, may be used to provide tripping through a shunt trip device on the breaker. D-c tripping power, or capacitor trip, is required for reliable trip under short-circuit conditions. Suitable current and potential transformers and a lockout relay are required in addition to the IJCV relays.

When generators are operated in parallel with other sources, a reverse power relay should be included for anti-motoring protection. A shunt trip device, which may be a-c operated, is required on the breaker.

TABLE III—AK Breakers for Motor-starting Applications

Induction Motor Starter Type	Max. Motor Horsepower Ratings			Endurance At Max. Rated Horsepower (No. of Operations on Motor Starting Duty†)
	220V	440V	550V	
AK-15	75 hp	150 hp	200 hp	9000
AK-25	200 hp	400 hp	500 hp	9000
AKU-25	150 hp‡	300 hp‡	400 hp‡	9000
AK-50	500 hp	1000 hp	1000 hp	9000
AKU-50	250 hp‡	500 hp‡	600 hp	9000

† *Number of operations before repair which may include replacement of interrupting unit parts. These numbers apply only to fully completed starts, and not to interrupted starts such as jogging, inching, automatic sequencing or protective relay operations. See ASA-C-37.13.*

These endurance ratings do not eliminate the need for periodic maintenance as indicated in the applicable instruction book for the breaker.

‡ *Motor ratings are limited by the maximum ratings of fuses which can be used on AKU breakers.*

Application Information

A-C POWER SYSTEM APPLICATION

RESISTANCE WELDING MACHINE CIRCUITS

Certain forms of low voltage power circuit breakers are particularly adaptable to and recommended for the protection of circuits which feed welding machines for spot, seam, projection, and flash welding.

Welding-type breakers are equipped with instantaneous trips and will promptly and safely interrupt overcurrents or short circuits and permit immediate restoration of service.

Breakers with time delay overcurrent trip devices are not recommended for use in circuits feeding welding machines because the relatively high intermittent welding currents sometimes cause undue wear in trip devices, resulting in calibration changes and nuisance tripping. Where overload protection is required, thermal overload relays and current transformers give better results.

The breaker which should be selected is one whose maximum load curve is just above the greatest load (during-weld current or kva) at a duty-cycle value for the welding application. After this has been selected, the maximum available RMS Symmetrical short current must be determined to complete the breaker application.

Examples for Selecting a Breaker

WHEN DURING-WELD KVA IS KNOWN

(a) During-weld kva = 600
Duty cycle = 0.15
Voltage = 440

Referring to Chart II (kva at 440 volts) on page 10, the point of 600 during-weld kva and 0.15 duty cycle is below the maximum loading curve of the AK-25Y1 (or AK-50Y3). This breaker is suitable for the conditions given.

WHEN DURING-WELD CURRENT IS KNOWN

(b) During-weld current = 1360 amp
Duty cycle = 0.15

Referring to Chart IV on page 10, we find that the point of 1360 amperes during-weld current and 0.15 duty cycle is below the maximum loading curve of the AK-25Y1 (or AK-50Y3), which is the breaker to select.

TABLE IV

The following tables list the maximum during-weld ampere and kva values, at various duty cycles, for which the breakers can be used. The values are obtained from the curves in the charts on page 10.

Duty Cycle	During-weld Amp Rms	During-weld Kva		
		220 Volts	440 Volts	550 Volts
AK-15Y1 and AK-25Y2 Breakers				
0.03	1530	337	674	841
.04	1325	292	584	729
.05	1185	261	522	652
.06	1080	238	475	594
.07	1000	220	440	550
.08	936	206	412	516
AK-15Y1 and AK-25Y2 Breakers (Cont.)				
.09	884	194	388	486
.10	839	185	370	461
.20	594	131	262	327
.30	484	108	215	266
.40	419	92	184	231
.50	375	83	165	206
.60	342	75	150	188
AK-25Y1 and AK-50Y3 Breakers				
0.03	4040	890	1780	2225
.04	3500	770	1540	1925
.05	3130	689	1378	1722
.06	2860	629	1258	1574
.07	2740	580	1161	1453
.08	2640	544	1086	1360
.09	2330	513	1025	1282
.10	2215	487	974	1219
.20	1566	345	689	861
.30	1278	281	562	703
.40	1107	244	487	609
.50	990	218	436	545
.60	903	199	398	497
AK-50Y2 Breaker				
0.03	10680	2350	4100	5870
.04	9260	2040	4080	5100
.05	8280	1820	3640	4550
.06	7550	1660	3320	4150
.07	6990	1540	3080	3840
.08	6540	1440	2880	3600
.09	6170	1360	2720	3390
.10	5860	1290	2580	3220
.20	4140	910	1820	2280
.30	3380	744	1488	1860
.40	2925	644	1288	1610
.50	2670	576	1152	1440
.60	2390	526	1052	1315

TABLE V—Available Resistance Welding Breakers

Type of Breaker	Interrupting Rating RMS Symmetrical Amperes 60 Cycles A.C.*			Range of Instantaneous Trip Calibration Amperes
	600 V	480 V	240 V	
AK-15Y1	14000	22000	25000	300 to 800, or
AK-25Y2	22000	30000	42000	600 to 1500
AK-25Y1	22000	30000	42000	600 to 1500, or
AK-50Y3	42000	50000	65000	1400 to 4000, or
				2000 to 5000
AK-50Y2	42000	50000	65000	1000 to 2500, or
				2000 to 5000, or
				4000 to 10000

* Where the interrupting capacity required for a particular installation is in excess of that of the rating of the breaker identified in the charts on page 10 as suitable for an application, then a breaker of the required interrupting rating should be selected in each case.

Application Information

A-C POWER SYSTEM APPLICATION

MAXIMUM LOADING CURVES FOR WELDING-TYPE BREAKERS

Chart I—For 220 Volts

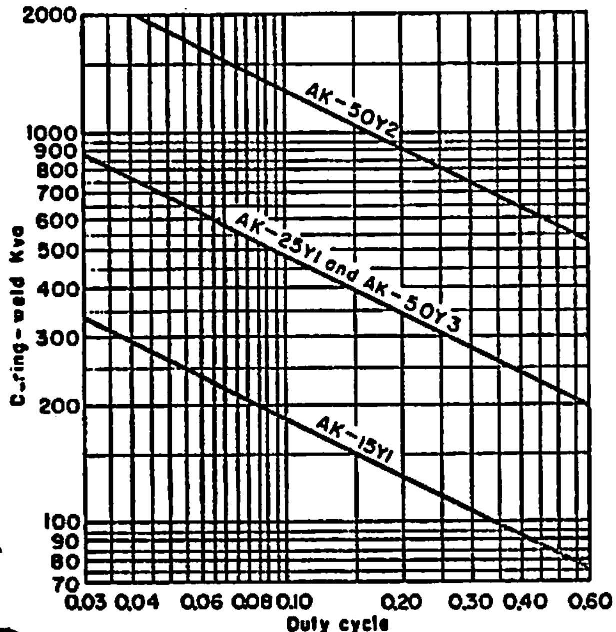


Fig. 19

Chart II—For 440 Volts

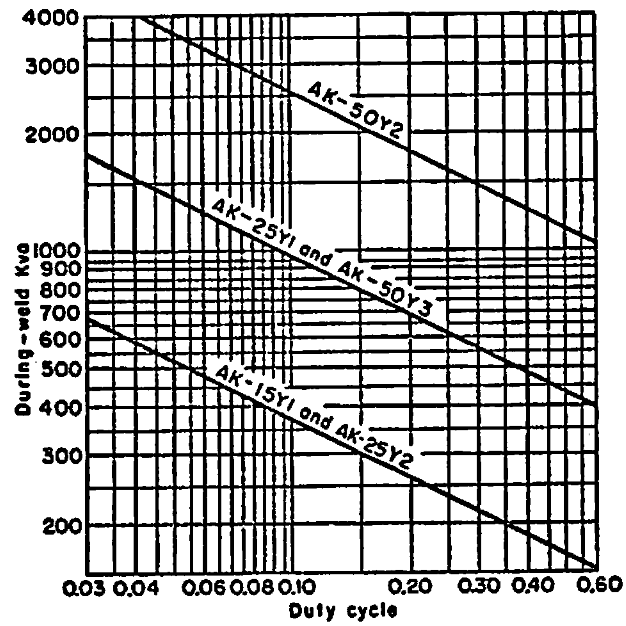


Fig. 20

Chart III—For 550 Volts

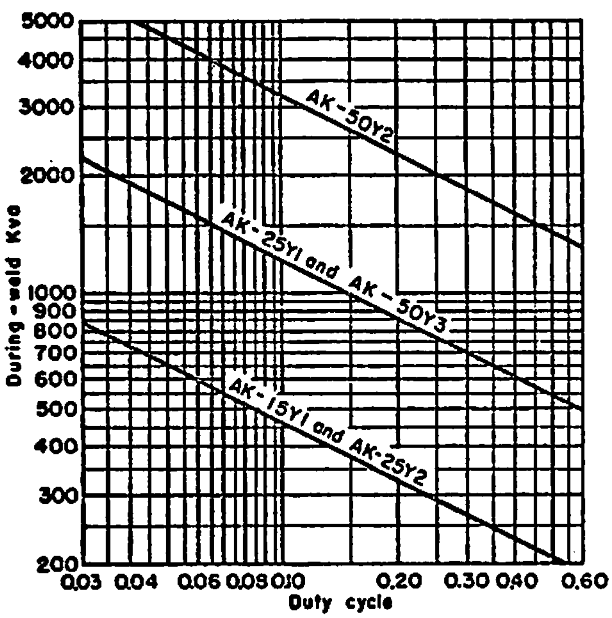


Fig. 21

Chart IV

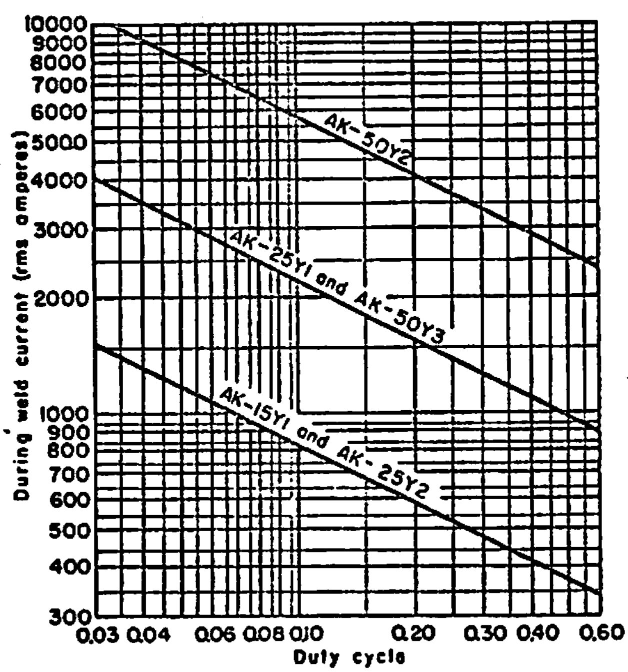


Fig. 22

The duty cycle is the fraction of time that current flows in any one minute.

Application Information

A-C POWER SYSTEM APPLICATION

GENERAL PURPOSE FEEDERS

For a-c circuits, there should be one breaker pole with overcurrent trip in each ungrounded conductor. For polyphase circuits, it is essential that all phases be disconnected simultaneously; therefore multipole breakers are used.

The dual-magnetic trip (Long time-instantaneous) with a 1B long time-delay characteristic is commonly used for general purpose a-c feeders. Instantaneous trip settings should be determined on the basis of the type of load and the type of protection desired. For instance, where arcing fault protection is a consideration, as low a setting as is consistent with the inrush characteristic of the load should be used.

SYSTEM APPLICATION OF BREAKER

System Application of Breakers—A complete application study considers the breaker in relation to the equipment which it protects, as well as in its relation to other breakers in the system. Load Center Unit Substations are perhaps the principal method of using breakers in which the functioning of one breaker with respect to another must be taken into consideration.

More than just trip characteristics must be taken into account — the relationship of interrupting ratings to available short-circuit current must also be carefully considered.

Basically there are two types of systems of breaker application:

1. Fully rated breakers are applied within their interrupting ratings:
   a. with instantaneous trips—tripping is instantaneous for short circuits.
   b. with selective trips—tripping is intentionally delayed up to interrupting rating of breaker.
2. Cascade breakers are applied above their interrupting rating. In accordance with NEMA Standards they must be backed-up with a fully rated breaker—also must be electrically operated from a remote position.

FULLY RATED SYSTEM—The fully rated system uses main and feeder breakers which are fully rated, that is, they have interrupting ratings equal to or greater than the available short circuit current. These breakers are equipped with general-purpose trip devices combining long time delay and instantaneous trip characteristics. No intentional time delay is introduced in the tripping characteristics at short circuit current levels to achieve selective tripping between the main and feeder breakers and/or the feeder breaker and branch circuit protective devices.

The current level of a fault on a feeder circuit depends on the location of the fault along the feeder conductors and may be as high as that available at the load terminals at the feeder breaker.

Due to the difference in current ratings between the main and feeder breakers and therefore the amount of time delay for a given level of fault current, some selectivity might exist depending on the magnitude of the fault current and the settings of the instantaneous trips.

In order for selectivity to exist for all possible levels of fault current on a feeder circuit, it is necessary that the main breaker be equipped with selective trips, that is, combinations of long time and short time delay *without* instantaneous trips.

SELECTIVE SYSTEM—The selective system is a term used to identify a series of protective devices, i.e. relays, breakers, and fuses, the time current characteristics of which have been selectively coordinated, so that under fault conditions power is removed only from that portion of the system on which the fault exists. The first place on a low-voltage distribution system that such coordination is usually established is within a unit substation between the main secondary and the feeder breakers. Such a substation is sometimes referred to as a "selective substation." This type of selective coordination is not to be confused with the "primary selective" or "secondary selective" load center distribution systems.

As manufacturing processes become more critical and the need for continuity of service increases it is usually found that the "selective coordination" of protection devices or the selective system is extended beyond the load center to include motor control centers, panelboards, and the like.

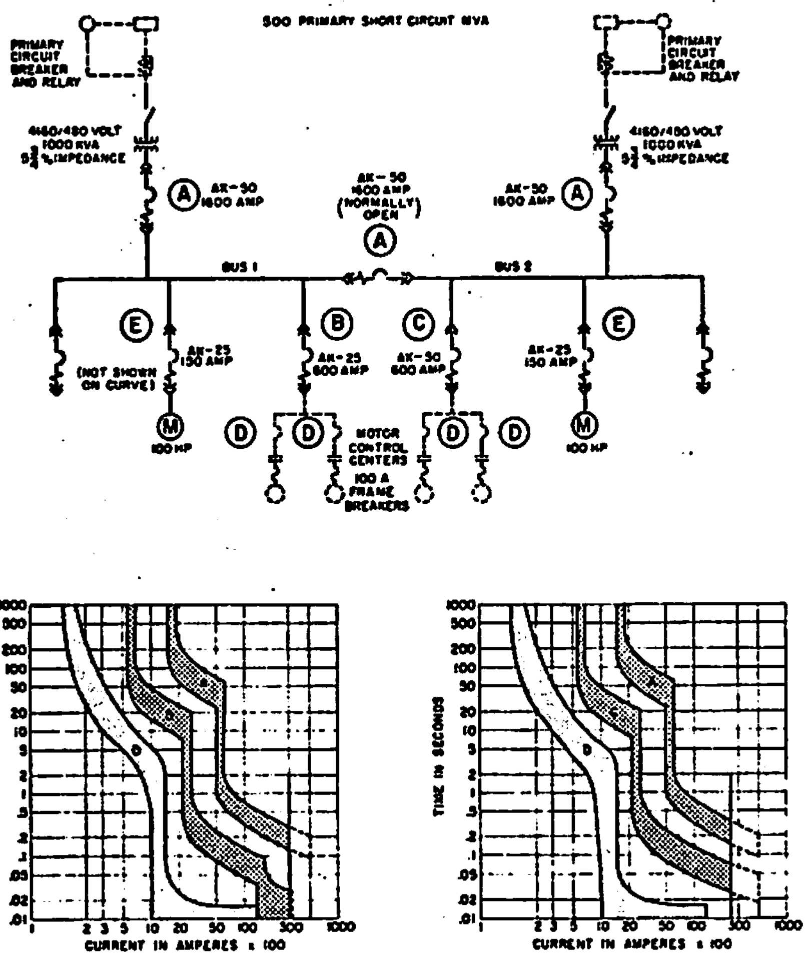
In considering a load center unit substation and the low voltage distribution circuits which are fed from it, two circuit areas become apparent:

1. The area that takes in the main breaker and any one feeder breaker. The impedance between these two protective devices is so small, that faults at the load terminals of the feeder breaker will be for all practical purposes the same magnitude as faults at the load terminals of the main breaker. For selectivity to exist between these two breakers, at all levels of short circuit current up to the maximum available, the main breaker must be equipped with long-time and short-time delay trips.
2. The area which encompasses th feeder breaker, the feeder cable and the next protective device which is frequently a molded case breaker, part of a combination starter in a grouped motor control equipment. In this area which overlaps the first area to the extent of the feeder breaker, appreciable impedance may exist between the feeder breaker and the fault at the load terminals of the combination starter. This means that fault current at the load terminals of the starter may be appreciably less than fault current which would exist for a fault at the load terminals of the feeder breaker. Even for short cable runs (50 feet) this can be true depending on the size of the cable.

The second area permits the use of the feeder breaker equipped with long- and short-time delay trips having an additional instantaneous element with its setting equal to or greater than the available short circuit current at the motor control center bus.

Application Information

A-C POWER SYSTEM APPLICATION



ZONE SELECTIVE SYSTEM

STANDARD SELECTIVE SYSTEM

Fig. 23

The instantaneous element provides short-circuit protection for the feeder cable and, where needed, backup for the molded case breakers in the starters.

Tests indicate that, for the limit of application of 100 ampere frame molded case breakers in starters of General Electric motor control centers, selectivity is obtained with an instantaneous trip setting of 12,000 amperes on the AK feeder breaker. For faults beyond the starters, the short-circuit current will be below the instantaneous trip setting and in the region of current that would cause the feeder breaker to trip on short-time delay. The AK breaker will therefore be selective with molded case breakers.

The requirements for zone selective feeders established in this manner differ from the requirements for the selective main breaker. AK breakers using a combination of long time delay short time delay, and instantaneous trip characteristics can be applied up to the interrupting rating with instantaneous trips.

The practice of providing selective tripping for faults beyond the second protective device and instantaneous tripping for faults between devices (cable circuits) gives rise to the term "zone selective system."

The requirements for applying power circuit breakers to obtain selective tripping are given in the following paragraphs. The discussion centers around Fig. 23, but the principles are basic to any application.

1. All circuit breakers, both main and feeder, must have interrupting ratings at least equal to the maximum available short-circuit current. The interrupting rating is a function of the voltage and the presence or absence of an instantaneous trip device. A suitable selection can be made from Tables I or VI.
2. Breaker A is a typical main breaker, without an instantaneous trip, and must be applied on the basis of ratings listed for breakers without instantaneous trips.
3. Feeder breaker C, which is selective with breakers D in the motor control center, should be selected on the same basis as A.
4. Feeder breaker B is equipped with instantaneous trips as well as with long time and short time delay trips, following the concept of a zone-selective system. This method of application may permit the use of a smaller frame size circuit breaker, as in the example.
5. Feeder breaker E, which is not required to be selective with a downstream protective device, is equipped with an instantaneous trip and applied on that basis.
6. The overcurrent tripping devices of the main breaker A must be so coordinated with the feeder breakers, that all feeder faults are cleared by the feeder breaker involved. The main breaker will trip only in the case of bus faults or the failure of the feeder breaker to trip. A feeder fault is, therefore, always cleared without interruption of service on other feeders.
7. Proper coordinating steps should be taken in fuse and relay application on the high-voltage side of the transformer when coordination with the rest of the system is desired.

Application Information

A-C POWER SYSTEM APPLICATION

EFFECT OF MOTOR CONTRIBUTION

When short circuits occur, motors (both synchronous and induction) in operation from the same source become generators for the time being and add their contributions to the short-circuit current. Where accurate data are not available it is customary to assume, for 240-, 480-, and 600-volt systems, that the motor load is equal to the kva rating of the source, and that the characteristics of the motors are such that the motor short-circuit contribution will be four times the normal current. In 208 or lower voltage systems, lighting, heating, welding, and other classes of nonregenerative load are likely to be present and hence, for such systems, it is customary to assume the motor load to be 50 percent of the total available power and the motor short-circuit contribution will be two times the normal current.

Short-circuit contributions from induction motors are very short-lived and by the time the breakers have opened they will have decreased to very low values. Synchronous motors, however, maintain their voltage for longer times and consequently they impose a heavier opening duty on the breakers. This may affect the satisfactory operation of the "C" breakers in the cascade (Fig. 24). Accordingly it has been made a condition of cascading that if more than 25 percent of the motor load is synchronous the problem should be referred to the Company for recommendations. The ratings in Tables VII, VIII, IX, and X are based on these considerations.

CASCADE SYSTEMS

Low-voltage power circuit breakers may be applied on circuits where the available fault current exceeds the interrupting rating of the breaker but these conditions must be fulfilled:

1. Provided there is a fully rated breaker backing up the breaker so applied. This is illustrated in Fig. 24 where "M" is the fully rated main breaker and "C" is the cascaded feeder breaker applied above its interrupting rating.
2. The feeder breaker "C" must have instantaneous trips. NEMA Standards recommend that these breakers be electrically operated.
3. The back-up breaker "M" must have its instantaneous trip set in accordance with NEMA Standards, so that it will trip when the fault current through the feeder breaker reaches 80% of the feeder breaker interrupting rating. The difference in fault currents between breakers "M" and "C" due to motor contributions must be taken into account in calculating the maximum allowable instantaneous trip setting on breaker "M."

Under the cascade system of application, a short circuit on a feeder breaker will be very likely to trip the main breaker and thus remove power from all feeder breakers. Herein lies the advantages of the fully rated system with selective trips on the main breaker. Since the feeder breakers of a fully rated system are able to open on a short circuit without assistance from the main breaker, selective trips delay tripping of the main breaker and permit it to ride over a fault on a feeder. In case of a bus fault between the main and feeder breakers or some unusual condition which prevents the feeder from clearing, the main breaker will open and remove the short circuit.

NEMA Standards state the operation

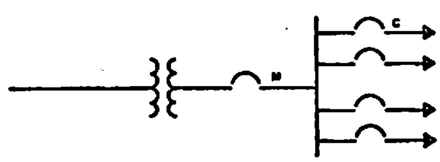


Fig. 24

of breakers in excess of their interrupting capacity (as in cascade) is limited to one operation, after which inspection, maintenance, and repair may be required.

EFFECT OF TWO SOURCES

Where two or more power sources are involved, as in Fig. 25, the total short-circuit current to be considered in the determination of the interrupting rating of breakers F can be taken as the sum of the currents from all sources that are added together as if coming from one source.

The continuous current requirements for each breaker M usually result in these breakers having adequate interrupting ratings for any faults. The M breakers must be adjusted so that all trip instantaneously before the fault current through the F breakers, from all sources, exceeds 80 percent of the interrupting rating of F. In order to conform to this rule, all sources of power which feed current through breaker F must be considered.

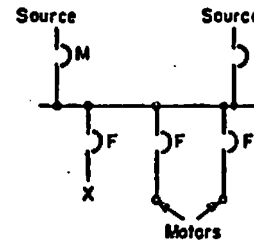


Fig. 25

This means, for Fig. 25, for example, that the current through F, to a fault in the left-hand feeder, is supplied not only from the two sources through breakers M but also from the motors operating in the two feeder circuits at the right of the feeder under consideration. The settings of the breakers M must take the motor contributions into account and be of proportional value. This can best be illustrated by an example, as follows:

EXAMPLE: Assume that each source in Fig. 25 is a 1000-kva, 480-volt transformer capable of supplying an rms symmetrical short-circuit current of 20,500 amperes, and that the motor load on each feeder will contribute an rms symmetrical short-circuit current of 4800 amperes. The total short-circuit current in the left-hand feeder through breaker F then will be:

$$2 \times 20{,}500 + 2 \times 4800 = 50{,}600 \text{ amp}$$

Each of the breakers M must be of 1600-ampere continuous current rating, this inherently provides breakers of 42,000-ampere interrupting rating, which is more than ample for the 20,500-ampere requirement. At F with a total short-circuit current of 50,600 amperes available, it is necessary to choose a breaker which has a minimum interrupting rating of half of this amount, or 25,300 amperes, which means an AK-1-25 breaker.

Of the 50,600-ampere total available short-circuit current for a feeder fault, 20,500 amperes is contributed by each transformer. Since the breakers M should trip when the current passing through breaker F is 80 percent of its interrupting rating at 480 volts, or

$$30{,}000 \times 80\% = 24{,}000 \text{ amp}$$

the trip setting of breakers M will be

$$20{,}500 \times \frac{24{,}000}{50{,}600} = 9800 \text{ amp}$$

Application Information

A-C POWER SYSTEM APPLICATION

The application tables on the following pages list the proper low voltage power circuit breakers for load center applications. The power circuit breakers have been co-ordinated with transformer and system capacities—electrically, thermally, and mechanically.

BASIS FOR APPLICATION TABLES

Application tables are based on the following:

1. A three-phase bolted fault at the low voltage terminals of the substation;

2. Transformer impedances listed in table;

3. Only source of power to the secondary is the substation transformer;

4. Total connected motor kva does not exceed 50 percent of transformer rating on 208Y/120-volt and 100 percent of transformer rating on 240-, 480-, and 600-volt systems;

5. The motor contribution is taken as 2.0 times the normal current of the transformer at 208Y/120 volts and 4.0 times normal at 240, 480, and 600 volts;

6. Coil sizes are listed for a circuit breaker applied at its maximum interrupting rating at the specified circuit voltage. Smaller coils may be used if available short-circuit current is less;

7. Tabulated values of short circuit current are in terms of RMS symmetrical amperes per NEMA Standard SG-3.

TABLE VI—Application Range—AK Circuit Breakers

G-E Breaker Type	Voltage Rating 60 Cycles A.C.	Interrupting Rating in Amperes, RMS Symmetrical		Overcurrent Trip Device Rating—Amperes					Short-time Rating Amperes RMS Symmetrical	Short Circuit Limit for 2-step Cascade Operation Amperes RMS Symmetrical
		With Inst. Trips	Without Inst. Trips	Min. with Instantaneous Characteristic	Min. with 2C Short-time Characteristic	Min. with 2B Short-time Characteristic	Min. with 2A Short-time Characteristic	Max. Breaker Rating		
AK-15	600	14,000	9,000	15	100	125	150	225	9,000	25,000
AK-25		22,000	22,000	40	175	200	250	600	22,000	42,000
AK-50		42,000	42,000	200	350	400	500	1600	42,000	85,000
AK-75		65,000	65,000	2000	2000	2000	2000	3000	65,000	85,000
AK-100		85,000	85,000	2000	2000	2000	2000	4000	85,000	85,000
AK-15	480	22,000	9,000	20	100	125	150	225	9,000	42,000
AK-25		30,000	22,000	100	175	200	250	600	22,000	60,000
AK-50		50,000	50,000	400	350	400	500	1600	50,000	85,000
AK-75		65,000	65,000	2000	2000	2000	2000	3000	65,000	85,000
AK-100		85,000	85,000	2000	2000	2000	2000	4000	85,000	85,000
AK-15	240	25,000	9,000	30	100	125	150	225	9,000	50,000
AK-25		42,000	22,000	150	175	200	250	600	22,000	85,000
AK-50		65,000	50,000	600	350	400	500	1600	50,000	100,000
AK-75		85,000	65,000	2000	2000	2000	2000	3000	65,000	130,000
AK-100		130,000	85,000	2000	2000	2000	2000	4000	85,000	130,000

STANDARD CONTINUOUS CURRENT RATINGS

G-E Breaker Type	Continuous Current Ratings (Observe minimum limits set by application tables above and on pages 15-18)
AK-15	15, 20, 30, 40, 50, 70, 90, 100, 125, 150, 175, 200, 225
AK-25	40, 50, 70, 90, 100, 125, 150, 175, 200, 225, 250, 300, 350, 400, 500, 600
AK-50	200, 225, 250, 275, 300, 350, 400, 500, 600, 800, 1000, 1200, 1600
AK-75	2000, 2500, 3000
AK-100	2000, 2500, 3000, 4000

SUBSTATION ELECTRICAL ARRANGEMENT

Substations are available in a selective, fully rated, or cascaded arrangement. Care should be taken to specify the arrangement that provides the balance of selectivity and protection required by the power system.

SELECTIVELY CO-ORDINATED SUBSTATIONS

A selectively coordinated substation uses fully rated breakers with long-time and short-time trip characteristics (LS) to delay the opening of the main circuit breaker until the faulted feeder has had an opportunity to clear. This provides service continuity for all but the faulted circuit.

Selectivity may be carried a step further in the substation by specifying selective feeder circuit breakers that incorporate long-time and short-time characteristics (LS) to allow downstream devices to clear faults within their area.

Refinement of the selective feeder incorporates the long-time, short-time with high-set instantaneous characteristics (LSI) to provide selectivity without sacrificing instantaneous fault protection. Further, this combination of trip characteristics permits application of the breaker up to its interrupting rating with instantaneous trips. This is called the Zone-Selective arrangement and is often desirable when the load-center feeder serves a motor control center.

FULLY RATED SUBSTATIONS

Fully rated arrangements use fully rated breakers with long-time and instantaneous trip characteristics (LI) on both main and feeder circuit breakers. The main circuit breaker may, or may not, trip for a feeder fault—depending on fault magnitude.

CASCADED SUBSTATIONS

Cascaded arrangements allow feeder breakers to be applied on circuits that are subject to fault currents in excess of the normal published interrupting rating of the breakers.

Under the cascade system a short circuit on the feeder circuit may trip the main breaker. NEMA standards state that the operation of breakers in excess of their interrupting rating (as in cascade) is limited to one operation after which inspection, maintenance or complete replacement may be required. It is further recommended that all feeders applied in cascade be power operated from a remote location.

EXAMPLES

The tables make it easy to select the proper G-E breakers for use with each system. For instance, using a fully rated system, a 1000-kva, 480-volt load-center unit substation with a primary source having a 150 mva maximum available short-circuit capacity, requires an AK-50 main breaker with AK-25 feeder breakers.

Should either the main circuit breaker, or feeder circuit breakers be equipped with selective trips, the appropriate breakers may be found under the columns headed Main-Selective, and Feeder-Selective or Zone-Selective. The main circuit breaker is the same size whether fully rated (LI) or selective (LS). However, the frame sizes of feeder breakers will depend upon whether they are applied as fully rated (LI), selective (LS) or zone selective (LSI).

Further, the tables indicate the main (LI) and cascaded feeder breakers (LI) for cascaded systems with a wide range of primary available short-circuit capacities and transformer sizes.

CONTINUOUS CURRENT

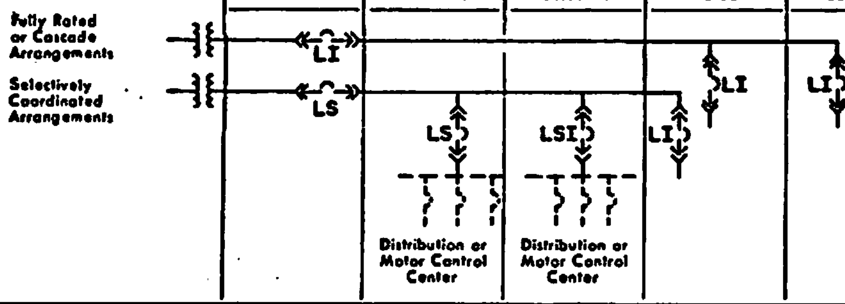
The breaker types listed under the system headings satisfy the requirements for interrupting capacity. They may not be large enough to satisfy the requirements for continuous current rating, in which case, the next larger type should be used.

Application Information

A-C POWER SYSTEM APPLICATION

TABLE VII—Low-voltage Power Circuit Breakers—208 Volts, Three-phase

						Main	Feeder Circuit Breakers							
						Fully Rated or Selective	Selective		Zone Selective		Fully Rated		Cascade	



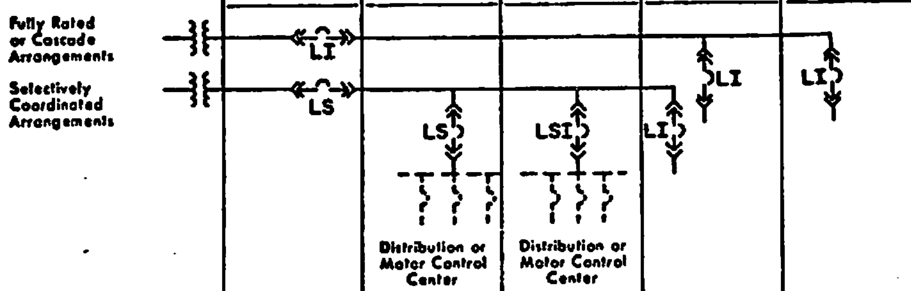
Transformer Rating 3-phase Kva and Impedance Percent	Maximum Short-circuit Mva Available From Primary System	Normal-load Continuous Current Amp	Short-circuit Current RMS Symmetrical Amp: Transformer Alone	50% Motor Load	Combined	Long-time Instantaneous or Long-time Short-time: Breaker	Long-time Short-time: Breaker	Coil Size	Long-time Short-time Instantaneous: Breaker	Coil Size	Long-time Instantaneous: Breaker	Coil Size	Long-time Instantaneous: Breaker	Coil Size
						Minimum* Breaker and Coil Size Recommended								
300 **4.5%	50 100 150 250 500 750 Unlimited	833	16300 17300 17700 18000 18300 18400 18500	1700	18000 19000 19400 19700 20000 20000 20200	AK-50	AK-25	175	AK-15	100	AK-15	30	AK-15 is fully rated	30
500 **4.5%	50 100 150 250 500 750 Unlimited	1388	25300 27800 28700 29500 30200 30400 30800	2800	28000 29600 31500 32300 33000 33200 33600	AK-50	AK-50	350	AK-25	175	AK-25	150	AK-15	30
750 5.75%	50 100 150 250 500 750 Unlimited	2080	28700 32000 33300 34400 35200 35600 36200	4200	32900 36200 37500 38600 39400 39800 40400	AK-75	AK-50	350	AK-25	175	AK-25	150	AK-15	30
1000 5.75%	50	2780	35800	5600	41400	AK-75	AK-50	350	AK-25	175	AK-25	150	AK-15	30
	100 150		41100 43200		46700 48800				AK-50	350	AK-50	350		
	250 500 750 Unlimited		45100 46600 47300 48200		50700 52200 52900 53800		AK-75	2000					AK-25	150
1500 5.75%	50	4160	47600	8300	55900	No main breaker available	AK-75	2000	AK-50	350	AK-50	350	Cascade not possible since no main breaker available	
	100 150 250 500 750 Unlimited		57500 61700 65600 68800 69900 72400		65800 70000 73900 77100 78200 80700		AK-100	2000	AK-75	2000	AK-75	2000		

* If larger trip coils are required, see Table VI—page 16.
L =Long-time delay trip (overload tripping).
S =Short-time delay trip (selective fault tripping).
I =Instantaneous trip (high fault fast tripping).
**Minimum impedance.

Application Information

A-C POWER SYSTEM APPLICATION

TABLE VIII—Low-voltage Power Circuit Breakers—240 Volts, Three-phase



Transformer Rating 3-phase Kva and Impedance Percent	Maximum Short-circuit Mva Available From Primary System	Normal-load Continuous Current Amp	Short-circuit Current RMS Symmetrical Amp: Transformer Alone	Short-circuit Current RMS Symmetrical Amp: 100% Motor Load	Short-circuit Current RMS Symmetrical Amp: Combined	Main (Fully Rated or Selective) — Long-time Instantaneous or Long-time Short-time: Breaker	Selective — Long-time Short-time: Breaker	Coil Size	Zone Selective — Long-time Short-time Instantaneous: Breaker	Coil Size	Fully Rated — Long-time Instantaneous: Breaker	Coil Size	Cascade — Long-time Instantaneous: Breaker	Coil Size
						Minimum* Breaker and Coil Size Recommended								
300 **4.5%	50 100 150 250 500 750 Unlimited	722	14200 15000 15400 15600 15800 15900 16000	2900	17100 17900 18300 18500 18700 18800 18900	AK-50	AK-25	175	AK-15	100	AK-15	30	AK-15 is fully rated	30
500 **4.5%	50	1203	21900	4800	26700	AK-50	AK-50	350	AK-25	175	AK-25	150	AK-15	30
	100 150 250 500 750 Unlimited		24000 24900 25600 26100 26300 26700		28800 29700 30400 30900 31100 31500									
750 5.75%	50 100 150 250 500 750 Unlimited	1804	24900 27800 28900 29800 30600 30800 31400	7200	32100 35000 36100 37000 37600 38000 38600	AK-75	AK-50	350	AK-25	175	AK-25	150	AK-15	30
1000 5.75%	50	2406	31100	9600	40700	AK-75	AK-50	350	AK-25	175	AK-25	150	AK-15	30
	100 150		35700 37500		45300 47100 48700				AK-50	350	AK-50	600		
	250 500 750 Unlimited		39100 40500 41000 41900		50100 50600 51500		AK-75	2000					AK-25	150
1500 5.75%	50 100	3609	41300 49800	14400	55700 64200	AK-100	AK-75	2000	AK-50	350	AK-50	600	AK-25	150
	150 250 500 750 Unlimited		53500 56900 59700 60600 62800		67900 71300 74100 75000 77200		AK-100	2000	AK-75	2000	AK-75	2000		

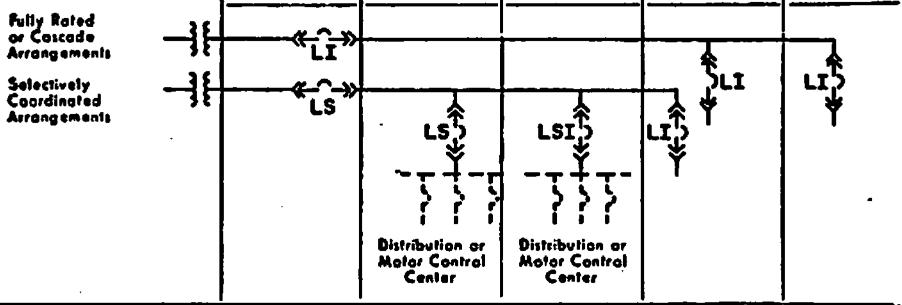
* If larger trip coils are required, see Table VI—page 16.
L =Long-time delay trip (overload tripping).
S =Short-time delay trip (selective fault tripping).
I =Instantaneous trip (high fault fast tripping).
**Minimum impedance.

Application Information

A-C POWER SYSTEM APPLICATION

TABLE IX—Low-voltage Power Circuit Breakers— 480 Volts, Three-phase

Main	Feeder Circuit Breakers			
Fully Rated or Selective	Selective	Zone Selective	Fully Rated	Cascade



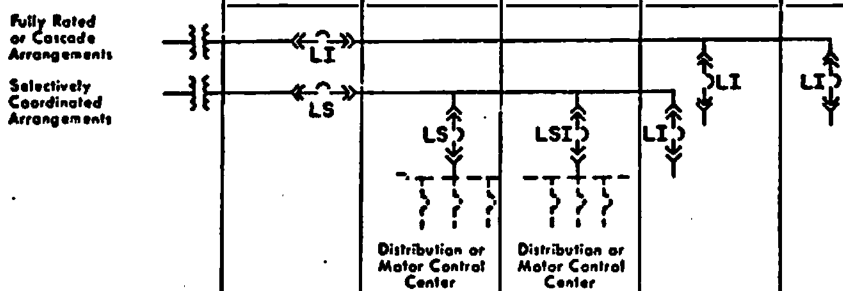
Transformer Rating 3-phase Kva and Impedance Percent	Maximum Short-circuit Mva Available From Primary System	Normal-load Continuous Current Amp	Short-circuit Current RMS Symmetrical Amp: Transformer Alone	Short-circuit Current RMS Symmetrical Amp: 100% Motor Load	Short-circuit Current RMS Symmetrical Amp: Combined	Main (Long-time Instantaneous or Long-time Short-time): Breaker	Selective (Long-time Short-time): Breaker	Selective: Coil Size	Zone Selective (Long-time Short-time Instantaneous): Breaker	Zone Selective: Coil Size	Fully Rated (Long-time Instantaneous): Breaker	Fully Rated: Coil Size	Cascade (Long-time Instantaneous): Breaker	Cascade: Coil Size
						Minimum* Breaker and Coil Size Recommended								
300 **4.5%	50	361	7100	1400	8500	AK-25	AK-15	100	AK-15	100	AK-15	20	AK-15 is fully rated	20
	100		7500		8900									
	150		7700		9100		AK-25	175						
	250		7800		9200									
	500		7900		9300									
	750		7900		9300									
	Unlimited		8000		9400									
500 **4.5%	50	601	10900	2400	13300	AK-50	AK-25	175	AK-15	100	AK-15	20	AK-15 is fully rated	20
	100		12000		14400									
	150		12400		14800									
	250		12800		15200									
	500		13100		15500									
	750		13200		15600									
	Unlimited		13400		15800									
750 5.75%	50	902	12500	3600	16100	AK-50	AK-25	175	AK-15	100	AK-15	20	AK-15 is fully rated	20
	100		13900		17500									
	150		14400		18000									
	250		14900		18500									
	500		15300		18900									
	750		15400		19000									
	Unlimited		15700		19300									
1000 5.75%	50	1203	15500	4800	20300	AK-50	AK-25	175	AK-15	100	AK-15	20		
	100		17800		22600		AK-50	350	AK-25	175	AK-25	100	AK-15	20
	150		18800		23600									
	250		19600		24400									
	500		20200		25000									
	750		20500		25300									
	Unlimited		20900		25700									
1500 5.75%	50	1804	20600	7200	27800	AK-75	AK-50	350	AK-25	175	AK-25	100	AK-15	20
	100		24900		32100				AK-50	350	AK-50	400		
	150		26700		33900									
	250		28400		35600									
	500		29800		37000									
	750		30300		37500									
	Unlimited		31400		38600									
2000 5.75%	50	2406	24700	9600	34308	AK-75	AK-50	350	AK-50	350	AK-50	400	AK-15	20
	100		31100		40700									
	150		34000		43600								AK-25	100
	250		36700		46300									
	500		39100		48700									
	750		40000		49600									
	Unlimited		41900		51500		AK-75	2000	AK-75	2000	AK-75	2000		
2500 5.75%	50	3008	28000	12000	40000	AK-100	AK-50	350	AK-50	350	AK-50	400		
	100		36400		48400									
	150		40500		52500		AK-75	2000	AK-75	2000	AK-75	2000	AK-25	100
	250		44500		56500									
	500		48100		60100								AK-50	400
	750		49500		61500									
	Unlimited		52300		64300									
3000 5.75%	50	3607	30700	14400	45100	AK-100	AK-50	350	AK-50	350	AK-50	400	AK-25	100
	100		41200		55600		AK-75	2000	AK-75	2000	AK-75	2000		
	150		46500		60900								AK-50	400
	250		51900		66300		AK-100	2000	AK-100	2000	AK-100	2000		
	500		56800		71200									
	750		58700		73100									
	Unlimited		62700		77100									

* If larger trip coils are required, see Table VI—page 16.
L = Long-time delay trip (overload tripping).
S = Short-time delay trip (selective fault trippin

Application Information

A-C POWER SYSTEM APPLICATION

...LE X—Low-voltage Power Circuit Breakers—600 Volts, Three-phase



Transformer Rating 3-phase Kva and Impedance Percent	Maximum Short-circuit Mva Available From Primary System	Normal-load Continuous Current Amp	Short-circuit Current RMS Symmetrical Amp: Transformer Alone	Short-circuit Current RMS Symmetrical Amp: 100% Motor Load	Short-circuit Current RMS Symmetrical Amp: Combined	Main: Fully Rated or Selective — Long-time Instantaneous or Long-time Short-time — Breaker	Feeder Circuit Breakers: Selective — Long-time Short-time — Breaker	Coil Size	Zone Selective — Long-time Short-time Instantaneous — Breaker	Coil Size	Fully Rated — Long-time Instantaneous — Breaker	Coil Size	Cascade — Long-time Instantaneous — Breaker	Coil Size
						Minimum* Breaker and Coil Size Recommended								
300 **4.5%	50 100 150 250 500 750 Unlimited	289	5700 6000 6100 6200 6300 6400 6400	1200	6900 7200 7300 7900 7500 7600 7600	AK-25	AK-15	100	AK-15	100	AK-15	15	AK-15 is fully rated	15
..0 **4.5%	50 100 150 250 500 750 Unlimited	481	8700 9600 10000 10200 10500 10500 10700	1900	10600 11500 11900 12100 12400 12400 12600	AK-25	AK-25	175	AK-15	100	AK-15	15	AK-15 is fully rated	15
750 5.75%	50 100	722	9900 11100	2900	12800 14000	AK-50	AK-25	175	AK-15	100	AK-15	15	AK-15 is fully rated	15
	150 250 500 750 Unlimited		11500 11900 12200 12300 12500		14400 14800 15100 15200 15400				AK-25	175	AK-25	40	AK-15	15
1000 5.75%	50 100 150 250 500 750 Unlimited	962	12500 14300 15000 15700 16200 16400 16800	3800	16300 18100 18800 19500 20000 20200 20600	AK-50	AK-25	175	AK-25	175	AK-25	40	AK-15	15
1500 5.75%	50	1444	16500	5800	22300	AK-50	AK-50	350	AK-50	350	AK-50	200	AK-15	15
	100 150 250 500 750 Unlimited		19900 21400 22700 23800 24200 25100		25700 27200 28500 29600 30000 30900								AK-25	40
2000 5.75%	50 100 150 250 500 750 Unlimited	1924	19700 24800 27200 29400 31200 32000 33500	7700	27400 32500 34900 37100 38900 39700 41200	AK-75	AK-50	350	AK-50	350	AK-50	200	AK-25	40
2500 5.75%	50 100 150	2406	22400 29200 32400	9600	32000 38800 42000	AK-75	AK-50	350	AK-50	350	AK-50	200	AK-25	40
	250 500 750 Unlimited		35700 38500 39600 41900		45300 48100 49200 51500		AK-75	2000	AK-75	200	AK-75	2000	AK-50	200
..%	50	2886	24600	11500	36100	AK-75	AK-50	350	AK-50	350	AK-50	200	AK-25	40
	100 150 250 500 750 Unlimited		33000 37300 41600 45500 47000 50200		44500 48800 53100 57000 58500 61700		AK-75	2000	AK-75	2000	AK-75	2000	AK-50	200

* If larger trip coils are required, see Table VI—page 16.
L =Long-time delay trip (overload tripping).
S =Short-time delay trip (selective fault tripping).
I =Instantaneous trip (high fault fast tripping).

Application Information

D-C POWER SYSTEM APPLICATION

D-C MACHINE CIRCUITS

D-c rotating machines are subject to burning of the commutator and brushes and to possible flashover on currents above the commutating limit, which is usually about 200 percent of the continuous rating. For this reason, it is necessary to disconnect such machines quickly from the circuit. Hence, power circuit breakers with instantaneous overcurrent trip devices, adjustable from 80 to 250 percent of the breaker rating, are generally recommended for d-c machines and feeders. For marine service, and such other applications where some sacrifice in machine protection is justified to ensure maximum continuity of service, the dual-magnetic trip, with inverse time tripping from 80 to 160 percent of the breaker rating, and instantaneous tripping at 8 to 12 times rating, can be used for d-c machines rated 250 volts and below.

For d-c generators and synchronous converters for general two-wire service, the recommended arrangements are shown in Fig. 26 and Fig. 29, with explanatory notes. Circuits to d-c motors should have the same arrangements as the d-c feeders.

For d-c, 3-wire machines, overcurrent protection is required in both sides of the armature, as shown in Fig. 28.

Time overcurrent protection is recommended for the neutral circuit, generally as part of an additional pole on the machine breaker. Usually the continuous rating of the machine neutral is approximately 25 percent of the full-load line current of the machine. This requires that the center pole on the 3-pole breaker shown in Fig. 28 be of lower capacity than the other poles, with calibration adjustable from 80 to 250 percent of the pole rating.

When two 2-wire generators are connected in series to supply power to a 3-wire system which gives a full-capacity neutral, a 3-pole breaker which has one pole in the positive lead, one in the negative, and the third in the common neutral circuit of the two generators is recommended. Each pole is provided with overcurrent protection, as shown in Fig. 29.

For very low-voltage d-c generators (of about 25 volts or less), such as are used for electrolytic service, it is usually not considered necessary to employ the high-current breakers which ordinarily would be required. For these machines, instantaneous overcurrent relays in the armature circuit (which function to reduce the generator field current) generally afford sufficient protection.

For exciters, it is not customary to furnish overcurrent protection. Sometimes, however, several exciters may be operated in parallel. In such cases, current-directional protection is recommended for each exciter. This should be of such a characteristic that it will trip its circuit breaker only on values of reverse current above those which may be caused by inductive action between the a-c machine armature and its field circuit, when a system disturbance occurs. Because the required settings of the current-directional device may be above the continuous-current rating of the breaker, it is generally necessary to provide separate reverse-current relays rather than direct-acting, reverse-current devices on the breakers. A two-pole nonautomatic breaker with a shunt-trip device, or a contactor, is required for each exciter for this application.

EQUALIZER CIRCUITS

Although knife switches can be used in the equalizer circuits of compound-wound machines, the use of power circuit breakers (as indicated in Fig. 27 to 29) usually offers advantages in switchgear, station layout, and operation. Because the equalizer circuit can in most applications be closed and opened simultaneously with the armature circuit, it is advantageous to use multipole breakers for combining both functions. The equalizer breaker poles need not be provided with overcurrent tripping, as the overcurrent protection to a machine must be provided in the armature circuit.

In two two-wire generators in series, the series fields of both generators are connected in the neutral side of each armature. A separate, two-pole equalizer breaker should be furnished for parallel operation, as illustrated in Fig. 29. This breaker (or double-pole switch, if switch is used) must be closed before the line breaker is closed, and opened after the line breaker trips.

Normally, the amount of current in an equalizer circuit is small, but this circuit must have a low resistance to be effective. It is recommended that the rating of the equalizer circuit and the devices be approximately one-third to one-half of the maximum or overload rating of the d-c machine.

REVERSE-CURRENT PROTECTION

For d-c generators and synchronous converters operating in parallel, or in parallel with another source, particularly in machines above 300 kw, it is desirable to provide current-directional or reverse-current devices on the circuit breakers to prevent abnormal interchange of current between the machines; also, to give more sensitive and faster internal-fault protection than is afforded by the overcurrent tripping devices. These reverse-current tripping devices (or separate reverse-current relays), used to trip the circuit breakers, are particularly recommended for d-c generators and synchronous converters which have time-overcurrent trip on the generator circuit breakers. The setting of these reverse-current devices should be as low as operating conditions will permit, but it must be high enough to prevent unnecessary tripping on normal values of regenerated load, or on slight interchange of current between the machines at light load. The setting of standard G-E reverse-current devices is 10 percent of the breaker rating.

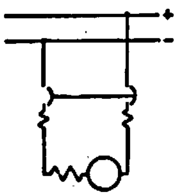
To give the best protection, each machine circuit breaker requires the same number of reverse-current tripping elements (whether devices on the breaker, or separate relays) in the armature circuits as there are overcurrent trips. In d-c, 3-wire machines, however, reverse-current protection is frequently provided in one side only, at some sacrifice in machine protection.

In some applications, protection from loss of driving power is necessary. In these cases, and in unattended (automatic) stations, current-directional relays rather than the reverse-current devices on the breakers themselves must be used to obtain the required degree of sensitivity. Such sensitive protection is liable to trip the machine under conditions of regenerated load, or of momentary interchanges of current among several machines that operate in parallel, and, accordingly, these applications require special consideration.

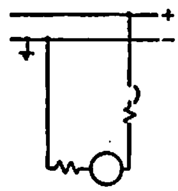
Application Information

D-C POWER SYSTEM APPLICATION

Direct-current Machine Circuits

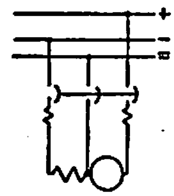


(a) Ungrounded negative
One 2-pole breaker with two overcurrent trips

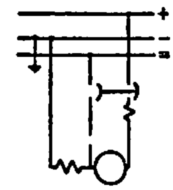


(b) Grounded negative
One 1-pole breaker with one overcurrent trip

Fig. 26. D-c, 2-wire, shunt-wound generator or synchronous converter, or compound-wound machine, for isolated operation



(a) Ungrounded negative
One 3-pole breaker with two overcurrent trips



(b) Grounded negative
One 2-pole breaker with one overcurrent trip

Fig. 27. D-c, 2-wire, compound-wound generator or synchronous converter, for parallel operation

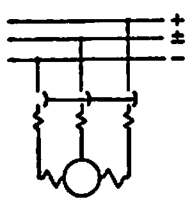


Fig. 28. D-c, 3-wire, shunt-wound generator or synchronous converter, or compound-wound machine, for isolated operation, grounded or ungrounded neutral

One 3-pole breaker with three* overcurrent trips (see Note A)

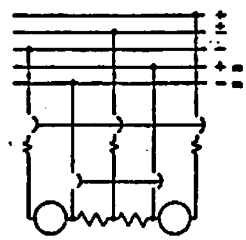


Fig. 29. D-c, 2-wire generators in series for 3-wire service, for parallel operation with other similar machines, grounded or ungrounded neutral

One 3-pole main and neutral breaker with three overcurrent trips and one 2-pole equalizer breaker with no overcurrent trips

Note A—For 3-wire, d-c machines, Fig. 28, a circuit-breaker pole with trip is shown in the neutral circuit. For 6-phase, 3-wire, d-c synchronous converters, some means must be provided additionally for disconnecting and segregating the transformer neutrals during the starting period (when the starting is done by means of taps in the low-voltage transformer windings).

* The overcurrent device on the breaker pole in the neutral circuit is usually of reduced capacity (25%), and should be calibrated for setting from 100 to 200 percent of the neutral pole rating.

D-C FEEDER CIRCUITS

Figs. 30 to 34, inclusive, show the required arrangements of breaker poles and overcurrent trip devices for the protection of feeder circuits on the various types of d-c systems. Since a majority of the feeder loads will be motors the recommendations for the protection of d-c machine circuits should be followed in selecting the overcurrent trip devices.

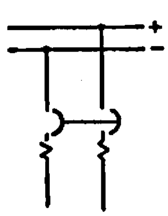


Fig. 30. Two-wire, ungrounded

† One 2-pole breaker with two overcurrent trips

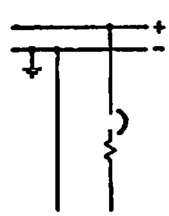


Fig. 31. Two-wire, grounded

¶ One 1-pole breaker with one overcurrent trip

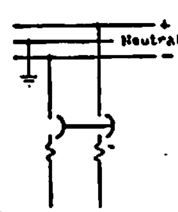


Fig. 32. Two-wire, connected to outside wires of three-wire grounded neutral circuit

One 2-pole breaker with two overcurrent trips

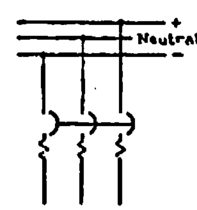


Fig. 33. Three-wire, ungrounded

One 3-pole breaker with three overcurrent trips

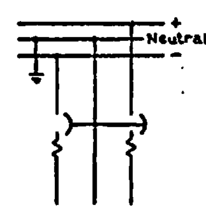


Fig. 34. Three-wire, grounded

¶ One 2-pole breaker with two overcurrent trips (one in each conductor, except neutral)

† Exception may be made for certain types of d-c feeders using single-pole circuit breakers.

¶ incoming service lines, where the National Electrical Code applies, reference should be made to paragraph 2351a. If the switch or circuit breaker does not interrupt the grounded conductor, other means shall be provided in the service cabinet or on the switchboard for disconnecting the grounded conductor from the interior winding.

D-C APPLICATIONS (Cont'd)

UNDERVOLTAGE DEVICES

For d-c generators or synchronous converters which operate in parallel with another source, it is desirable to insure the disconnection of the machine from the system, both on normal and emergency shutdowns, in order that the machine cannot subsequently be subjected to voltage from the system source. For manually operated breakers this requires a direct-acting undervoltage device with its coil connected across the machine armature circuit. For synchronous converters or for motor-driven generators, the coil of the undervoltage device should be placed in series with the normally open auxiliary switch on the running breaker or field contactor, whichever closes last in the starting sequence. Also, for d-c machines equipped with overspeed or other protective devices, or a control switch for remote tripping, and without a reliable source of tripping power in the station (such as an operating or tripping storage battery).

FIELD DISCHARGE BREAKERS

These breakers are equipped with a field discharge clip using silver-alloy contacts. This clip is connected to the main-contact operating shaft and, therefore, operates independently of the breaker mechanism. The field-discharge clip closes BEFORE the main circuit is broken, thus assuring positive protection for field coils against high induced voltages when the breaker is opened either normally or by a protective device or relay. With the AKF breakers the field-discharge clips overlap the main contacts both opening and closing.

Double-pole field breakers are available as follows:

Type	D-c Voltage Rating	Continuous Amp Rating	Nominal Field Voltage Rating—D-c Volts
AKF-1B	250	600	125/250
AKF-2C	500	2000	250/375/500
AKF-2D	500	4000	250/375/500

OPERATING MECHANISMS

Power-circuit breaker operating mechanisms perform the function of closing and opening the breaker contacts in response either to a manual effort or an electrical signal. Basically, operating mechanisms fall into two categories.

a. **Direct acting** in which the closing force is furnished by an operator (manual) solenoid or motor (electrical).

b. **Stored energy** (both manual and electrical) in which an energy storing means is interposed between the control source and the breaker contacts.

In recent years, there has been a strong trend towards stored energy operating mechanisms because of the important advantages they offer. These include: increased safety of operation, prolonged contact and breaker life, wider breaker application, particularly selective tripping and motor starting, reduced maintenance and a reduction in control power requirements for electrical breakers.

General Electric Type AK circuit breakers utilize stored energy closing mechanisms. Models are available for either manual or electrical operation.

STORED ENERGY CLOSING

A spring-operated "stored energy" closing mechanism provides fast, constant-speed closing for either electrical or manual AK-2-15 and AK-2-25 power circuit breakers. This mechanism, an extension of the principle long used in large-sized AK breakers, provides a closing speed completely independent of the operator (manual) or the voltage level of the control power source (electrical).

A manually operated breaker uses an insulated plastic handle. To close the breaker, the handle is first rotated counterclockwise through approximately 100 degrees. This resets the mechanism and partially stores energy in the closing spring. The handle is then rotated clockwise, completing the charging of the springs. As it approaches the normal rest position, the mechanism goes "over center," releasing energy to close the contacts. Upon receiving a tripping impulse, the breaker contacts are driven open at high speed by the same springs that are used for closing. A unique "rebound latch" which operates only during opening, prevents the contacts from rebounding in the closing direction.

Electrically operated models use an a-c or d-c solenoid to charge the closing spring and provide total closing time of less than 5 cycles from the instant the close button is energized. The solenoid is small, compact, has a low total-energy requirement, and affords greater accessibility for adjustment of overload trip devices. Electrically operated breakers are normally furnished without manual handles, but with a maintenance closing device.

The electrical stored energy closing mechanism utilizes energy stored in powerful closing springs to close the breaker contacts. A small universal motor, which can be operated from ac or dc, drives a gear reducer unit. The output of this unit charges the closing springs through a charging crank and cam.

In the charged position, the springs are positively blocked by the "advance of center" location of the charging crank with respect to the charging cam. When the closing switch is operated the motor quickly drives the crank over center, releasing the springs and closing the contacts. Once the springs are released, the contacts will close regardless of continuity of control power. This is important when breakers are accidentally closed in on a short circuit and the control power source is the main bus.

Recharging is done immediately after a closing operation at a low rate of energy input. This means low closing current—only 4 amp at 115 volts ac. The springs, therefore, are always charged and ready to close the breaker.

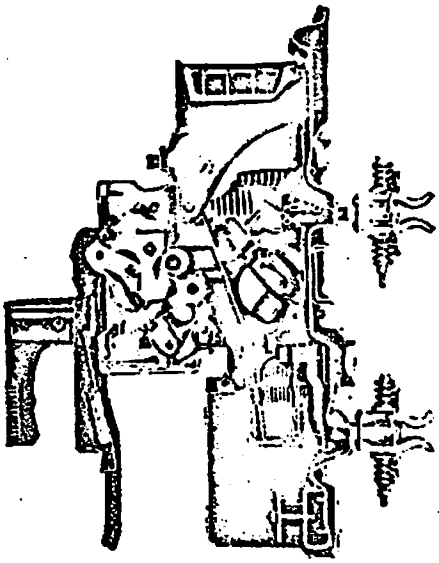
Contacts require considerably more energy for closing under short circuit or overload conditions than under normal load. Each time the springs are charged, there is enough energy stored to close the contacts under full short-circuit conditions. Energy in excess of that required to close the breaker under a particular load is absorbed by the flywheel effect of the gear box, and is returned to the closing springs.

A second set of springs is used to open the contacts when the breaker receives a trip impulse.

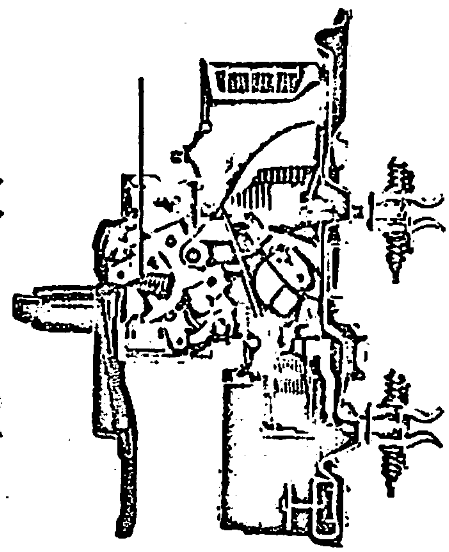
A detachable ratchet handle, which can be slipped over the extension shaft of the gear box, is provided for maintenance operation.

Application Information

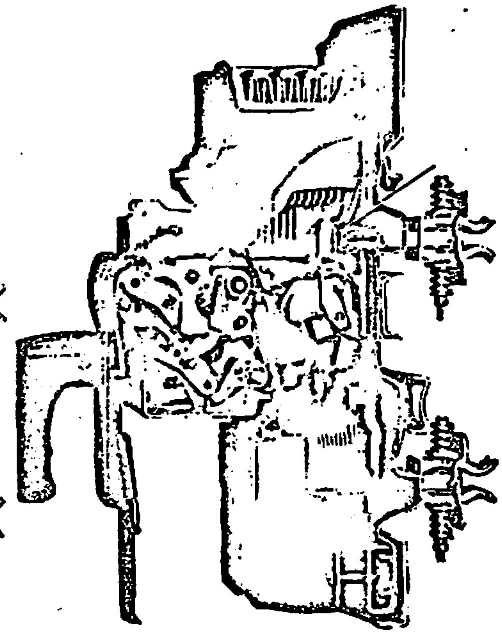
OPERATING MECHANISMS



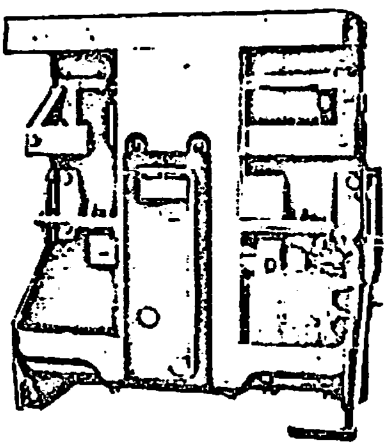
(Photo 8024516)
Fig. 35. CUTAWAY VIEW of manual stored energy mechanism ...acts (arrow) are in open position.



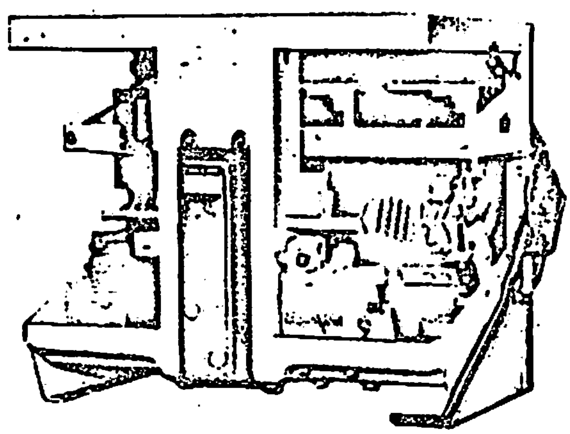
(Photo 8024517)
Fig. 36. AS HANDLE IS ROTATED counterclockwise, powerful closing spring (arrow) is charged



(Photo 8024515)
Fig. 37. AS HANDLE IS RETURNED to original position, spring discharges and contacts (arrow) are closed quickly and firmly



(Photo 8014990)
Fig. 38



(Photo 8014990)
Fig. 39

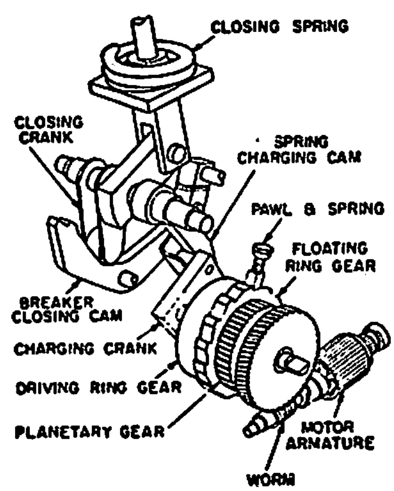


Fig. 40

Electrical stored energy closing mechanisms

CONTROL-POWER REQUIREMENTS

Successful operation of electrical breakers is dependent on a reliable control-power source. The operating currents of the closing mechanisms and shunt trip coils together with control-circuit fuse ratings and operating voltage ranges are listed in Table XI.

Note: The following control-power transformers are recommended where only one breaker at a time is being closed.

AK-2-15, -25	3 KVA (All control voltages)
AK-2-50, AK-2-75, AK-2-100	½ KVA (All control voltages)

TABLE XI—Operating Currentsψ

Type of Breaker	Ampere Rating	Closing Mechanism: 115-volt, 60-cycle (Operating Range 95–125 V)		230-volt, 60-cycle (Operating Range 190–250 V)		125-volt, D-c (Operating Range 90–130 V)		250-volt, D-c (Operating Range 180–260 V)		Shunt Trip Operating Current in Amp At Rated Volts Min Recommended Fuse Rating for All Trip Circuits——30 Amp			
		Operating Current in Amperes at Rated Volts	Ampere Rating of Fuse	Operating Current in Amperes at Rated Volts	Ampere Rating of Fuse	Operating Current in Amperes at Rated Volts	Ampere Rating of Fuse	Operating Current in Amperes at Rated Volts	Ampere Rating of Fuse	115 V 60-cycle Range 95–125 V	230 V 60-cycle Range 190–250 V	125 V D-c Range 70–140 V	250 V D-c Range 140–280 V
AK-2-15 AK-2-25	15–225 40–600	153/78φ	30	68/28φ	15	44/44φ	10	24/24φ	6	12.3/10.8φ	6.9/5.7φ	1.9/1.9φ	1.0/1.0φ
AK-2-50	200–1600	9/4φ	6	4/2.6φ	6	30/4φ	6	15/2φ	6	12.3/10.8φ	6.9/5.7φ	1.9/1.9φ	1.0/1.0φ
AK-2-75	2000–3000	9/4φ	6	4/2.6φ	6	30/4φ	6	15/2φ	6	12.3/10.8φ	6.9/5.7φ	1.9/1.9φ	1.0/1.0φ
AK-2-100	4000	9/4φ	10	4/3.2φ	10	30/5φ	10	15/2.5φ	10	12.3/10.8φ	6.9/5.7φ	1.9/1.9φ	1.0/1.0φ

ψ Values listed for operating currents are subject to change and should be used for estimating purposes only.
φ Inrush/sustained.

REPETITIVE DUTY

Circuit breakers are designed primarily to perform the function of circuit interruption under short-circuit conditions. Nevertheless modern circuit-breaker mechanisms are capable of many operations under full-load operation and inrush conditions such as encountered in motor starting applications. Industry standards have been established for the minimum performance which is indicated in Table XII. With adequate maintenance G-E breakers can be expected to exceed the standards. Refer to Switchgear Marketing when questions arise with respect to specific applications.

TABLE XII—Repetitive Duty and Normal Maintenance

Type of Breaker	Circuit Breaker Designation Interrupting Rating, Amperes	Number of Operations: Number of Operations Between Servicing, Par. A	No Load Mechanical, Par. B, E, F, G, H, and I	Full Load Nonfault, Par. C, E, F, G, H, and J	Full Load Fault, Par. C, E, F, G, H, I, and K	Inrush Nonfault, Par. D, E, F, G, H, and J	Inrush Fault, Par. D, E, F, G, H, I, and K
	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7
AK-15	15,000	2500	50,000	5000	4000	3500	2500
AK-25	25,000	1750	35,000	3500	2800	2500	1750
AK-50	50,000	500	10,000	1000	800	750	500
AK-75	75,000	250	5,000	500	400	....	....
AK-100	100,000	250	5,000	500	400	....	....

NOTES FOR TABLE XII

Power-operated circuit breakers, when operating under usual service conditions, shall be capable of operating the number of times specified in the above table. The operating conditions and the permissible effect of such operations upon the breaker are given in the following lettered paragraphs. For each column, all paragraphs listed in the column heading must be given consideration.

This standard applies to all parts of a circuit breaker that function during normal operation. It does not apply to other parts, such as overcurrent tripping devices, that function only during infrequent abnormal circuit conditions.

SERVICING

A. Servicing shall consist of adjusting, cleaning, lubricating, tightening, etc. as recommended by the manufacturers. The operations listed are on the basis of servicing at intervals of six months or less.

CIRCUIT CONDITIONS

B. When closing and opening no load.

C. When closing and opening currents up to the continuous current rating of the circuit breaker at voltages up to the maximum design voltage and at 80 percent power factor or higher.

D. When closing currents up to 600 percent and opening currents up to 100 percent (80 percent power factor or higher) of the continuous current rating of the circuit breaker at voltages up to the maximum design voltage.

OPERATING CONDITIONS

E. With rated control voltage applied.

F. Frequency of operation not to exceed 20 in 10 minutes or 30 in one hour. Rectifiers or other auxiliary devices may further limit the frequency of operations.

G. Servicing at no greater intervals than shown in Column 2 of the table.

CONDITION OF THE CIRCUIT BREAKER AFTER THE OPERATIONS SHOWN IN THE TABLE

H. No parts shall have been replaced except as qualified by par. K.

I. Circuit breaker shall be in a condition to meet all of its current, voltage and interrupting ratings.

J. The circuit breaker shall be in a condition to meet all its current and voltage ratings but not necessarily its interrupting rating.

OPERATION UNDER FAULT CONDITIONS

K. If a fault operation occurs before the completion of the permissible operations, it is not to be inferred that the breaker can meet its interrupting rating or complete its number of operations without servicing and making replacements if necessary.

Application Information

OVERCURRENT TRIPPING DEVICES

General Electric low-voltage power circuit breakers are equipped with tripping devices used for two distinct functions:

a. As a means of opening the breaker during the process of normal switching operations initiated by an operator or an automatic switching equipment.

b. As a means of automatically opening the breaker under abnormal power-system conditions for circuit-protective purposes.

Normal switching tripping is effected by one of the following devices:

1. Manual trip button—supplied on all breakers both manually and electrically operated.
2. Shunt-trip device—supplied on all electrical breakers and optionally available on manual breakers. Shunt trips are normally energized from a reliable constant potential source such as a storage battery or control power transformer.

Automatic protective tripping is effected by one of the following devices, depending on the type of breaker and the means employed for initiating the tripping:

1. Direct-acting series overcurrent tripping device Type EC-1 and EC-1B embodying instantaneous, short time-delay and long time-delay elements or specified combinations thereof. This trip is used primarily for selective tripping of breakers. Table XIII and Fig. 45 and 46 show the calibrations and time-current characteristics of these elements available for various ratings of breakers.
2. Direct-acting series overcurrent tripping device Type EC-2A embodies instantaneous and long time-delay elements with adjustable instantaneous pickup and long time-delay elements. This trip is used on breakers in fully-rated and cascaded systems. Table XIII and Fig. 44 show the calibrations and time-current characteristic of these elements which are available only on circuit breakers Types AK-2-15, -25, and -50.

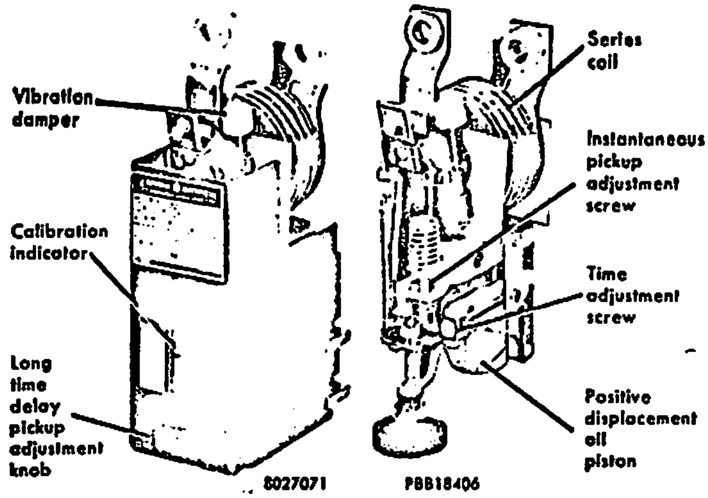


Fig. 41. Type EC-2A magnetic overcurrent tripping device. Series trip for 225, 600, and 1600 amp frame size breakers

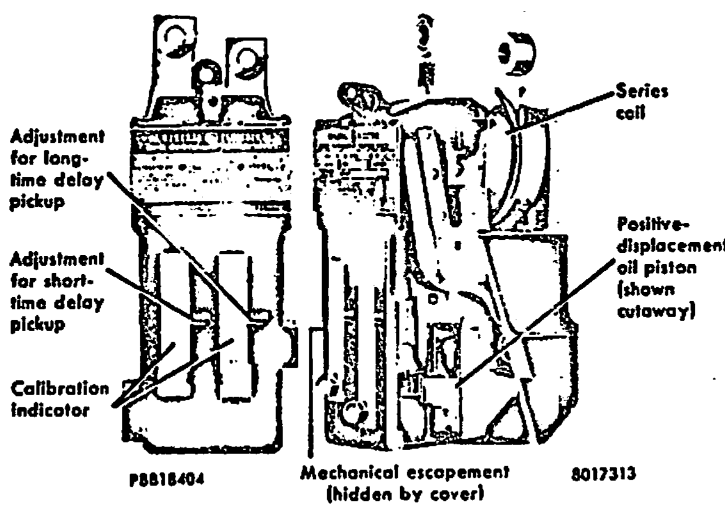


Fig. 42. Type EC-1 magnetic overcurrent tripping device. Series trip for 225, 600, and 1600 amp frame size breakers

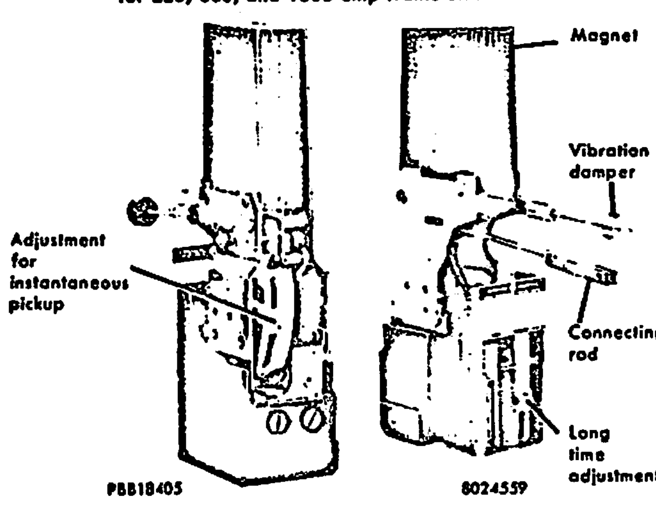


Fig. 43. Type EC-1B magnetic overcurrent tripping device. Trips for 3000 and 4000 amp frame size breakers

Application Information

TRIPPING DEVICES (Cont'd)

3. Undervoltage trip device—optionally available for all breakers both manually and electrically operated. Breaker tripping occurs when a spring mechanism is released by the reduction in voltage on a shunt-holding coil which is usually energized directly from the main power circuit. The undervoltage device may have either instantaneous or time-delay action depending on the application requirements.
   The timing device is static, consisting of a capacitor-resistor combination. Time delay is readily adjustable over a range of 1 to 5 seconds. The device is adaptable for use with Thermo-tectors and for remote tripping.

4. Reverse-current trip device—optionally available for mounting on pole units of d-c breakers for the detection of change in current direction in d-c circuits. They are potential polarized by coils rated 125 or 250 volts and are set to trip on reverse current equal to 10 percent of the breaker continuous current rating.

Type EC overcurrent trip devices are magnetically operated, using a series coil or single conductor and an associated magnetic structure to provide tripping force. Three basic characteristics—long time delay, short time delay, and instantaneous—can be used singly or in combination for a wide variety of applications.

Long time delay is accomplished with a positive-displacement oil piston. Sealing of the assembly eliminates variations caused by dust and dirt. Accurate machining of the piston and cylinder, a calibrated orifice, and silicone oil keep variations in time delay due to changes in ambient temperature to a minimum.

Short time delay is accomplished with a rugged mechanical escapement.

Instantaneous tripping is obtained with a tension spring in series with the long time-delay piston.

TABLE XIII

TRIPS FOR 225-, 600-, AND 1600-AMP FRAME SIZE BREAKERS

EC-2A Fully Adjustable Trip for all applications where the combination of long time delay and instantaneous, or instantaneous alone is required.

Available Characteristics	Range of Pickup Adjustment*	Time Delay (at 600% of Pickup Setting)	Factory Setting*
Long time	80–160% calibrated at 80, 100, 120, 140 and and 160% of coil rating	(1A) Maximum-adj. 15 to 38 sec. (1B) Intermediate-adj. 7.5 to 18 sec. (1C) Minimum-adj. 3.3 to 8.2 sec.	1B—18 sec. 100%
Instantaneous	6–12X coil rating 4–9X coil rating 9–15X coil rating 80–250% coil rating†	Select one range—6 to 12X furnished unless otherwise specified	12X 9X 15X 100%

† Not available with long time delay.

TRIPS FOR 225-, 600-, AND 1600-AMP FRAME SIZE BREAKERS

EC-1 Selective Trips combine long time and short time elements for intentional delay up to the interrupting rating of the breaker. (See Table I, Col. 4.) For special applications, instantaneous may be added.

Available Characteristics	Range of Pickup Adjustment*	Time Delay	Factory Setting
Long time	80–160% (Factory set at 100%)	(1A) Max. 30 sec. at 6 x pickup (1B) Inter. 15 sec. at 6 x pickup (1C) Min. 5 sec. at 6 x pickup	1B—100%
Short-time	2–5 x coil rating 3–7 x coil rating 4–10 x coil rating	(2A) Max. 24 cycles at 2½ x pickup (2B) Inter. 16 cycles at 2½ x pickup (2C) Min. 8 cycles at 2½ x pickup	
Instantaneous	Non-adjustable	High Set	Must be specified

* Pickup tolerances are ±10% for EC-2A and EC-1 trip devices.

TRIPS FOR 3000- AND 4000-AMP FRAME SIZE BREAKERS

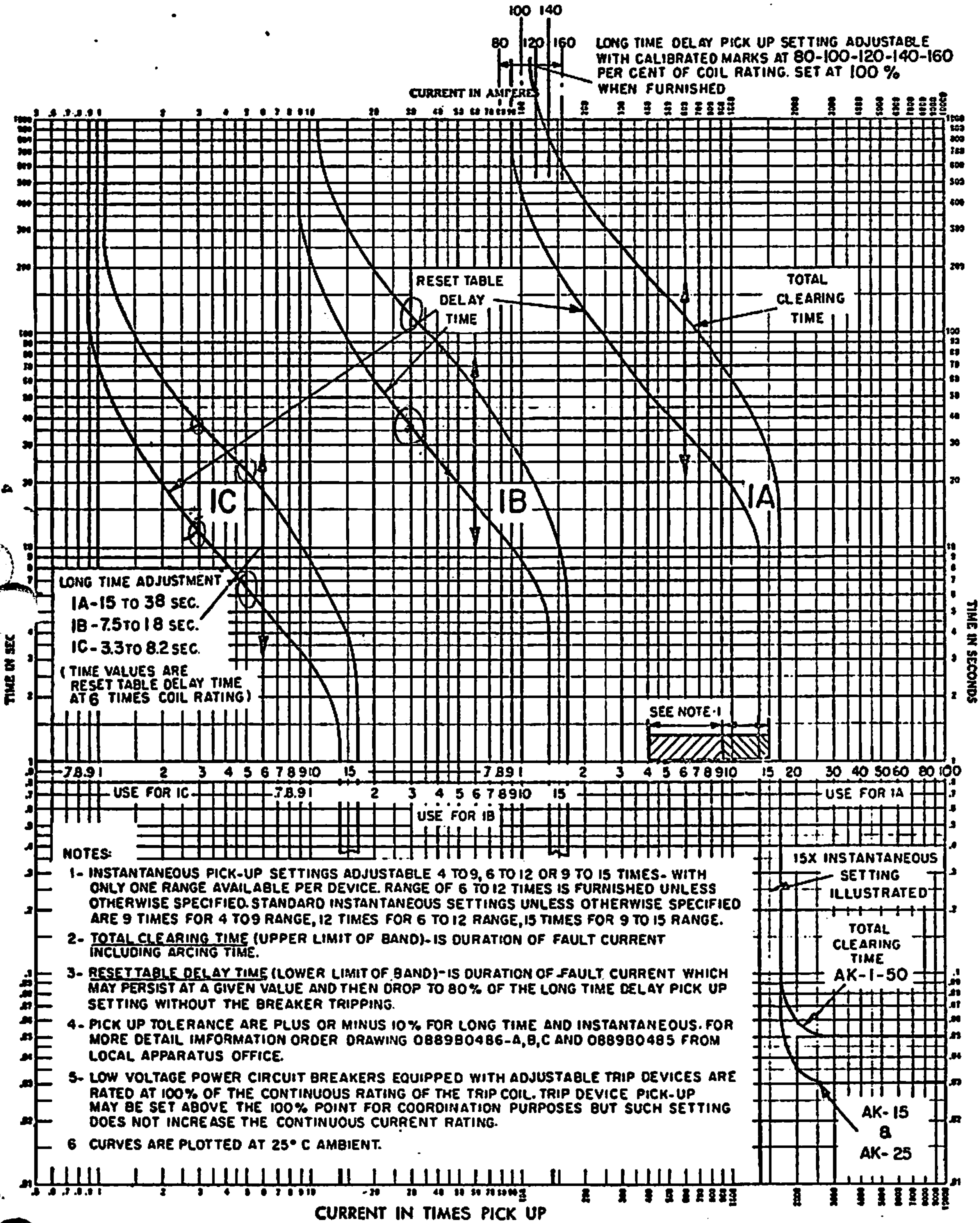
EC-1B Fully Adjustable Trip and Selective Trips for all applications where combinations of long time delay, and instantaneous, or instantaneous alone is required—short time delay also available.

Available Characteristics	Range of Pickup Adjustment*	Time Delay	Factory Setting
Long time	80–160% calibrated at 80, 100, 120, 140 and 160% of coil rating	1(BB) Max. 4.5 sec. @6X pickup (1CC) Min. 2 sec. @6X pickup	1BB—100%
Short time	Three ranges available—select one 2, 3.5, 5X 3, 5, 7X 4, 7, 10X	(2AA) Max. 24 cycles @2½X pickup (2BB) Inter. 16 cycles @2½X pickup (2CC) Min. 8 cycles @2½X pickup	Must be specified
*Instantaneous	Three ranges available—select one 6–12X coil rating 4–9X coil rating 9–15X coil rating	Select one range—6 to 12X furnished unless otherwise specified	12X 9X 15X

* Pickup tolerances are ±15% for EC-1B.

Application Information

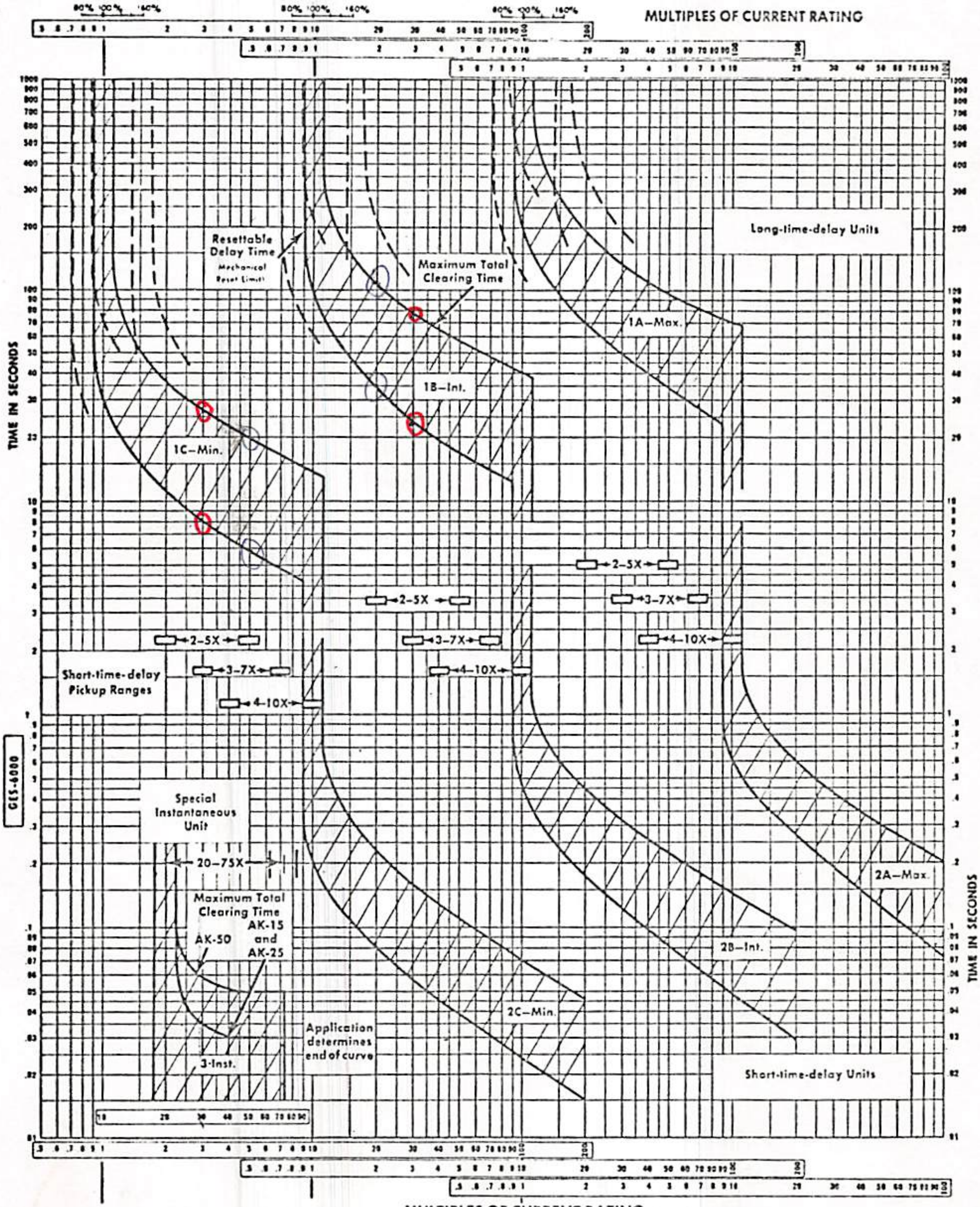
?E EC-2A TRIPPING DEVICE CHARACTERISTICS



(Drawing 088980484)

Fig. 44. Time-current characteristics of the Type EC-2 and EC-2A trip device for AK-2-15, -25 and -50 circuit breaker

Application Information



MULTIPLES OF CURRENT RATING

GENERAL ELECTRIC

TYPE AK LOW-VOLTAGE POWER CIRCUIT BREAKER

EC-1 SERIES TRIP DEVICE

GES-6000

Current Ratings (Amperes)

AK-15 15, 20, 30, 40, 50, 70, 90, 100, 125, 150, 175, 200, 225

AK 25 40, 50, 70, 90, 100, 125, 150, 175, 200, 225, 250, 300, 350, 400, 500, 600

AK 50 200, 225, 250, 300, 350, 400, 500, 600, 800, 1000, 1200, 1600

Long-time-delay, Short-time-delay and Instantaneous Time-current Curves

(Curves apply at 60 cycles for ambient temperature of 25 C)

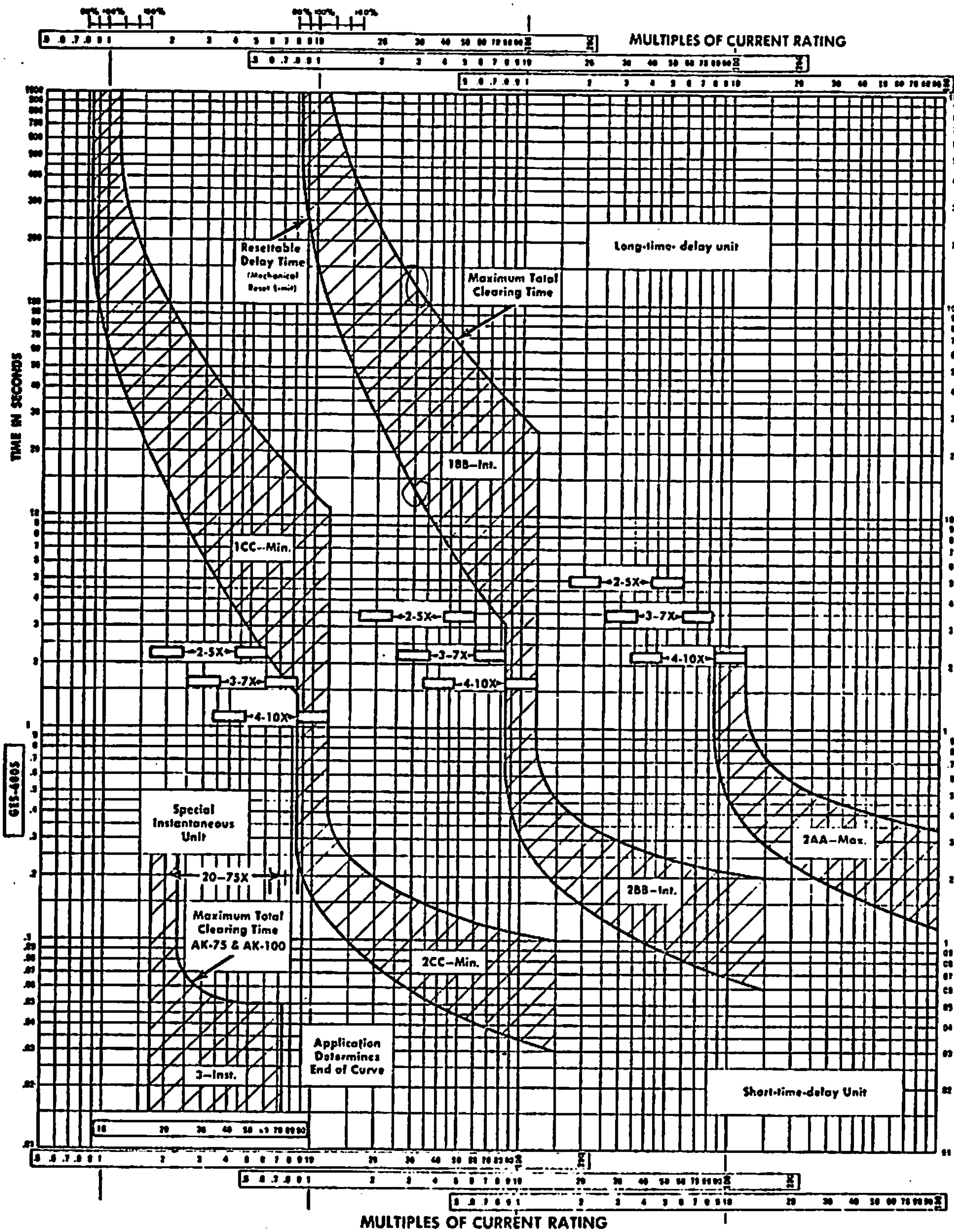
Adjustments

Long-time-delay Unit: Pickup current settings are 80 to 160% of rating. (Settings higher than 100% do not increase the continuous current ratings.

Short-time-delay Unit: Pickup current settings are 2 to 5X, or 3 to 7X, or 4 to 10X of ratings.

Instantaneous Unit: Special pickup current settings are 25–75X of ratings.

Application Information



GENERAL ELECTRIC	TYPE AK LOW-VOLTAGE POWER CIRCUIT BREAKER **EC-1B SERIES TRIP DEVICE**	GES-6005

Current Ratings (Amperes)

AK-75	2000, 2500, 3000
AK-100	2000, 2500, 3000, 4000

Long-time-delay, Short-time-delay and Instantaneous Time-current Curves

(Curves apply at 60 cycles for ambient temperature of 25 C)

Adjustments

Long-time-delay Unit: Pickup current settings are 80 to 160% of rating. Settings higher than 100% do not increase the continuous current ratings.
Short-time-delay Unit: Pickup current settings are 2 to 5X or 3 to 7X, or 4 to 10X of ratings.
Instantaneous Unit: Special pickup current settings are 20-75X of ratings.

INSTRUCTIONS

GEH-2021D

SUPERCEDES GEH-2021C

AK LOW VOLTAGE POWER CIRCUIT BREAKERS

INSTALLATION AND OPERATION

Types

AK-1-15	AK-2A-15	AKF-1A-25
AK-1-25	AK-2A-25	AKF-1B
AK-1-50	AK-2A-50	AKF-1C
AK-1-75	AK-2A-75	AKF-2C
AK-1-100	AK-2A-100	AKF-1D
AK-2-15	AK-2-50S	AKF-2D
AK-2-25	AK-2-75S	AKU-2-25
AK-2-50	AK-2-100S	AKU-2-50
AK-2-75	AK-2A-50S	AKU-2-50S
AK-2-100	AK-2A-75S	AKU-2A-25
AK-1A-25	AK-2A-100S	AKU-2A-50

SWITCHGEAR DEPARTMENT

GENERAL ELECTRIC

PHILADELPHIA, PA.

INSTALLATION AND OPERATION OF TYPE AK POWER CIRCUIT BREAKER

RECEIVING, HANDLING AND STORAGE

Before installing, or operating these circuit breakers, make a careful reading of the sections of these instructions which are pertinent to the anticipated work.

Upon receipt of a circuit breaker, immediately make an examination for any damage or loss sustained in shipment. If injury, loss or rough handling is evident, file a damage claim at once with the transportation company and notify the nearest General Electric Sales Office.

Unpack the circuit breaker as soon as possible after it has been received. Exercise care in the unpacking to avoid damage to the breaker parts. Be sure that no loose parts are missing or left in the packaging material. Blow out any dirt or loose particles of packaging material remaining on/or in the breaker.

If the circuit breaker is not to be placed in service at once, store it in a clean, dry location in an upright position. Support it to prevent bending of the studs or damage to any of the breaker parts. Do not cover the breaker with any packing or other material which absorbs moisture, that may cause corrosion of breaker parts. A covering of kraft or other non-absorbent paper will prevent dust from settling on the breaker.

INSTALLATION

LOCATION

In choosing a location for the installation of an AK Circuit Breaker, there are two factors to be considered. The first of these is the effect of the location on the breaker itself. Much better performance and longer life may be expected if the area is clean, dry, dust-free, and well ventilated, than if the opposites to these conditions exist. The second consideration is convenience for operation and maintenance. The breaker should be easily accessible to the operator, and there should be sufficient space allowed for maintenance work to be done if this becomes necessary.

MOUNTING

AK Circuit Breakers are designed to be mounted in any one of three ways. These are dead front mounting, individual mounting with the enclosure being provided, and drawout mounting in which the breaker is designed for insertion into a cubicle in drawout equipment such as a substation or control board.

DEAD FRONT BREAKERS

These breakers are designed for mounting in a switchboard or enclosing case of the customer's design and construction. Mounting in this instance consists of bolting the breaker frame to a supporting structure within the switchboard or enclosure, connecting the power buses or cables, and making any necessary control connections. The front cover of the breaker enclosure may be a hinged door or a plate bolted to the panel. In either case, it should have a section cut out, through which the front escutcheon of the breaker may protrude. Outline drawing numbers giving the dimensions needed for preparing a suitable enclosure or cubicle for the various types of AK breakers are given below. These are for standard 2 or 3 pole breakers.

Breaker	Typical Outline Drawing No.
AK-1-15	256C753
AK-1-25	256C754
AK-2-15 and 25	695C116
AK-1-50 Man. Oper.	248C703
AK-1-50 Elec. Oper.	238C123
AK-2-50 S. E. Man. Oper.	845C281
AK-1-75	238C192
AK-1-100	238C193
AK-2-75 Elec. Oper.	269C225
AK-2-75 S. E. Man. Oper.	845C284
AK-2-100 Elec. Oper.	269C227
AK-2-100 S. E. Man. Oper.	845C290

The surface on which the breaker is mounted must be flat throughout in order not to impose any internal distortion on the breaker unit. The supporting structure must be rigid enough to avoid any possibility of the breaker studs supporting the weight of the breaker. Minimum cutout dimensions, as given by the appropriate outline drawing, must be maintained to provide adequate electrical clearance.

INDIVIDUALLY ENCLOSED BREAKERS

Individually enclosed breakers are supplied with several types of enclosures, most common is the general purpose type or the weather resistant type. The former is used for favorable indoor locations and the latter for outdoor locations or indoor locations that may be subject to unfavorable conditions. All of the enclosures are provided with suitable means for mounting on walls or supporting framework. Removable cover plates are supplied with the enclosures which may be drilled or machined to accommodate the entrance of bus ducts, conduits or cables. Steps in the procedure for installing enclosed breakers follow:

1. If the breaker is an AK-15, AK-25 or an AK-50, remove it from the enclosure. With AK-50 breakers, a handle and cam arrangement is used for that part of the breaker movement that involves the disengagement or engagement of the primary disconnect. AK-75 and AK-100 breakers are bolted solidly to the enclosure frame and need not be removed from the enclosure.

2. Remove cover plates of enclosure and prepare them to accommodate whatever power entrance means is used.

3. Mount enclosing case to supporting structure.

4. Replace cover plates and make power connections to stationary terminals in enclosure.

5. If the breaker is a type AK-15, AK-25 or AK-50 and has been removed from the enclosure, it may now be replaced. Control power connections to the terminal board should be made as required. (See CONNECTIONS).

6. Before energizing the power circuit, operate the breaker several times to be sure that it is functioning properly. (See OPERATION).

DRAWOUT BREAKERS AKD EQUIPMENT

Mounting drawout breakers consists of simply placing the breaker in the proper position with respect to its enclosure, sliding or rolling it to a stop position, and, by means of a racking handle and mechanism, racking it through the last part of its movement during which the stationary and movable halves of the disconnects engage. Large drawout breakers are fastened to a telescoping tray which extends out from the enclosure to receive the breaker. Small breakers have guides on their side plates which slide in channels in the enclosures. Both large and small breakers have a test position in which the secondary disconnects are engaged, but the primary disconnects are not. In this position, the breaker may be operated electrically without energizing the load cable or bus.

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.

Use D50H47 lubricant on the disconnect terminals to reduce the force required to insert the breaker.

The procedure for inserting and withdrawing a drawout breaker from its enclosure is as follows:

Inserting Breaker AK-15 and 25

1. Trip the breaker.

2. Raise the breaker until the guides on the sides of the breaker are level with their mating supporting channels in the enclosure, and slide the breaker part way into its enclosure. (Note - The breaker will be obstructed by a position stop at the bottom of the enclosure after the breaker has traveled only a short distance into the cubicle. Lift the position stop handle, located at the bottom right of the enclosure, which will release the position stop and allow the breaker to travel further into the cubicle).

3. Raise the rackout handle forward and up as far as its travel will permit and push the breaker into the enclosure until the rackout pins on the handle assembly bear against the housing rackout cams on the side of the enclosing case.

4. Push downward on the rackout handle forcing the pins on the handle up into the slot in the stationary cam plate. This action forces the breaker through a final short portion of its movement into the enclosure and allows the operator to provide the force necessary to make the primary disconnects engage the stationary studs in the enclosure. In performing this operation, make sure that the handle is rotated downwards as far as its free travel will permit and then pull the racking handle down to be sure the trip interlock is released. (Note - When the racking handle is in any position other than completely down, the breaker cannot be operated and is held trip-free by the trip interlock. This applies to the "fully in" and "test" positions.)

Withdrawing Breaker AK-15 and 25

1. Trip the breaker open. If the breaker is not open, the interlock lever of the drawout mechanism will not permit operation of the rackout handle.

2. Pull the racking handle up and forward as far as it will travel, disengaging the primary disconnects.

3. Slide the breaker out until the position stop engages in the front slot in the bottom of the breaker carriage. The breaker is now in the "test" position, where its primary disconnects are safely disconnected from the line and load terminals of the enclosure. (Note - Refer to section describing "Test Position" in these instructions.)

4. To remove the breaker from its enclosure, lift the position stop handle and slide the breaker forward until the position stop engages the rear slot in the bottom of the breaker carriage. This is the safety position stop where both the primary and secondary contacts are disengaged. Again lift the position stop handle. Slide the breaker slightly forward to remove it from the enclosure.

Inserting Breaker AK-50, 75 and 100

1. Lift the breaker to a position approximately six inches above the height of the compartment tray.

2. Pull the drawout tray out under the breaker as far as the tray will travel. NOTE - When installing an individual skeleton housing for a drawout AK-50 or 75, locate a bolt head over the two front bottom mounting holes of the housing to provide a limit stop for the drawout tray.

3. Lower the breaker about 1/2" above the dowel pins on the tray and push the breaker back into its compartment so that the rear bottom angle of the breaker is against the guides on the tray directly back of the dowel pins.

4. Slowly lower the breaker onto the tray and at the same time guide it so that the holes in the rear angle of the breaker fit over the two dowel pins on the tray. If the breaker is correctly positioned on the dowels, its rear and side bottom frame angles will all sit firmly on the tray.

5. Insert two 3/8 inch hex. head screws through the holes in the front of the side angles on the breaker and thread them part way into the tapped holes in the tray. Do not tighten screws firmly. This provides better alignment of the primary stationary studs and the primary disconnects for the subsequent racking operation.

6. Push the breaker into the compartment until the "test" position stop engages to prevent further travel. (Note - Refer to section describing "Test Position" in these instructions.)

7. Release the test position stop by depressing its lever and push the breaker back into the compartment until the racking pins on the housing butt against the outer surface of the racking cam. In this position, the racking pin has lifted the locking arm on the cam which allows the racking handle to be lifted enough to allow the pawl to engage the first notch on the cam.

8. When the pawl engages the first notch on the cam, push the handle down again to its normal position. This causes the cam to rotate about the racking pin. Repeat this operation five times to rack the breaker into its final operating position. Interlocks hold the breaker trip free until it is racked into the fully contacted position. The fifth stroke of the handle is only a partial stroke and does not result in any further movement of the breaker. It does serve three useful purposes: it positions the cam so that it cannot rotate and allow the breaker to back out under short circuit stresses; the partial stroke signals that the racking operation is complete, and it releases the trip interlock which was engaged by the racking pin during the previous four pumps of the racking arm. NOTE: Once a racking operation has been started, it must be completed, as the breaker cannot be reversed until the racking operation is completed.

9. After completing the fifth racking stroke, lift the handle as high as it will go and allow it to drop to its normal position. NOTE: Any strokes beyond this point will cause the breaker to be trip free. Tighten the 3/8 inch hex head screws inserted in the front holes of the drawout tray during step 5 of this operation. The breaker is now in the operating position.

Withdrawing Breaker AK-50, 75 and 100

1. Trip the breaker to release the positive racking interlock.

2. Lift the racking handle as far as it will go.

This operation will re-engage the trip interlock to hold the breaker trip-free for the remainder of the racking operation. Note that here the cam is rotated by lifting the handle, whereas in racking the breaker in, the operation is performer as a result of pushing the handle down.

3. Reset the handle to its lowered position and lift it again. This operation must be performed 5 times to completely disengage the cams from their racking pins. After the fifth lifting stroke let the handle drop to its normal position.

4. Pull the breaker out of its compartment until the test position stop engages to hold the breaker in the "test" position.

5. Depress the test position stop handle and pull the breaker out of its compartment as far as the drawout tray will travel.

6. Remove the two 3/8 hex. head screws which hold the breaker on the tray.

7. Attach a lifting device to the top frame of the breaker.

8. Lift the breaker approximately 1/2 inch off the dowel pins on the tray and then pull the breaker forward until its primary contacts clear the compartment.

9. Push the tray all the way back into its compartment. The breaker is now free from its compartment.

TEST POSITION

The "Test Position", as referred to in the previous instructions, is that breaker position where the primary power disconnect contacts are safely disengaged but the secondary control disconnects are engaged. In this position, the breaker may be tested or operated, manually or electrically without energizing the primary power circuit, provided the racking handle has been moved to the completely down position, thus releasing the trip interlock.

For a more complete description of drawout mechanisms and enclosures see AKD DRAWOUT EQUIPMENT INSTRUCTIONS, GEH-1830 and AKD5 Drawout Equipment Instructions GEH-83902.

DRAWOUT BREAKERS AKD5 EQUIPMENT

NOTE: AKD5 breakers are identified by letter "A" appearing after breaker number - example, "AK-2A-15".

Drawout Mechanism Operation - There are four positions of the drawout mechanism:

1. The Connected Position - the breaker in the operating position, both primary and secondary contacts made and the door may be closed.

2. The Test Position - the primary (power) contacts not made but the secondary (control) contacts are made. Any breaker test not involving power may be made in this position. The door may be closed in this position.

3. Disconnect Position - neither the primary nor the secondary contacts made. The door may be closed.

4. Fully Withdrawn Position - the breaker completely out of its compartment ready for removal from the inner housing. The door must be open in this position.

NOTE: The mechanism is designed to reverse automatically in the connect and fully disconnected position. Once an operation is started it must be completed. Completion of an operation is indicated by the red knob retracting to its original position.

Fig. 1 (457A683)

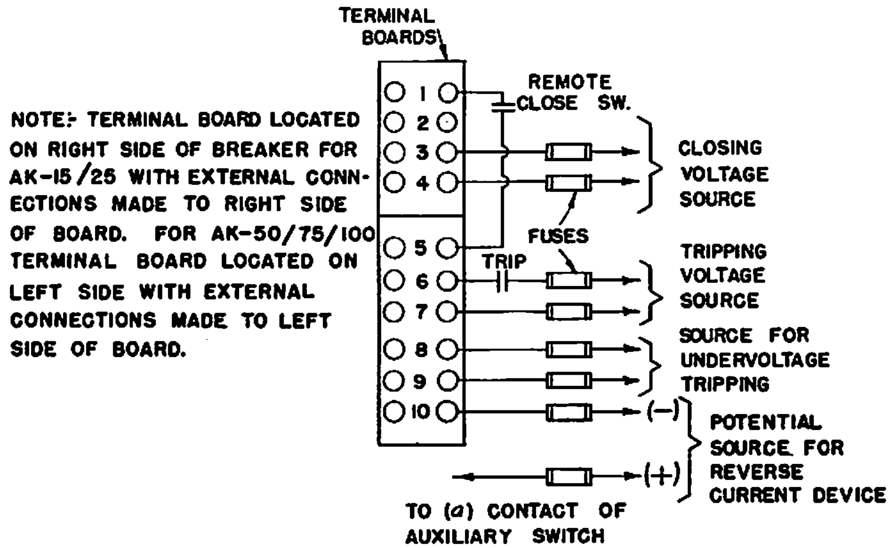


Fig. 1 (Front View)

Breaker Insertion AK-2A - With the inner housing in the connected position proceed as follows:

1. Pull the red knob. Pull the mechanism operating handle fully out and allow it to return to its original position. Repeat this three more times. The inner house is now in the test position.

2. Pull the red knob again. Pull the mechanism operating handle two complete strokes drawing the inner housing to the disconnect position.

3. Open the housing door and rotate the two track lock links, releasing the tracks. Pull the tracks out to the limit of their travel. This is the fully withdrawn position.

4. With a lifting device, raise the breaker so the mounting pins are about one inch above the tracks. Lower breaker so the breaker mounting pins drop into the slots in the tracks. Remove the lifting device cable.

5. Push the breaker in against the track stops. Rotate the two lock links to lock the breaker in place. Close the door.

NOTE: When moving a breaker from one position to another be sure breaker is tripped open.

6. Pull the red knob. Pull the mechanism operating handle two times until the test position is reached.

Figs. 2 & 3 (127A6413)

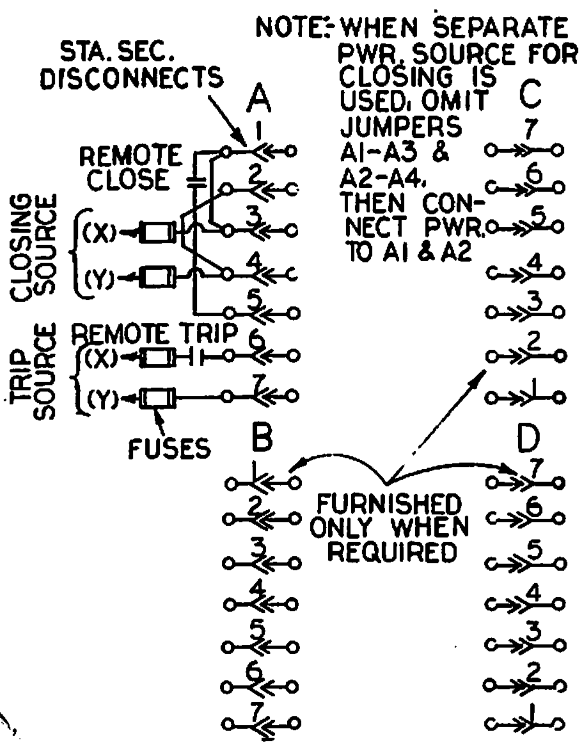


Fig. 2 Front View AK-15 and 25 Breaker Compartment

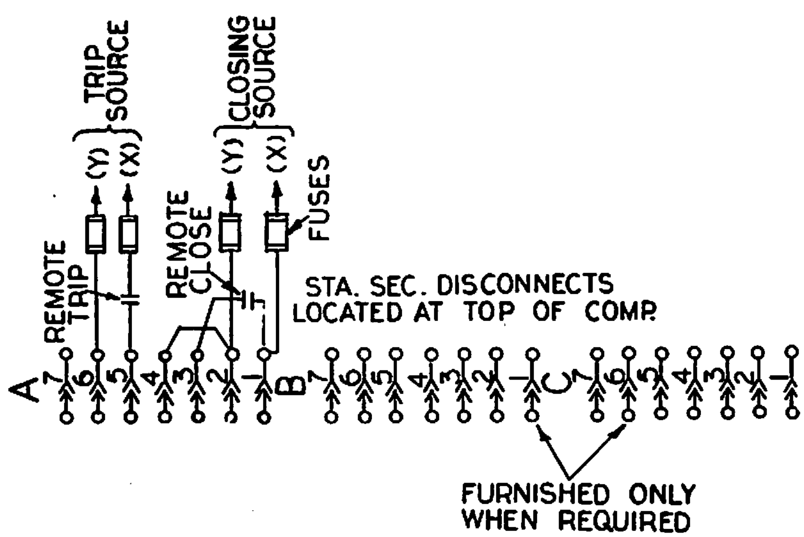


Fig. 3 Front View AK-50, 75, 100 Breaker Compartment

7. Pull the red knob again and pull the mechanism operating handle four times. The breaker will now be completely inserted, in its connected position.

Breaker Removal AK-2A

1. Trip the breaker.
2. Move the breaker and inner housing to the fully withdrawn position. (See Breaker Insertion, Steps 1, 2 and 3).
3. Attach lifting device and lift breaker up and away from compartment until primary disconnects clear the compartment.
4. Move the inner housing to the connected position by pushing the tracks back against the track stops and then follow Steps 6 and 7 under Breaker Insertion. The inner housing is now in the connected position and the breaker is free from its compartment.

NOTE: The installation of AK50S/75S/100S/AKF2C/2D and breakers equipped with the quick-closing mechanism is the same as the other breakers described in this book. The only difference occurs with drawout breakers. The compartments that house the quick-close breakers will be equipped with an interlock that prevents the manual discharging of the closing springs while the breaker is in the racked in (connected position). This interlock will be provided with both AKD and AKD5 equipment that require quick-close breakers.

CONNECTIONS

All electrical connections should be made to assure good conductivity. Mating surfaces should be parallel and firmly bolted or clamped together. Contact surfaces should be clean and have a smooth finish. The bus or cable connecting to the breaker should have adequate current-carrying capacity to prevent excessive heating. Control circuit connections should be made according to the wiring diagram which applies to each breaker specifically. Depending on the breaker type, those connections are made either to a terminal board on the breaker or to the stationary parts of the secondary disconnects.

INDIVIDUALLY ENCLOSED AND STATIONARY BREAKERS

The customers external connections for operation of breaker control components and accessories are shown in Fig. 1.

DRAWOUT BREAKERS

The customers external control connections to these breakers are made to the stationary secondary disconnected located in the breaker compartment as shown in Figs. 2 and 3, AKD Equipment and Figs. 4 and 5 AKD5 Equipment. (Note - If the breaker is used in a General Electric Company, Drawout Switchgear Equipment, all external connections must be made to terminal blocks located in the rear vertical wiring trough of the equipment.)

OPERATION

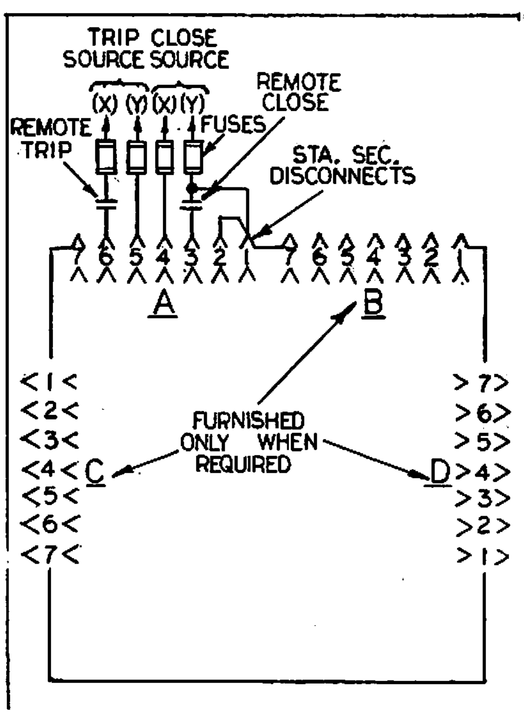
MANUAL CLOSING

AK-1-15 and AK-1-25 breakers are closed by rotating the breaker handle in a clockwise direction approximately 90 degrees. After tripping, the closing mechanism resets automatically by means of springs.

AK-2-15/25 and AK-1-50 manually operated breakers are closed by turning the handle 90 degrees counterclockwise and then clockwise 90 degrees back to the original position. The initial counterclockwise movement resets the closing mechanism. The clockwise movement closes the breaker.

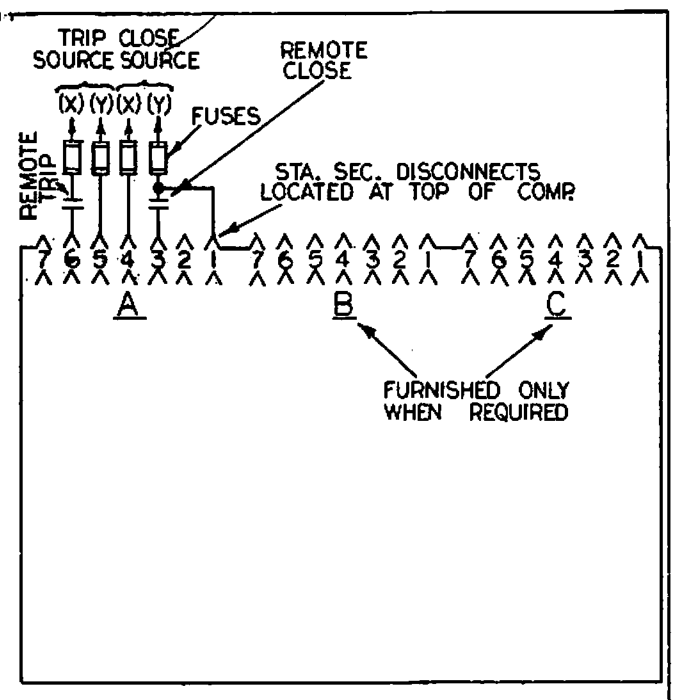
In closing an AK-1-15/25/50 manual breaker on a load, make the handle movement with a fast, snapping action in order to prevent unnecessary heating of the breaker contacts.

The closing mechanism of the AK-2-50/75/100 manual breakers is a spring



FRONT VIEW AK-1A-15,25 & AK-2A-15, 25
BREAKER COMPARTMENT

Fig. 4



FRONT VIEW AK-2A-50,75,100
BREAKER COMPARTMENT

Fig. 5

Figs. 4 & 5 (0156A2377)

charged mechanism similar to the one used on AK-50/75/100 electrically operated breakers. AK-2-50/75/100 manual breakers are closed by rotating the closing handle counterclockwise through approximately 120 degrees, and then clockwise back through 120 degrees to the normal handle position. Four such complete movements of the handle are required to close the breaker. During the four counterclockwise movements and the first three clockwise movements of the handle, the springs are charged. After approximately 70 degrees travel of the fourth clockwise handle movement, the spring charged mechanism is driven over-center and the breaker closes. A charge-indicator, numbered 1 to 4, viewed through the breaker front escutcheon, moves with each complete handle movement and indicates the number of complete handle movements that have been performed.

ELECTRICAL CLOSING (Figures 6 and 7)

STANDARD BREAKERS

AK-15 and AK-25 electrically operated breakers are closed by a solenoid coil. The armature of the solenoid is linked to the breaker mechanism and its movement, operating through the mechanism, closes the breaker. The closing solenoid circuit may be operated by a push button closing switch on the breaker or by a remote switch or relay, depending on the individual arrangements desired. When a closing signal is given, the X relay coil is energized and it in turn closes its contacts. One of these seals in the X coil circuit; the other three, which are arranged in series, energize the solenoid closing coil. As the breaker closes, a mechanically operated switch opens one pair of its contacts (bb) and closes another (aa). The contacts which open cut out the X relay coil. The contacts which close energize the Y relay coil, whose contacts now seal in the Y coil and hold open the X relay coil circuit. This prevents another closing operation if one of the protective devices operates to trip the breaker before contact at the closing switch is released.

Large AK breakers (AK-50/75/100) are closed by the discharge of a closing spring. This rotates a crankshaft which, by means of an attached roller, operates a closing cam, forcing the movable breaker contacts against the stationary contacts. The closing spring is charged through the operation of a motor and gear reduction unit.

The electrical control system is comprised of an X relay, two double contact mechanically operated switches (F and G), a push button closing switch and any means for remote closing which the user may incorporate into the system. When voltage is first applied to the breaker, (before any closing signal is given) the motor is energized through two of the X relay contacts and the two G switch contacts. The motor then compresses the closing springs to the "pre-charged" position at which point the mechanically operated F and G switches are operated. This opens the G contacts, stopping the motor, and closes the F contacts, which readies the system for the actual closing of the breaker. When the push button or remote switch signals for a closing operation, the X relay coil is

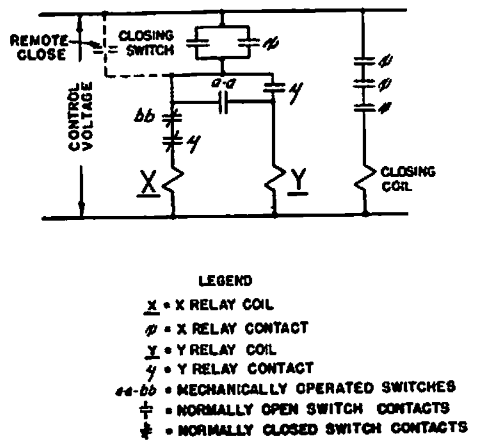


Fig. 6 Simplified Elementary Diagram Internal Wiring AK-15 and 25

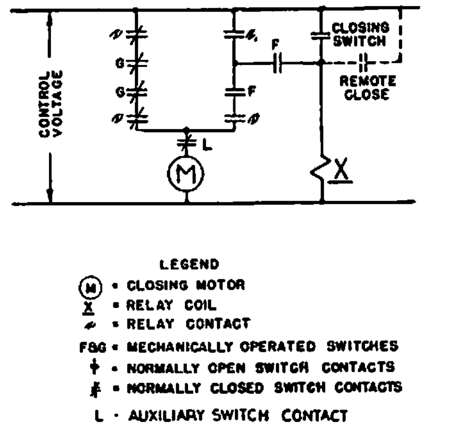


Fig. 7 Simplified Elementary Diagram Internal Wiring AK-50, 75 and 100

energized, operating the X contacts. This seals in the X relay and energizes the motor once again and the closing operation takes place.

QUICK CLOSE BREAKERS (Figure 8)

Functionally, the quick close mechanism differs from the standard electrical mechanism in that the pre-charge operation is extended to completely charge the closing springs. At the end of the charging operation, which takes approximately 5 seconds, a latch plate engages the prop roller to prevent the closing springs from discharging.

With the closing springs fully charged the breaker is ready for a closing operation upon release of the prop roller. This may be accomplished either manually, by depressing the closing lever on the breaker, or electrically by closing the remote closing switch. Upon the release of the prop roller the closing springs discharge and close the breaker in the same manner as on the standard electrical breaker.

With control voltage applied, the motor is energized through the G switch contacts, and charges the closing springs. When the springs reach the fully charged position, the mechanically operated switches operate, reversing their contacts. Upon operation of these switches the motor is stopped by the opening of the G switch. The closing of the F switch prepares the breaker for a closing operation.

A closing signal now given energizes the control relay X whose contacts close and complete the circuit through the closing relay coil. With the closing relay coil energized the breaker closes as described above. At the same time the closing relay contact closes to energize the anti-pump relay causing its contacts to reverse providing the anti-pump feature.

When the breaker closes, the mechanical operated G switches close to energize the motor again and the F switches open and de-energize the control relay. The auxiliary switch contact opens preventing the control relay from being energized until the breaker is tripped open. With the G switches closed, the motor charges the closing springs ready for the next closing operation.

MANUAL OR MAINTENANCE CLOSING OF ELECTRICAL BREAKERS

All electrical breakers may be closed manually by means of the maintenance handle furnished with the breaker or switchgear.

To close AK-1-15/25 breakers:

1. Make sure handle is in proper position. Handle is stamped this side up.
2. Place the handles fork like fingers above the armatures stop nut that extends below the magnet behind the front escutcheon and lift up. This forces the armature down closing the breaker's contacts.

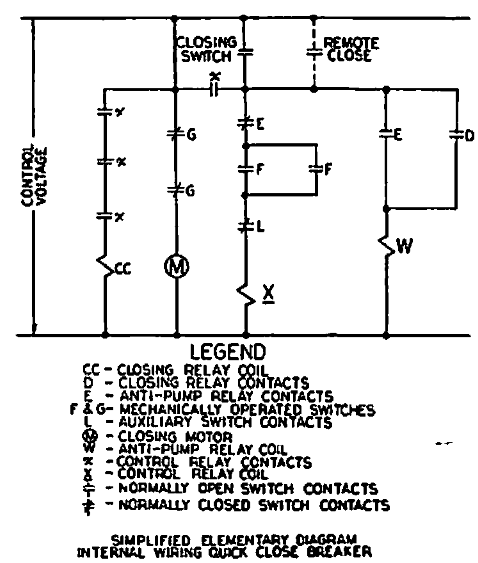


Fig. 8

To close AK-2-15/25 breakers:

1. Place the two small hooks of the handle into the two slots located in the lower portion of the front escutcheon.

2. Rotation of the long end of the handle downwards forces the shorter end of the handle upwards against the bottom of the solenoid armature, and closes the breaker's contacts.

To close AK-50/75/100 breakers:

1. Place the ratchet type maintenance handle on the shaft that protrudes from the gear reduction unit.

2. Operate handle until the spring charge indicator reads charged.

3. Continue to operate handle until the closing springs discharge and close the contacts.

To close AK-50S/75S/100S, AKF 2C, 2D breakers and breakers equipped with the quick closing mechanism:

NOTE: All AKD, or AKD-5 drawout type breakers equipped with the quick closing mechanism cannot normally be closed manually when in the racked in (connected position), due to mechanical designed interference between the enclosure and the spring discharge lever on the breaker. If manual closing is desired with the breaker racked in, the interference feature must be removed, otherwise the breaker can be manually closed in the test position or fully racked out position only.

1. With the ratchet type maintenance handle applied to the gear box shaft, operate the handle until the springs are fully charged. The fully charged position is indicated by the spring charge indicator and by solid resistance to any further handle operation.

2. Push down on the push to close lever to release the energy stored in the closing springs which closes the breaker's contacts.

TRIPPING

The breaker is tripped open by the displacement of a mechanism latch, which allows a toggle linkage supporting the movable contacts in the closed position to collapse. This trip latch is fastened rigidly to a trip shaft which runs horizontally from left to right through the breaker. All of the means provided for tripping the breaker operate through striker arms which displace the mechanism trip latch by moving against trip paddles fastened on the trip shaft. Looking at the breaker from the right, counterclockwise rotation of the trip shaft causes the breaker to trip; clockwise movement resets the mechanism latch. The manual trip button, overload devices, shunt trip, undervoltage tripping device, and reverse current trip all operate in this fashion to trip the breaker. The movement of the striker arms of all of these, when activated, should move from 1/32 to 1/16 inch beyond the point at which tripping occurs. This is what is meant by the expression, "positive tripping".

Most air circuit breakers are equipped with series overcurrent trip devices either of the dual magnetic type (instantaneous and time delay tripping) or instantaneous alone. Breakers are designed to carry up to 100% of the continuous current rating of their trip devices. Any attempt to carry higher currents for a prolonged period will cause overheating and possible damage.

For a more detailed discussion of the construction, operation, and application of overcurrent trip devices refer to the following publications:

1. Maintenance manual for specific breaker involved (see "Maintenance").

2. "Selection and Application of Power Circuit Breakers" GET-1113.

TYPE AKU AND BREAKERS WITH FUSE-BREAKER COMBINATIONS

Open Fuse Lockout Device

This device may be furnished with any of the above type breakers. The open fuse lockout device consists of 3 separately operated devices (one per breaker pole) each wired in parallel to corresponding breaker fuses. These devices are mounted on the left hand side of the breaker (looking from front). The purpose of this device is to trip the breaker upon the blowing of any one of the breaker fuses. This energizes the coil of the device causing the armature to engage the trip paddle, thereby tripping the breaker. Once operated, the armature is latched in the closed air gap position allowing the reset button to extend forward indicating which fuse has blown, and simultaneously holding the breaker in the trip-free position until the latch closed armature is released by the operating of the manual reset button.

MAINTENANCE INSTRUCTIONS

INSPECTION

BEFORE INSPECTION OR ANY MAINTENANCE WORK IS DONE, BE SURE THAT THE BREAKER IS IN THE OPEN POSITION. ALL ELECTRICAL POWER, BOTH PRIMARY AND CONTROL SOURCES SHOULD ALSO BE DISCONNECTED.

Periodic inspection of the circuit breaker is recommended at least once a year. More frequent inspections are recommended, if severe load conditions, dust, moisture, or other unfavorable conditions exist.

Always inspect the breaker after a short circuit current has been interrupted.

At the time of inspection, the following checks should be made after the breaker has been de-energized.

1. Manually operate the breaker several times, checking for obstructions or excessive friction.

2. Electrically operate the breaker several times (if breaker has electrical control) to ascertain whether the electrical attachments are functioning properly.

3. Remove the arc quenchers by removing the channel shaped retaining bar.

4. Inspect arc quenchers and contacts r breakage or excessive burning. Should arc quencher barriers or contacts be eroded to half their original thickness they should be replaced.

LUBRICATION

In general, the circuit breaker requires moderate lubrication. Bearing points and sliding surfaces should be lubricated at the regular inspection periods with a thin film of GE Lubricant D50H15. Before lubricating remove any hardened grease and dirt from latch and bearing surfaces with kerosene. ALL EXCESS LUBRICANT SHOULD BE REMOVED WITH A CLEAN CLOTH TO AVOID ANY ACCUMULATION OF DIRT OR DUST.

On drawout breakers, the contact surface of the disconnect studs should be cleaned and greased with GE Grease Specification D50H47.

These instructions have as their purpose the imparting of information of a general nature concerning the installation and operation of Type AK power circuit breakers. If more complete and specific information is required, such as might be needed for overhauling the breaker, trouble shorting, or replacing parts of the breaker, refer to the complete instruction for the particular breaker type involved. These are:

Maintenance Manual	Breaker Type
GEI-74602	AK-1-15, AK-1/1A-25 Man. Operated.
GEI-74603	AK-1-15, AK-1/1A-25 Elec. Operated.
GEI-74623	AKF-1B/1A-25 Man. Oper.
GEI-74624	AKF-1B/1A-25 Elec. Oper.
GEI-50299	All AK-2/2A-15/25, AKU-2/2A-25
GEI-74600	All AK-1/2/2A-50/75/100, AKU-2/2A-50, AK-2/2A-50S/75S/100S, AKF-1C/2C/1D/2D/2E

Renewal parts bulletins for the various types of breakers are:

Bulletin	Breaker Type
GEF-3506	AK-1-15/25 and AKF-1B
GEF-3878	AK-1-50 up to and including dash 9
GEF-3879	AK-1-75/100
GEF-4149	AK-2-15-25
GEF-4150	AK-1-50-10-11 and AK-2-50

INSTRUCTIONS

GEH-2021C
SUPERSEDES GEH-2021B

AK LOW VOLTAGE POWER CIRCUIT BREAKERS

INSTALLATION AND OPERATION

Types

AK-1-15	AK-2-50	AK-2A-75	AK-2A-100S
AK-1-25	AK-2-75	AK-2A-100	AKF-1A-25
AK-1-50	AK-2-100	AK-2-50S	AKF-1B
AK-1-75	AK-1A-25	AK-2-75S	AKF-1C
AK-1-100	AK-2A-15	AK-2-100S	AKF-2C
AK-2-15	AK-2A-25	AK-2A-50S	AKF-1D
AK-2-25	AK-2A-50	AK-2A-75S	AKF-2D

LOW VOLTAGE SWITCHGEAR DEPARTMENT
GENERAL ELECTRIC
PHILADELPHIA, PA.

INSTALLATION AND OPERATION OF TYPE AK POWER CIRCUIT BREAKER

RECEIVING, HANDLING AND STORAGE

Before installing, or operating these circuit breakers, make a careful reading of the sections of these instructions which are pertinent to the anticipated work.

Upon receipt of a circuit breaker, immediately make an examination for any damage or loss sustained in shipment. If injury, loss or rough handling is evident, file a damage claim at once with the transportation company and notify the nearest General Electric Sales Office.

Unpack the circuit breaker as soon as possible after it has been received. Exercise care in the unpacking to avoid damage to the breaker parts. Be sure that no loose parts are missing or left in the packaging material. Blow out any dirt or loose particles of packaging material remaining on/or in the breaker.

If the circuit breaker is not to be placed in service at once, store it in a clean, dry location in an upright position. Support it to prevent bending of the studs or damage to any of the breaker parts. Do not cover the breaker with any packing or other material which absorbs moisture, that may cause corrosion of breaker parts. A covering of kraft or other non-absorbent paper will prevent dust from settling on the breaker.

INSTALLATION

LOCATION

In choosing a location for the installation of an AK Circuit Breaker, there are two factors to be considered. The first of these is the effect of the location on the breaker itself. Much better performance and longer life may be expected if the area is clean, dry, dust-free, and well ventilated, than if the opposites to these conditions exist. The second consideration is convenience for operation and maintenance. The breaker should be easily accessible to the operator, and there should be sufficient space allowed for maintenance work to be done if this becomes necessary.

MOUNTING

AK Circuit Breakers are designed to be mounted in any one of three ways. These are dead front mounting, individual mounting with the enclosure being provided, and drawout mounting in which the breaker is designed for insertion into a cubicle in drawout equipment such as a substation or control board.

DEAD FRONT BREAKERS

These breakers are designed for mounting in a switchboard or enclosing case of the customer's design and construction. Mounting in this instance consists of bolting the breaker frame to a supporting structure within the switchboard or enclosure, connecting the power buses or cables, and making any necessary control connections. The front cover of the breaker enclosure may be a hinged door or a plate bolted to the panel. In either case, it should have a section cut out, through which the front escutcheon of the breaker may protrude. Outline drawing numbers giving the dimensions needed for preparing a suitable enclosure or cubicle for the various types of AK breakers are given below. These are for standard 2 or 3 pole breakers.

Breaker	Typical Outline Drawing No.
AK-1-15	256C753
AK-1-25	256C754
AK-2-15 and 25	695C116
AK-1-50 Man. Oper.	248C703
AK-1-50 Elec. Oper.	238C123
AK-2-50 S. E. Man. Oper.	845C281
AK-1-75	238C192
AK-1-100	238C193
AK-2-75 Elec. Oper.	269C225
AK-2-75 S. E. Man. Oper.	845C284
AK-2-100 Elec. Oper.	269C227
AK-2-100 S. E. Man. Oper.	845C290

The surface on which the breaker is mounted must be flat throughout in order not to impose any internal distortion on the breaker unit. The supporting structure must be rigid enough to avoid any possibility of the breaker studs supporting the weight of the breaker. Minimum cutout dimensions, as given by the appropriate outline drawing, must be maintained to provide adequate electrical clearance.

INDIVIDUALLY ENCLOSED BREAKERS

Individually enclosed breakers are supplied with several types of enclosures, most common is the general purpose type or the weather resistant type. The former is used for favorable indoor locations and the latter for outdoor locations or indoor locations that may be subject to unfavorable conditions. All of the enclosures are provided with suitable means for mounting on walls or supporting framework. Removable cover plates are supplied with the enclosures which may be drilled or machined to accommodate the entrance of bus ducts, conduits or cables. Steps in the procedure for installing enclosed breakers follow:

1. If the breaker is an AK-15, AK-25 or an AK-50, remove it from the enclosure. With AK-50 breakers, a handle and cam arrangement is used for that part of the breaker movement that involves the disengagement or engagement of the primary disconnect. AK-75 and AK-100 breakers are bolted solidly to the enclosure frame and need not be removed from the enclosure.

2. Remove cover plates of enclosure and prepare them to accommodate whatever power entrance means is used.

3. Mount enclosing case to supporting structure.

4. Replace cover plates and make power connections to stationary terminals in enclosure.

5. If the breaker is a type AK-15, AK-25 or AK-50 and has been removed from the enclosure, it may now be replaced. Control power connections to the terminal board should be made as required. (See CONNECTIONS).

6. Before energizing the power circuit, operate the breaker several times to be sure that it is functioning properly. (See OPERATION).

DRAWOUT BREAKERS AKD EQUIPMENT

Mounting drawout breakers consists of simply placing the breaker in the proper position with respect to its enclosure, sliding or rolling it to a stop position, and, by means of a racking handle and mechanism, racking it through the last part of its movement during which the stationary and movable halves of the disconnects engage. Large drawout breakers are fastened to a telescoping tray which extends out from the enclosure to receive the breaker. Small breakers have guides on their side plates which slide in channels in the enclosures. Both large and small breakers have a test position in which the secondary disconnects are engaged, but the primary disconnects are not. In this position, the breaker may be operated electrically without energizing the load cable or bus.

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.

Use D50H47 lubricant on the disconnect terminals to reduce the force required to insert the breaker.

The procedure for inserting and withdrawing a drawout breaker from its enclosure is as follows:

Inserting Breaker AK-15 and 25

1. Trip the breaker.

2. Raise the breaker until the guides on the sides of the breaker are level with their mating supporting channels in the enclosure, and slide the breaker part way into its enclosure. (Note - The breaker will be obstructed by a position stop at the bottom of the enclosure after the breaker has traveled only a short distance into the cubicle. Lift the position stop handle, located at the bottom right of the enclosure, which will release the position stop and allow the breaker to travel further into the cubicle).

3. Raise the rackout handle forward and up as far as its travel will permit and push the breaker into the enclosure until the rackout pins on the handle assembly bear against the housing rackout cams on the side of the enclosing case.

4. Push downward on the rackout handle forcing the pins on the handle up into the slot in the stationary cam plate. This action forces the breaker through a final short portion of its movement into the enclosure and allows the operator to provide the force necessary to make the primary disconnects engage the stationary studs in the enclosure. In performing this operation, make sure that the handle is rotated downwards as far as its free travel will permit and then pull the racking handle down to be sure the trip interlock is released. (Note - When the racking handle is in any position other than completely down, the breaker cannot be operated and is held trip-free by the trip interlock. This applies to the "fully in" and "test" positions.)

Withdrawing Breaker AK-15 and 25

1. Trip the breaker open. If the breaker is not open, the interlock lever of the drawout mechanism will not permit operation of the rackout handle.

2. Pull the racking handle up and forward as far as it will travel, disengaging the primary disconnects.

3. Slide the breaker out until the position stop engages in the front slot in the bottom of the breaker carriage. The breaker is now in the "test" position, where its primary disconnects are safely disconnected from the line and load terminals of the enclosure. (Note - Refer to section describing "Test Position" in these instructions.)

4. To remove the breaker from its enclosure, lift the position stop handle and slide the breaker forward until the position stop engages the rear slot in the bottom of the breaker carriage. This is the safety position stop where both the primary and secondary contacts are disengaged. Again lift the position stop handle. Slide the breaker slightly forward to remove it from the enclosure.

Inserting Breaker AK-50, 75 and 100

1. Lift the breaker to a position approximately six inches above the height of the compartment tray.

2. Pull the drawout tray out under the breaker as far as the tray will travel. NOTE - When installing an individual skeleton housing for a drawout AK-50 or 75, locate a bolt head over the two front bottom mounting holes of the housing to provide a limit stop for the drawout tray.

3. Lower the breaker about 1/2" above the dowel pins on the tray and push the breaker back into its compartment so that the rear bottom angle of the breaker is against the guides on the tray directly back of the dowel pins.

4. Slowly lower the breaker onto the tray and at the same time guide it so that the holes in the rear angle of the breaker fit over the two dowel pins on the tray. If the breaker is correctly positioned on the dowels, its rear and side bottom frame angles will all sit firmly on the tray.

5. Insert two 3/8 inch hex. head screws through the holes in the front of the side angles on the breaker and thread them part way into the tapped holes in the tray. Do not tighten screws firmly. This provides better alignment of the primary stationary studs and the primary disconnects for the subsequent racking operation.

6. Push the breaker into the compartment until the "test" position stop engages to prevent further travel. (Note - Refer to section describing "Test Position" in these instructions.)

7. Release the test position stop by depressing its lever and push the breaker back into the compartment until the racking pins on the housing butt against the outer surface of the racking cam. In this position, the racking pin has lifted the locking arm on the cam which allows the racking handle to be lifted enough to allow the pawl to engage the first notch on the cam.

8. When the pawl engages the first notch on the cam, push the handle down again to its normal position. This causes the cam to rotate about the racking pin. Repeat this operation five times to rack the breaker into its final operating position. Interlocks hold the breaker trip free until it is racked into the fully contacted position. The fifth stroke of the handle is only a partial stroke and does not result in any further movement of the breaker. It does serve three useful purposes: it positions the cam so that it cannot rotate and allow the breaker to back out under short circuit stresses; the partial stroke signals that the racking operation is complete, and it releases the trip interlock which was engaged by the racking pin during the previous four pumps of the racking arm. NOTE: Once a racking operation has been started, it must be completed, as the breaker cannot be reversed until the racking operation is completed.

9. After completing the fifth racking stroke, lift the handle as high as it will go and allow it to drop to its normal position. NOTE: Any strokes beyond this point will cause the breaker to be trip free. Tighten the 3/8 inch hex head screws inserted in the front holes of the drawout tray during step 5 of this operation. The breaker is now in the operating position.

Withdrawing Breaker AK-50, 75 and 100

1. Trip the breaker to release the positive racking interlock.

2. Lift the racking handle as far as it will go.

This operation will re-engage the trip interlock to hold the breaker trip-free for the remainder of the racking operation. Note that here the cam is rotated by lifting the handle, whereas in racking the breaker in, the operation is performer as a result of pushing the handle down.

3. Reset the handle to its lowered position and lift it again. This operation must be performed 5 times to completely disengage the cams from their racking pins. After the fifth lifting stroke let the handle drop to its normal position.

4. Pull the breaker out of its compartment until the test position stop engages to hold the breaker in the "test" position.

5. Depress the test position stop handle and pull the breaker out of its compartment as far as the drawout tray will travel.

6. Remove the two 3/8 hex. head screws which hold the breaker on the tray.

7. Attach a lifting device to the top frame of the breaker.

8. Lift the breaker approximately 1/2 inch off the dowel pins on the tray and then pull the breaker forward until its primary contacts clear the compartment.

9. Push the tray all the way back into its compartment. The breaker is now free from its compartment.

TEST POSITION

The "Test Position", as referred to in the previous instructions, is that breaker position where the primary power disconnect contacts are safely disengaged but the secondary control disconnects are engaged. In this position, the breaker may be tested or operated, manually or electrically without energizing the primary power circuit, provided the racking handle has been moved to the completely down position, thus releasing the trip interlock.

For a more complete description of drawout mechanisms and enclosures see AKD DRAWOUT EQUIPMENT INSTRUCTIONS, GEH-1830 and AKD5 Drawout Equipment Instructions GEH-83902.

DRAWOUT BREAKERS AKD5 EQUIPMENT

NOTE: AKD5 breakers are identified by letter "A" appearing after breaker number - example, "AK-2A-15".

Drawout Mechanism Operation - There are four positions of the drawout mechanism:

1. **The Connected Position** - the breaker in the operating position, both primary and secondary contacts made and the door may be closed.
2. **The Test Position** - the primary (power) contacts not made but the secondary (control) contacts are made. Any breaker test not involving power may be made in this position. The door may be closed in this position.
3. **Disconnect Position** - neither the primary nor the secondary contacts made. The door may be closed.
4. **Fully Withdrawn Position** - the breaker completely out of its compartment ready for removal from the inner housing. The door must be open in this position.

NOTE: The mechanism is designed to reverse automatically in the connect and fully disconnected position. Once an operation is started it must be completed. Completion of an operation is indicated by the red knob retracting to its original position.

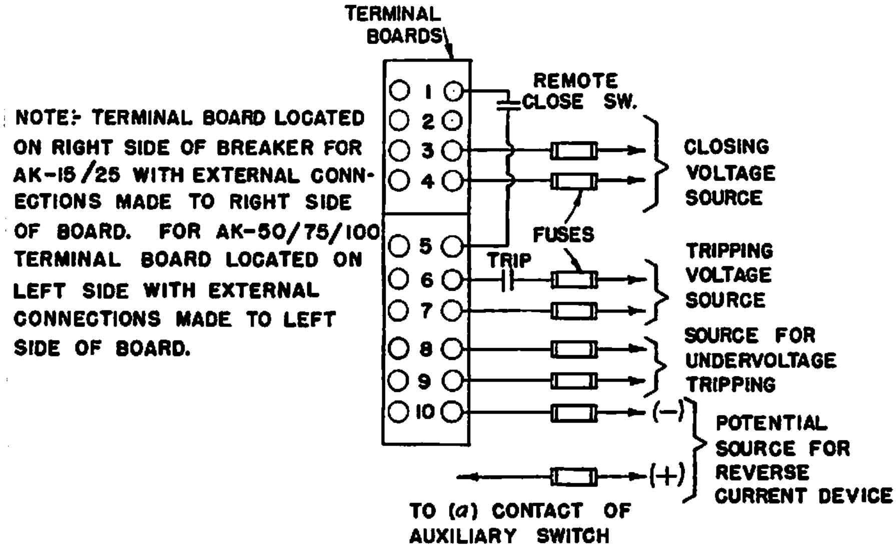


Fig. 1 (Front View)

Fig. 1 (457A683)

Breaker Insertion AK-2A - With the inner housing in the connected position proceed as follows:

1. Pull the red knob. Pull the mechanism operating handle fully out and allow it to return to its original position. Repeat this three more times. The inner house is now in the test position.
2. Pull the red knob again. Pull the mechanism operating handle two complete strokes drawing the inner housing to the disconnect position.
3. Open the housing door and rotate the two track lock links, releasing the tracks. Pull the tracks out to the limit of their travel. This is the fully withdrawn position.
4. With a lifting device, raise the breaker so the mounting pins are about one inch above the tracks. Lower breaker so the breaker mounting pins drop into the slots in the tracks. Remove the lifting device cable.
5. Push the breaker in against the track stops. Rotate the two lock links to lock the breaker in place. Close the door.

   NOTE: When moving a breaker from one position to another be sure breaker is tripped open.

6. Pull the red knob. Pull the mechanism operating handle two times until the test position is reached.

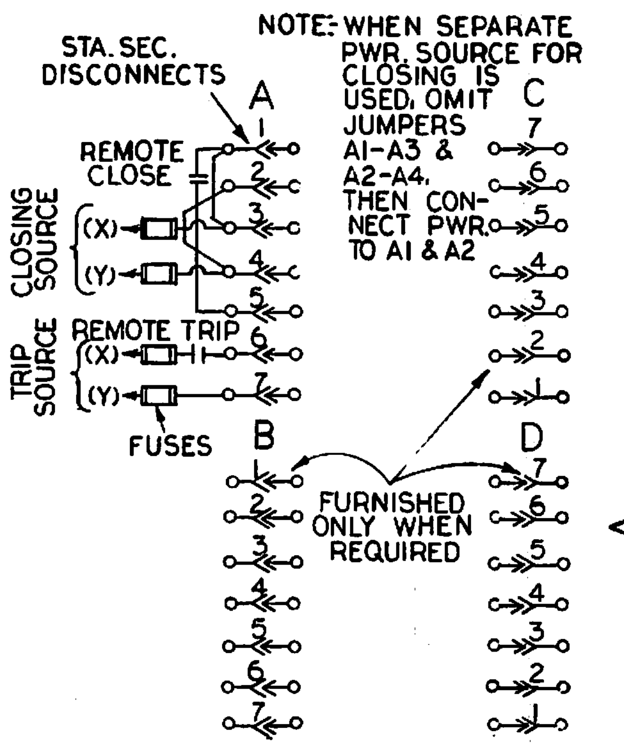


Fig. 2 Front View AK-15 and 25 Breaker Compartment

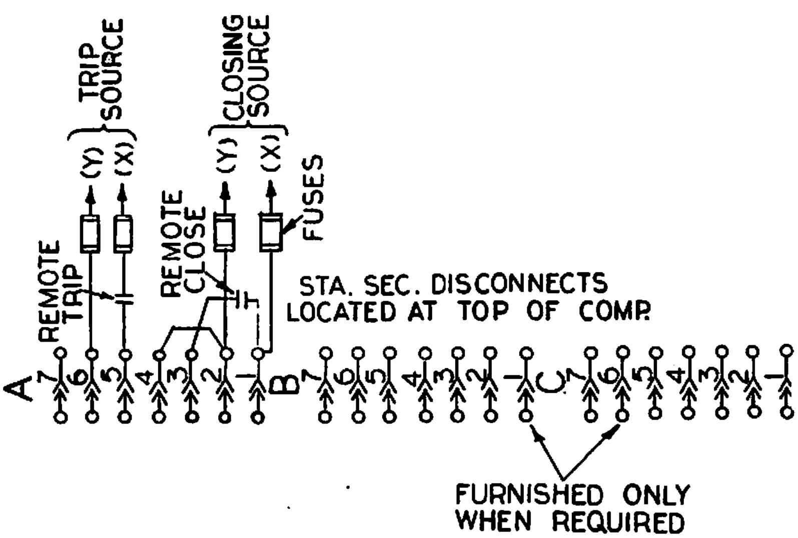


Fig. 3 Front View AK-50, 75, 100 Breaker Compartment

Figs. 2 & 3 (127A6413)

7. Pull the red knob again and pull the mechanism operating handle four times. The breaker will now be completely inserted, in its connected position.

Breaker Removal AK-2A

1. Trip the breaker.

2. Move the breaker and inner housing to the fully withdrawn position. (See Breaker Insertion, Steps 1, 2 and 3).

3. Attach lifting device and lift breaker up and away from compartment until primary disconnects clear the compartment.

4. Move the inner housing to the connected position by pushing the tracks back against the track stops and then follow Steps 6 and 7 under Breaker Insertion. The inner housing is now in the connected position and the breaker is free from its compartment.

NOTE: The installation of AK50S/75S/100S/AKF2C/2D and breakers equipped with the quick-closing mechanism is the same as the other breakers described in this book. The only difference occurs with drawout breakers. The compartments that house the quick-close breakers will be equipped with an interlock that prevents the manual discharging of the closing springs while the breaker is in the racked in (connected position). This interlock will be provided with both AKD and AKD5 equipment that require quick-close breakers.

CONNECTIONS

All electrical connections should be made to assure good conductivity. Mating surfaces should be parallel and firmly bolted or clamped together. Contact surfaces should be clean and have a smooth finish. The bus or cable connecting to the breaker should have adequate current-carrying capacity to prevent excessive heating. Control circuit connections should be made according to the wiring diagram which applies to each breaker specifically. Depending on the breaker type, those connections are made either to a terminal board on the breaker or to the stationary parts of the secondary disconnects.

INDIVIDUALLY ENCLOSED AND STATIONARY BREAKERS

The customers external connections for operation of breaker control components and accessories are shown in Fig. 1.

DRAWOUT BREAKERS

The customers external control connections to these breakers are made to the stationary secondary disconnected located in the breaker compartment as shown in Figs. 2 and 3, AKD Equipment and Figs. 4 and 5 AKD5 Equipment. (Note - If the breaker is used in a General Electric Company, Drawout Switchgear Equipment, all external connections must be made to terminal blocks located in the rear vertical wiring trough of the equipment.)

OPERATION

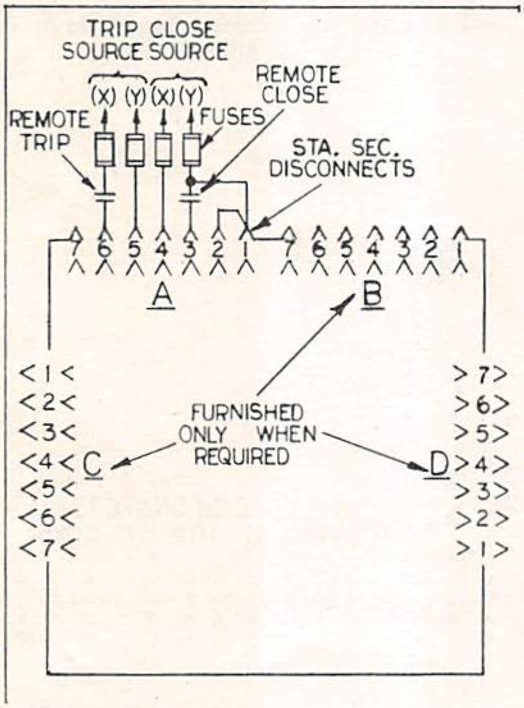
MANUAL CLOSING

AK-1-15 and AK-1-25 breakers are closed by rotating the breaker handle in a clockwise direction approximately 90 degrees. After tripping, the closing mechanism resets automatically by means of springs.

AK-2-15/25 and AK-1-50 manually operated breakers are closed by turning the handle 90 degrees counterclockwise and then clockwise 90 degrees back to the original position. The initial counterclockwise movement resets the closing mechanism. The clockwise movement closes the breaker.

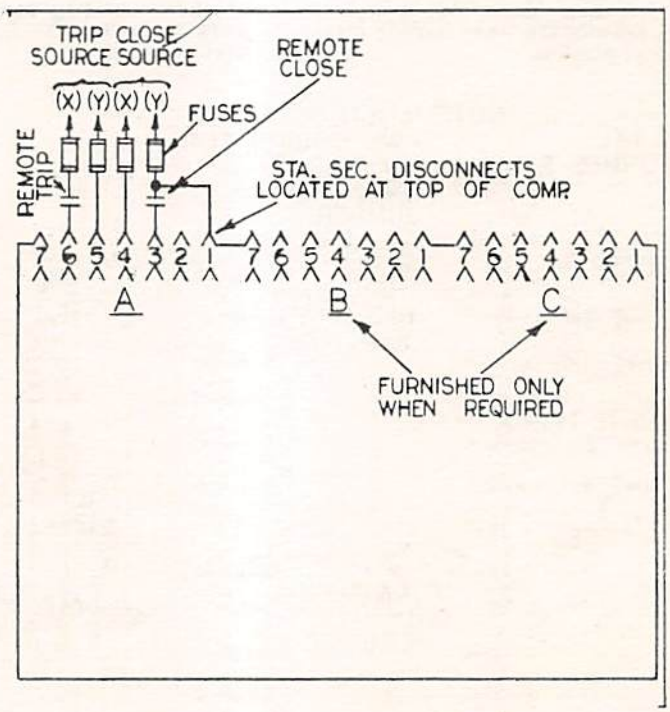
In closing an AK-1-15/25/50 manual breaker on a load, make the handle movement with a fast, snapping action in order to prevent unnecessary heating of the breaker contacts.

The closing mechanism of the AK-2-50/75/100 manual breakers is a spring



FRONT VIEW AK-1A-15,25 & AK-2A-15,25
BREAKER COMPARTMENT

Fig. 4



FRONT VIEW AK-2A-50,75,100
BREAKER COMPARTMENT

Fig. 5

Figs. 4 & 5 (0156A2377)

charged mechanism similar to the one used on AK-50/75/100 electrically operated breakers. AK-2-50/75/100 manual breakers are closed by rotating the closing handle counterclockwise through approximately 120 degrees, and then clockwise back through 120 degrees to the normal handle position. Four such complete movements of the handle are required to close the breaker. During the four counterclockwise movements and the first three clockwise movements of the handle, the springs are charged. After approximately 70 degrees travel of the fourth clockwise handle movement, the spring charged mechanism is driven over-center and the breaker closes. A charge-indicator, numbered 1 to 4, viewed through the breaker front escutcheon, moves with each complete handle movement and indicates the number of complete handle movements that have been performed.

ELECTRICAL CLOSING
(Figures 6 and 7)

STANDARD BREAKERS

AK-15 and AK-25 electrically operated breakers are closed by a solenoid coil. The armature of the solenoid is linked to the breaker mechanism and its movement, operating through the mechanism, closes the breaker. The closing solenoid circuit may be operated by a push button closing switch on the breaker or by a remote switch or relay, depending on the individual arrangements desired. When a closing signal is given, the X relay coil is energized and it in turn closes its contacts. One of these seals in the X coil circuit; the other three, which are arranged in series, energize the solenoid closing coil. As the breaker closes, a mechanically operated switch opens one pair of its contacts (bb) and closes another (aa). The contacts which open cut out the X relay coil. The contacts which close energize the Y relay coil, whose contacts now seal in the Y coil and hold open the X relay coil circuit. This prevents another closing operation if one of the protective devices operates to trip the breaker before contact at the closing switch is released.

Large AK breakers (AK-50/75/100) are closed by the discharge of a closing spring. This rotates a crankshaft which, by means of an attached roller, operates a closing cam, forcing the movable breaker contacts against the stationary contacts. The closing spring is charged through the operation of a motor and gear reduction unit.

The electrical control system is comprised of an X relay, two double contact mechanically operated switches (F and G), a push button closing switch and any means for remote closing which the user may incorporate into the system. When voltage is first applied to the breaker, (before any closing signal is given) the motor is energized through two of the X relay contacts and the two G switch contacts. The motor then compresses the closing springs to the "pre-charged" position at which point the mechanically operated F and G switches are operated. This opens the G contacts, stopping the motor, and closes the F contacts, which readies the system for the actual closing of the breaker. When the push button or remote switch signals for a closing operation, the X relay coil is

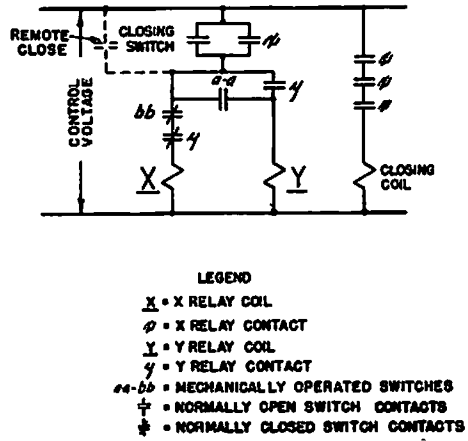


Fig. 6 Simplified Elementary Diagram Internal Wiring AK-15 and 25

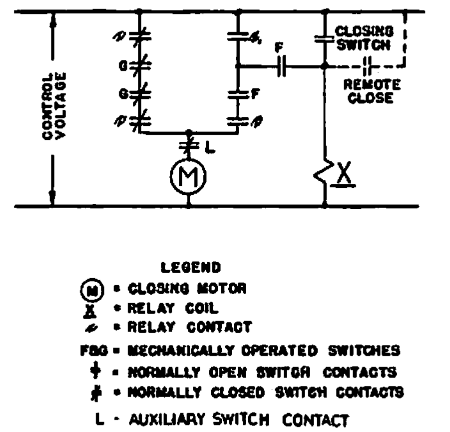


Fig. 7 Simplified Elementary Diagram Internal Wiring AK-50, 75 and 100

energized, operating the X contacts. This seals in the X relay and energizes the motor once again and the closing operation takes place.

QUICK CLOSE BREAKERS
(Figure 8)

Functionally, the quick close mechanism differs from the standard electrical mechanism in that the pre-charge operation is extended to completely charge the closing springs. At the end of the charging operation, which takes approximately 5 seconds, a latch plate engages the prop roller to prevent the closing springs from discharging.

With the closing springs fully charged the breaker is ready for a closing operation upon release of the prop roller. This may be accomplished either manually, by depressing the closing lever on the breaker, or electrically by closing the remote closing switch. Upon the release of the prop roller the closing springs discharge and close the breaker in the same manner as on the standard electrical breaker.

With control voltage applied, the motor is energized through the G switch contacts, and charges the closing springs. When the springs reach the fully charged position, the mechanically operated switches operate, reversing their contacts. Upon operation of these switches the motor is stopped by the opening of the G switch. The closing of the F switch prepares the breaker for a closing operation.

A closing signal now given energizes the control relay X whose contacts close and complete the circuit through the closing relay coil. With the closing relay coil energized the breaker closes as described above. At the same time the closing relay contact closes to energize the anti-pump relay causing its contacts to reverse providing the anti-pump feature.

When the breaker closes, the mechanical operated G switches close to energize the motor again and the F switches open and de-energize the control relay. The auxiliary switch contact opens preventing the control relay from being energized until the breaker is tripped open. With the G switches closed, the motor charges the closing springs ready for the next closing operation.

MANUAL OR MAINTENANCE CLOSING OF ELECTRICAL BREAKERS

All electrical breakers may be closed manually by means of the maintenance handle furnished with the breaker or switchgear.

To close AK-1-15/25 breakers:

1. Make sure handle is in proper position. Handle is stamped this side up.
2. Place the handles fork like fingers above the armatures stop nut that extends below the magnet behind the front escutcheon and lift up. This forces the armature down closing the breaker's contacts.

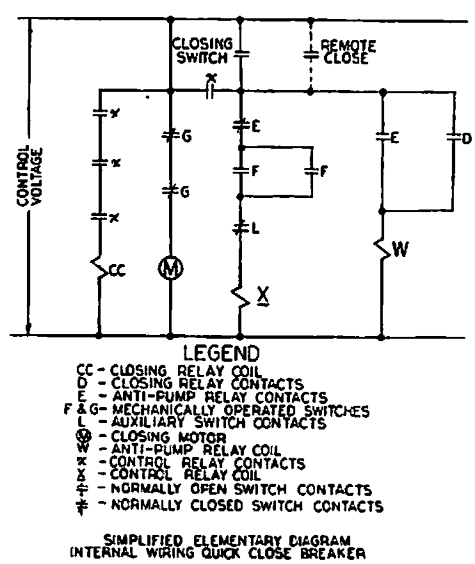


Fig. 8

To close AK-2-15/25 breakers:

1. Place the two small hooks of the handle into the two slots located in the lower portion of the front escutcheon.

2. Rotation of the long end of the handle downwards forces the shorter end of the handle upwards against the bottom of the solenoid armature, and closes the breaker's contacts.

To close AK-50/75/100 breakers:

1. Place the ratchet type maintenance handle on the shaft that protrudes from the gear reduction unit.

2. Operate handle until the spring charge indicator reads charged.

3. Continue to operate handle until the closing springs discharge and close the contacts.

To close AK-50S/75S/100S, AKF 2C, 2D breakers and breakers equipped with the quick closing mechanism:

NOTE: All AKD, or AKD-5 drawout type breakers equipped with the quick closing mechanism cannot normally be closed manually when in the racked in (connected position), due to mechanical designed interference between the enclosure and the spring discharge lever on the breaker. If manual closing is desired with the breaker racked in, the interference feature must be removed, otherwise the breaker can be manually closed in the test position or fully racked out position only.

1. With the ratchet type maintenance handle applied to the gear box shaft, operate the handle until the springs are fully charged. The fully charged position is indicated by the spring charge indicator and by solid resistance to any further handle operation.

2. Push down on the push to close lever to release the energy stored in the closing springs which closes the breaker's contacts.

TRIPPING

The breaker is tripped open by the displacement of a mechanism latch, which allows a toggle linkage supporting the movable contacts in the closed position to collapse. This trip latch is fastened rigidly to a trip shaft which runs horizontally from left to right through the breaker. All of the means provided for tripping the breaker operate through striker arms which displace the mechanism trip latch by moving against trip paddles fastened on the trip shaft. Looking at the breaker from the right, counterclockwise rotation of the trip shaft causes the breaker to trip; clockwise movement resets the mechanism latch. The manual trip button, overload devices, shunt trip, undervoltage tripping device, and reverse current trip all operate in this fashion to trip the breaker. The movement of the striker arms of all of these, when activated, should move from 1/32 to 1/16 inch beyond the point at which tripping occurs. This is what is meant by the expression, "positive tripping".

Most air circuit breakers are equipped with series overcurrent trip devices either of the dual magnetic type (instantaneous and time delay tripping) or instantaneous alone. Breakers are designed to carry up to 100% of the continuous current rating of their trip devices. Any attempt to carry higher currents for a prolonged period will cause overheating and possible damage.

For a more detailed discussion of the construction, operation, and application of overcurrent trip devices refer to the following publications:

1. Maintenance manual for specific breaker involved (see "Maintenance").

2. "Selection and Application of Power Circuit Breakers" GET-1113.

MAINTENANCE INSTRUCTIONS

INSPECTION

BEFORE INSPECTION OR ANY MAINTENANCE WORK IS DONE, BE SURE THAT THE BREAKER IS IN THE OPEN POSITION. ALL ELECTRICAL POWER, BOTH PRIMARY AND CONTROL SOURCES SHOULD ALSO BE DISCONNECTED.

Periodic inspection of the circuit breaker is recommended at least once a year. More frequent inspections are recommended, if severe load conditions, dust, moisture, or other unfavorable conditions exist.

Always inspect the breaker after a short circuit current has been interrupted.

At the time of inspection, the following checks should be made after the breaker has been de-energized.

1. Manually operate the breaker several times, checking for obstructions or excessive friction.

2. Electrically operate the breaker several times (if breaker has electrical control) to ascertain whether the electrical attachments are functioning properly.

3. Remove the arc quenchers by removing the channel shaped retaining bar.

4. Inspect arc quenchers and contacts for breakage or excessive burning. Should arc quencher barriers or contacts be eroded to half their original thickness they should be replaced.

LUBRICATION

In general, the circuit breaker requires moderate lubrication. Bearing points and sliding surfaces should be lubricated at the regular inspection periods with a thin film of GE Lubricant D50H15. Before lubricating remove any hardened grease and dirt from latch and bearing surfaces with kerosene. ALL EXCESS LUBRICANT SHOULD BE REMOVED WITH A CLEAN CLOTH TO AVOID ANY ACCUMULATION OF DIRT OR DUST.

On drawout breakers, the contact surface of the disconnect studs should be cleaned and greased with GE Grease Specification D50H47.

These instructions have as their purpose the imparting of information of a general nature concerning the installation and operation of Type AK power circuit breakers. If more complete and specific information is required, such as might be needed for overhauling the breaker, trouble shorting, or replacing parts of the breaker, refer to the complete instruction for the particular breaker type involved. These are:

Maintenance Manual	Breaker Type
GEI-74602	AK-1-15/25 Man. Oper.
GEI-74603	AK-1-15/25 Elec. Oper.
GEI-50299	AK-2-15/25 Man. & Elec.
GEI-74623	AKF-1B Man. Oper.
GEI-74624	AKF-1B Elec. Oper.
GEI-74600	AK-1-50 Man. Oper.
GEI-74600	AK-1-50 Elec. Oper.
GEI-74600	AK-1-75/100 Elec. Oper.
GEI-74600	AK-2-50/75/100 S. E. Man. Oper.
GEI-74600	AK-2-50/75/100 Elec. Oper.
GEI-74600	AKF-1C, AKF-2C
GEI-74600	AKF-1D
GEI-74600	AKF-2D

Renewal parts bulletins for the various types of breakers are:

Bulletin	Breaker Type
GEF-3506	AK-1-15/25 and AKF-1B
GEF-3878	AK-1-50 up to and including dash 9
GEF-3879	AK-1-75/100
GEF-4149	AK-2-15-25
GEF-4150	AK-1-50-10-11 and AK-2-50

INSTRUCTIONS

GEH-2021

AK AIR CIRCUIT BREAKERS INSTALLATION AND OPERATION

Types

AK-1-15	AKF-1C
AK-1-25	AKF-1D
AK-1-50	AK-2-15
AK-1-75	AK-2-25
AK-1-100	AK-2-75
AKF-1B	AK-2-100

LOW VOLTAGE SWITCHGEAR DEPARTMENT

GENERAL ELECTRIC

PHILADELPHIA, PA.

INSTALLATION AND OPERATION OF TYPE AK AIR CIRCUIT BREAKER

INSTALLATION

LOCATION

In choosing a location for the installation of an Air Circuit Breaker, there are two factors to be considered. The first of these is the effect of the location on the breaker itself. Much better performance and longer life may be expected if the area is clean, dry, dust-free, and well ventilated, than if the opposites to these conditions exist. The second consideration is convenience for operation and maintenance. The breaker should be easily accessible to the operator, and there should be sufficient space allowed for maintenance work to be done if this becomes necessary.

MOUNTING

AK Air Circuit Breakers are designed to be mounted in any one of three ways. These are dead front mounting, individual mounting with the enclosure being provided, and drawout mounting in which the breaker is designed for insertion into a cubicle in drawout equipment such as a substation or control board.

Dead Front Breakers

These breakers are designed for mounting in a switchboard or enclosing case of the customer's design and construction. Mounting in this instance consists of bolting the breaker frame to a supporting structure within the switchboard or enclosure, connecting the power buses or cables, and making whatever control connections are necessary. The front cover of the breaker enclosure may be a hinged door or a plate bolted to the panel. In either case, it should have a section cut out, through which the front escutcheon of the breaker may protrude. Outline drawings giving the dimensions needed for preparing a suitable enclosure or cubicle for the various types of AK breakers are given below. These are for standard 2 or 3 pole breakers.

Breaker	Outline Drawing No.
AK-1-15	256C753
AK-1-25	256C754
AK-1-50 man. oper.	248C703
AK-1-50 elec. oper.	238C123
AK-1-75	238C192
AK-1-100	238C193
AK-2-15 and 25	695C116
AK-2-75	269C225
AK-2-100	269C227

The surface on which the breaker is mounted must be flat throughout in order not to impose any internal distortion on the breaker unit. The supporting structure should be rigid enough to avoid any possibility of the breaker studs supporting the weight of the breaker. Minimum cutout dimensions, as given by the appropriate outline drawing, must be maintained to provide adequate electrical clearance.

Individually Enclosed Breakers

Individually enclosed breakers are supplied with several types of enclosures, most commonly with the general purpose type or the weather resistant type. The former is used for favorable indoor locations and the latter for outdoor locations or indoor locations that may be subject to unfavorable conditions. All of the enclosures are provided with suitable means for mounting on floors, walls or supporting framework. Removable cover plates are supplied with the enclosures which may be drilled or machined to accommodate the entrance of bus ducts, conduits or cables. Steps in the procedure for installing enclosed breakers follow:

1. If the breaker is an AK-15, AK-25 or an AK-50, remove it from the enclosure. With AK-50 breakers, a handle and cam arrangement is used for that part of the breaker movement that involves the disengagement or engagement of the primary disconnects. AK-75 and AK-100 breakers are bolted solidly to the enclosure frame and need not be removed from the enclosure.

2. Remove cover plates of enclosure and prepare them to accommodate whatever power entrance means is used.

3. Mount enclosing case to supporting structure.

4. Replace cover plates and make power connections to stationary terminals in enclosure.

5. If enclosure is of a type that makes use of secondary disconnects, make control connections to stationary parts of the disconnects.

6. If the breaker is a type AK-15, AK-25 or AK-50 and has been removed from the enclosure, it may now be replaced. Control power connections to the terminal board should be made if and as required. (See CONNECTIONS).

7. Before energizing the power circuit, operate the breaker several times to be sure that it is functioning properly. (See OPERATION).

Drawout Breakers

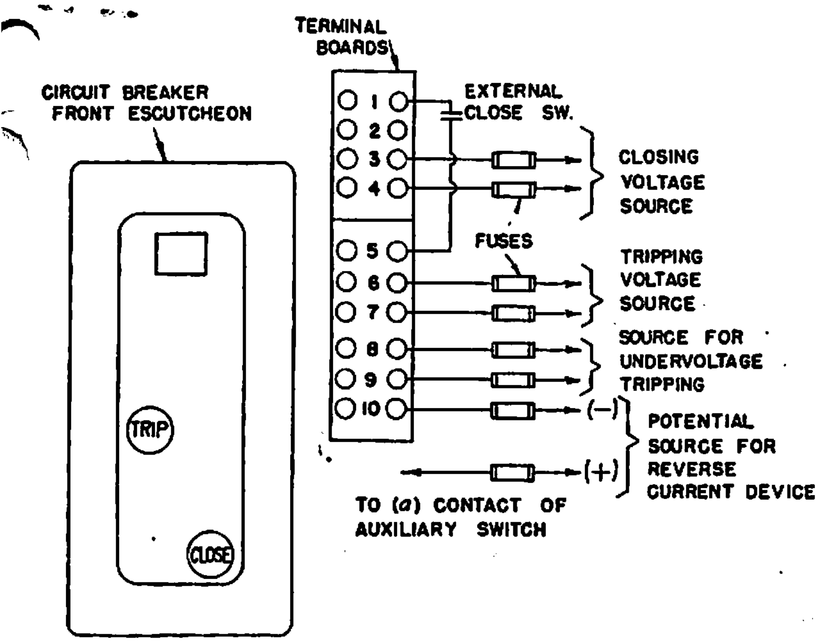
Mounting drawout breakers consists of simply placing the breaker in the proper position with respect to its enclosure, sliding or rolling it to a stop position, and, by means of a racking handle and mechanism, racking it through the last part of its movement during which the stationary and movable halves of the disconnects engage. Large drawout breakers are fastened to a telescoping tray which extends out from the enclosure to receive the breaker. Small breakers have guides on their side plates which slide in channels in the enclosures. Both large and small breakers have a test position in which the secondary disconnects are engaged, but the primary disconnects are not. In this position, the breaker may be operated electrically without energizing the load cable or bus.

For a more complete description of drawout mechanisms and enclosures see DRAWOUT EQUIPMENT INSTRUCTIONS, GEH-1830.

CONNECTIONS: Figure 1

All electrical connections should be made with a view toward good conductivity. Mating surfaces should be parallel and firmly bolted or clamped together. Contact surfaces should be clean and have a smooth finish. The bus or cable connecting to the breaker should have adequate current-carrying capacity to prevent excessive heating. Control circuit connections should be made according to the wiring diagram which applies to each breaker specifically. Depending on the breaker type, these connections are made either to a terminal board on the breaker or to the stationary parts of secondary disconnects.

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.



EXTERNAL CONNECTIONS FOR OPERATION OF BREAKER CONTROL COMPONENTS AND ACCESSORIES

Figure 1

On breakers other than drawout breakers, external control connections are made to a vertical 10 point terminal board on stationary dead front and individually enclosed breakers. Numbering the points from 1 to 10, from the top to the bottom, connections are made as follows: Closing voltage is applied between 3 and 4; tripping voltage between 6 and 7. An external closing switch may be connected between 1 and 5. If the breaker has an undervoltage tripping device, the voltage for this is applied between 8 and 9. If the breaker is a DC breaker and has a reverse current device, DC voltage is applied between terminal 10 and the "a" contact of the second stage from the right of the auxiliary switch. The negative lead is connected to terminal post 10. If the breaker is a small AK type (AK-15/25), the terminal board is on the right side of the breaker and connections are made to the right side of the board. Exactly the reverse of this is true if the breaker is a large AK type (AK-50/75/100).

OPERATION

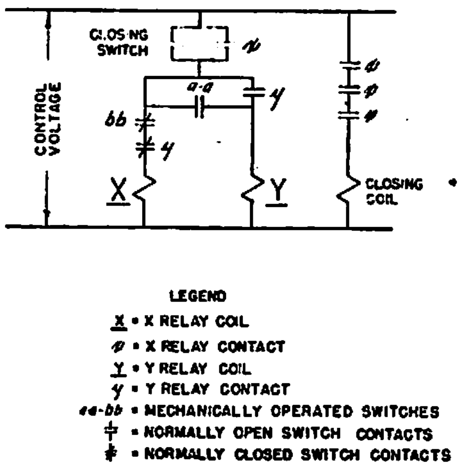
MANUAL CLOSING

AK-1-15 and AK-1-25 Breakers are ..ed by rotating the breaker handle in a ..ockwise direction approximately 90 degrees from its normal vertical position. After tripping, the closing mechanism re..ts automatically by means of springs. ..-2-15/25 and AK-50 manually operated ..eakers are closed by turning the handle counterclockwise and then clockwise back to the original position, again through about 90 degrees. The initial counterclockwise movement resets the closing mechanism.

In closing an AK-1-15/25/50 manual breaker on a load, it is desirable to make the handle movement with a reasonably fast, snapping action in order to prevent unnecessary heating of the breaker contacts.

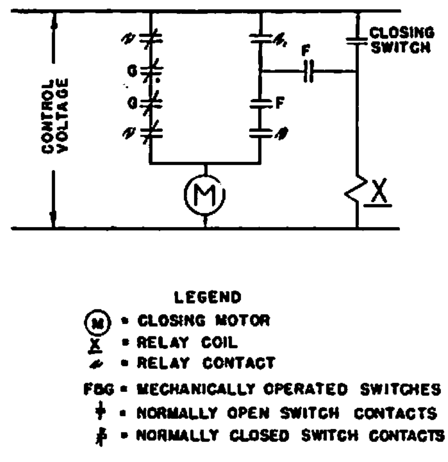
ELECTRICAL CLOSING: Figures 2A and 2b

AK-15 and AK-25 electrically operated breakers are closed when a closing solenoid coil is energized. The magnetic force generated by the solenoid moves an armature into the solenoid coil. The armature is linked to the breaker mechanism and its movement, operating through the mechanism, closes the movable contacts against the stationary contacts of the breaker. The closing solenoid circuit may be closed by a push button closing switch on the breaker or by a remote switch or relay, depending on the individual arrangements desired. When a closing signal is given, the X relay coil is energized and it in turn closes its four sets of contacts. One of these seals in the X coil circuit; the other three, which are arranged in series, energize the solenoid closing coil. As the breaker closes, ..echanically operated switch opens one ..r of its contacts (bb) and closes another (aa). The contacts which open cut out the X relay coil. The contacts which close ..ergize the Y relay coil, whose contacts now seal in the Y coil and hold open the X relay coil circuit. This prevents another closing operation if one of the protective devices operates to trip the breaker before contact at the closing switch is released.



SIMPLIFIED ELEMENTARY DIAGRAM
INTERNAL WIRING AK-1-15 AND 25

Figure 2A



SIMPLIFIED ELEMENTARY DIAGRAM
INTERNAL WIRING AK-1-50,75, AND 100

Figure 2B

Large AK breakers (AK-50/75/100) are closed by the discharge of a closing spring. This rotates a crankshaft which, by means of an attached roller, operates a closing cam, forcing the movable breaker contacts against the stationary contacts. The closing spring is charged through the operation of a motor and gear reduction unit.

The electrical control system is comprised of an X relay, two double contact mechanically operated switches (F and G), a push button closing switch and any means for remote closing which the user may incorporate into the system. When voltage is first applied to the breaker, (before any closing signal is given) the motor is energized through two of the X relay contacts and the two G switch contacts. The motor then compresses the closing springs to the "pre-charged" position at which point the mechanically operated F and G switches are operated.

Fig. 1 (457A683)

Fig. 2A (457A685)

Fig. 2B (457A684)

This opens the G contacts, stopping the motor, and closes the F contacts, which readies the system for the actual closing of the breaker. When the push button or remote switch signals for a closing operation, the X relay coil is energized, operating the X contacts. This seals in the X relay and energizes the motor once again and the closing operation takes place. Closing again operates the F and G switches so their contacts again assume their original position and the motor continues to run until the "pre-charged" position is reached.

TRIPPING

The breaker is tripped open by the displacement of a mechanism latch, which allows a toggle linkage supporting the movable contacts in the closed position to collapse. This trip latch is fastened rigidly to a trip shaft which runs horizontally from left to right through the breaker. All of the means provided for tripping the breaker operate through striker arms which displace the mechanism trip latch by moving against trip paddles fastened on the trip shaft. Looking at the breaker from the right, counterclockwise rotation of the trip shaft causes the breaker to trip; clockwise movement resets the mechanism latch. The manual trip button, overload devices, shunt trip, undervoltage tripping device, and reverse current trip all operate in this fashion to trip the breaker. The movement of the striker arms of all of these, when activated, should have at least a perceptible amount of movement beyond the point at which tripping occurs. This is what is meant by the expression, "positive tripping".

Most air circuit breakers are equipped with series overcurrent trip devices either of the dual magnetic type (instantaneous and time delay tripping) or instantaneous alone. Breakers are designed to carry up to 100% of the continuous current rating of their trip devices. Any attempt to carry higher currents for a prolonged period will cause overheating and possible damage.

Breakers are usually shipped with the pickups of the trip devices set at 100% of coil rating. To get best protection and to avoid nuisance tripping from a fluctuating load, it is generally recommended that the pickup be set at 125% of the actual steady state load current. For example, a breaker rated at 1200 amperes continuous current with a 1000 ampere load should have its trip device set to pick up at 1250 amperes. (Slightly above the 100% calibration mark on the trip scale plate of the device).

For a more detailed discussion of the construction, operation, and application of overcurrent trip devices refer to the following publications:

1. Instruction Book for specific breaker involved (see "Maintenance").

2. "Selection and Application of Air Circuit Breakers" GET-1113.

3. "Overcurrent Trip Device - Type EC-2" GEI-50216. This applies only to trip devices on AK-15/25/50 breakers.

MAINTENANCE INSTRUCTIONS

These instructions have as their purpose the imparting of information of a general nature concerning the installation and operation of type AK air circuit breakers. If more complete and specific information is required, such as might be needed for overhauling the breaker, trouble shooting, or replacing parts of the breaker, refer to the complete instruction for the particular breaker type involved. These are:

Instruction Book	Breaker Type
GEH-1824	AK-1-15 or 25 man. oper.
GEH-1807	AK-1-15 or 25 elec. oper.
GEH-1799	AK-1-50 man. oper.
GEH-1798	AK-1-50 elec. oper.
GEH-1823	AK-1-75 or 100
GEH-1831	AKF-1B man. oper.
GEH-1832	AKF-1B elec. oper.
GEH-50210	AKF-1C
GEH-50212	AKF-1D
GEI-50299	AK-2-15/25
GEI-57077	AK-2-75/100

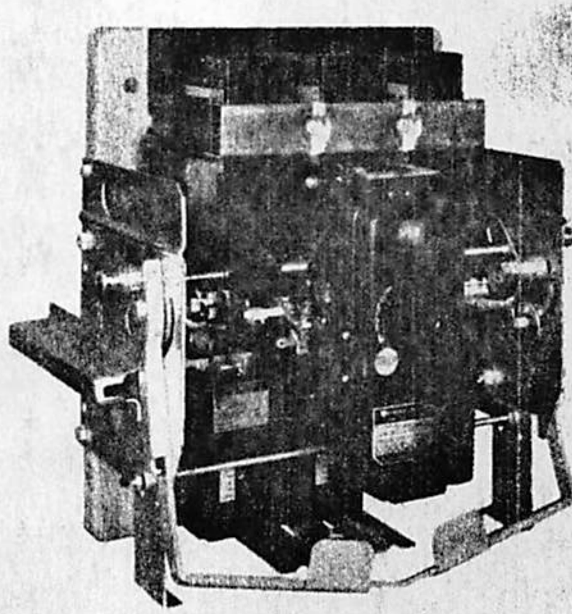
Renewal parts bulletins for the various types of breakers are:

Bulletin	Breaker Type
GEF-3506	AK-1-15/25 and AKF-1B
GEF-3878	AK-1-50
GEF-3879	AK-1-75/100

INSTRUCTIONS
MAINTENANCE

GEI-74602
SUPERSEDES GEH-1824

POWER CIRCUIT BREAKERS



Types AK-1-15-3 to 10
and AK-1-25-3 to 10
Manually Operated

LOW VOLTAGE SWITCHGEAR DEPARTMENT

GENERAL ELECTRIC

PHILADELPHIA, PA.

CONTENTS

POWER CIRCUIT BREAKER

TYPES AK-1-15-3 TO 10 AND AK-1-25-3 TO 10 MANUALLY OPERATED

INTRODUCTION

The instructions contained herein provide information for performing maintenance procedures and for replacing AK-1-15/25 breaker components and accessories. For information regarding the receiving, handling, storage and installation of these breakers, refer to GEH-2021A, furnished with all AK breakers.

The AK-1-15 and AK-1-25 breakers differ, in that, the AK-1-25 has an extra contact per pole with corresponding differences in the upper stud and interrupter.

As various design improvements and new features were added, the suffix digit of the breaker type number was progressively increased. All of these models are essentially the same breaker, as changes were mainly of a minor nature. These are tabulated below:

AK-1-15/25-3 Basic model

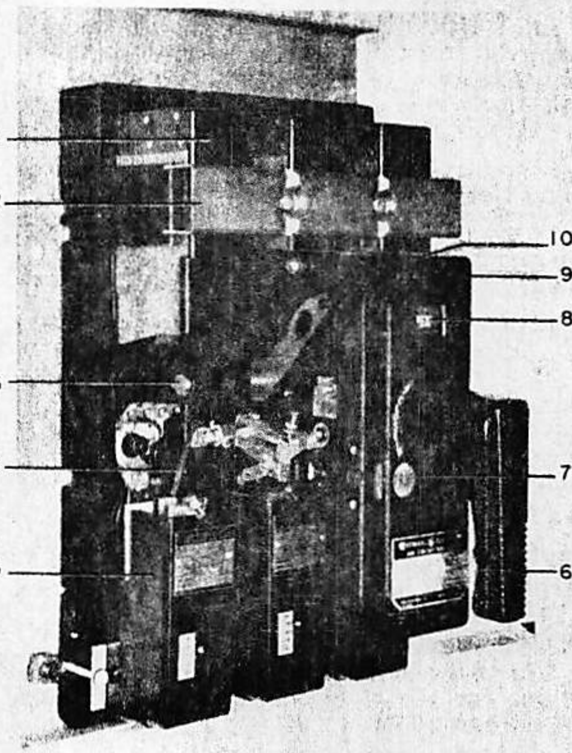
AK-1-15/25-6 Stationary primary disconnects and cable clamp redesigned. (Only enclosed breakers affected).

AK-1-15/25-7 New type of front escutcheon and closing handle. Trip button relocated on escutcheon and reset lever for bell alarm and lockout device changed.

AK-1-15/25-8 EC-2 overcurrent device used instead of the EC-1 device except on units requiring short-time delay tripping.

AK-1-15/25-9 New drawout frame introduced.

NOTE: Suffix digit number changes which do not appear above do not apply to manual breakers.



1. Arc Quencher
2. Clamp
3. Main Shaft
4. Trip Paddle
5. Series Overcurrent Device
6. Operating Handle
7. Trip Button
8. Position Indicator
9. Front Escutcheon
10. Grounding Strap

Fig. 1 Oblique Left View of AK-1-25 Breaker

Fig. 1 (8020283)

OPERATION

MANUAL - FIG. 1

The breaker may be closed manually by rotating the operating handle (6) 90 in the clockwise direction. After the breaker closes the operating handle is returned to its normal position by a spring force. This breaker may be tripped manually by the trip button (7), or automatically by any of the tripping devices with which the breaker may be equipped. The mechanism is automatically reset when the breaker trips, however, the breaker is "trip-free" from the closing mechanism which assures that it cannot be closed as long as any tripping device is functioning.

MAINTENANCE

INSPECTION

BEFORE INSPECTION OR ANY MAINTENANCE WORK IS DONE, BE SURE THAT THE BREAKER IS IN THE OPEN POSITION. ALL ELECTRICAL POWER, BOTH PRIMARY AND CONTROL SOURCES, SHOULD ALSO BE DISCONNECTED.

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.

Periodic inspection of the circuit breaker is recommended at least once a year. More frequent inspections are recommended, if severe load conditions, dust, moisture, or other unfavorable conditions exist.

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.

At all times it is important not to permit pencil lines, paint, oil or other foreign materials to remain on the insulating surfaces of the breaker as they may cause low resistance between points of different potential and result in eventual electrical breakdown.

Always inspect the breaker after a short circuit current has been interrupted.

At the time of periodic inspection, the following checks should be made after the breaker has been de-energized.

1. Manually operate the breaker several times, check for obstructions or excessive friction.
2. Arc quencher (see Section on "Arc Quencher").
3. Contact condition, wipe, and pressure (See Section on "Pole Unit Assembly").
4. Latch engagement (See Adjustments under "Operating Mechanism").
5. Overcurrent device tripping (See Adjustments under "Series Overcurrent Tripping Device").

TOOLS

The tools listed below will adequately equip an operator for any maintenance operation on all Type AK-1-15 and 25 Breakers:

#1 Phillips Screw Driver
#2 Phillips Screw Driver with 8" shaft
#3 Phillips Screw Driver
K101-1/2 Crescent (Short) Screw Driver
K505-1/2 Crescent (Long Thin) Screw Driver
K306 Crescent (Standard) Screw Driver

H-28 8" Gas Pliers
654 Pointed Nose Side Cutting 6" Pliers
#2 Waldes Truarc Pliers Straight
#2 Waldes Truarc Pliers 90^{o} Angle

Ratchet Socket Wrench 1/2" Drive
7/16" - 1/2" Drive Socket
9/16" - 1/2" Drive Socket
5/8" - 1/2" Drive Socket
3/4" - 1/2" Drive Socket
13/16" - 1/2" Drive Socket
15/16" - 1/2" Drive Socket
10" Extension Bar 1/2" Drive
6" Extension Bar 1/2" Drive
8" Adjustable End Wrench
1/4" - 5/16" (Blue Point) Open End Wrench
1/2" - 9/16" Open End Wrench
5/8" - 3/4" Open End Wrench
3/8" - 7/16" Open End Wrench
11/32" - 5/16" Open End Wrench

1/16" Allen Head Wrench for #6 Screw
5/64" Allen Head Wrench for #8 Screw
3/32" Allen Head Wrench for #10 Screw
1/8" Allen Head Wrench for 1/4" Screw
5/16" Straight Shank Allen Head Wrench for 3/8" screw, with adapter for 1/2" drive ratchet

8 oz. Ball peen hammer

5/8" 6 point open box wrench

3/8" Spintite

NOTE: Obtain from local hardware, do not order on General Electric Company.

LUBRICATION

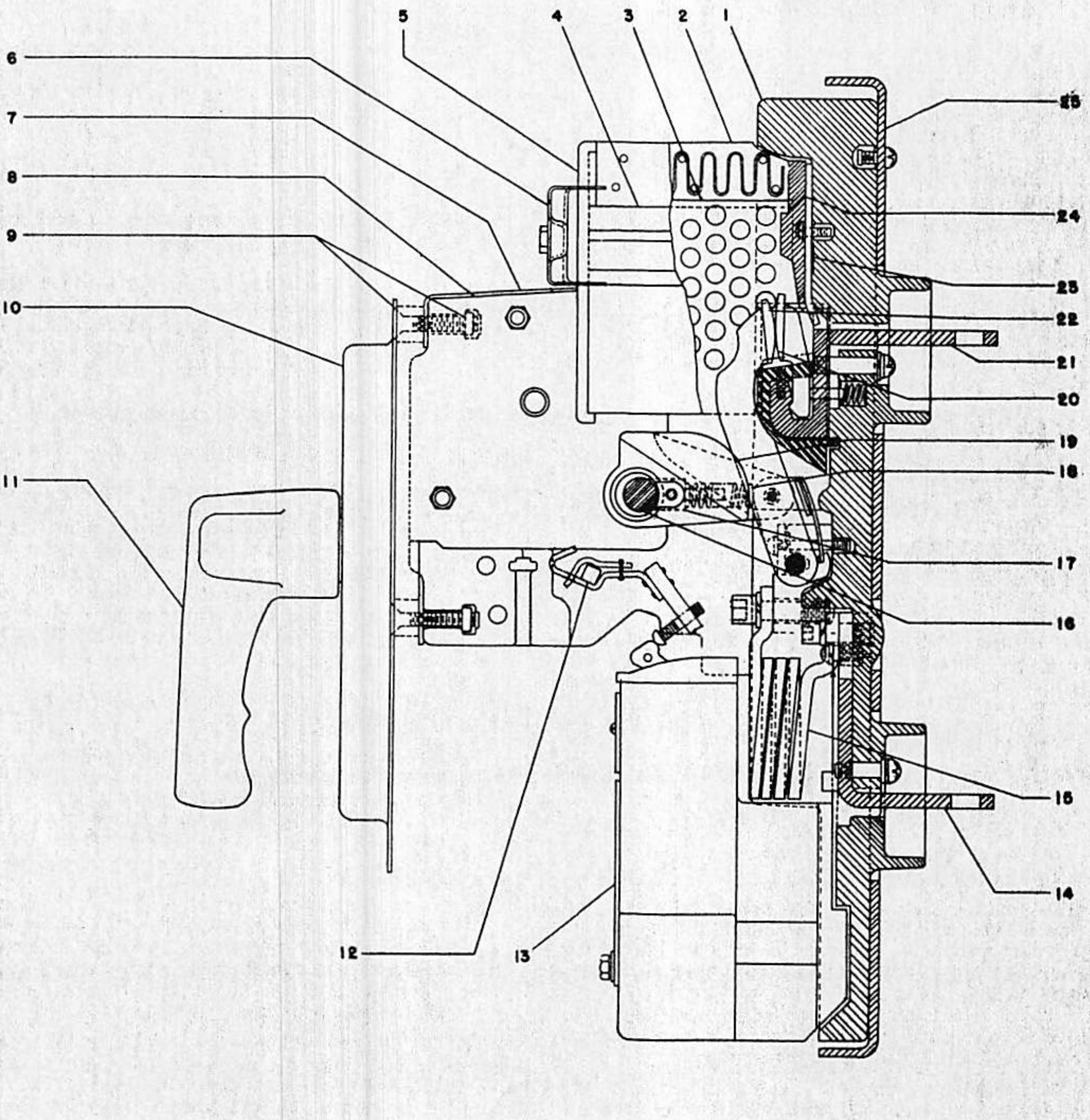
In general, the circuit breaker requires moderate lubrication. Bearing points and latch surfaces should be lubricated at the regular inspection periods with a thin film of extreme temperature, high-pressure, light grease similar to G. E. Spec. No. D50H15. Hardened grease and dirt should be removed from latch and bearing surfaces by using kerosene. ALL EXCESS LUBRICANT SHOULD BE REMOVED WITH A CLEAN CLOTH IN ORDER TO AVOID ANY ACCUMULATION OF DIRT OR DUST.

At each maintenance period, all silver to silver friction points, such as primary disconnects, should be cleaned and given a fresh coat of G. E. Spec. No. D50H47 lubricant.

TROUBLE SHOOTING

TROUBLE	CAUSE	REMEDY
Overheating	Contacts not aligned. Contacts dirty, greasy or coated with dark film. Contacts badly burned or pitted. Current carrying surfaces dirty. Bolts and nuts at terminal connection not tight. Current in excess of breaker rating. Excessive ambient temperature.	Adjust contacts. Clean contacts. Replace contacts. Clean surfaces of current carrying parts. Tighten, but do not exceed elastic limit of bolts or fittings. Decrease load, rearrange circuit or install larger breaker. Provide adequate ventilation.
Failure to Trip.	Travel of tripping device does not provide positive release of tripping latch. Worn or damaged trip unit parts. Binds in overcurrent device.	Re-adjust or replace trip unit. Replace trip unit. Replace overcurrent device.
False Tripping	Overcurrent pick-up too low. Overcurrent time-setting too short. Bind in overcurrent device.	Change adjustment or replace with higher rated device. Change adjustment or replace with higher rated device. Replace device.
Failure to Close and Latch	Binding in attachments preventing resetting of latch. Chipped or worn latch. Latch out of adjustment. Latch return spring too weak or broken. Hardened or gummy lubricant on bearing and latch surfaces.	Re-align and adjust attachments. Replace latch. Adjust latch. Replace spring. Clean bearing and latch surfaces.

Fig. 2 (T-6490325)



1. Pole Unit Base
2. Muffler
3. Inside Barrier
4. Outside Barrier
5. Front Cap
6. Clamp
7. Strap
8. Operating Mechanism
9. Mounting Screw & Nut
10. Front Escutcheon
11. Operating Handle
12. Trip Shaft
13. Overcurrent Trip Device
14. Lower Stud
15. Series Coil
16. Main Shaft
17. Cap
18. Opening Spring
19. Insulating Link
20. Stationary Contact
21. Upper Stud
22. Movable Contact
23. Fiber Strap
24. Rear Support
25. Steel Base

Fig. 2 Right Side View of Breaker

BASIC BREAKER COMPONENTS

ARC QUENCHER - FIG. 2

Each arc quencher has several compound inside barriers (3) containing a large number of perforations and two outside barriers (4) without perforations, as well as a front cap (5) and a rear support (24) held in place by a fiber strap (23). A clamp (6) is attached to the breaker base by two bolts. Clamp (6) holds all the arc quencher assemblies to their respective pole units. A muffler (2) is located on top of the compound barriers. The compound barriers and the muffler, together with the slots between the barriers, serve to extinguish the arc.

The arc quenchers should be inspected at the regular inspection period. If the barriers are cracked or eroded to one-half their original thickness, they should be replaced.

REPLACEMENT, FIG. 2

1. Remove clamp (6) by removing two bolts.
2. Unclasp fiber strap (23).
3. Remove front cap (5), muffler (2), outside barriers (4), inside barriers (3) and rear support (24).
4. Install new or disassembled parts in reverse order.

NOTE: In re-assembling the rear support (24) to the breaker, be sure and push the rear support toward the top of the pole unit so that that the clearance in the rear support will accommodate the screwhead of the back plate.

POLE UNIT ASSEMBLY - FIG. 3

The contact assembly of each pole unit consists of a stationary and a movable contact sub-assembly.

The stationary contact assembly consists of parallel contact fingers (3) with silver alloy tips, the upper stud (20) and pins (4) with compression springs (19) which provide continuous contact pressure between the contact fingers and the upper stud (20). A shunt (21) is used to prevent pitting at the pivot point of the stationary fingers when carrying high momentary currents. The stationary contact fingers are held in place by the upper stud cap (6).

The movable contact assembly consists of parallel contact arms (5) with silver alloy tips, a contact carrier (18) with a spring (17) which provides continuous contact between the contact arms and pin (15). A clamp (14) secures pin (15) to the contact support (16). A flexible connection (12) is provided to prevent pitting at the pivot point of the movable contact arms when carrying high momentary currents.

The movable contact assembly is connected to the main shaft (16), Fig. 2, by an insulating link (7) for operating the contacts when the breaker closes. A definite amount of contact pressure (see Measuring Contact Pressure") must be exerted by the movable contacts against the stationary contacts. A definite amount of contact wipe, or the distance that the stationary contacts are pushed to the rear by the movable contacts (see "Measuring Contact Wipe"), must result during the closing operation. Both contact pressure and contact wipe should be checked at the regular inspection period.

MEASURING CONTACT PRESSURE - FIG. 3

1. Remove arc quencher (see "Replacements" under Arc Quencher).
2. With the breaker closed, place a push-type scale against the upper front of the stationary contact tip (3).
3. Exert pressure against the push-type scale until the contacts just part. When the contacts first part the scale should read between <u>4 to 6 pounds.</u> If the proper pressure is not indicated, see "Adjusting Contact Wipe and Pressure".
4. Re-assemble parts in reverse order.

MEASURING CONTACT WIPE - FIG. 3

1. Remove arc quencher (see "Replacements" under Arc Quencher).
2. Measure the dimension between the inside surface of the pole base and the top edge of the stationary contact tip (3), (a) with the breaker open, (b) with the breaker closed.
3. The difference between these two measurements should be approximately 7/32".
4. Re-assemble parts in reverse order.

ADJUSTING CONTACT WIPE AND CONTACT PRESSURE - FIG. 3

1. Remove arc quenchers (see "Replacements" under Arc Quencher).
2. Remove tru-arc retaining ring from main shaft (16), Fig. 2, nearest the insulating link and contact assembly to be adjusted.
3. Loosen clamp (9) which secures eccentric bushing (8).
4. Turn the eccentric bushing in the insulating link (7) thereby moving the insulating link closer or farther away from the stationary contacts, as required to obtain proper wipe.
5. Re-assemble parts in the reverse order after making proper adjustments.

NOTE: To adjust the insulating link in the center pole unit, first, push the main shaft through the right hand insulating link and into the center link as described in items 2 and 3 above. Opening spring and cap will drop out. Adjust center insulating link as described in item 4 above. Reassemble parts in reverse order being careful to replace opening spring and cap in their proper position.

If any of the contacts are badly corroded or pitted, thereby, making it impossible to adjust for proper contact pressure or wipe, such stationary contacts and/or movable contact assemblies should be replaced. A commonly used "rule of thumb" is that contact replacement is indicated if less than one-half the original thickness (approx. 1/8 inch) of the contact tip material remains. See "Replacements" below.

If the proper contact pressure does not exist when the wipe is within its limits, the stationary contact springs must be replaced.

REPLACEMENTS

Movable Contact Assembly, Fig. 3

1. Remove front escutcheon (see "Replacements" under Operating Mechanism).
2. Disconnect external wiring to the terminal board and auxiliary switch.
3. Remove arc quenchers (see "Replacements" under Arc Quenchers).
4. Remove tru-arc washer from one end of the main shaft and push main shaft through insulating link (7).
5. Remove four mounting bolts (26), Fig. 5 and lift entire operating mechanism from breaker.
6. Remove four screws which attach braid (12) to the movable contact arms.
7. Remove two screws and clamp (14).
8. Remove the movable contact assembly.
9. Remove the insulating link from the old movable contact assembly and re-assemble this same link to the new movable contact assembly.
10. Remove braid (12) from new movable contact assembly.
11. Install new movable contact assembly and replace clamp (14).
12. Remove screw from left hand coil terminal.
13. Remove old braid.
14. Install new braid by re-assembling coil terminal screw and four screws in the movable contact assembly.
15. Replace parts in reverse order.
16. Adjust contact wipe and contact pressure (see above).

Stationary Contact - Fig. 3

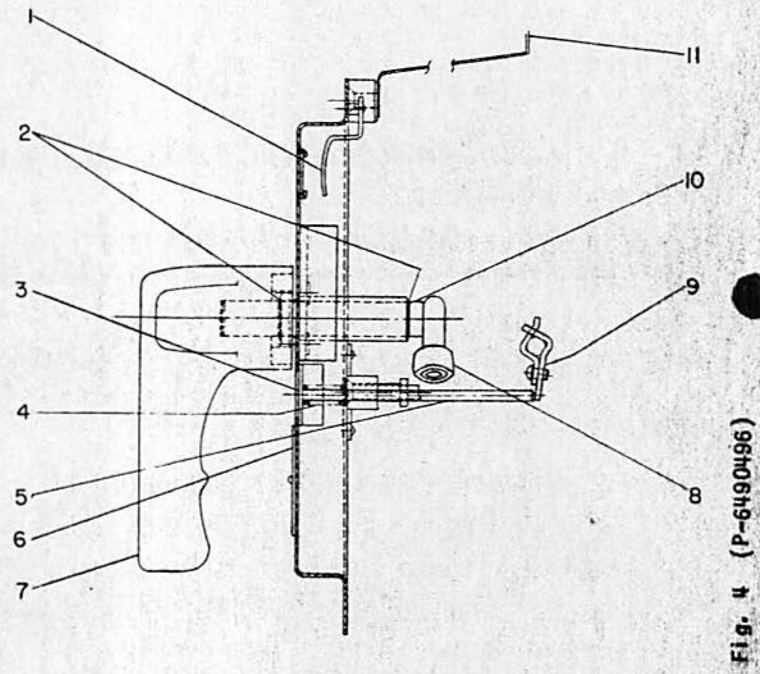
1. Remove arc quencher (see "Replacements" under Arc Quencher).
2. Remove upper stud cap (6) by removing two holding screws.
3. Pry the stationary contact (3) from upper stud (20).
4. Replace the new stationary contact in reverse order. (It may be necessary to tap the new stationary contact into place by using a rawhide mallet).
5. Adjust contact wipe and contact pressure (see above).

OPERATING MECHANISM

The breaker closing mechanism consists of a front escutcheon and operating handle assembly and an operating mechanism. The combination of these two assemblies serve to close the breaker by means of an operating handle.

FRONT ESCUTCHEON ASSEMBLY - FIG. 4

The front escutcheon is mounted on front of the operating mechanism frame by four screws (9) Fig. 2. The front escutcheon and operating handle assembly consists of:



1. Position Indicator
2. Retaining Ring
3. Trip Button
4. Spring
5. Trip Rod
6. Nameplate
7. Operating Handle
8. Roller
9. Trip Paddle
10. Shaft
11. Strap

Fig. 4 Front Escutcheon and Operating Handle Assembly

a. A pistol grip operating handle (7) attached to one end of the shaft (10) which extends through the front escutcheon. The other end of the shaft has a roller (8) attached to it.
b. A trip rod (5) which extends to the front escutcheon and which has a trip button (3) mounted to it.

The breaker may be locked in the tripped position by depressing the trip button (3) and inserting a padlock through the slot in the side of the front escutcheon.

BREAKER OPERATING MECHANISM - FIG. 5

The operating mechanism is supported between two molded side frames in front of the center pole unit. It consists of a toggle linkage (17), cam (11), crank (10), latch (13), trip shaft (14), and roller (12).

The breaker is closed by rotating the operating handle 90° clockwise causing roller (5) to engage cam (11), thereby straightening the toggle linkage, which closes the breaker. The breaker is held in the closed position by prop (19) resting against pin (16) and by latch (13) against roller (12).

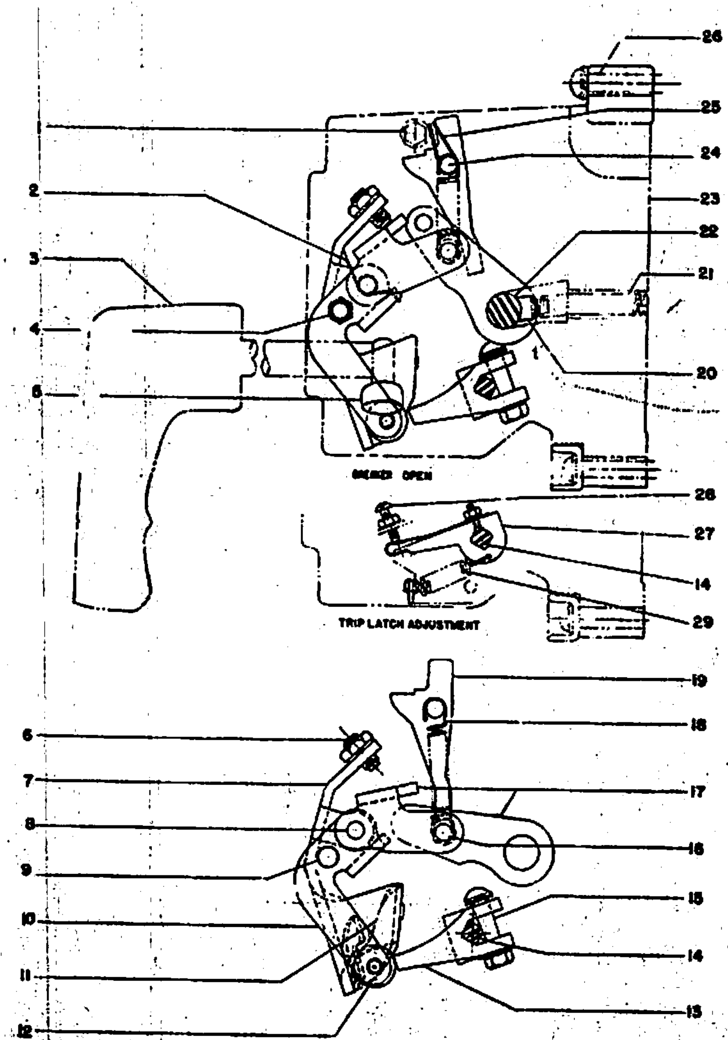
The breaker mechanism is tripped by rotating trip shaft (14), and releasing trip latch (13) which causes the toggle linkage to collapse, thereby allowing the opening springs (21) to push the main shaft and movable contacts forward to the open position. Trip latch (13) is automatically reset during the opening operation providing none of the trip devices are actuated. Latch adjusting screw (28) limits the rotation of the trip shaft (14) and thus determines the amount of latch engagement.

ADJUSTMENTS, FIG. 5

There should be 5/64" engagement between the latch (13) and roller (12). To obtain the adjustment proceed as follows:

1. Loosen the locking nut on adjusting screw (28).

Fig. 5 (P-6423666)



1. Screw
2. Cam Return Spring
3. Handle
4. Hold In Post
5. Cam Roller
6. Adjusting Screw
7. Cam Support
8. Cam Support Pin
9. Crank Pivot Pin
10. Crank
11. Cam
12. Roller
13. Trip Latch
14. Trip Shaft
15. Tapered Insert
16. Toggle Link Pin
17. Toggle Links
18. Spring
19. Prop
20. Cap
21. Opening Spring
22. Main Shaft
23. Mechanism Frame
24. Prop Pin
25. Prop Return Spring
26. Mounting Bolts
27. Buffer Paddle
28. Latch Adjusting Screw
29. Trip Shaft Return Spring

Fig. 5 Operating Mechanism (Breaker Closed)

2. Manually hold the breaker contacts in a position in which the movable contacts are just touching the stationary contacts.

3. Turn down adjusting screw (28) until the breaker trips open. Normally the force required to rotate the trip shaft is small enough so that the spring on the buffer paddle (27) is not noticeably deflected. If any deflection is observed while turning down the screw, back off screw until spring returns, then turn down screw again. If deflection persists, check trip shaft for binds.

4. Mark position of adjusting screw head when breaker trips.

5. Repeat steps 2 and 3 and check position of adjusting screw in relation to marked position.

6. If adjusting screw is in the same position as it was in the first tripping, back off the adjusting screw (28) three complete turns and tighten locknut. If it is not, repeat steps 2 and 3 until a constant position of the adjusting screw is determined before backing off three turns and locking. This check is necessary to avoid a false setting due to accidental tripping.

7. Latch adjustment should now be correct. Operate breaker several times to assure that the mechanism is functioning properly.

The clearance between the latch (13) and roller (12) should be between 1/32" to 1/16" when the breaker is open, in order to allow the mechanism to reset automatically when the breaker opens, and at the same time, provide the necessary overtravel for prop (19) to move on toggle link pin (16). If not enough clearance is provided the mechanism will not reset. If too much clearance is provided, prop (19) will not move on pin (16). This adjustment is obtained by turning the Allen Head adjusting screw (6).

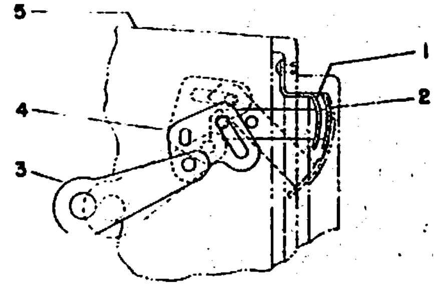
REPLACEMENTS - FIG. 5

Operating Mechanism

1. See "Replacements" under Movable Contact Assembly, items 1 to 5.
2. Replace operating mechanism in reverse order.

Two Opening Springs (21)

1. Remove arc quencher (see "Replacements" under Arc Quencher).
2. Remove tru-arc washer from end of main shaft (16), Fig. 2, nearest the spring to be removed.
3. Push main shaft to opposite side of operating mechanism. Cap (20) and spring (21) will back up into slot occupied by main shaft.
4. Remove cap (20) and spring (21) from slot by using small screwdriver.
5. Install new springs in reverse order after assembling cap (20) to new spring and pushing cap and spring in place.



1. Stationary Indicator (Open)
2. Movable Indicator (Closed)
3. Link
4. Crank
5. Mechanism Frame

Fig. 6 Position Indicator With Auxiliary Switch

Reset Spring (18)

1. Remove operating mechanism (see "Replacements" under movable Contact Assembly, items 1 to 5).
2. Remove paddles from the trip shaft on the right side of the breaker.
3. Remove tru-arc from right side of trip shaft.
4. Remove return spring (29).
5. Remove screw (1).
6. Remove nut from right end of hold-in post (4).
7. Remove right hand mechanism frame.
8. Remove reset spring (18). Replace parts in reverse order.

NOTE: To replace torsion springs (2) and (25) follow procedure for removing reset spring (18) as above and, in addition, remove the necessary tru-arc washers and pins.

Front Escutcheon Assembly - Fig. 5.

1. Remove four mounting screws (9), Fig. 2.
2. Now pull forward on the operating handle turning and tipping the front escutcheon slightly until dislodged from the breaker.
3. To remount the front escutcheon assembly, first, hold the trip shaft in a trip free position. Then pull the cam support (7) slightly forward.
4. Insert the shaft (10), Fig. 4 and roller (8), Fig. 4 into the hole of the cam support so that the roller drops behind cam (11).
5. Replace the four mounting screws to secure the front escutcheon assembly to the mechanism frame.

The operating handle may be removed by simply removing the set screw tapped in the hole in the handle. Some handles are held to the shaft by two set screws, which requires both set screws be removed in order to remove the handle.

If two set screws are used to hold the operating handle to the shaft, the long set screw should be replaced first and the short set screw on top.

NOTE: On older model breakers where the trip button is mounted in the operating handle, the trip rod and return spring must be removed by pushing

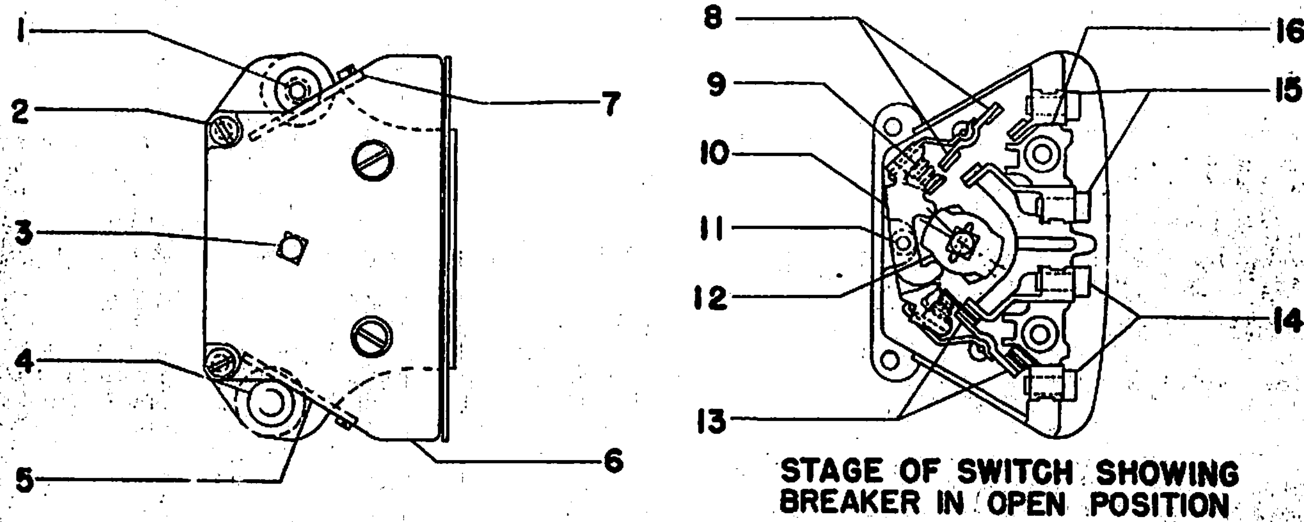


Fig. 7 (242C588)

1. Mounting Bolt
2. Tie Bolt
3. Shaft
4. Screw
5. Bottom Cover
6. End Plate
7. Top Cover
8. "a" Contacts
9. Contact Spring
10. Rocker Arm
11. Pin
12. Cam
13. "b" Contacts
14. "b" Terminals
15. "a" Terminals
16. Barrier

Fig. 7 Rotary Auxiliary Switch

the trip rod forward through the operating handle. In reassembly, sufficient clearance between the long set screw and the trip rod must be provided. Advance the long set screw into the tapped hole in the operating handle until it just binds the trip rod. Then back off the set screw one turn and lock the long set screw by inserting short set screw. Check trip rod for free movement.

AUXILIARY SWITCH - FIG. 7

The auxiliary switch is mounted on the left side of the operating mechanism. The main shaft (16), Fig. 2, of the breaker causes crank (4), Fig. 6, to rotate as the breaker opens and closes. The crank operates the auxiliary switch shaft (3), which opens and closes the "a" and "b" contacts of the switch. (The "a" contacts are open when the breaker is open; the "b" contacts are closed when the breaker is open). The opening and closing of the auxiliary switch contacts is determined by the arrangement of cams (12), mounted on the auxiliary switch shaft (3). The top terminals of the switch are "a" contacts, the bottom terminals are "b" contacts.

ADJUSTMENTS - FIG. 7

The contacts of any stage may be changed from "a" to "b" or vice versa. If changes are desired in the operation of the contacts, an approved drawing of the cam (12) arrangement should be obtained or a careful sketch made. In order to change an "a" contact to a "b" contact, it is necessary to remove the four tie bolts (2) and change the position of the particular cam 90° in relation to the shaft. Ccntacts should be cleaned occasionally to insure proper performance.

REPLACEMENTS, FIG. 7

1. Disconnect all leads to the auxiliary switch.
2. Remove mounting bolt (1) and screw (4) to remove device from breaker.
3. If no approved sketch of the cam arrangement is available, remove the end plate (6) from the device by removing the four tie bolts (2) and draw a sketch of the position of the particular cam in relation to the shaft.
4. Before installing the new device, see that the cams are in the same position as in the device that is being replaced.
5. Install the new device in reverse order.

PROTECTIVE DEVICES

An AK-1-15 or AK-1-25 breaker may be equipped with any combination of the following protective devices:

1. Overcurrent trip
2. Reverse Current trip
3. Undervoltage trip.

TIME DELAY UNDERVOLTAGE TRIPPING DEVICE FIG. 8

This device is mounted to a bracket on the right side of the operating mechanism (looking from the front). The purpose of this device is to trip the breaker for undervoltage. For rated voltage, the armature (3) is attracted by magnet (14). If the voltage falls below a predetermined value the magnet (14) releases the armature (3). Spring (4) then pulls armature (3) upward against the restraining force of the oil in cylinder (10); this action causes a time delay. When the spring overcomes the restraining force of the oil the armature engages screw (20) thus rotating the trip shaft and opening the breaker.

ADJUSTMENTS, FIG. 8

1. An adjusting screw (20) in the trip paddle (22) is used to allow from 1/32 to 1/16 inch overtravel after tripping the breaker.

2. The armature pick-up is a function of the open air gap of the armature. The air gap is factory set by means of adjusting screw (2) so that the armature will pick-up at 80% of rated voltage. In order to make this adjustment in the field, a variable voltage source is required. The air gap should be increased if pick-up occurs at less than 80% of rated voltage and decreased if pick-up occurs at more than 80%.

3. A calibration spring (4) attached to adjusting screw (18) establishes the drop-out value of voltage which results in breaker tripping. This is largely a factory adjustment, the drop-out value being 30 to 60% of rated voltage.

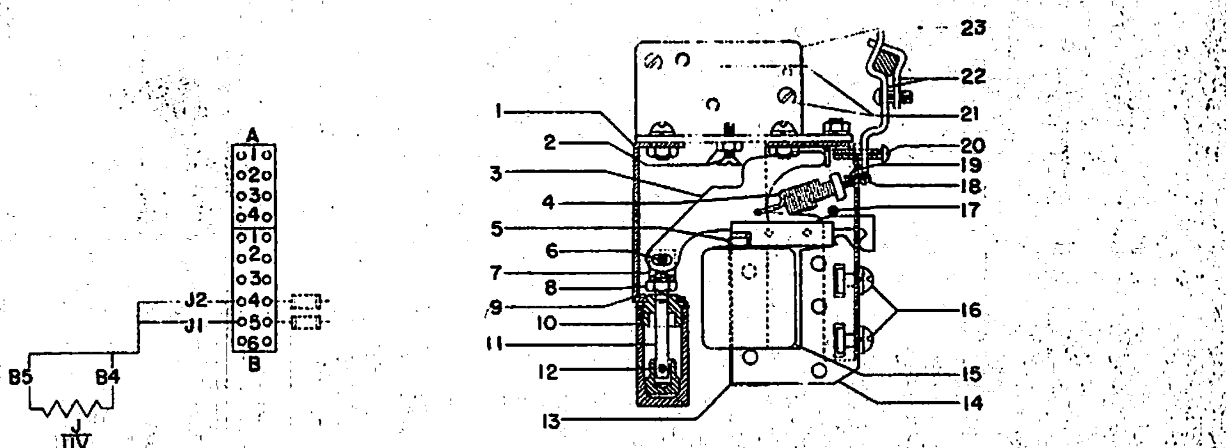
4. The time-delay of the device may be varied somewhat by changing the relative positions of the connecting rod (11) and clevis (7). This is accomplished by loosening the locking nut (8), raising or lowering the plunger (12) by turning the connecting rod (11) which is threaded into the clevis (7). When any time-delay of 3 to 10 seconds exists from loss of voltage, the device is considered satisfactorily adjusted.

5. From 1/4 to 3/8 inch of oil should be maintained in the cylinder at all times. In order to make an inspection of the oil, the cylinder (10) may be unscrewed from the cap (9). Use a silicone oil, such as, G.E. 9981LT40NV or similar, in the cylinder.

REPLACEMENTS, FIG. 8

<u>Time Delay Undervoltage Device</u>

1. Disconnect coil leads.
2. Remove two screws from bracket (1). (Bracket is omitted when instantaneous undervoltage device is used).
3. Remove four mounting screws (21) and remove device.
4. Install new device in reverse order.



1. Bracket
2. Adjusting Screw & Nut
3. Armature
4. Spring
5. Shading Ring
6. Pin
7. Clevis
8. Locking Nut
9. Cap
10. Cylinder
11. Connection Rod
12. Plunger
13. Clamp
14. Magnet
15. Coil
16. Screws
17. Pin
18. Adjusting Screw
19. Locking Wire
20. Adjusting Screw
21. Mounting Screws
22. Trip Paddle & Clamp

Fig. 8 Time Delay Undervoltage Tripping Device

Coil (15)

1. Disconnect leads to coil.
2. Remove two screws (16).
3. Remove magnet and coil assembly.
4. Straighten laminations around shading ring (5).
5. Remove shading ring and straighten lower end of coil clamp (13).
6. Remove coil. Install new coil in reverse order.

INSTANTANEOUS UNDERVOLTAGE TRIPPING DEVICE

This undervoltage tripping device is constructed similarly to the time delay undervoltage tripping device with the exception that the cylinder (10), plunger (12), connecting rod (11), clevis (7), bracket (1), and locking nut (8), as shown in Fig. 8 are omitted.

The adjustments and replacements for this device are also the same as those for the time delay undervoltage tripping device.

OVERCURRENT TRIPPING DEVICES

The typical overcurrent trip device consists of a magnetic structure, a series current coil, and a pivoted armature. Depending on the type of individual device, the movement of the armature may be delayed by a timing device, of either the oil dashpot or escapement gear and pallet type.

An AK-1-15/25 breaker may be equipped with either the EC-2 or EC-1 overcurrent trip device. The majority of applications will require the use of the EC-2 device. The EC-1 device is normally used when the short-time delay feature is required, or when the trip device is used to operate a special overcurrent alarm switch.

Most circuit breakers are equipped with series overcurrent trip devices either of the dual magnetic type (instantaneous and time delay tripping) or instantaneous alone. Breakers are designed to carry up to 100% of the continuous current rating of their trip devices. Any attempt to carry higher currents for a prolonged period will cause overheating and possible damage.

EC-2 DEVICE

The EC-2 overcurrent tripping device is available in three forms:

1. Dual overcurrent trip, with long-time delay and high-set instantaneous tripping.

2. Low-set instantaneous tripping.

3. High-set instantaneous tripping.

The dual trip has adjustable long-time and instantaneous pick-up settings and adjustable time settings. Both forms of instantaneous trips have adjustable pick-up settings.

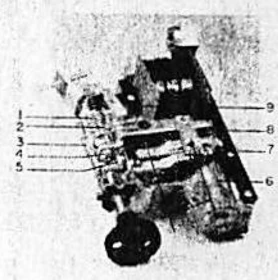
1. Series Coil
2. Trip Adjustment Screw
3. Opening for Time Adjustment
4. Pickup Indicator & Calib. Plate
5. Pickup Adjustment Knob

Fig. 9 EC-2 Overcurrent Trip

DUAL OVERCURRENT TRIP, WITH LONG-TIME DELAY AND HIGH-SET INSTANTANEOUS TRIPPING. - FIG. 9

By means of the adjustment knob (5), which can be manipulated by hand, the current pick-up point can be varied from 80 to 160 percent of the series coil rating. The indicator and the calibration plate (4), on the front of the case, provide a means of indicating the pick-up point setting in terms of percentage of coil rating. The calibration plate is indexed at percentage settings of 80, 100, 120, 140 and 160.

The long-time delay tripping feature can be supplied with any one of three time-current characteristics which correspond to the NEMA standards maximum, intermediate and minimum long-time delay operating bands. These are identified as 1A, 1B and 1C characteristics, respectively. Approximate tripping time for each of these, in the same order are 30, 15 and 5 seconds at 600% of the pick-up value of current. (See time-current characteristic curves 286B201 A, B and C).



1. Instantaneous Calibration Spring
2. Movable Nut (Index Pointer)
3. Time-Delay Calibration Spring
4. Instantaneous Pickup Adjustment Screw
5. Time-Delay Adjustment Screw
6. Oil Dashpot
7. Dashpot Arm
8. Connecting Link
9. Instantaneous Pickup Calibration Marks

Fig. 10 EC-2 Overcurrent Trip With Cover Removed

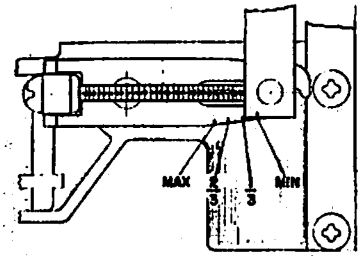


Fig. 11 Time-Adjustment Indexing

TIME ADJUSTMENT - FIG. 10

The tripping time may be varied within the limits shown on the characteristic curves by turning the time adjustment screw (5). Turning in a clockwise direction increases the tripping time; counter-clockwise decreases it. The dashpot arm (7) is indexed at four points, max. - 2/3 - 1/3 - min. from left to right, as viewed in Figs. (10) and (11). When the index mark on the connecting link (8) lines up with the indicated mark on the dashpot arm, the approximate time as shown by the characteristic curve is indicated. Figure 13 shows typical time-current curves for the EC-2 and EC-1 tripping devices. The 1A and 1B characteristic devices are usually shipped with the time setting at the 2/3 mark and the 1C characteristic at the 1/3 mark. The standard characteristic curves are plotted at the same settings.

Time values are inversely proportional to the effective length of the dashpot arm. Therefore, the linkage setting that gives the shortest time value is the one at which dimension "A", Fig. 10, is greatest. The time adjustment screw (5), may be turned by inserting a Phillips head screwdriver through the hole in the front of the case, but if it is desired to relate the linkage setting to the index marks on the linkage it will be necessary to remove the case. This may be done by removing the two mounting screws, one on each side of the case, which may be taken off without disturbing the trip unit itself.

NOTE: Forcing the adjusting screw to either extreme position may cause binding of the device and should be avoided.

INSTANTANEOUS LOW-SET TRIPPING - FIG. 9

The low-set instantaneous pick-up point may be varied by the adjustment knob (5). The calibration in this case usually ranges from 80% to 250% of the series coil rating, the calibration plate being indexed at values of 80%, 100%, 150%, 200% and 250% of the coil rating.

INSTANTANEOUS HIGH-SET TRIPPING - FIG. 10

The high set instantaneous pick-up value may have one of the following three ranges: 4 to 9 times coil rating; 6 to 12 times coil rating or 9 to 15 times coil rating. The pick-up setting may be varied by turning the instantaneous trip adjusting screw (4).

Three standard calibration marks will appear on the operating arm at (9), and the value of these calibration marks will be indicated by stampings on the arm as follows: (4X - 6.5X - 9X) or (6X - 9X - 12X) or (9X - 12X - 15X).

At the factory, the pick-up point has been set at the nameplate value of the instantaneous trip current. (Usually expressed in times the ampere rating of the trip coil.) The variation in pick-up setting is accomplished by varying the tensile force on the instantaneous spring (1). Turning the adjustment screw (4) changes the position of the movable nut (2), on the screw. The spring is anchored to this movable nut so that when the position of the nut is changed, there is a corresponding change in the spring load. As the spring is tightened, the pick-up point is increased. The top edge of the movable nut (2), serves as an index pointer and should be lined up with the center of the desired calibration mark, punched slots on operating arm, to obtain the proper instantaneous trip setting.

ADJUSTMENTS, EC-2 - FIG. 9

In addition to the pick-up settings and time-delay adjustments already described, overcurrent trip devices must be adjusted for positive tripping. This adjustment is made at the factory on new breakers, but must be made in the field when the breaker mechanism or the overcurrent trip devices have been replaced.

Positive tripping is achieved when adjustment screw (2), is in such a position that it will always carry the trip paddle on the trip shaft beyond the point of tripping the breaker, when the armature closes against the magnet.

In order to make the adjustment, first unscrew adjusting screw (2), until it will not trip the breaker even though the armature is pushed against the magnet. Then, holding the armature in the closed position, advance the screw until it just trips the breaker. After this point has been reached, advance the screw two additional full turns. This will give an overtravel of 1/16 of an inch and will make sure that activation of the device will always trip the breaker.

Adjustment screw (2), can best be manipulated by an extended 1/4 inch hex socket wrench.

In order to gain access to the adjustment screw of the center pole overcurrent device, it will be necessary to remove the operation mechanism and attached components as a complete unit. To remove the mechanism, follow the first five steps of "Replacement - Movable Contact Assembly" under "Pole Unit Assembly".

REPLACEMENT, EC-2

Replacement of the EC-2 overcurrent trip device is accomplished by the following procedure:

1. Remove the mechanism as a complete unit as described in the first five steps of "Replacement - Movable Contact Assembly" under "Pole Unit Assembly".

2. Remove the steel clamps which fasten the cover of the device to the back of the breaker. NOTE: Pickup settings on the cover of each device are calibrated for the specific device. When replacing covers, replace on associated device.

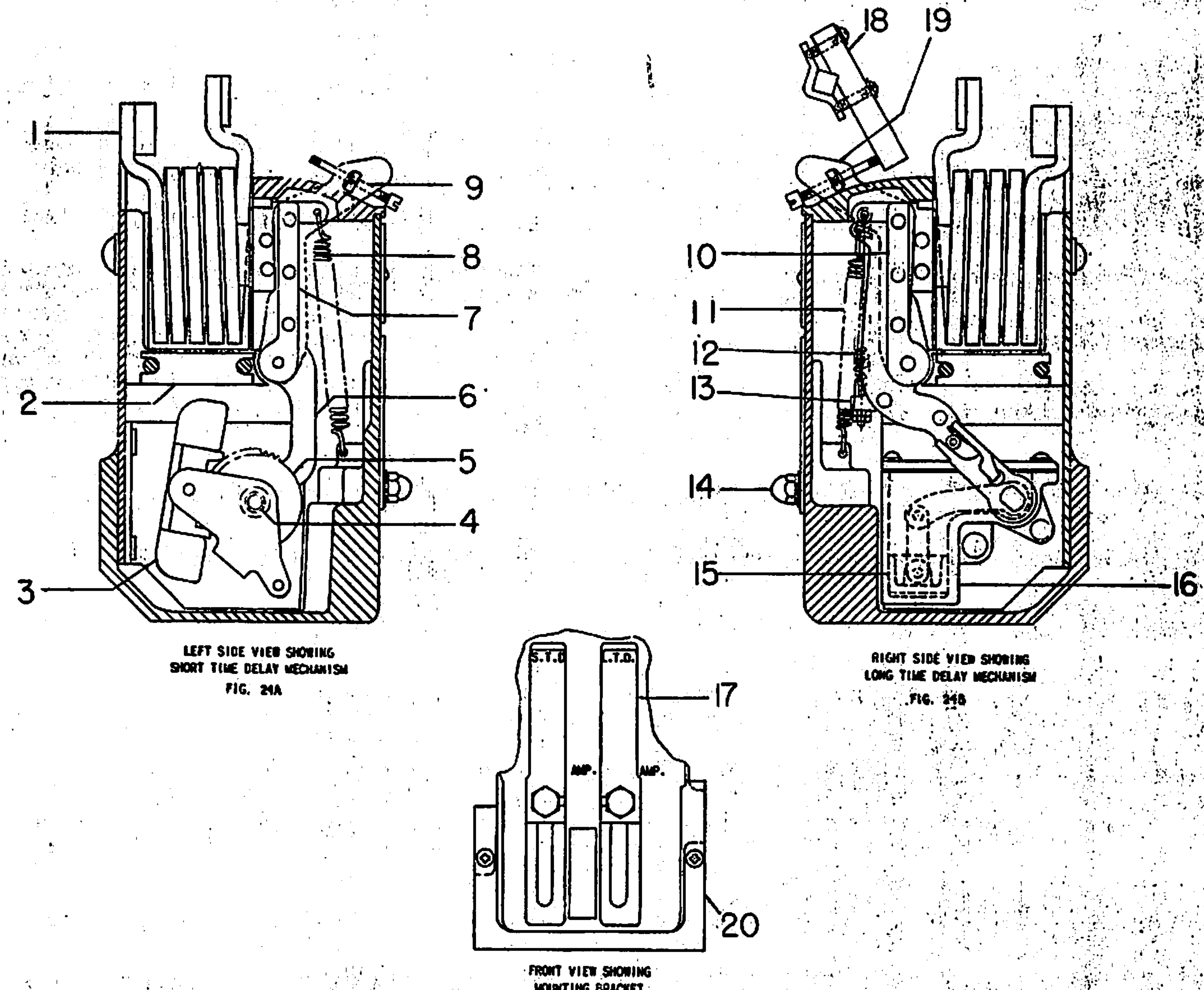


Fig. 12 (P-6423678)

1. Series Coil
2. Magnet
3. Pallet
4. Pinion
5. Escape Wheel
6. Driving Segment
7. S.T.D. Armature
8. S.T.D. Calibration Spring
9. Trip Paddle Adjusting Screw
10. L.T.D. Armature
11. L.T.D. Calibration Spring
12. Instantaneous Trip Spring
13. Spring Holder
14. Calibration Clamp Nut
15. Plunger
16. Cylinder
17. Calibration Plate
18. Trip Paddle
19. Trip Arm
20. Clamping Bracket

Fig. 12 Series Overcurrent Tripping Device

3. Remove the 3/8 inch bolts which fasten the coil of the overcurrent device to the breaker copper.

4. Remove the round head screw which fastens the frame of the overcurrent device to the breaker base.

5. After reassembling breaker with new overcurrent device, adjust for "positive trip" as described under "Adjustments" of this section.

NOTE: When replacing an EC-1 device with an EC-2, or vice versa, it will be necessary to replace the trip paddles on the trip shaft. These will be provided with the replacement trip units.

EC-1 DEVICE

The EC-1 device can be provided with the following tripping combinations:

1. Long time delay, short time delay and instantaneous tripping.

2. Long time and short time delay tripping only.

3. Long time delay and instantaneous tripping.

4. Short time delay and instantaneous tripping.

5. Short time delay tripping only.

6. Instantaneous tripping only.

   (a) Adjustable (Low set)
   or
   Nonadjustable (High set)

SHORT TIME DELAY TRIPPING, FIG. 12

The armature (7) is retained by calibrating spring (8). After the magnetic force, produced by an overcurrent condition, overcomes this restraining force, the armature movement is further retarded by an escapement mechanism which produces an inverse time delay characteristic. The mechanism is shown in the left side view of Fig. 12.

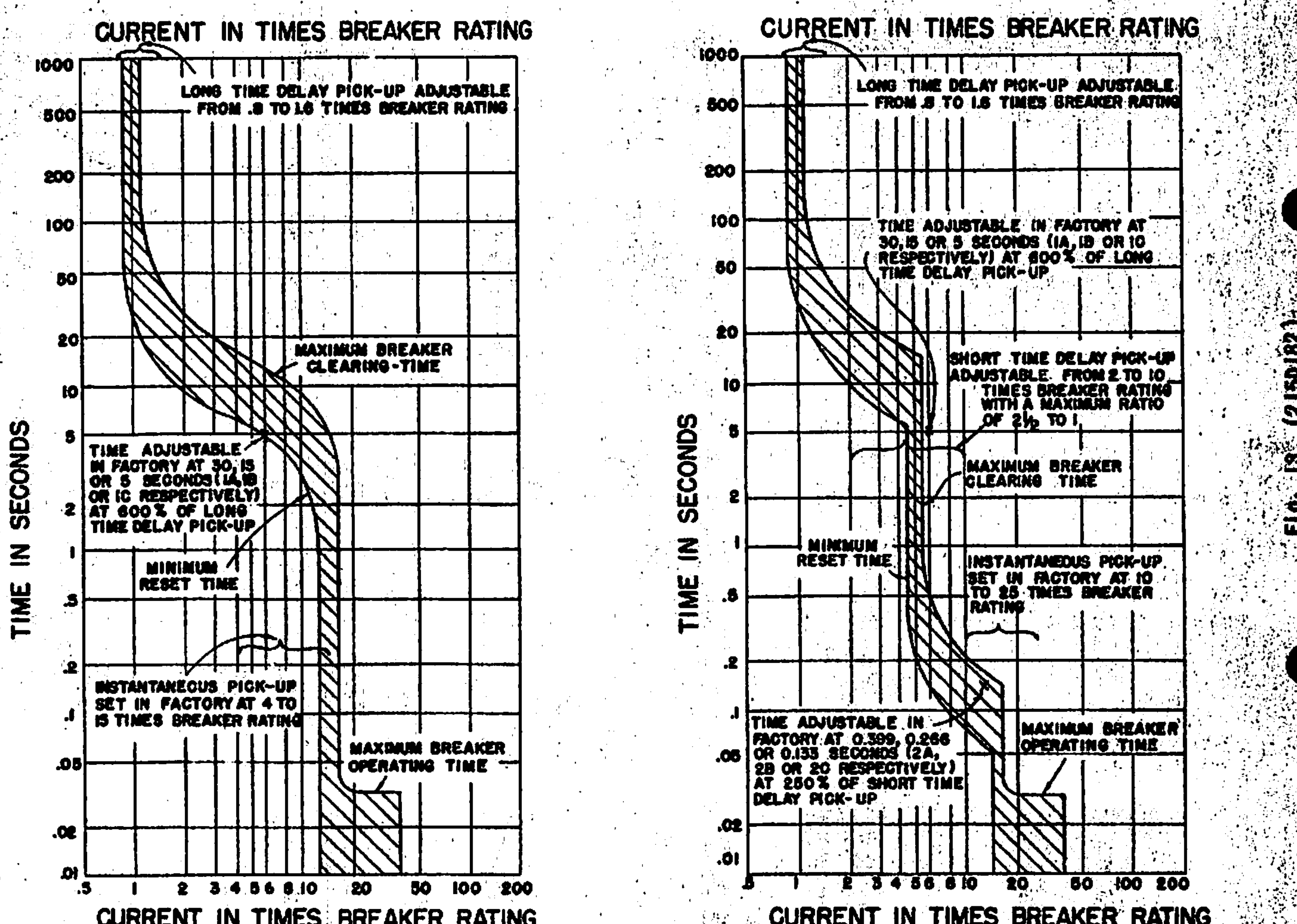


Fig. 13 Typical Time-Current Characteristic of Series Overcurrent Trip Device in 25°C Ambient

The pickup for this device can be field set between limits having a ratio of 2-1/2 to 1 in the range of 200 to 1000% of the coil rating.

LONG TIME DELAY TRIPPING, FIG. 12

The armature (10), is retained by the calibration spring (11). After the magnetic force, produced by an overcurrent condition, overcomes this restraining force, the armature movement is further retarded by the flow of silicone oil in a dashpot, which produces an inverse time delay characteristic. The mechanism is shown in the right side view of Fig. 12.

INSTANTANEOUS TRIPPING, FIG. 12

(a) Adjustable instantaneous tripping takes place after the magnetic force produced by an overcurrent condition, overcomes the restraining force of the adjustable calibration spring (11).

(b) Nonadjustable instantaneous tripping takes place after the magnetic force produced by an overcurrent condition overcomes the restraining force of a nonadjustable spring (12).

SELECTIVE TRIPPING

Selective overcurrent tripping is the application of circuit breakers in series so that only the circuit breaker nearest the fault opens. Any one or combination of two or more of the preceding over-current devices may be used in a selective system. The breaker having the shorter time setting and lower pickup will trip before the breaker having the longer setting and higher pickup, provided the fault is on the part of the line protected by the breaker having the lower settings.

For the exact characteristics and setting of each breaker in a selective system, reference should be made to a coordination chart for the particular system.

ADJUSTMENTS, EC-1 - FIG. 12

The EC-1 device may be adjusted for positive tripping by following the same procedure described above for the EC-2 device and using adjusting screw (9).

REPLACEMENT - EC-1

The EC-1 device may be replaced by following the same procedure described under "Replacement - EC-2".

REVERSE CURRENT TRIPPING DEVICE - FIG. 14

The device is enclosed in a molded case and is mounted on the right pole base similarly to the series overcurrent tripping device.

The reverse current tripping device consists of a series coil (1) with an iron core mounted between two pole pieces (7), also a potential coil (4) connected across a constant source of voltage and mounted around a rotary-type armature (6). Calibration spring (3) determines the armature pick-up when a reversal of current occurs.

As long as the flow of current through the breaker is in the normal direction, the magnetic flux of the series coil and the magnetic flux of the potential coil produce a torque which tends to rotate the armature counter-clockwise. The calibration spring also tends to rotate the armature in the same direction. This torque causes the armature to rest against the stop screw (9) attached to a bearing plate on the right side of the device.

If the current through the series coil (1) is reversed, the armature (6) tends to move in the clockwise direction against the restraint of the calibration spring (3). When the current reversal exceeds the calibration setting, the armature revolves clockwise causing the trip rod (2) to move upward engaging the trip paddle (14), thereby tripping the breaker.

ADJUSTMENTS - FIG. 14

The only field adjustment that should be required on the reverse current device is that of "positive tripping", which is the amount of overtravel of the trip rod (2) beyond the point of tripping the breaker. Proper overtravel is provided, if the trip rod (2) advances the trip paddle (14) 1/32" to 3/64" beyond the point of tripping the breaker. To adjust for "positive tripping", proceed as follows:

NOTE: Be extremely cautious not to have hands near moving breaker parts when making this adjustment.

1. Manually lift the trip rod (2) as high as possible and turn the adjusting screw (15) into the trip paddle (14) until it will not touch the trip rod and trip the breaker.

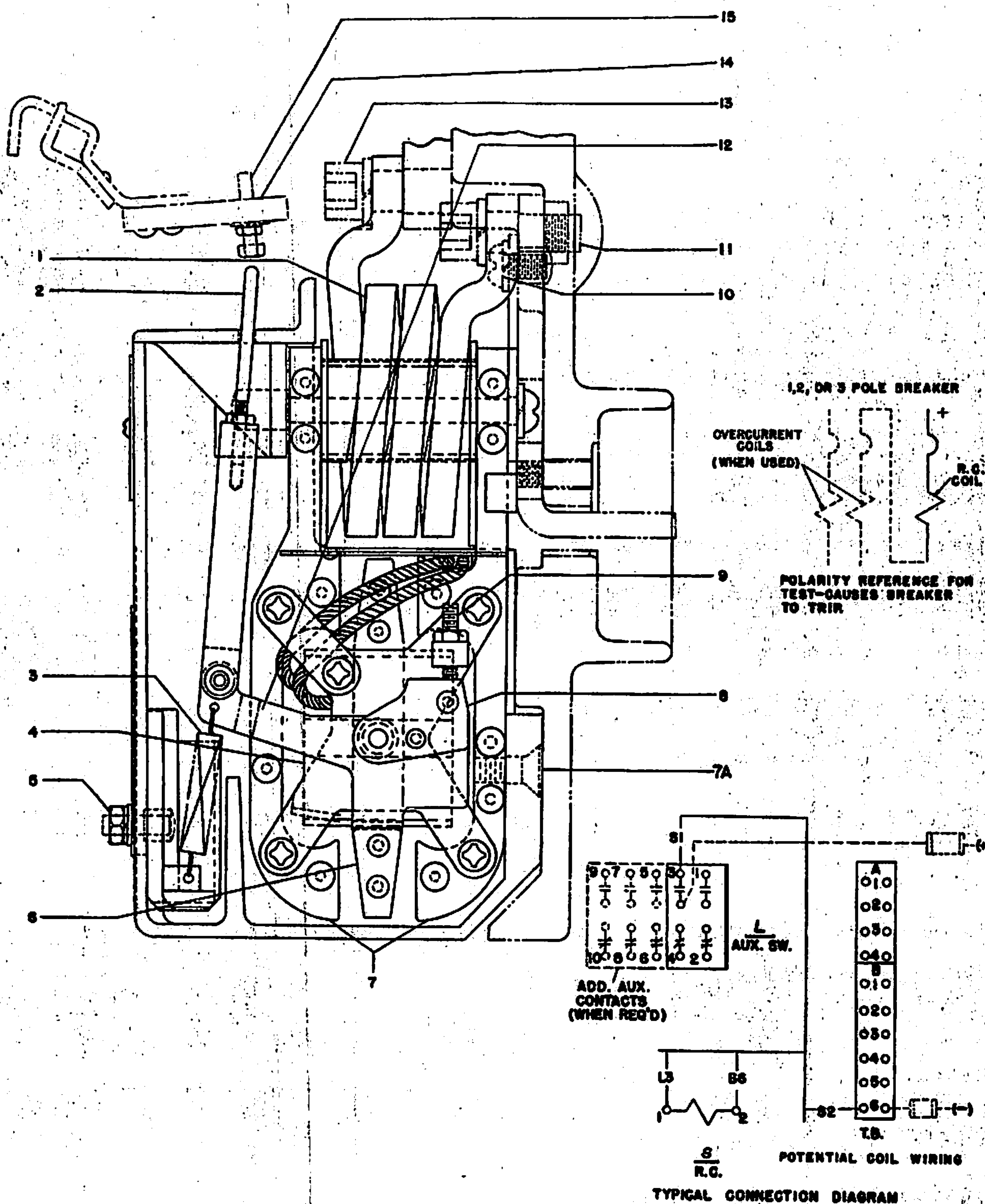
2. Back-out the adjusting screw (15) to a position where the breaker is just tripped when the trip rod is lifted as far as it will go.

3. Back-out the adjusting screw (15) an additional 1-1/2 turns from the position established in step 2 and the proper overtravel should be obtained.

4. Be sure to tighten the locking nut on the adjusting screw.

REPLACEMENT

After removing the wiring for the potential coil the reverse current device can be removed and replaced by following the procedure outlined for replacing the series overcurrent device. For wiring, see Fig. 14.



1. Series Coil
2. Trip Rod
3. Spring (Calib.)
4. Potential Coil
5. Calibration Nut
6. Armature
7. Pole Pieces
7A. Screws
8. Counterweight
9. Stop Screw
10. Mounting Screw
11. Screw
12. Trip Crank
13. Screw
14. Trip Paddle
15. Adj. Screw

Fig. 14 Reverse Current Tripping Device

BREAKER ACCESSORIES

SHUNT TRIPPING DEVICE FIG. 15

The shunt tripping device is mounted on a bracket attached to the right side of the operating mechanism (looking from the front).

A remote switch or relay contact is used to close the circuit of the device causing the armature (9) to engage the trip paddle (11) thereby tripping the breaker. The spring (2) is used to return the armature to the neutral position after the breaker trips.

To prevent overheating, the coil (7) is cut off by contacts of the auxiliary switch which are open when the breaker is open.

ADJUSTMENTS

From 1/32" to 1/16" overtravel of the armature is required when the breaker is tripped. If any adjustment is nececessary to provide this amount of overtravel, the trip lever is formed in or out accordingly.

REPLACEMENT

Coil (7)

1. Disconnect leads to coil.
2. Remove magnet (6) and coil from frame (3).
3. Bend lower end of clamp (8) straight and remove.
4. Remove coil and install new coil in reverse order.

If, for some reason, the entire device is to be replaced, this is accomplished by removing the fasteners between the shunt trip device frame (3) and supporting bracket (13).

After replacing either the coil or the entire shunt trip device, the overtravel adjustment should be checked.

BELL ALARM AND LOCKOUT DEVICES

BELL ALARM DEVICE - FIG. 16

A bell alarm device is available which operates when an overcurrent trips the breaker. It consists primarily of a lever (7) and hanger (11) riveted to auxiliary shaft (6), latch (12), catch (16), switch (1), reset lever (3), and mounting bracket (4).

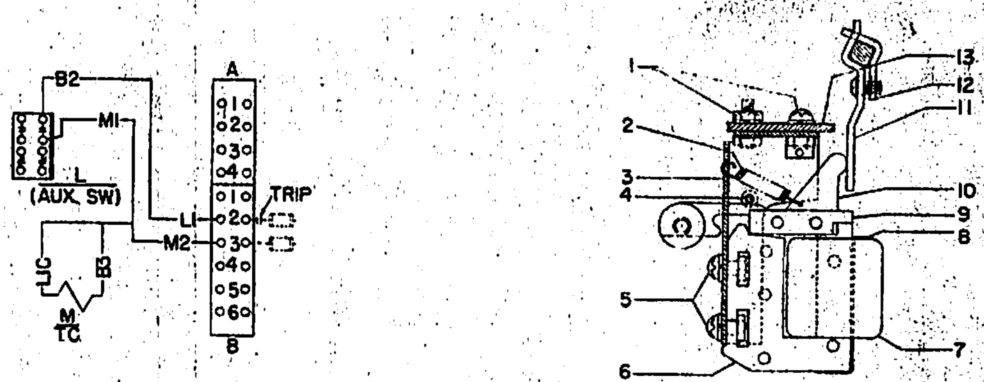
When the breaker is tripped by an overcurrent the overcurrent device trip arm (8) causes lever (7), hanger (11), and latch (12) to rotate counterclockwise as a single member about pin (9). This disengages the latch from the catch (16). When the breaker opens, link (17) also releases the catch, allowing its spring to rotate it counterclockwise about pin (15). This in turn permits plunger of switch (1) to move downward, closing the lower contact of the switch and thereby completing the alarm circuit.

If the breaker is opened by means other than the overcurrent device, the latch (12) remains in position and does not allow the catch to rotate even though it is released by link (17).

Operation of the reset lever (3) returns the catch and switch contacts to their original position. At the same time, spring (5) resets latch (12).

LOCKOUT DEVICE - FIG. 16

The lockout device consists of the same mechanism as the bell alarm device except that a screw (18) secures the hanger (11) to latch (12). This causes these two parts to function as a unit. Whenever the breaker is opened due to an overcurrent, the trip paddle (10) will be held in the tripped position by the lever (7), thereby locking the breaker in the open position until the lockout mechanism is reset manually by means of the reset lever (3).



1. MTG Screw (3)
2. Spring
3. Frame
4. Pin
5. Screws
6. Magnet
7. Coil
8. Clamp
9. Armature
10. Armature Arm
11. Trip Paddle
12. Clamp
13. Supporting Bracket

Fig. 15 Shunt Tripping Device

Fig. 15 (2150176)

ADJUSTMENTS - FIG. 16

In order for the bell alarm and lockout device to function properly the following conditions must exist:

1. The auxiliary trip shaft (6) must swing freely from its points of suspension and hang perfectly level with respect to the breaker parts.

2. The auxiliary shaft must be positioned so that each of its clearance cut-outs has such a position relative to its respective overcurrent device trip arm that the trip arm can operate without encountering interference from the shaft and contacts the shaft only at lever (7).

3. When the breaker is closed, lever (7) must hang in a position such that it touches neither the trip arm (8) or the adjusting screw in the trip paddle (10). The optimum condition is an equidistant position.

4. The latch (12) and the catch (16) must be so positioned relative to one another that when the breaker is closed and reset, the latch will clear the catch when the latch is rotated counterclockwise. The catch is mounted on the same supporting bracket as switch (1). This bracket may be shifted vertically by dismounting the switch and loosening the hardware which fastens the bracket to the mechanism side frame.

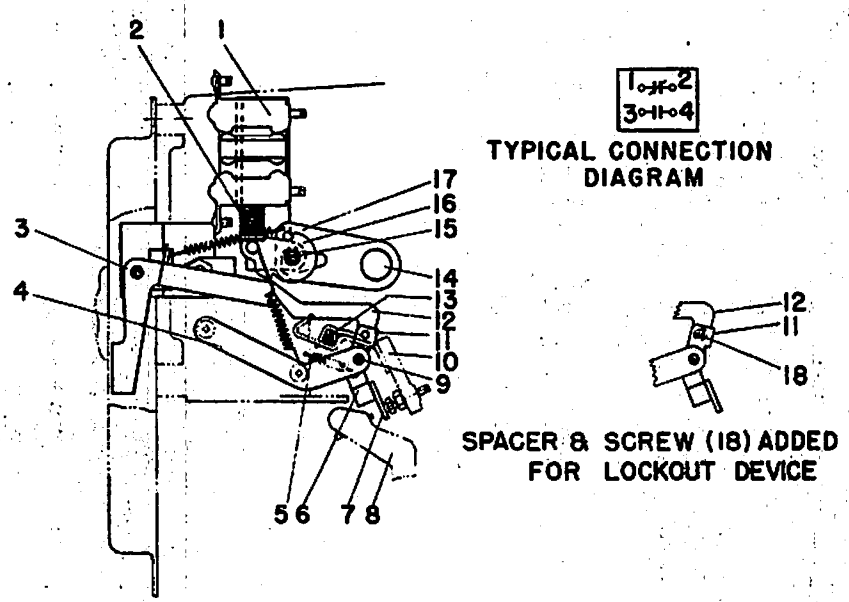
DRAWOUT BREAKER - FIG. 17

The drawout circuit breaker consists of a circuit breaker mounted in a drawout carriage which comprises the drawout mechanism. The drawout mechanism consists of guides (2), racking pins (1), racking handle (5), interlock lever (7) and an interlock arrangement which prevents the insertion or withdrawal of the breaker when in the closed position. The drawout carriage is also equipped with a test position stop, where the secondary disconnects are engaged but the primary disconnects are safely parted. In this position the breaker may be operated for test purposes without energizing the primary circuit.

Older model breakers were equipped with rollers in place of guides on the breaker side frames, otherwise the drawout mechanism are similar.

It is recommended that a fresh coat of G. E. Lubricant D50H47 be applied to the primary disconnects at each inspection period.

For a complete description of the inserting and withdrawing operations, refer to GEH-2021A furnished with all AK breakers.

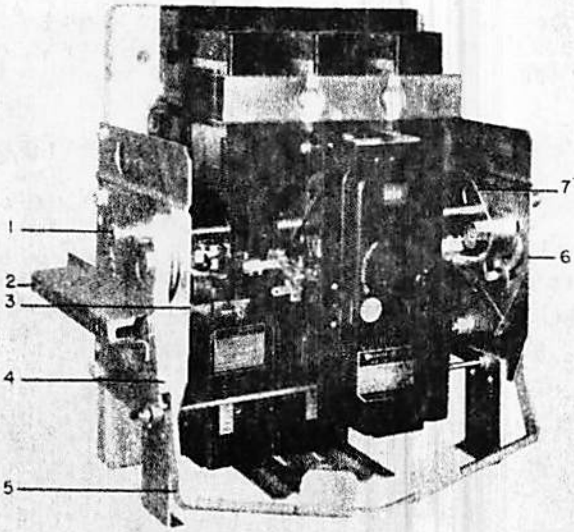


1. Switch	7. Lever	13. Trip Shaft
2. Plunger	8. Trip Arm	14. Main Shaft
3. Reset Lever	9. Pin	15. Pin
4. Mounting Bracket	10. Trip Paddle	16. Catch
5. Spring	11. Hanger	17. Link
6. Auxiliary Shaft	12. Latch	18. Screw (Lockout)

Fig. 16 Bell Alarm and Lockout Device

Fig. 17 (8021085)

Fig. 18 (8017973)



1. Racking Pin
2. Guide
3. Locking Pin
4. Handle Socket
5. Racking Handle
6. Trip Cam
7. Interlock Lever

Fig. 17 AK-1-25 Drawout Breaker

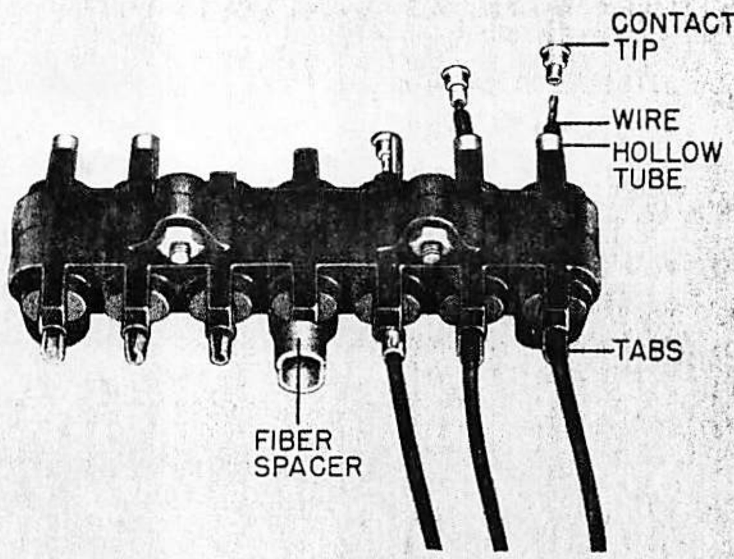


Fig. 18 Movable Secondary Disconnects

DISCONNECTS

PRIMARY DISCONNECTS

The primary disconnects are attached to the ends of the breaker studs on the rear side of the breaker base. Each disconnect assembly consists of two pair of opposed contact fingers. These are secured to the breaker stud by a bolt which passes through the assembly and the stud. When engaged with the stationary stud of the enclosure, the disconnect fingers exert a set amount of force against the stationary stud through the action of the compression springs. Retainers and spacers hold the contact fingers in correct alignment for engagement with the stud. The amount of force which the fingers exert against the stud is determined by degree to which the springs are compressed by the bolt and nut which hold the assembly together. If, for any reason, the disconnects must be taken apart, the position of the nut on the bolt should be carefully noted, so that in reassemblying, the original amount of compression can be restored by replacing the nut at its former position on the bolt.

SECONDARY DISCONNECT, FIG. 18

The secondary disconnects serve as connections between breaker control circuit elements and external control circuits. They are used only on drawout type breakers. A terminal board serves the same purpose on stationary mounted and general purpose enclosure mounted breakers. The secondary disconnects allow removal of the breaker without the necessity of having to detach external connections.

The movable part of the secondary disconnect consists of an insulating body which holds a conducting spring loaded plunger to which a flexible lead is attached. As the breaker moves into its enclosure, the plunger is depressed by sliding onto the stationary disconnects of the enclosure.

REPLACEMENT OF MOVABLE SECONARY DISCONNECTS

1. Unfasten disconnect body from breaker back frame.
2. Open tabs which hold wires on inner side.
3. Pull contact tip loose from hollow tube.
4. Remove contact tip by cutting wire at its base.
5. Push wire through hollow tube of new disconnect assembly.
6. Strip insulation off end of wire to about 1/4 of an inch from end.
7. Place new contact tip on end of wire and crimp.
8. Pull wire through hollow tube until contact tip fits snugly against end of hollow tube.
9. Crimp tab on other side of assembly to hold wire in place.
10. Any hollow tubes which are not used should be pushed into the disconnect body and held in that position by placing fibre spacers over inner ends of tubes and spreading tabs.
11. When all wires have been connected, refasten the body of the assembly to the breaker back frame.

WELDING BREAKERS

The Type AK-1-15Y1 and AK-1-25Y1 breakers are intended for the protection of resistance welding machines. They trip instantaneously at higher current settings than breakers provided with the regular instantaneous adjustable overcurrent tripping device. This type breaker differs from the regular breaker only in the provision that higher current settings may be obtained.

Standard calibration ranges for Type AK-1-15Y1, Fig. 19, are as follows:

a. 300 to 800 amperes

b. 600 to 1500 amperes

Standard calibration ranges for Type AK-1-25Y1, Fig. 19, are as follows:

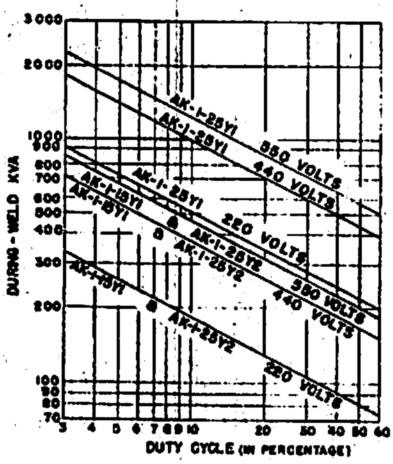
a. 600 to 1500 amperes

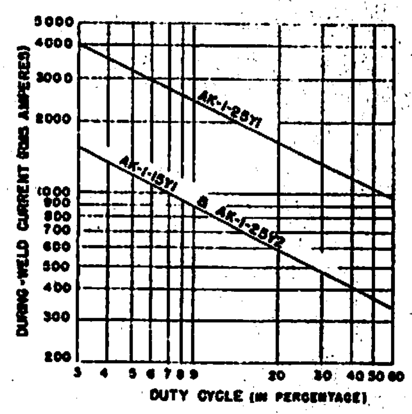
b. 1400 to 4000 amperes

c. 2000 to 5000 amperes

Other ranges can be provided within reasonable limits where the highest calibration settings will not exceed approximately 2-1/2 times the lowest calibration setting.

These breakers are not given a continuous current rating since the duty imposed is intermittent and quite variable depending upon various types of welding to be done. The breakers are designed to safely carry "during-weld amperes" or "during-weld KVA" at welding periods not exceeding the corresponding "duty cycle" as tabulated below. ("Duty cycle" is the per cent of time that current flows in any one minute.)





Duty Cycle (%)	During-weld Amp Rms	AK-1-15Y1 Breaker During-weld Kva 220 Volts	440 Volts	550 Volts
3	1530	337	674	841
4	1325	292	584	729
5	1185	261	522	652
6	1080	238	475	594
7	1000	220	440	550
8	936	206	412	516
9	884	194	194	388
10	839	185	185	370
20	594	131	262	327
30	484	108	215	266
40	419	92	184	231
50	375	83	165	206
60	342	75	150	188

Duty Cycle (%)	During-weld Amp Rms	AK-1-25Y1 Breaker During-weld Kva 220 Volts	440 Volts	550 Volts
3	4040	890	1780	2225
4	3500	770	1540	1925
5	3130	689	1378	1722
6	2860	629	1258	1574
7	2740	580	1161	1453
8	2640	544	1087	1360
9	2330	513	1025	1282
10	2215	487	974	1219
20	1566	345	689	861
30	1278	281	562	703
40	1107	244	487	609
50	990	218	436	545
60	903	199	398	497

Fig. 19 Current and Duty Cycle Limits of Types AK-1-15Y1 and AK-1-25Y1 Breakers

Fig. 19 (2678332)

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, GEF-3506.

In the absence of a Renewal Parts Bulletin, the described parts should be identified by giving the complete nameplate data of the circuit breaker or accessory.

Renewal parts which are furnished may not be identical with the original parts, since improvements are made from time to time. Parts which are furnished will be interchangeable.

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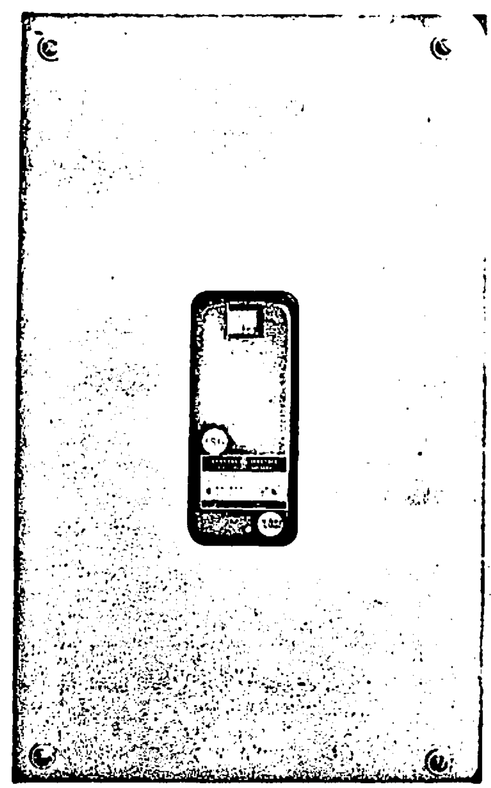
GENERAL ELECTRIC COMPANY, PHILADELPHIA, PA.

INSTRUCTIONS
MAINTENANCE

GEI-74603
SUPERSEDES GEH-1807B

POWER CIRCUIT BREAKERS



Types
AK-1-15 and AK-1-25
Electrically Operated

LOW VOLTAGE SWITCHGEAR DEPARTMENT

GENERAL ELECTRIC

PHILADELPHIA, PA.

CONTENTS

AIR CIRCUIT BREAKERS ELECTRICALLY OPERATED TYPES AK-1-15-3 THROUGH AK-1-15-10 AND AK-1-25-3 THROUGH AK-1-25-10

INTRODUCTION

The instructions contained herein provide information for performing maintenance procedures and for replacing AK-1-15/25 breaker components and accessories. For information regarding the receiving, handling, storage and installation of these breakers, refer to GEH-2021A, furnished with all AK breakers.

The AK-1-15 and AK-1-25 breakers differ, in that, the AK-1-25 has an extra contact per pole with corresponding differences in the upper stud and interrupter.

As various design improvements and new features were added, the suffix digit of the breaker type number was progressively increased. All of these models are essentially the same breaker, as changes were largely of a minor nature. These are tabulated as follows:

AK-1-15/25-3	Basic model.
AK-1-15/25-4	Improved "Y" relay in solenoid control system.
AK-1-15/25-6	Stationary primary disconnect and cable clamp redesigned. (Only enclosed breakers affected.)
AK-1-15/25-7	New type of front escutcheon and closing handle. Trip button relocated on escutcheon and reset lever of bell alarm and lockout breakers changed.
AK-1-15/25-8	EC-2 overload trip device used instead of the EC-1 device except on units requiring the short time delay feature.
AK-1-15/25-9	New drawout frame introduced.
AK-1-15/25-10	Improved "Y" relay in solenoid control system.

OPERATION

MANUAL

An electrical breaker may be equipped with a manual operating handle, thus providing both manual and electrical closing features. Breakers which are equipped with manual handles may be closed by rotating the handle 90° in the clockwise direction. Electrical breakers which do not have a manual operating handle may be closed by means of the manual maintenance handle furnished with the breaker. The closing mechanism automatically resets when the breaker trips, regardless of the type of breaker closing.

If the front escutcheon (9) Fig. 2 has been removed from the breaker, the maintenance handle can no longer be used. However, the breaker may still be closed manually by inserting a screw driver in the cam support as shown in Fig. 9, and then rotating its handle upwards and toward the top rear of the breaker.

The breaker may be tripped manually by means of the manual trip button in the front escutcheon (older model breakers in the manual operating handle), or automatically by any of the tripping devices with which it is equipped.

ELECTRICAL

The breaker is closed electrically by means of a push button, located on the front of the breaker, or by a remote switch. When the closing contact is made the x contactor becomes energized, thereby closing the x contacts and energizing the breaker closing solenoid, which causes the breaker to close. When the breaker closes, the prop switch causes the breaker closing solenoid to be de-energized.

The breaker may be tripped manually by pushing the manual trip button, which is located on the front escutcheon or automatically by any of the trip devices with which the breaker is equipped. The breaker mechanism will automatically reset when the breaker is tripped. The breaker is "trip free" from the closing mechanism, which assures that it cannot be closed as long as any trip device is functioning.

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.

ELECTRICAL CONTROL CIRCUIT - Fig. 1

Figure 1 shows a typical elementary and connection diagram for the AK-1-15 and 25 breakers, with the breaker in the open position.

When normal voltage is supplied to the control curcuit, either by closing a remote switch or relay, or by the push button PB, the closing contactor coil X (9-10) will become energized through contacts BB (1-2) and Y (4-3). The X contacts will then close, sealing in the X coil through contact X (1-2) and energizing the breaker closing coil CC (1-2) through contacts X (3-4), X (6-5), and X (7-8). This causes the armature to move downward and the breaker to close, thereby opening the BB (1-2) contact and closing the BB (3-4) contact of the prop switch.

Prop switch contact BB (1-2) opens the circuit to the X contactor coil (9-10), thus de-energizing the breaker closing coil CC (1-2) by opening contacts X (3-4), X (6-5), and X (7-8). Prop switch contact AA (3-4) will also energize the permissive relay Y (6-5), providing contact is maintained at the closing switch. The Y relay will in turn open its contact Y (4-3), thus holding open the X contactor coil circuit and providing the circuits anti-pump feature, as long as contact is maintained at the closing switch.

The breaker may be tripped electrically by a remote switch or relay which will energize the shunt trip coil TC (1-2) and trip the breaker. The trip impulse is interrupted by an "A" auxiliary switch contact (1-1C) which is connected in the shunt trip circuit.

MAINTENANCE

INSPECTION

BEFORE INSPECTION OR ANY MAINTENANCE WORK IS DONE! BE SURE THAT THE BREAKER IS IN THE OPEN POSITION. ALL ELECTRICAL POWER, BOTH PRIMARY AND CONTROL SOURCES, SHOULD ALSO BE DISCONNECTED.

Periodic inspection of the circuit breaker is recommended at least once a year. More frequent inspections are recommended, if severe load conditions, dust, moisture, or other unfavorable conditions exist.

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.

At all times it is important not to permit pencil lines, paint, oil or other foreign materials to remain on the insulating surfaces of the breaker as they may cause low resistance between points of different potential and result in eventual electrical breakdown.

Always inspect the breaker after a short circuit current has been interrupted.

At the time of periodic inspection, the following checks should be made after the breaker has been de-energized.

1. Manually operate the breaker several times, check for obstructions or excessive friction.
2. Electrically operate the breaker several times to ascertain whether the electrical attachments are functioning properly.
3. Arc quencher (See Section on "Arc Quencher").
4. Contact condition, wipe, and pressure (See Section on "Pole Unit Assembly").
5. Latch engagement (See Adjustments under "Operating Mechanism").
6. Overcurrent device tripping (See Adjustments under "Series Overcurrent Tripping Device").

TOOLS

The tools listed below will adequately equip an operator for any maintenance operation on AK-1-15 and AK-1-25 breakers.

#1 Phillips Screw Driver
#2 Phillips Screw Driver with 8" shaft
#3 Phillips Screw Driver
K101-1/2 Crescent (Short) Screw Driver
K505-1/2 Crescent (Long Thin) Screw Driver
K306 Crescent (Standard) Screw Driver

H-28 8" Gas Pliers
654 Pointed Nose Side Cutting 6" Pliers
#2 Waldes Truarc Pliers Straight
#2 Waldes Truarc Pliers 90° Angle

Ratchet Socket Wrench 1/2" Drive
7/16" - 1/2" Drive Socket
9/16" - 1/2" Drive Socket
5/8" - 1/2" Drive Socket
3/4" - 1/2" Drive Socket
13/16" - 1/2" Drive Socket
15/16" - 1/2" Drive Socket
10" Extension Bar 1/2" Drive
6" Extension Bar 1/2" Drive

8" Adjustable End Wrench
1/4" - 5/16" (Blue Point) Open End Wrench
1/2" - 9/16" Open End Wrench

5/8" - 3/4" Open End Wrench
3/8" - 7/16" Open End Wrench
11/32" - 5/16" Open End Wrench

1/16" Allen Head Wrench for #6 Screw
5/64" Allen Head Wrench for #8 Screw
3/32" Allen Head Wrench for #10 Screw
1/8" Allen Head Wrench for 1/4" Screw
5/16" Straight Shank Allen Head Wrench for 3/8" screw, with adapter for 1/2" drive ratchet

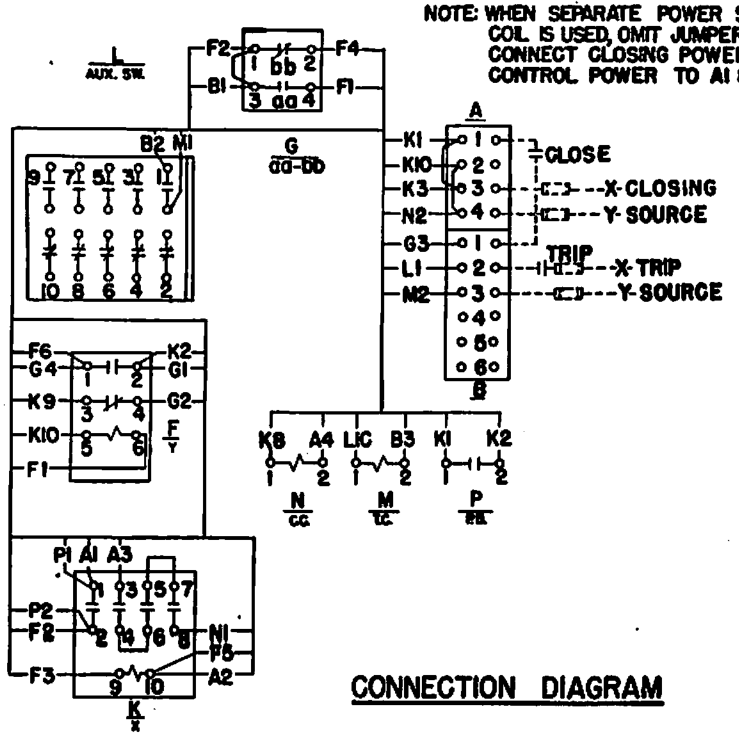
8 oz. Ball peen hammer

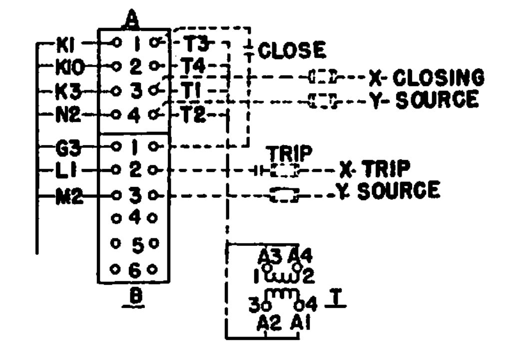
5/8" 6 point open box wrench

3/8" Spintite

NOTE: Obtain from local hardware, do not order on General Electric Company.

NOTE: WHEN SEPARATE POWER SOURCE FOR CLOSING COIL IS USED, OMIT JUMPERS A1-A3 & A2-A4 THEN CONNECT CLOSING POWER TO A3 & A4 AND CONTROL POWER TO A1 & A2.





o----o CUSTOMER WIRING

o——o FACTORY WIRING

o——o FACTORY WIRING FOR ENCLOSED BKR. CUSTOMER WIRING FOR STATIONARY BKR.

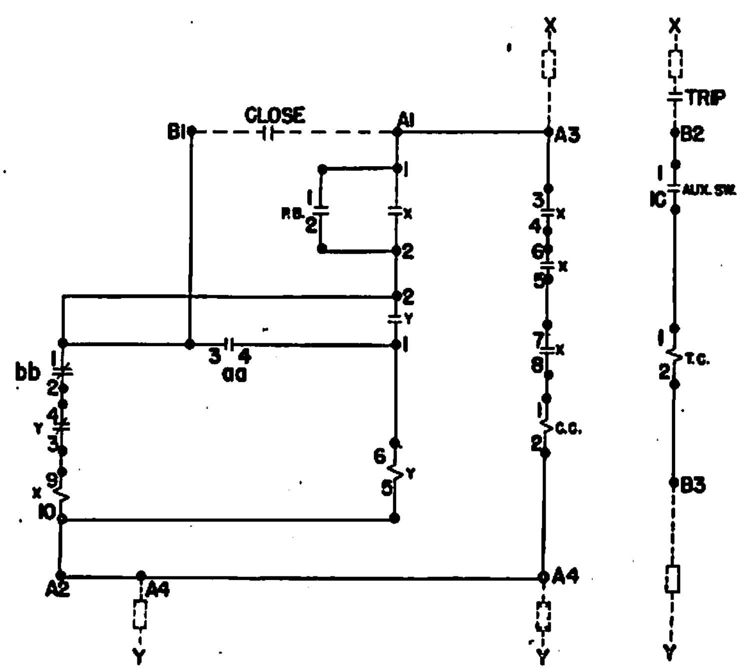
ALTERNATE WIRING FOR USE WITH FOLLOWING CONTROL VOLTAGE RATING

440 V. AC.	25~
575 V. AC.	60~
575 V. AC.	50~
575 V. AC.	25~

CONNECTION DIAGRAM

LIST OF ABBREVIATIONS

A-TERMINAL BOARD LOCATED TOP RIGHT, FRONT VIEW.
B-TERMINAL BOARD-LOCATED UNDER-A.
F-ANTI-PUMP PERMISSIVE RELAY.
G-(aa-bb)-MECHANISM SWITCH.
K-(X)-CLOSING CONTACTOR-3 SETS OF CONTACTS IN SERIES (MAIN) & 1 SET FOR SEAL-IN.
L-(AUX. SW.)-AUX. SW-2"a" & 2"b" CONTACTS (STD) OR 5"a" & 5"b" (SPECIAL).
M-(T.C.)-SHUNT TRIP DEVICE.
N-(C.C.)-SOLENOID CLOSING COIL.
P-(P.B.)-CLOSING SWITCH ON BREAKER.
T-TRANSFORMER.



ELEMENTARY DIAGRAM

Fig. I (2150185)

Fig. I

LUBRICATION

In general, the circuit breaker requires moderate lubrication. Bearing points and latch surfaces should be lubricated at the regular inspection periods with a thin film of extreme temperature, high-pressure, light grease similar to G.E. Spec. No. D50H15. Hardened grease and dirt should be removed from latch and bearing surfaces by using kerosene. ALL EXCESS LUBRICANT SHOULD BE REMOVED WITH A CLEAN CLOTH IN ORDER TO AVOID ANY ACCUMULATION OF DIRT OR DUST.

At each inspection period, all silver to silver friction points, such as primary disconnects should be cleaned and given a fresh coat of G.E. Spec. No. D50H47 lubricant.

TROUBLE SHOOTING

The following table lists several typical symptoms of breaker malfunctions together with their causes and remedies. If, at any time, these symptoms are observed, their cause should be determined and the necessary corrective action should be taken.

TROUBLE SHOOTING

TROUBLE	CAUSE	REMEDY
Overheating	Contacts not aligned.	Adjust contacts.
	Contacts dirty, greasy or coated with dark film.	Clean contacts.
	Contacts badly burned or pitted.	Replace contacts.
	Current carrying surfaces dirty.	Clean surfaces of current carrying parts.
	Bolts and nuts at terminal connections not tight.	Tighten, but do not exceed elastic limit of bolts or fittings.
	Current in excess of breaker rating.	Decrease load, rearrange circuit or install larger breaker.
	Excessive ambient temperature.	Provide adequate ventilation.
Failure to Trip	Travel of tripping device does not provide positive release of tripping latch.	Re-adjust or replace trip unit.
	Worn or damaged trip unit parts	Replace trip unit.
	Binds in overcurrent device.	Replace overcurrent device.
False Tripping	Overcurrent pick-up too low.	Change adjustment or replace with higher rated device.
	Overcurrent time-setting too short.	Change adjustment or replace with higher rated device.
	Bind in overcurrent device.	Replace device.
Failure to Close and Latch	Binding in attachments preventing resetting of latch.	Re-align and adjust attachments.
	Chipped or worn latch.	Replace latch.
	Latch out of adjustment.	Adjust latch.
	Latch return spring too weak or broken.	Replace spring.
	Hardened or gummy lubrication on bearing and latch surfaces.	Clean bearing and latch surfaces.
	Closing solenoid burned out.	Replace solenoid coil.
	Solenoid control device not functioning properly.	Re-adjust or replace device.

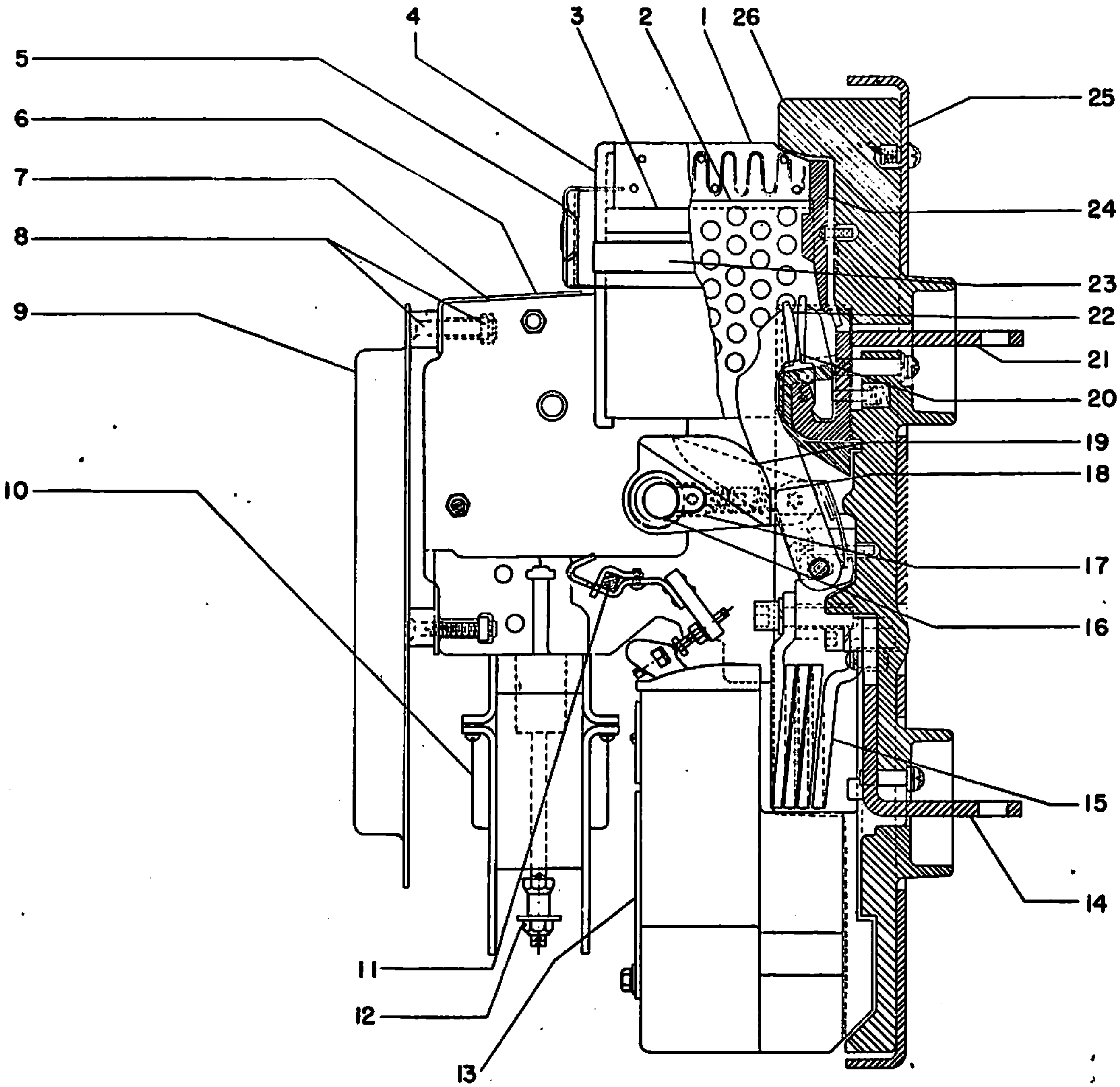
BASIC BREAKER COMPONENTS

ARC QUENCHER - FIG. 2

Each arc quencher has several compound inside barriers (2) containing a large number of perforations and two outside barriers (3) without perforations, as well as a front cap (4) and a rear support (24) held in place by a fiber strap (23). A clamp (5) is attached to the breaker base by two bolts. Clamp (5) holds all the arc quencher assemblies to their respective pole unit. A muffler (1) is located on top of the compound barriers. The compound barriers and the muffler, together with the slots between the barriers and the muffler, together with the slots between the barriers, serve to extinguish the arc.

The arc quenchers should be inspected at the regular inspection period. If the barriers are cracked or eroded to one-half their original thickness, they should be replaced.

Fig. 2 (215D170)



1. Muffler
2. Inside Barrier
3. Outside Barrier
4. Front Cap
5. Clamp
6. Strap
7. Operating Mechanism
8. Mounting Screw & Nut
9. Front Escutcheon
10. Hub
11. Trip Shaft
12. Stop Nut
13. Overcurrent Trip Device
14. Lower Stud
15. Series Coil
16. Main Shaft
17. Cap
18. Opening Spring
19. Insulating Link
20. Stationary Contact
21. Upper Stud
22. Movable Contact
23. Fiber Strap
24. Rear Support
25. Steel Base
26. Pole Unit Base

Fig. 2 Right Side View of Breaker

REPLACEMENT, FIG. 2

1. Remove clamp (5) by removing two bolts.

2. Unclasp fiber strap (23).

3. Remove front cap (4), muffler (1), outside barriers (3), inside barriers (2) and rear support (24).

4. Install new or disassembled parts in reverse order.

NOTE: In re-assembling the rear support (24) to the breaker, be sure and push the rear support toward the top of the pole unit so that the clearance in the rear support will accommodate the screw-head of the back plate.

POLE UNIT ASSEMBLY - FIG. 6

The contact assembly of each pole unit consists of a stationary and a movable contact subassembly.

The stationary contact assembly consists of parallel contact fingers (3) with silver alloy tips, the upper stud (20) and pins (4) with compression springs (19) which provide continuous contact pressure between the contact fingers and the upper stud (20). A shunt (21) is used to prevent pitting at the pivot point of the stationary fingers when carrying high momentary currents. The stationary contact fingers are held in place by the upper stud cap (6).

The movable contact assembly consists of parallel contact arms (5) with silver alloy tips, a contact carrier (18) with a spring (17) which provides continuous contact between the contact arms and pin (15). A clamp (14) secures pin (15) to the contact support (16). A flexible connection (12) is provided to prevent pitting at the pivot point of the movable contact arms when carrying high momentary currents.

The movable contact assembly is connected to the main shaft (16), Fig. 2, by an insulating link (7) which causes the contacts to move when the breaker is operated. Each movable contact assembly must exert a definite amount of contact pressure (see "Measuring Contact Pressure") against the stationary contacts when the breaker closes. During a closing operation, a definite amount of contact wipe must result, the distance which the stationary contacts are forced to the rear by the movable contact. (See "Measuring Contact Wipe"). At regular inspection periods both contact pressure and contact wipe should be checked.

MEASURING CONTACT PRESSURE - Fig. 6

1. Remove arc quencher (see "Replacement" under arc quencher).

2. With the breaker closed, place a push-type scale against the upper front end of the stationary contact tip (3).

3. Exert pressure against the push-type scale until the contacts just part. When the contacts first part the scale should read between 4 to 6 pounds. If the proper pressure is not indicated, (see "Adjusting Contact Wipe and Pressure").

4. Re-assemble parts in reverse order.

MEASURING CONTACT WIPE, FIG. 6

1. Remove arc quencher (see "Replacement" under Arc Quencher).

2. Measure the dimension between the inside surface of the pole base and top edge of the stationary contact tip (3), (a) with the breaker open, (b) with the breaker closed.

3. The difference between these two measurements should be within the limits of 3/32" and 1/4". If not within this range, the contact wipe must be adjusted.

4. With the breaker closed, the stationary contacts should have a minimum of 1/16" overtravel, measured at the contact tips, before reaching the limit of their movement in the direction of closing.

5. Replace arc quencher.

ADJUSTING CONTACT WIPE AND CONTACT PRESSURE" FIG. 6

1. Remove arc quenchers (see "Replacements" under Arc Quencher).

2. Remove tru-arc retaining ring from main shaft (16), Fig. 2, nearest the insulating link and contact assembly to be adjusted.

3. Loosen clamp (9) which secures eccentric bushing (8).

4. Turn the eccentric bushing in the insulating link (7) thereby moving the insulating link closer or farther away from the stationary contacts, as required to obtain proper wipe.

5. Reassemble parts in the reverse order after making adjustments.

NOTE: To adjust the insulating link in the center pole unit, first, push the main shaft through the right hand insulating link (7) and into the center insulating link as described in item 2 and 3 above. Opening spring (18), Fig. 2 and cap (17) Fig. 2, will drop out. Adjust center insulating link as described in step 4 above. Re-assemble parts in reverse order being careful to replace the opening spring and cap to their proper position.

If any of the contacts are badly corroded or pitted, thereby making it impossible to adjust for proper contact pressure or wipe, such stationary contacts or movable contact assemblies should be replaced. A commonly used "rule of thumb" is that contact replacement is indicated if less than one-half the original thickness (approx. 1/8 of an inch) of the contact tip material remains. See "Replacements" below.

If the proper contact pressure does not exist when the wipe is within its limits, the stationary contact springs (19) must be replaced.

REPLACEMENTS

Movable Contact Assembly, Fig. 6

1. Remove arc quenchers (see "Replacement" under "Arc Quencher").
2. Remove main shaft from breaker by removing tru-arc retainer from one end and pushing shaft through insulating links (7). (See Figs. 3 and 4.) As shaft clears the mechanism side frames, the opening springs and caps, (18) and (17) Fig. 2, will probably drop out of their recesses in the side frames. If the breaker is of the drawout type, handle socket, interlock lever, bushing and nut must be removed on the side from which the main shaft is to be removed.
3. Remove the upper mechanism mounting screws (Refer to Fig. 3).
4. Loosen lower mechanism mounting screws by using screw driver in slot provided on threaded end of screw which projects through back frame of breaker. (See Fig. 5.)
5. Mechanism and attached components may now be lifted clear of the breaker. If breaker is of the drawout type, movement of the mechanism will be somewhat restricted by control wires. There will be enough freedom, however, to allow the mechanism to be lifted to the top of the drawout frame, or on later model breakers, to the top of the pole base, where it should be secured by tying.
6. Remove insulating link (7) by removing tru-arc and drifting out pin (11).
7. Remove clamps (14) by removing fastening hardware.
8. Remove series coil terminals bolts. Movable contact unit is now free and may be removed.
9. Breaker may now be reassembled with new contact assembly by reversing the above described procedure. In remounting mechanism, be sure that dowels in mechanism side frames are well seated in dowel holes in the pole unit base. (See Fig. 7.) It will also be necessary to compress the opening spring and cap in the recess in the mechanism side frame in order to obtain clearance for replacement of the main shaft.
10. Check contact wipe and pressure and adjust if necessary.

Stationary Contact (3) Fig. 6

1. Remove arc quencher (see Replacements" under Arc Quencher).
2. Remove upper stud cap (6) by removing two holding screws threaded through the top of the cap.
3. Pry the stationary contacts (3) from upper stud (20) with a screw driver as shown in Fig. 7. Stationary contacts of the outer poles are readily accessible. On the center pole, it is recommended that the mech-

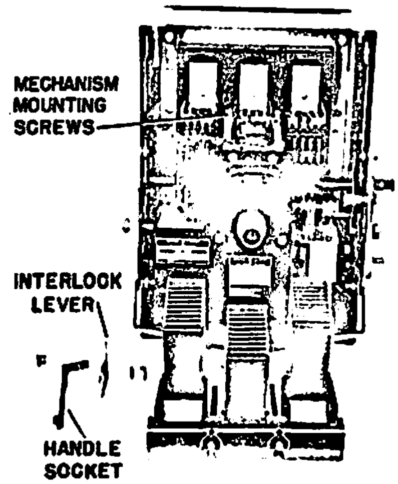


Fig. 3 Arc Quenchers and Handle Socket Removed from Drawout Breaker

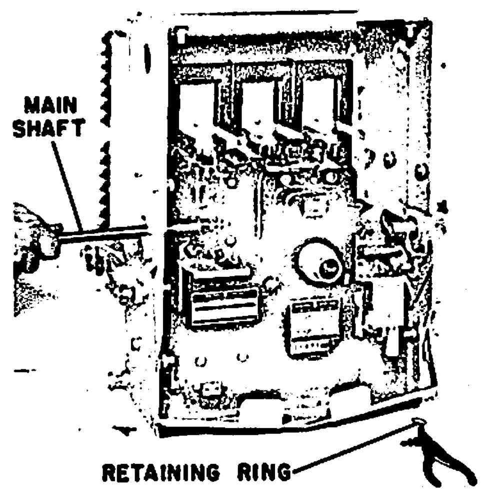


Fig. 4 Removal of Main Shaft from Drawout Breaker

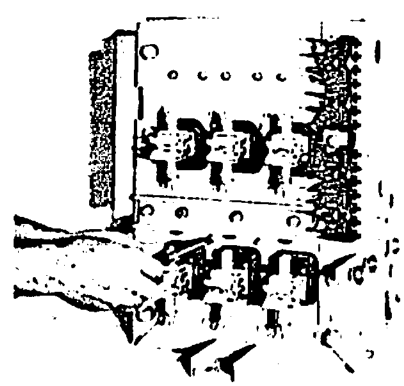
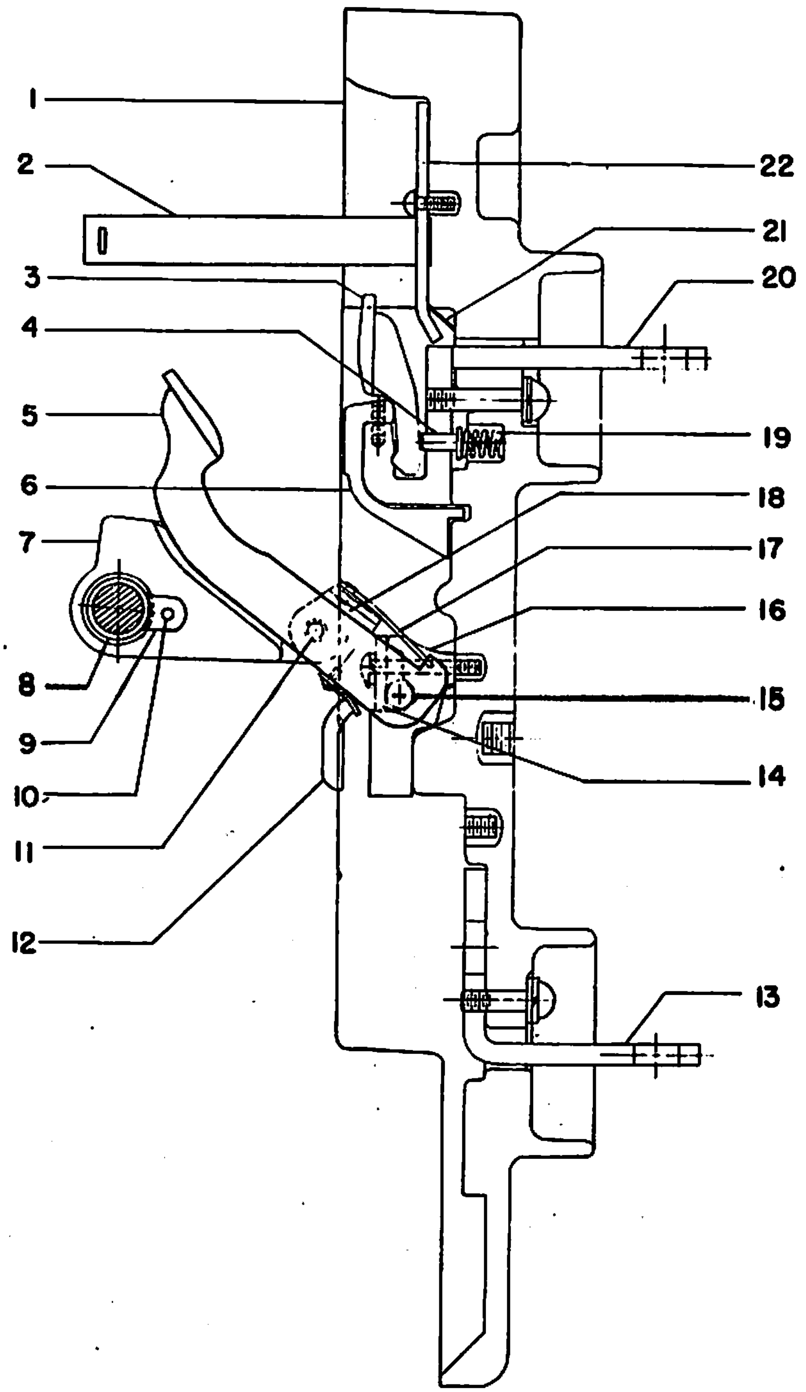


Fig. 5 Loosening Lower Mechanism Mounting Bolts



1. Pole Unit Base
2. Fiber Strap
3. Stationary Contact
4. Contact Pin
5. Movable Contact Arm
6. Upper Stud Cap
7. Insulating Link
8. Eccentric Bushing
9. Clamp
10. Screw
11. Pin
12. Flexible Connection and Terminal
13. Lower Stud
14. Clamp
15. Pin
16. Contact Support
17. Spring
18. Contact Carrier
19. Spring
20. Upper Stud
21. Shunt
22. Steel Plate

Fig. 6 Pole Unit Assembly

anism be removed to facilitate removal of the stationary contacts. Refer to steps 1 to 5 of the procedure for "Replacing Movable Contacts."

4. Replace the new stationary contact in reverse order. (It may be necessary to tap the new stationary contact into place by using a rawhide mallet).
5. Adjust contact wipe and contact pressure (see above).

OPERATING MECHANISM

WITHOUT CLOSING HANDLE - Fig. 9

The operating mechanism is supported between two molded side frames in front of the center pole unit. It consists of a toggle linkage (19), crank (5), latch (15), trip shaft (12), roller (6), closing links (1), and armature (14).

When the coil (8) is energized it pulls armature (14) downward, which through closing links (1), causes the toggle linkage (19) to straighten. This motion causes the main shaft (18) and movable contacts to move to the closed position. As soon as the toggle linkage is straightened the prop (23) moves on top of prop pin (20) and roller (6) moves on latch (15) thereby holding the mechanism in the closed position. The motion of the prop (23) causes switch (25) to operate, thus de-energizing the closing coil.

The breaker mechanism is tripped by rotating the trip shaft (12), and releasing latch (15) which causes the toggle linkage to collapse, thereby allowing the opening springs (17) to push the main shaft and movable contacts forward to the open position. Trip latch (15) is automatically reset during the opening operating providing none of the trip devices are actuated. Latch adjusting screw (9) limits the rotation of the trip shaft (12) and thus determines the amount of latch engagement.

To operate the breaker manually see section titled "Manual" under "Operation".

Adjustments, Fig. 9

Latch (15) is adjusted to provide approximately 5/64" engagement between latch and roller (6). To adjust for proper latch engagement, follow the procedure described below:

1. Loosen locknut on adjusting screw (9).
2. Hold breaker contacts in a position in which the movable contacts are just touching the stationary contacts. This may be done by any of the provided means of manual closing.
3. Turn down adjusting screw (9) until breaker trips open. Normally the force required to rotate the trip shaft is small enough so that the spring on the buffer paddle (10) is not noticeably deflected. If any deflection is observed while turning down the screw, back off screw until spring returns, then turn down screw again. If deflection persists, check trip shaft for binds.
4. Mark position of adjusting screw head.
5. Repeat steps 2 and 3 and check position of adjusting screw in relation to marked position.

Fig. 7 (8018942)

Fig. 8 (8018924)

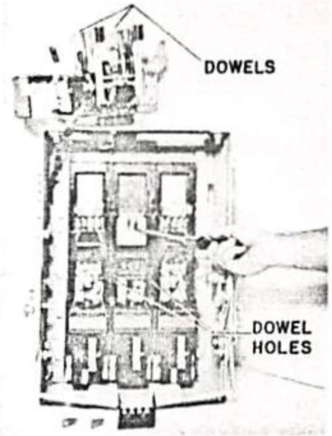


Fig. 7 Removal of Stationary Contacts

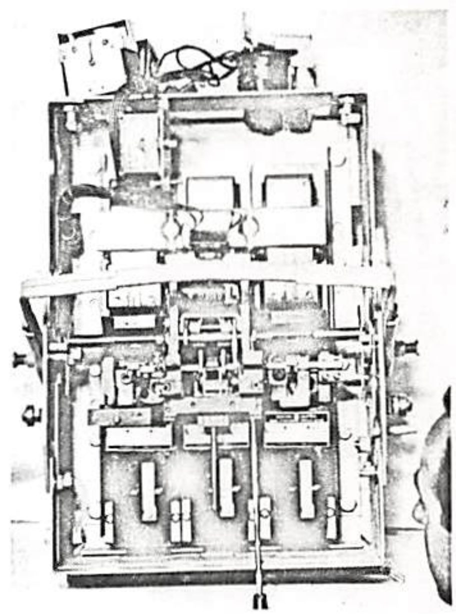


Fig. 8 Dismounting Upper Section of Magnet

6. If adjusting screw is in the same position as it was in the first tripping, back off the screw 3 full turns and tighten locknut. If it is not, repeat steps 2 and 3 until a constant tripping position is determined before backing off the three turns and locking. This check is necessary to avoid a false setting due to accidental tripping.
7. Operate the breaker electrically several times to make sure that the mechanism functions correctly.

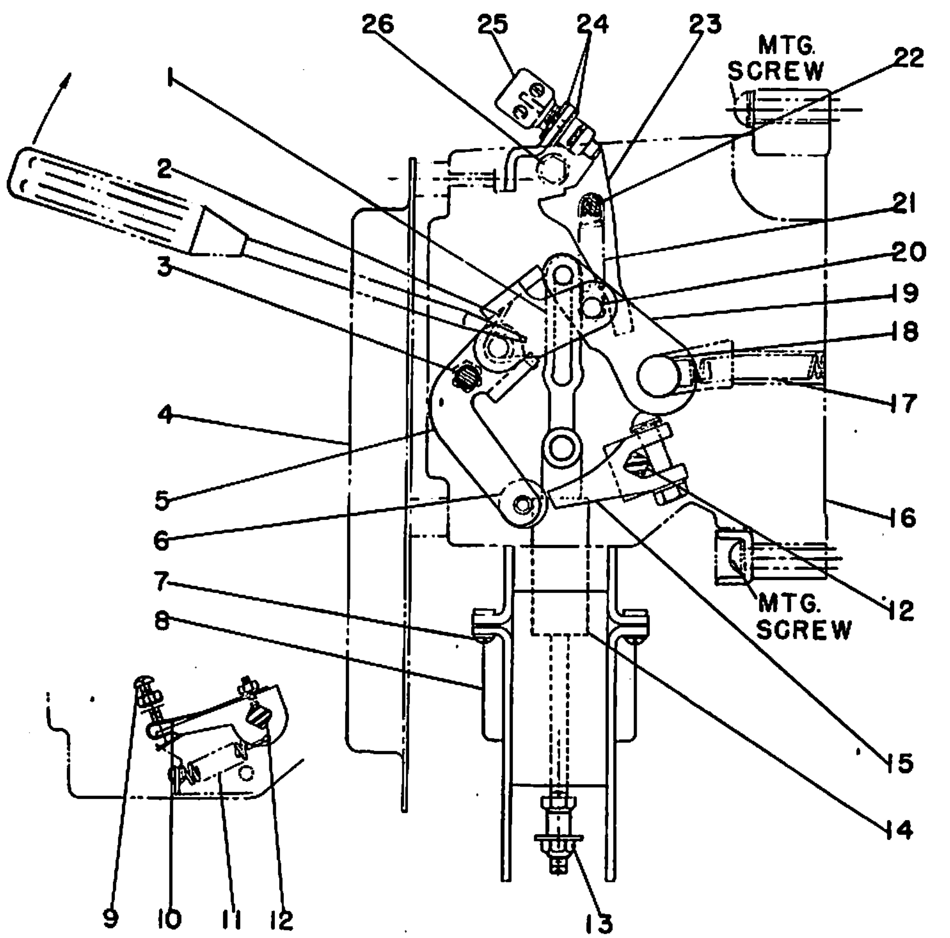
With the breaker open, the stop nut (13) should be adjusted so that there is approximately 1/16" clearance between the bottom of the magnet and the upper stop nut. This will restrict linkage movement in tripping but allow enough movement for the mechanism to reset.

Replacements, Fig. 9

Mechanism

NOTE: If a reasonable amount of care is exercised when replacing the mechanism, wiring lead connections will not be overstressed and need not be disconnected during the disassembly procedure. The electrical accessories may be tied up out of the way of the operator. If leads are disconnected, they should be marked to avoid incorrect connection.

1. Remove arc quenchers (see "Replacement" under "Arc Quencher").
2. Remove escutcheon (4).
3. If breaker is supplied with a terminal block, dismount block by removing two screws in back which fasten it to the supporting bracket.
4. Remove shunt trip supporting bracket by taking out the two screws which fasten it to the mechanism side frame. The nuts for these screws are loosely held in the recess on the inner side of the frame. If breaker is supplied with an undervoltage device, this also will be dismounted since it is held by the same supporting bracket.
5. If breaker is supplied with a closing switch, dismount switch base by removing two screws (10), Fig. 13.
6. Remove solenoid control device cover.
7. Remove X contactor and Y relay together, first removing two screws securing Y relay to arm which projects from magnet, then loosening the three screws which fasten the X contactor to the supporting arms. Both devices can then be removed by lifting slightly and moving towards front of breaker.



1. Closing Link
2. Cam Return Spring
3. Hold in Post
4. Escutcheon
5. Crank
6. Roller
7. Screw
8. Coil (Solenoid)
9. Trip Shaft Adj. Screw
10. Buffer Paddle
11. Trip Shaft Ret. Spring
12. Trip Shaft
13. Stop Nut
14. Armature
15. Latch
16. Mech. Frame
17. Opening Spring
18. Main Shaft
19. Toggle Link
20. Pin
21. Reset Spring
22. Prop Pin
23. Prop
24. Locknuts
25. Switch (Prop)
26. Screw

Fig. 9 Operating Mechanism Without Operating Handle

8. Remove stop nuts (13) from armature plunger (14).
9. Remove lower section of magnet and closing coil by taking out four screws (7).
10. Remove upper section of magnet by taking out two screws which fasten it to mechanism side frames. (See Fig. 8).
11. Remove auxiliary switch by taking out bolt (1) and screw (4), Fig. 12.
12. Remove cutoff switch (25) by removing locknuts (24).
13. Remove tru-arc and take out main shaft (18), being careful not to lose opening spring (17) and cap which may pop out when main shaft is removed.
14. Take off mechanism by removing mounting screws from mechanism frame.
15. Mechanism may now be replaced as a unit or disassembled and then reassembled with new parts as needed.
16. Reassembly of the breaker is accomplished by reversing the procedure described. In replacing the mechanism, make sure that the dowels on the mechanism side frames are properly seated in the dowel holes in the pole unit base; (see Fig. 7) also that the opening springs and caps are positioned properly when replacing the main shaft.
17. Adjust prop switch as described under "Adjustments" in "Solenoid Control System" and check operation of breaker manually and electrically.

Opening Springs (17) Fig. 9 or (16) Fig. 10

Opening springs may be replaced by following the first two steps of the procedure for replacing the "Movable Contact Assembly."

WITH CLOSING HANDLE, FIG. 10

The electrically operated mechanism equipped with a manual operating handle is shown in Fig. 10. This mechanism is similar to the one furnished without an operating handle with the following exceptions:

a. There is only one stop nut (11) on the lower end of the rod extending from the armature (12) since there is no need to provide for operation by the maintenance handle.

b. The mechanism which is furnished with an operating handle contains a cam support (7) and cam (6), whereas the mechanism furnished without an operating handle contains neither of these parts.

The sequence for electrical operation is the same as given for the mechanism furnished without an operating handle. (Refer to the second paragraph under, "Operating Mechanism - Without Closing Handle").

Turning the operating handle (5) in the clockwise direction 90° causes a roller attached to the operating shaft to engage cam (6) thereby moving the cam support (7) toward link (4). This motion straightens the operating linkage, thereby moving the main shaft (17) and movable contacts to the closed position. Prop (22) engaging pin (19) and latch (13) resting on roller (8) will hold the contacts in the closed position. Rotating the tripshaft (14) in the counter-clockwise direction will release the roller (8) which causes the toggle linkage to collapse thereby allowing the opening springs (16) to push the main shaft and movable contacts forward to the open position. Trip latch (13) is automatically reset during the opening operation, providing none of the trip devices are actuated.

Adjustments - Fig. 10

In addition to the adjustments shown for mechanisms furnished without an operating handle, adjustment screw (26) must be set for proper operation. This adjustment is satisfactory if the screw is set in such a position that the following two conditions exist:

1. In closing, there must be enough overtravel of the mechanism to easily allow prop (22) to move on pin (19).
2. When the breaker is open, roller (8) must clearly be free of contact with latch (13).

Replacements - Fig. 10

The replacement of parts in the operating mechanism furnished with a manual handle are similar to those for the mechanism furnished without a handle, with the following additions:

Front Escutcheon Assembly

1. Remove four mounting screws (8), Fig. 2.
2. Now pull forward on the operating handle turning and tipping the front escutcheon slightly until dislodged from the breaker.
3. To remount the front escutcheon assembly, first, hold the trip shaft in a trip free position. Then pull the cam support, (7) slightly forward.
4. Insert the operating shaft and roller into the hole of the cam support so that the roller drops behind cam (6).
5. Replace the four mounting screws to secure the front escutcheon assembly to the mechanism frame.

Replacing the Operating Handle

1. Remove the short set screw from the tapped hole in the operating handle.
2. Back off a second longer set screw from the same tapped hole until it is moved clear of the shaft.
3. Pull forward on operating handle until it is released from the front excutcheon and operating shaft.
4. Re-assemble operating handle to front escutcheon and operating shaft in reverse order.

NOTE: On older model breakers where the trip button is mounted in the operating handle, the trip rod and return spring must be removed by pushing the trip rod forward through the operating handle. In reassembly, sufficient clearance between the long set screw and the trip rod must be provided. Advance the long set screw into the tapped hole in the operating handle until it just binds the trip rod. Then back off on set screw one turn and lock the long set screw by inserting short set screw. Check trip rod for free movement.

ADDITION OF CLOSING HANDLE - FIG. 10

If it is desired to add a manual closing handle to a breaker which was not furnished with one originally, the conversion may be made by following the procedure below. Required parts catalog numbers may be obtained by reference to Renewal Parts Bulletin GEF-3506.

1. Follow steps 1 to 14 of procedure for replacement of the mechanism.
2. After mechanism has been removed, remove right mechanism side frame by removing hardware at (3) and (26), Fig. 9, all trip shaft attachments to the right of the mechanism, and the trip shaft retaining ring.
3. The toggle linkage and armature, now free of the mechanism side frames, may be disassembled and reassembled with the parts required for manual operation. Return spring, (2) Fig. 10, replaces (2) Fig. 9, and cam support (7), is added to the linkage assembly. Fig. 10 shows how the linkage should be reassembled.
4. Reassemble mechanism and breaker parts with exception of escutcheon.
5. Mount new escutcheon assembly, which will include a manual operating handle, according to the directions in the section titled "WITH CLOSING HANDLE" under "Replacements".
6. Adjust screw (26) as described in "Adjustments" under "WITH CLOSING HANDLE."
7. Check manual and electrical operation of breaker.

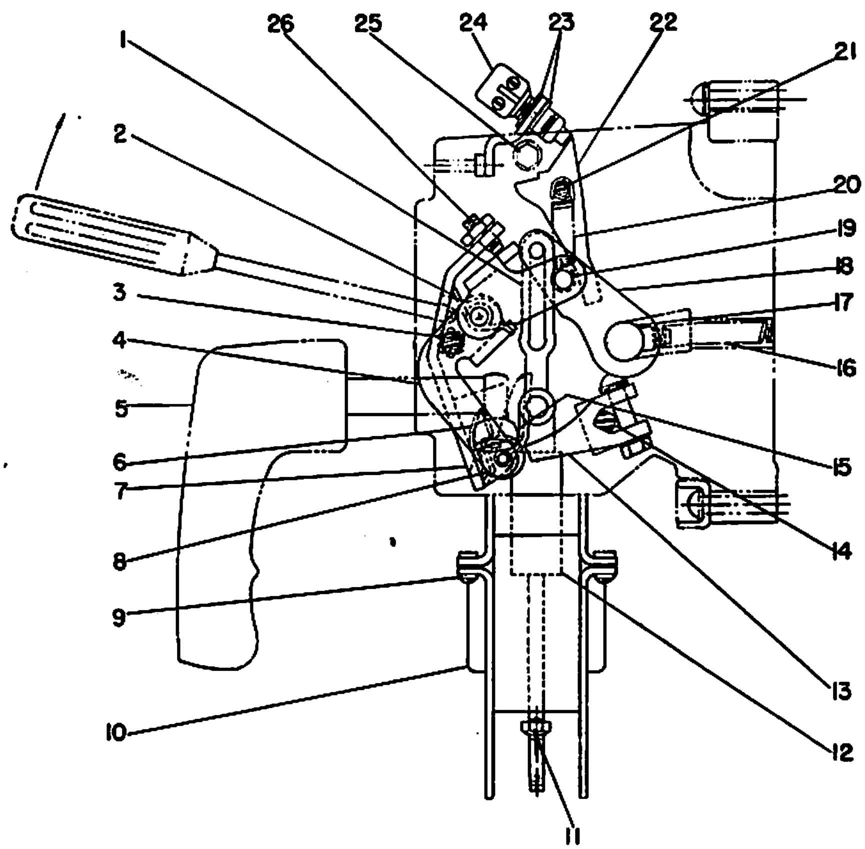


Fig. 10 (242C651)

1. Closing Link	7. Cam Support	14. Trip Shaft	21. Prop Pin
2. Cam Return Spring	8. Roller	15. Cam Roller	22. Prop
3. Hold in Post	9. Screw	16. Opening Spring	23. Locknuts
4. Link	10. Coil	17. Main Shaft	24. Switch
5. Handle	11. Stop Nut	18. Toggle Link	25. Screw
6. Cam	12. Armature	19. Pin	26. Adjusting Screw
	13. Latch	20. Reset Spring	

Fig. 10 Operating Mechanism with Closing Handle

AUXILIARY SWITCH - FIG. 12

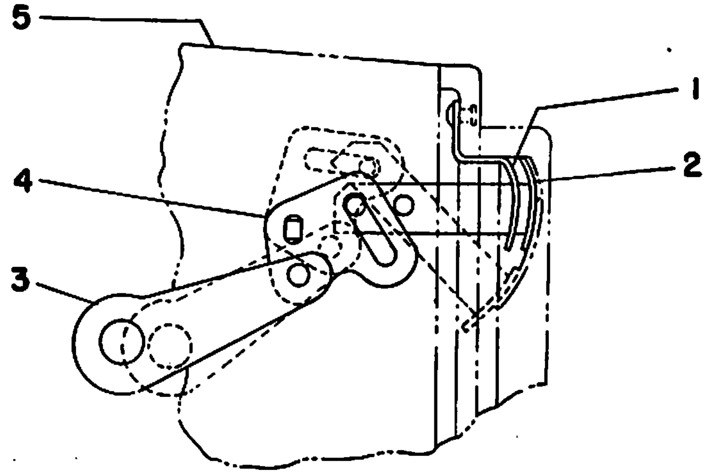
The auxiliary switch is mounted on the left side of the operating mechanism. The main shaft (17), Fig. 10, of the breaker causes crank (4), Fig. 11; to rotate as the breaker opens and closes. The crank operates the auxiliary switch shaft (3) which opens and closes the "a" and "b" contacts of the switch. (The "a" contacts are open when the breaker is open; the "b" contacts are closed when the breaker is open). The opening and closing of the auxiliary switch contacts is determined by an arrangement of cams (12), mounted on the auxiliary switch shaft (3). The top terminals of the switch are "a" contacts, the bottom terminals are "b" contacts.

ADJUSTMENTS, FIG. 12

The contacts of any stage may be changed from "a" to "b" or vice versa. If changes are desired in the operation of the contacts, an approved drawing of the cam (12) arrangement should be obtained or a careful sketch made. In order to change a "a" contact to a "b" contact, it is necessary to remove the four tie bolts (2) and change the position of the particular cam 90° in relation to the shaft. Contacts should be cleaned occasionally to insure proper performance.

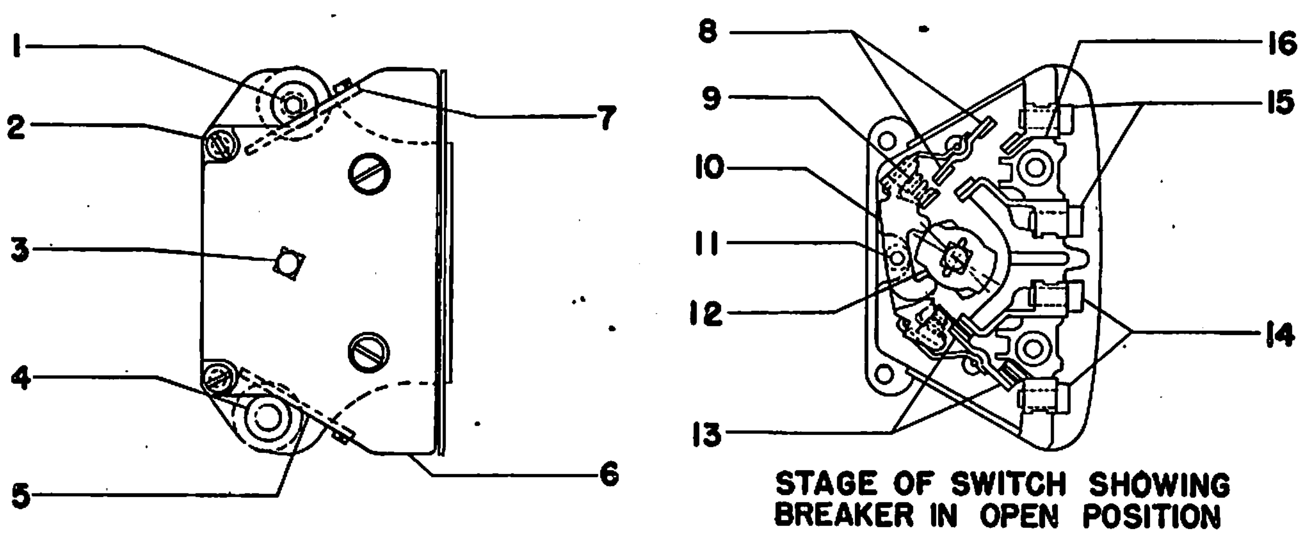
REPLACEMENTS, FIG. 12

1. Disconnect all leads to the auxiliary switch.
2. Remove mounting bolt (1) and screw (4) to remove device from breaker.



1. Stationary Indicator (Open)
2. Movable Indicator (Closed)
3. Link
4. Crank
5. Mechanism Frame

Fig. 11 Position Indicator



1. Mounting Bolt
2. Tie Bolt
3. Shaft
4. Screw
5. Bottom Cover
6. End Plate
7. Top Cover
8. 'a' Contacts
9. Contact Spring
10. Rocker Arm
11. Pin
12. Cam
13. 'b' Contacts
14. 'b' Terminals
15. 'a' Terminals
16. Barrier

Fig. 12 Auxiliary Switch

3. If no approved sketch of the cam arrangement is available, remove the end plate (6) from the device by removing the four tie bolts (2) and draw a sketch of the position of the particular cam in relation to the shaft.
4. Before installing the new device, see that the cams are in the same position as in the device that is being replaced.
5. Install the new device in reverse order.

ELECTRICAL CLOSING DEVICES AND CONTROLS

The electrical closing devices and controls consist of the following:

a. Closing Switch
b. Solenoid Control System
c. Closing Solenoid

CLOSING SWITCH, FIG. 13

The closing switch is located in the lower right hand corner of the front escutcheon (1).

A push button extends through the front escutcheon and is supported by bracket (3). Spring (6) returns the push button to a neutral position after the movable contact (8) has momentarily engaged the stationary contacts (12). Two retainers (2) and spacer (7) are used to hold the movable contact in place.

The stationary contacts (12) and insulation strip (13) are attached to the closing solenoid by bracket (9) and screws (10). A remote closing switch may be used to close the circuit of the solenoid control system, thereby energizing the closing solenoid.

Adjustments

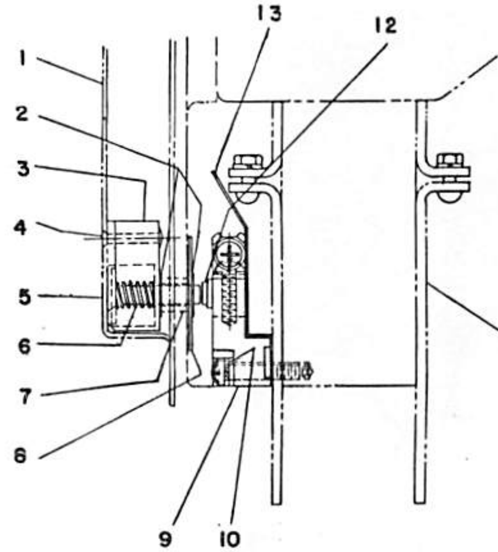
The closing switch requires no attention, other than cleaning of contact occasionally.

SOLENOID CONTROL SYSTEM - FIG. 14

This system consists of an X contactor and Y relay which are located on the left side of the operating mechanism. It also contains a prop switch (25), Fig. 9, which is located in the top front of the operating mechanism (looking from the front). The sequence of operation is as follows:

a. When the closing switch is closed, the coil of the X contactor becomes energized.
b. The contacts of the X contactor close, sealing its coil in and also energizing the breaker closing coil.
c. The breaker then closes and latches causing the bb contact of the prop switch (25), Fig. 9, to open thereby de-energizing the X contactor coil and the breaker closing coil.

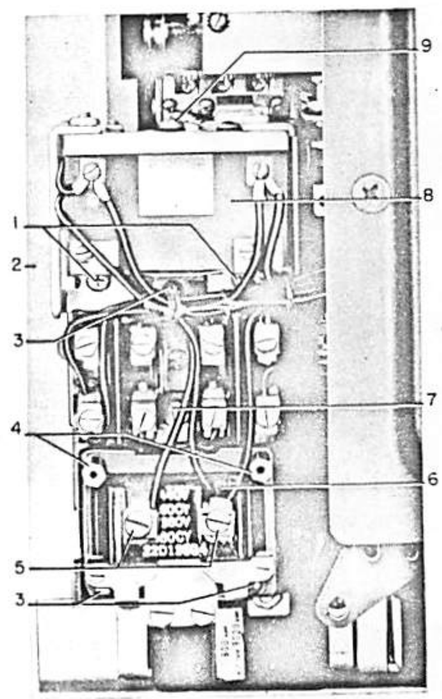
NOTE: If the closing switch is closed while the breaker is in the closed position, or if it remains closed after the breaker closes, the coil of the Y relay will become energized through the aa contact of the prop switch (25), Fig. 9. This will open the circuit to the X contactor coil, thereby preventing



1. Front Escutcheon
2. Retainers
3. Bracket
4. Rivets
5. Push Button
6. Spring
7. Spacer
8. Movable Contact
9. Bracket
10. Screw
11. Closing Solenoid
12. Stationary Contact
13. Insulation Strip

Fig. 13 Closing Switch

Fig. 13 (M-6496854)



1. Mtg. Screws, Y Relay
2. Frame, Y Relay
3. Mtg. Screws, X Contactor
4. Hex. Posts
5. Term. Screws, X Contactor
6. X Contactor
7. Armature Screw
8. Y Relay
9. Mtg. Screw, Y Relay Coil

Fig. 14 X Contactor and Y Relay (AK-1-15/25-9)

Fig. 14 (8019829)

the X contactor from operating. This feature makes it impossible to operate the closing solenoid when the breaker is already closed. It also provides for cut-off of the closing solenoid and anti-pump operation.

ADJUSTMENTS - FIG. 9

The only adjustment required for this system is on the prop switch (25). To make this adjustment proceed as follows:

1. Press the trip button in the front of the breaker.
2. Maintain pressure on the trip button and at the same time close the breaker with the maintenance operating handle.
3. The prop switch (25) should operate just before the armature (14) reaches the end of its stroke. To obtain this adjustment move the prop switch toward or away from the prop (23). Moving the switch too close to the prop can result in damage to the switch if its operating button is forced to travel beyond the limit of its movement. It is also possible, in this case, for the switch not to toggle when the breaker closes. (When the breaker closes, the prop moves away from the switch and the button is extended). This would leave the bb contacts closed with the breaker closed, and burn out the contactor and closing solenoid coils. If, on the other hand, the switch is too far away from the prop, it is possible for the bb contacts to remain open when the breaker is open. This would make it impossible to close the breaker electrically. This condition could also result in false tripping even though the switch may operate, since the thrust of the switch button is depended upon to move the prop into position and hold it in place on breaker closing operations.

REPLACEMENTS - FIG. 14

Y Relay and Coil - Fig. 14

1. Remove relay cover by removing two cover screws.

2. Disconnect wiring from front of relay (8) by loosening terminal screws.

3. Remove two screws (1) which fasten relay frame (2) to upper extension of magnet frame.

4. The relay and its frame are now free of the breaker.

5. With the relay (8) removed, the coil may now be removed by removing two small cotter keys at rear of relay frame.

6. Remove small spring at rear-center of relay frame.

7. Remove coil mounting screw (9) from center of coil. The coil may now be removed.

8. Install new coil or relay in reverse order.

X Contactor - Fig. 14

1. Perform steps 1 and 2 of "Replacing Y Relay and Coil".

2. Remove three mounting screws (3) which fasten the X contactor to magnet frame extensions.

3. The X contactor is now free from the breaker. Install new X contactor in reverse order.

X Contactor Coil

1. The X contactor coil may be removed without removing the X contactor by first disconnecting wiring from X contactor terminal screws (5).

2. Remove two hex. shaped posts (4). The coil is now free of its mounting.

3. Remove screw (7) which fastens the armature to the movable contacts. The coil is now completely removed.

4. Install new coil in reverse order.

Prop Switch (25), Fig. 9

1. Remove wiring.
2. Remove locknuts (24) from switch.
3. Replace switch in reverse order.

CLOSING SOLENOID, FIG. 9

The closing solenoid is located directly below the operating mechanism. It consists of a coil (8), a magnet, an armature (14), and four closing links (1).

The closing solenoid is connected in series with the main contacts on the X contactor and is energized or de-energized when these contacts are closed or opened, respectively. When the closing solenoid is energized, its armature (14) is drawn downward into the coil (8) pulling the four closing links (1) in the same direction. This action straightens the toggle linkage (19), of the operating mechanism, thereby closing the breaker. As the operating mechanism moves into the closed position, the prop switch (25) operates, causing the X contactor coil and breaker closing coil (8) to be de-energized.

ADJUSTMENT - FIG. 9

The stop nut (13) should be set so that there is approximately 1/16" clearance between the nut and the magnet when the breaker is in the open position. This adjustment is required in order to allow the mechanism linkage to reset.

REPLACEMENTS, FIG. 9

Closing Solenoid

1. Remove the X contactor and Y relay (see "Replacements" under Solenoid Control System).
2. Remove stop nut (13).
3. Remove four screws (7) which attach lower part of magnet to upper part of magnet.
4. Remove two screws (see Fig. 8) which attach upper part of magnet to the two side frames of the operating mechanism.

5. Install new closing solenoid in reverse order.

Coil (8) - Fig. 9

1. Remove lower member of magnet as described in steps 1 to 3 of "Closing Solenoid Replacement".

2. Remove wiring to coil (8) by disconnecting one lead at the X contactor and cutting the other lead three to four inches from coil.

3. Remove brass coil guides and the coil may now be removed.

4. Install new coil in reverse order.

PROTECTIVE DEVICES

An AK-1-15 or AK-1-25 breaker may be equipped with any combination of the following protective devices:

1. Overcurrent trip
2. Reverse Current trip
3. Undervoltage trip

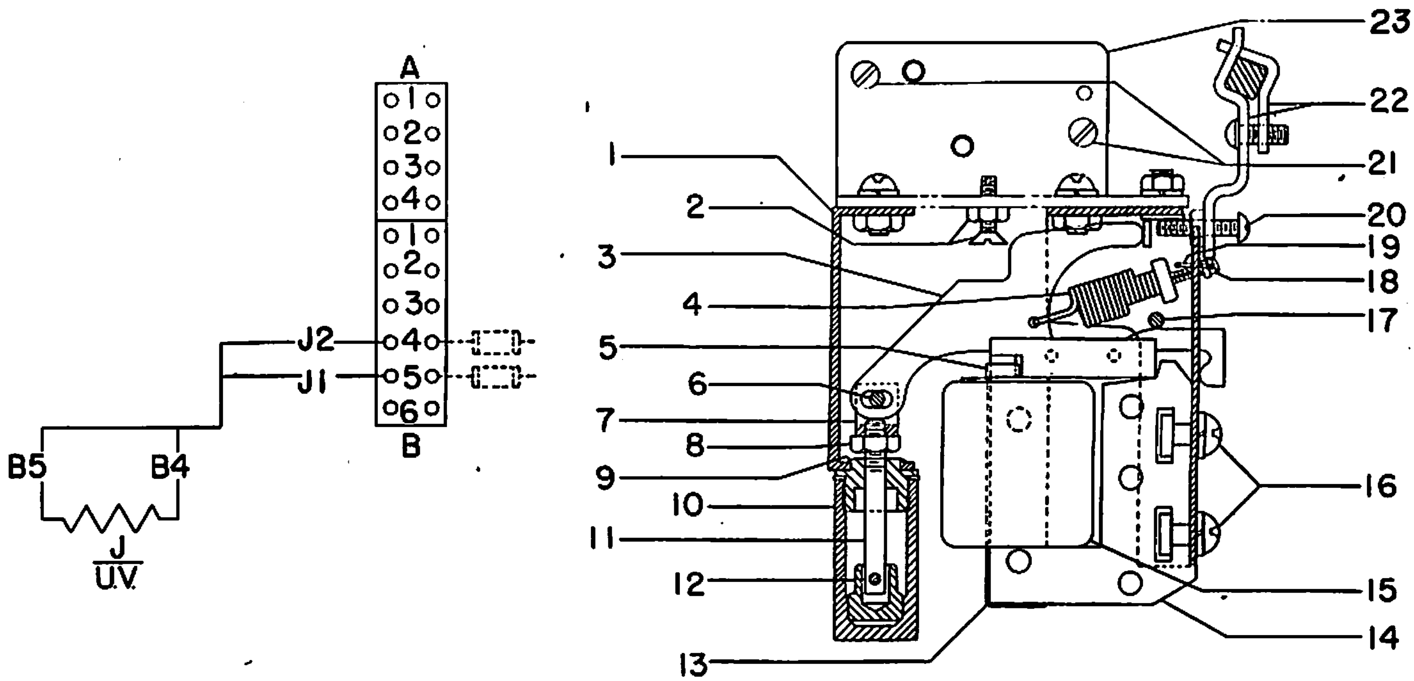
TIME DELAY UNDERVOLTAGE TRIPPING DEVICE - FIG 15

This device is mounted to a bracket on the right side of the operating mechanism (looking from the front). The purpose of this device is to trip the breaker for undervoltage. For rated voltage, the armature (3) is attracted by magnet (14). If the voltage falls below a predetermined value the magnet (14) releases the armature (3). Spring (4) then pulls armature (3) upward against the restraining force of the oil in cylinder (10); this action causes a minimum time delay of 3 seconds. When the spring overcomes the restraining force of the oil the armature engages screw (20) thus rotating the trip shaft and opening the breaker.

ADJUSTMENTS - Fig. 15

1. An adjusting screw (20) in the trip paddle (22) is used to adjust for "positive tripping". The overtravel of the trip paddle from the point of tripping the breaker should be 1/32 to 1/16 inch, which may be visually observed when making this adjustment.

2. The armature pick-up is a function of the open air gap of the armature. The air gap is factory set by means of adjusting screw (2) so that the



1. Bracket	5. Shading Ring	10. Cylinder	14. Magnet	19. Locking Wire
2. Adjusting Screw and Nut	6. Pin	11. Connection Rod	15. Coil	20. Adjusting Screws
3. Armature	7. Clevis	12. Plunger	16. Screws	21. Mounting Screws
4. Spring	8. Locking Nut	13. Clamp	17. Pin	22. Trip Paddle & Clamp
	9. Cap		18. Adjusting Screw	23. Supporting Bracket

Fig. 15 Time Delay Undervoltage Tripping Device

armature will pick-up at 80% of rated voltage. In order to make this adjustment in the field a variable voltage source is required. The air gap should be increased if pick-up occurs at less than 80% of rated voltage and decreased if pick-up occurs at more than 80%.

3. A calibration spring (4) attached to adjusting screw (18) extablishes the drop-out value of voltage which results in breaker tripping. This is largely a factory adjustment, the drop-out value being 30 to 60% of rated voltage.

4. The time-delay of the device may be varied somewhat by changing the relative positions of the connecting rod (11) and clevis (7). This is accomplished by loosening the locking nut (8) then raising or lowering the plunger (12) by turning the connecting rod (11) which is threaded into the clevis (7). When any time-delay of 3 to 10 seconds exists from loss of voltage, the device is considered satisfactorily adjusted.

5. From 1/4 to 3/8 inch of oil should be maintained in the cylinder (10) at all times. In order to make an inspection of the oil, the cylinder may be unscrewed from the cap (9). Use a silicone oil, such as, G.E. 9981LT40NV or similar, in the cylinder.

REPLACEMENTS, FIG. 15

Coil

The only part of the undervoltage device that is likely to require replacement during the life of the breaker is the coil (15). The replacement procedure follows:

(Note:- It is advisable to replace the magnet and coil assembly as nearly as possible in its exact original position in relation to the device frame. Doing this will result in having the same open air gap between armature and magnet and will insure the device's picking up at the same voltage value).

1. Disconect coil leads.
2. Remove two screws (16), freeing magnet (14) and coil (15) from device. (It may be more convenient to remove the entire device from its supporting bracket (23) before removing the magnet and coil. If the device is of the time-delay type, bracket (1) will also have to be removed from bracket (23).
3. Straighten laminations which were bent to hold shading ring (5) in place.
4. Removing shading ring (5).
5. Straighten end of coil clamp (13).
6. Remove coil, install new coil, and reassemble device by reversing disassembly procedure.

Device

If the entire device is replaced, simply remove the hardware fastening the frame of the device to supporting bracket (23). If a time-delay device, bracket (1) must also be removed from bracket (23).

INSTANTANEOUS UNDERVOLTAGE TRIPPING DEVICE

This undervoltage tripping device is constructed similarly to the time delay undervoltage tripping device with the exception that the cylinder (10), plunger (12), connecting rod (11), clevis (7), bracket (1), and locking nut (8), as shown in Fig. 15 are omitted.

The adjustments and replacements for this device are also the same as those for the time delay undervoltage tripping device.

OVERCURRENT TRIPPING DEVICES

The typical overcurrent trip device consists of a magnetic structure, a series current coil, and a pivoted armature. Depending on the type of individual device, the movement of the armature may be delayed by a timing device, of either the oil dashpot or escapement gear and pallet type.

An AK-1-15/25 breaker may be equipped with either the EC-2 or EC-1 overcurrent trip device. The majority of applications will require the use of the EC-2 device. The EC-1 device is normally used when the short-time delay feature is required, or when the trip device is used to operate a special overcurrent alarm switch.

Most circuit breakers are equipped with series overcurrent trip devices either of the dual magnetic type (instantaneous and time delay tripping) or instantaneous alone. Breakers are designed to carry up to 100% of the continuous current rating of their trip devices. Any attempt to carry higher currents for a prolonged period will cause overheating and possible damage.

EC-2 DEVICE

The EC-2 overcurrent tripping device is available in three forms:

1. Dual overcurrent trip, with long-time delay and high-set instantaneous tripping.
2. Low-set instantaneous tripping.
3. High-set instantaneous tripping.

The dual trip has adjustable long-time and instantaneous pick-up setting and adjustable time settings. Both forms of instantaneous trips have adjustable pick-up settings.

DUAL OVERCURRENT TRIP, WITH LONG-TIME DELAY AND HIGH-SET INSTANTANEOUS TRIPPING.

By means of the adjustment knob (5), Fig. 16, which can be manipulated by hand, the current pickup point may be varied from 80 to 160 percent of the series coil rating. The indicator and a calibration plate (4), Fig. 16, on the front of the case provide a means of indicating the pick-up point setting in terms of percentage of coil rating. The calibration plate is indexed at percentage settings of 80, 100, 120, 140 and 160.

The long-time delay tripping feature can be supplied with any one of three time-current characteristics which correspond to the NEMA standards maximum, intermediate and minimum long-time delay operating bands. These are identified as 1A, 1B and 1C characteristics, respectively. Approximate tripping time for each of these, in the same order are 30, 15 and 5 seconds at 600% of the pick-up value of current. (See time-current characteristic curves 286B201A, B and C).

TIME ADJUSTMENT - Fig. 17

The tripping time may be varied within the limits shown on the characteristic curves (Fig. 19) by turning the time adjustment screw (5). Turning in a clockwise direction increases the tripping time; counterclockwise decreases it. The dashpot arm (7) is indexed at four points, max. - 2/3 - 1/3 - min. from left to right, as viewed in Figs. 17 and 18. When the index mark on the connecting link (8) lines up with the indicated mark on the dashpot arm, the approximate time as shown by the characteristic curve is indicated. Fig. 19 shows typical time-current curves for the EC-2 and EC-1 tripping devices. The 1A and 1B characteristic devices are usually shipped with the time setting at the 2/3 mark and the 1C characteristic at the 1/3 mark. The standard characteristic curves are plotted at the same setting.

Time values are inversely proportional to the effective length of the dashpot arm. Therefore, the linkage setting that give the shortest time value is the one at which dimension "A", Fig. 17, is greatest. The time adjustment screw (5), may be turned by inserting a Phillips head screwdriver through the hole in the front of the case, but if it is desired to relate the linkage setting to the index marks on the linkage it will be necessary to remove the case. This may be done by removing the two mounting screws, one on each side of the case, which may be taken off without disturbing the trip unit itself.

NOTE: Forcing the adjusting screw to either extreme positon may cause binding of the device and should be avoided.

INSTANTANEOUS-LOW-SET TRIPPING - FIG. 16

The low-set instantaneous pick-up point may be varied by the adjustment knob (5). The calibration in this case usually ranges from 80% to 250% of the series coil rating, the calibration plate being indexed at values of 80%, 100%, 150%, 200% and 250% of the coil rating.

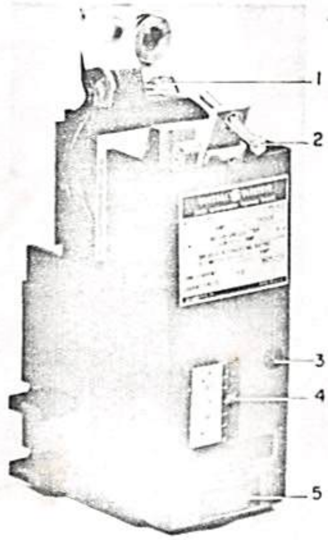
INSTANTANEOUS-HIGH-SET TRIPPING - FIG. 17

The high set instantaneous pick-up value may have one of the following three ranges: 4 to 9 times coil rating; 6 to 12 times coil rating or 9 to 15 times coil rating. The pick-up setting may be varied by turning the instantaneous trip adjusting screw (4).

Three standard calibration marks will appear on the operating arm at (9), and the value of these calibration marks will be indicated by stampings on the arm as follows:

4X		6X		9X
6.5X	or	9X	or	12X
9X		12X		15X

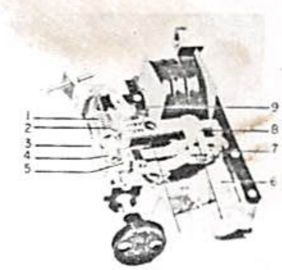
At the factory, the pick-up point has been set at the nameplate value of the instantaneous trip current. (Usually expressed in times the ampere rating of the trip coil.) The variations in pick-up setting is accomplished by varying the tensil force on the instantaneous spring (1). Turning the adjustment screw (4) change the position of the movable nut (2), on the screw. The spring



1. Series Coil
2. Trip Adjustment Screw
3. Opening for Time Adjustment
4. Pickup Indicator & Calibr Plate
5. Pickup Adjustment Knob

Fig. 16 EC-2 Overcurrent Trip

Fig. 16 (6024842)



1. Instantaneous Calibration Spring
2. Movable Nut (Index Pointer)
3. Time-Delay Calibration Spring
4. Instantaneous Pickup Adjustment Screw
5. Time-Delay Adjustment Screw
6. Oil Dashpot
7. Dashpot Arm
8. Connecting Link
9. Instantaneous Pickup Calibration Marks

Fig. 17 EC-2 Overcurrent Trip with Cover Removed

Fig. 17 (6024843)

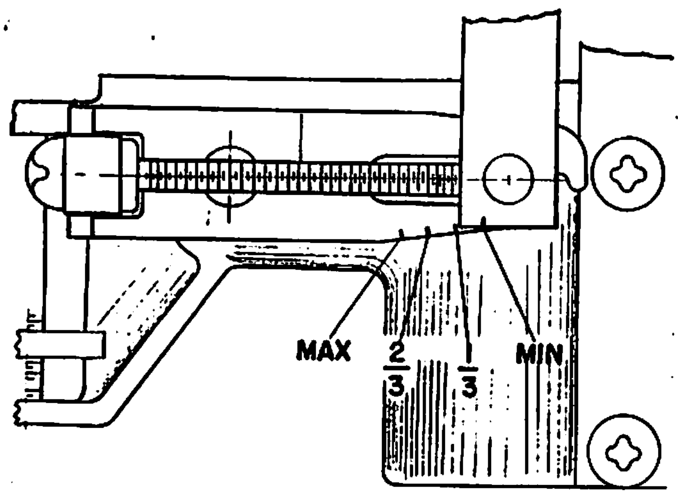


Fig. 18 Time-Adjustment Indexing

is anchored to this movable nut so that when the position of the nut is changed, there is a corresponding change in the spring load. As the spring is tightened, the pick-up point is increased. The top edge of the movable nut (2), serves as an index pointer and should be lined up with the center of the desired calibration mark, punched slots on operating arm, to obtain the proper instantaneous trip setting.

ADJUSTMENTS, EC-2 - FIG. 16

In addition to the pick-up settings and time-delay adjustments already described, overcurrent trip devices must be adjusted for positive tripping. This adjustment is made at the factory on new breakers, but must be made in the field when the breaker mechanism or the overcurrent trip devices have been replaced.

Positive tripping is achieved when adjustment screw (2), is in such a position that it will always carry the trip paddle on the trip shaft beyond the point of tripping the breaker when the device armature closes against the magnet.

In order to make the adjustment, first unscrew trip adjustment screw (2), until it will not trip the breaker even though the armature is pushed

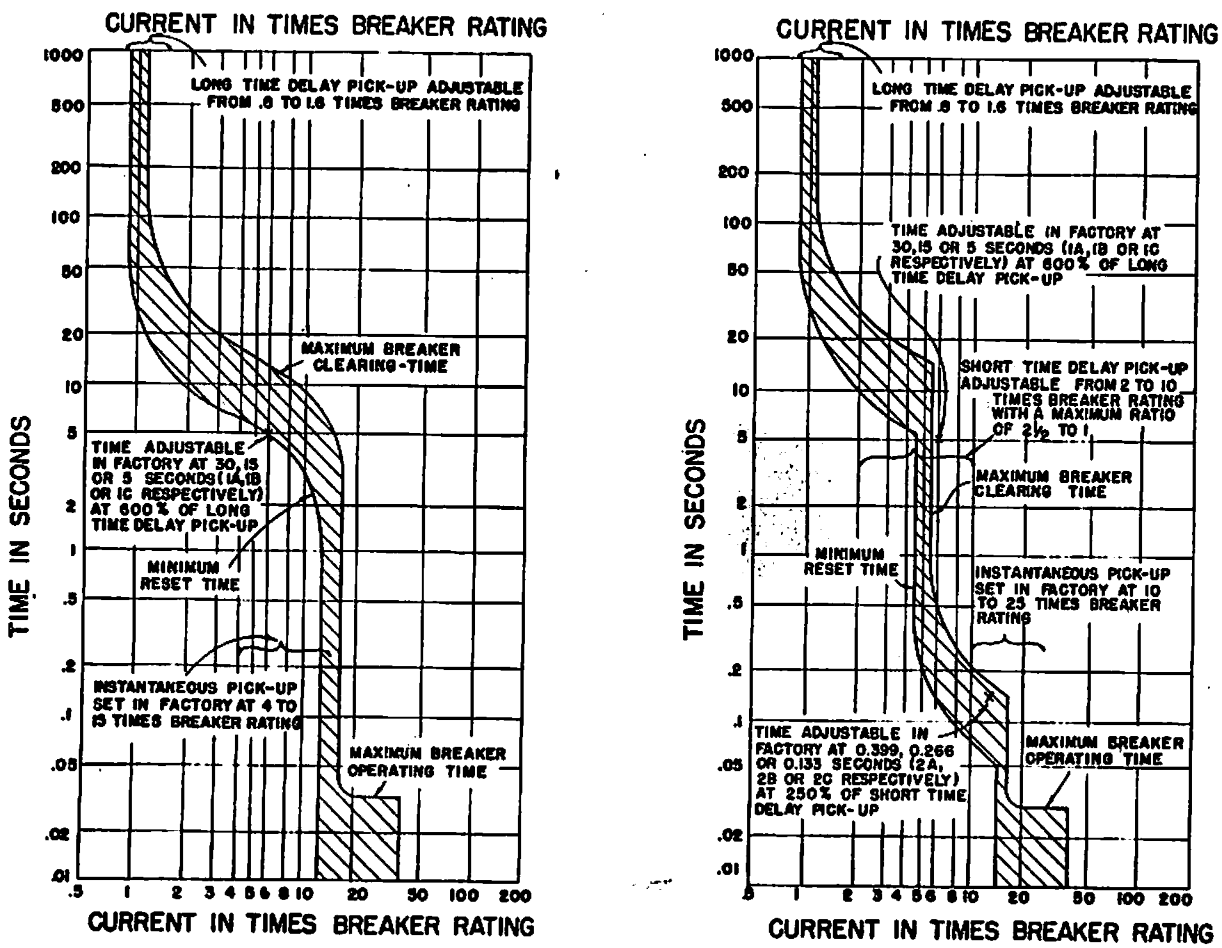


Fig. 19 Typical Time-Current Characteristic of Series Overcurrent Trip Device in 25° C Ambient.

Fig. 18 (417A464)
Fig. 19 (215D182)

against the magnet. Then, holding the armature in the closed position, advance the screw until it just trips the breaker. After this point has been reached, advance the screw two additional full turns. This will give an overtravel of 1/16 of an inch and will make sure that activation of the device will always trip the breaker.

Adjustment screw (2), can best be manipulated by an extended 1/4 inch hex socket wrench.

In order to gain access to the adjustment screw of the center pole overcurrent device, it will be necessary to remove the operating mechanism and attached components as a complete unit. To remove the mechanism, follow the first five steps of "Replacement - Movable Contact Assembly" under Pole Unit Assembly".

REPLACEMENT, EC-2

Replacement of the EC-2 overcurrent trip device is accomplished by the following procedure:

1. Remove the mechanism as a complete unit as described in the first five steps of "Replacement - Movable Contact Assembly" under "Pole Unit Assembly".

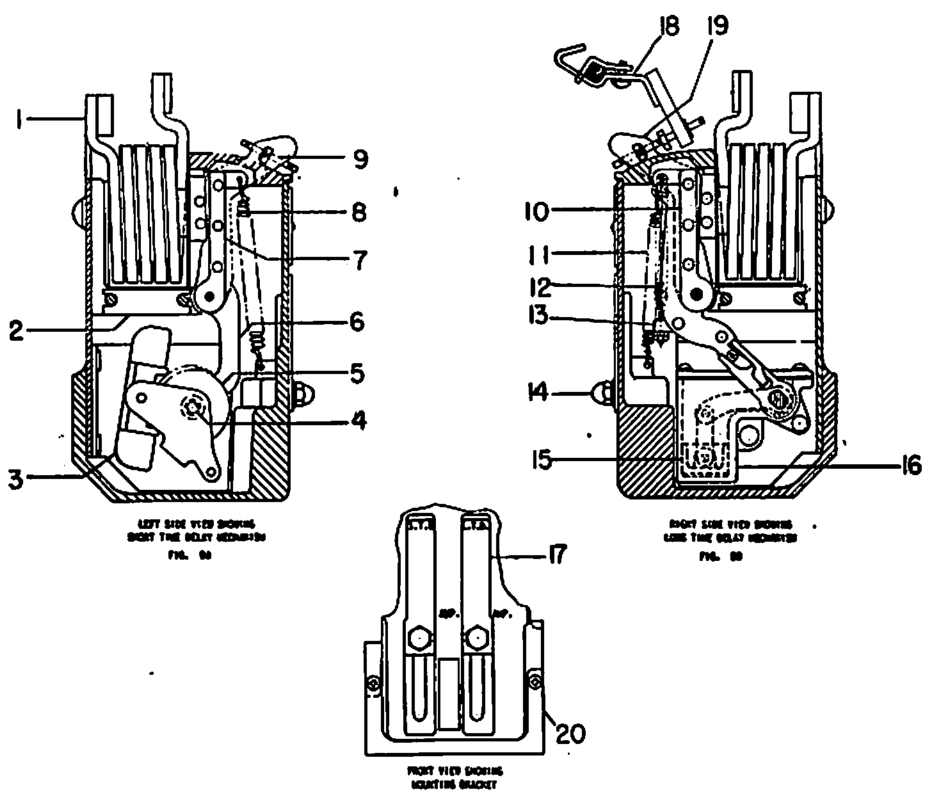
2. Remove the steel clamps which fasten the cover of the device to the back of the breaker. NOTE: Pickup settings on the cover of each device are calibrated for the specific device. When replacing covers, replace on associated device.

3. Using a 5/16 inch Allen Head Wrench, remove the 3/8 inch bolts which fasten the coil of the overcurrent device to the breaker copper.

4. Remove the round head screw which fastens the frame of the overcurrent device to the breaker base.

5. After reassembling breaker with new overcurrent device, adjust for "positive trip" as described under "Adjustments" of this section.

NOTE: When replacing an EC-1 device with an EC-2, or vice versa, it will be necessary to replace the trip paddles on the trip shaft. These will be provided with the replacement trip units.



1. Series Coil
2. Magnet
3. Pallet
4. Pinion
5. Escape Wheel
6. Driving Segment
7. S.T.D. Armature
8. S.T.D. Calibration Spring
9. Trip Paddle Adjusting Screw
10. L.T.D. Armature
11. L.T.D. Calibration Spring
12. Instantaneous Trip Spring
13. Spring Holder
14. Calibration Clamp Nut
15. Plunger
16. Cylinder
17. Calibration Plate
18. Trip Paddle
19. Trip Arm
20. Clamping Bracket

Fig. 20 Type EC-1 Series Overcurrent Tripping Device

Fig. 20 (256C884)

EC-1 DEVICE

The EC-1 device can be provided with the following tripping combinations:

1. Long time delay, short time delay and instantaneous tripping.
2. Long time and short time delay tripping only.
3. Long time delay and instantaneous tripping.
4. Short time delay and instantaneous tripping.
5. Short time delay tripping only.
6. Instantaneous tripping only.

(a) Adjustable (Low set)
Or
Nonadjustable (High set)

SHORT TIME DELAY TRIPPING, FIG. 20

The armature (7) is retained by calibrating spring (8). After the magnetic force, produced by an overcurrent condition, overcomes this restraining force, the armature movement is further retarded by an escapement mechanism which produces an inverse time delay characteristic. The mechanism is shown in the left side view of Fig. 20.

The pickup for this device can be field set between limits having a ratio of 2-1/2 to 1 in the range of 200 to 1000% of the coil rating.

LONG TIME DELAY TRIPPING, FIG. 20

The armature (10) is retained by the calibration spring (11). After the magnetic force, produced by an overcurrent condition, overcomes this restraining force, the armature movement is further retarded by a flow of silicone oil in a dashpot, which produces an inverse time delay characteristic. The mechanism is shown in the right side view of Fig. 20.

INSTANTANEOUS TRIPPING, FIG. 20

(a) Adjustable instantaneous tripping takes place after the magnetic force produced by an overcurrent condition, overcomes the restraining force of the adjustable calibration spring (11).

(b) Nonadjustable instantaneous tripping takes place after the magnetic force produced by an overcurrent condition overcomes the restraining force of a nonadjustable calibration spring (12).

SELECTIVE TRIPPING

Selective overcurrent tripping is the application of circuit breakers in series so that only the circuit breaker nearest the fault opens. Any one or combination of two or more of the preceding over-current devices may be used in a selective system. The breaker having the shorter time setting and lower pickup will trip before the breaker having the longer setting and higher pickup, provided the fault is on the part of the line protected by the breaker having the lower setting.

For the exact characteristics and setting of each breaker in a selective system, reference should be made to a coordination chart for the particular system.

ADJUSTMENTS - EC-1 - Fig. 20

The EC-1 device may be adjusted for positive tripping by following the same procedure described above for the EC-2 device and using adjusting screw (9).

REPLACEMENT - EC-1

When replacing the EC-1 device, refer to the section entitled "Replacement" under EC-2 device.

REVERSE CURRENT TRIPPING DEVICE - FIG. 21

The device is enclosed in a molded case and is mounted on the right pole base similarly to the series overcurrent tripping device.

The reverse current tripping device consists of a series coil (1) with an iron core mounted between two pole pieces (7), also a potential coil (4) connected across a constant source of voltage and mounted around a rotary-type armature (6). Calibration spring (3) determines the armature pick-up when a reversal of current occurs.

As long as the flow of current through the breaker is in the normal direction, the magnetic flux of the series coil and the magnetic flux of the potential coil produce a torque which tends to rotate the armature counter-clockwise. The calibration spring also tends to rotate the armature in the same direction. This torque causes the armature to rest against the stop screw (9) attached to a bearing plate on the right side of the device.

If the current through the series coil (1) is reversed, the armature (6) tends to move in the clockwise direction against the restraint of the calibration spring (3). When the current reversal exceeds the calibration setting, the armature revolves clockwise causing the trip rod (2) to move upward engaging the trip paddle adjusting screw (15) thereby tripping the breaker.

ADJUSTMENTS - Fig. 21

The only field adjustment that should be required on the reverse current device is that of "positive tripping", which is the amount of overtravel of the trip rod (2) beyond the point of tripping the breaker. Proper overtravel is provided, if the trip rod (2) advances the trip paddle (14) 1/32 to 3/64 inch beyond the point of tripping the breaker. To adjust for "positive tripping", proceed as follows:

NOTE: Be extremely cautious not to have hands near moving breaker parts when making this adjustment.

1. Manually lift the trip rod (2) as high as possible and turn the adjusting screw (15) into the trip paddle (14) until it will not touch the trip rod and trip the breaker.

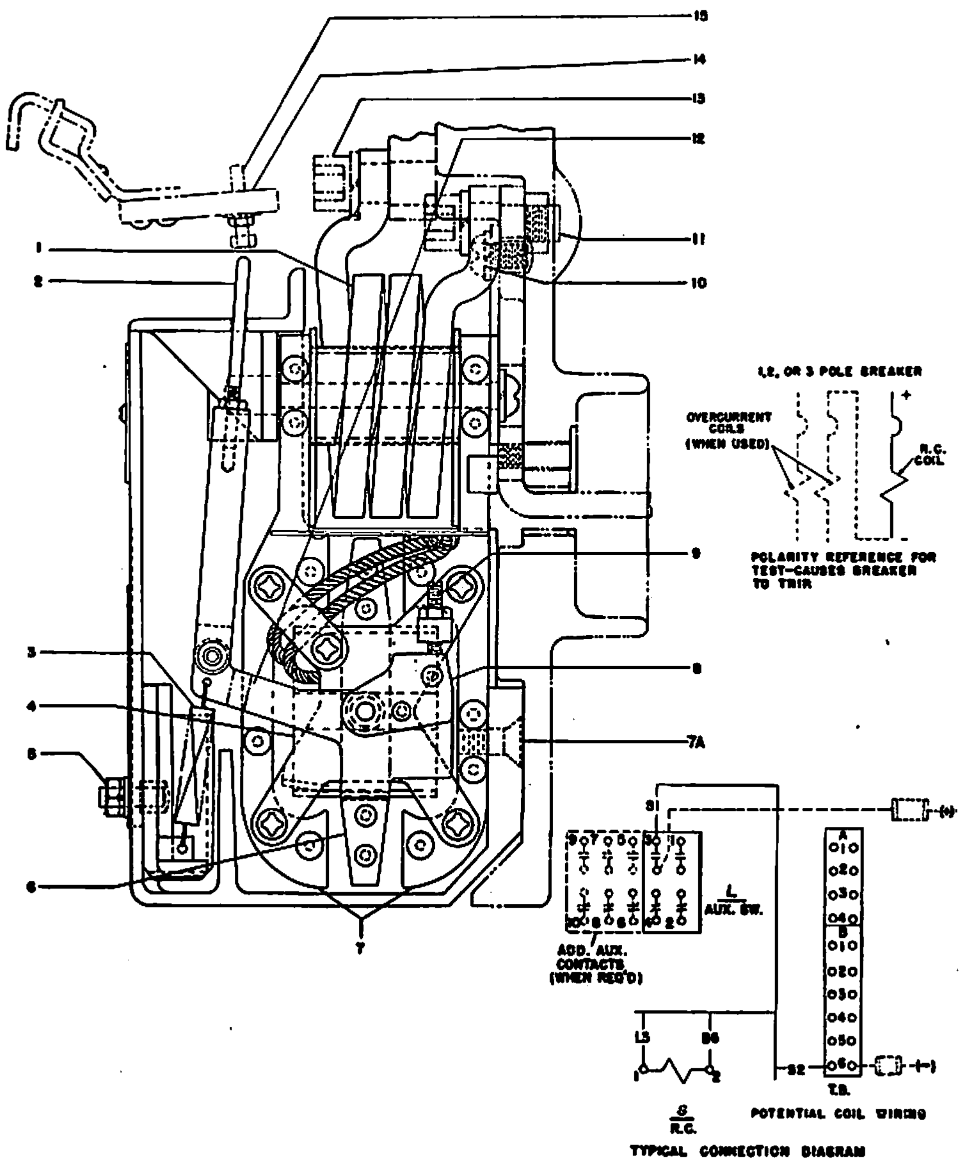
2. Back-out the adjusting screw (15) to a position where the breaker is just tripped when the trip rod is lifted as far as it will go.

3. Back-out the adjusting screw (15) an additional 1-1/2 turns from the position established in step 2 and the proper overtravel should be obtained.

4. Be sure to tighten the locking nut on the adjusting screw.

REPLACEMENT

After removing the wiring for the potential coil the reverse current device can be removed and replaced by following the procedure outlined for replacing the series overcurrent device. For wiring, see Fig. 21.



1. Series Coil
2. Trip Rod
3. Spring (Calib.)
4. Potential Coil
5. Calibration Nut
6. Armature
7. Pole Pieces
7A. Screws
8. Counterweight
9. Stop Screw
10. Mounting Screw
11. Screw
12. Trip Crank
13. Screw
14. Trip Paddle
15. Adj. Screw

Fig. 21 Reverse Current Tripping Device

Fig. 21 (T-6490346)

BREAKER ACCESSORIES

SHUNT TRIPPING DEVICE - FIG. 22

The shunt tripping device is mounted on a bracket attached to the right side of the operating mechanism (looking from the front).

A remote switch or relay contact is used to close the circuit of the device causing the armature (9) to engage the trip paddle (11) thereby tripping the breaker. The spring (2) is used to return the armature to the neutral position after the breaker trips.

To prevent overheating, the coil (7) is cut off by contacts of the auxiliary switch which are open when the breaker is open.

ADJUSTMENTS

From 1/32" to 1/16" overtravel of the armatue is required when the breaker is tripped. If any adjustment is necessary to provide this amount of overtravel, the trip lever is formed in or out accordingly.

REPLACEMENT

Coil (7)

1. Disconnect leads to coil.
2. Remove magnet (6) and coil from frame (3).
3. Bend lower end of clamp (8) straight and remove.
4. Remove coil and install new coil in reverse order.

If, for some reason, the entire device is to be replaced, this is accomplished by removing the fasteners between the shunt trip device frame (3) and supporting bracket (13).

After replacing either the coil or the entire shunt trip device, the overtravel adjustment should be checked.

BELL ALARM AND LOCKOUT DEVICES

BELL ALARM DEVICE - FIG. 23

A bell alarm device is available which operates when an overcurrent trips the breaker. It consists primarily of a lever (7) and hanger (11) riveted to auxiliary shaft (6), latch (12), catch (16), switch (1), reset lever (3), and mounting bracket (4).

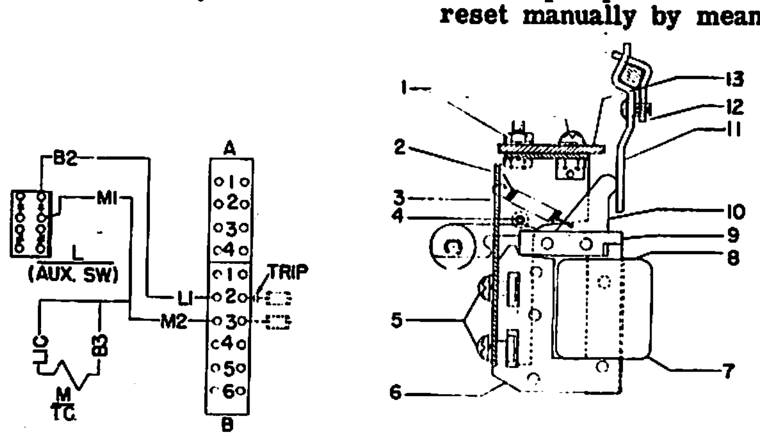
When the breaker is tripped by an overcurrent the overcurrent device trip arm (8) causes lever (7), hanger (11), and latch (12) to rotate counterclockwise as a single member about pin (9). This disengages the latch from the catch (16). When the breaker opens, link (17) also releases the catch, allowing its spring to rotate it counterclockwise about pin (15). This in turn permits plunger of switch (1) to move downward, closing the lower contact of the switch and thereby completing the alarm circuit.

If the breaker is opened by means other than the overcurrent device, the latch (12) remains in position and does not allow the catch (16) to rotate even though it is released by link (17).

Operation of the reset lever (3) returns the catch and switch contacts to their original position. At the same time, spring (5) resets latch (12).

LOCKOUT DEVICE - FIG. 23

The lockout device consists of the same mechanism as the bell alarm device except that a screw (18) secures the hanger (11) to latch (12). This causes these two parts to function as a unit. Whenever the breaker is opened due to an overcurrent, the trip paddle (10) will be held in the tripped position by the lever (7), thereby locking the breaker in the open position until the lockout mechanism is reset manually by means of the reset lever (3).



1. Mtg. Screws (3)
2. Spring
3. Frame
4. Pin
5. Screws
6. Magnet
7. Coil
8. Clamp
9. Armature
10. Armature Arm
11. Trip Paddle
12. Clamp
13. Supporting Bracket

Fig. 22 Shunt Tripping Device

Fig. 22 (215D176)

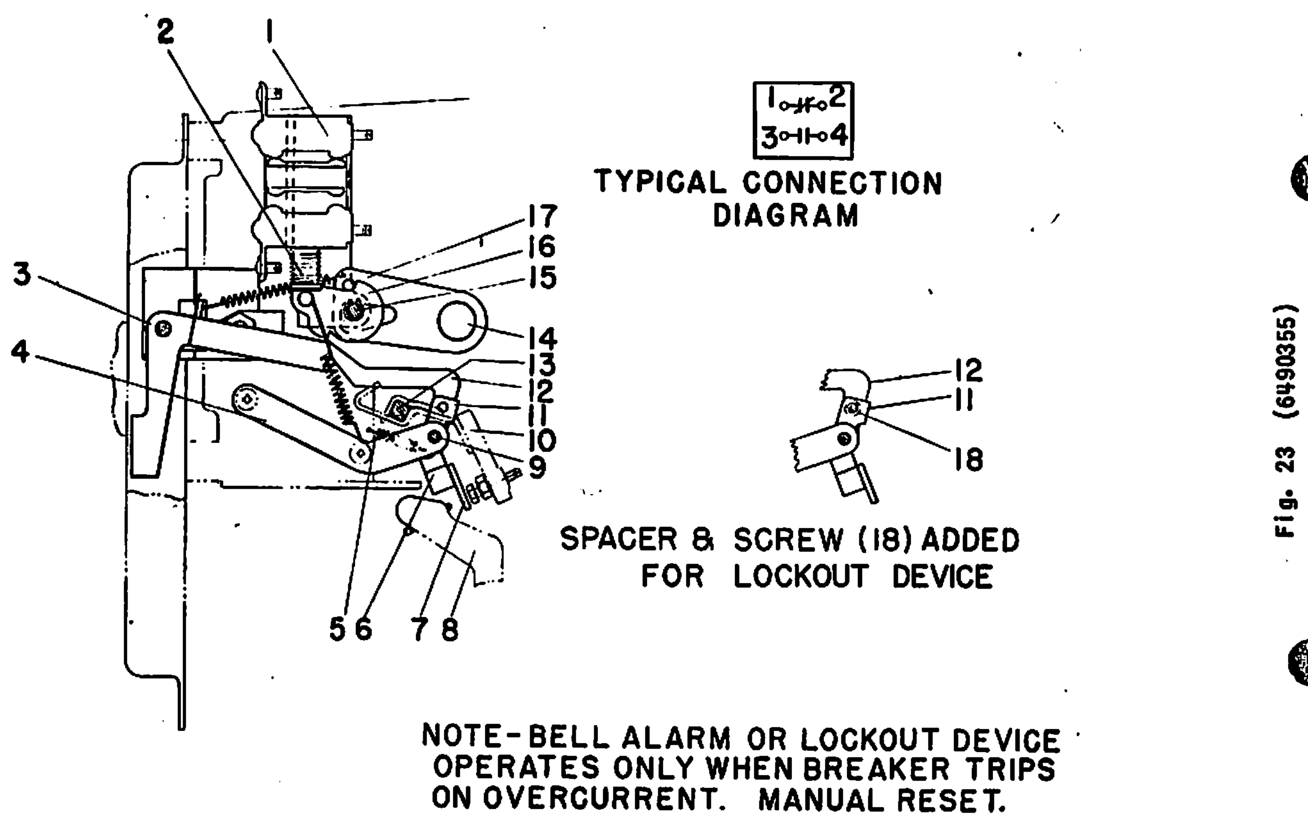
ADJUSTMENTS

In order for the bell alarm and lockout device to function properly the following conditions must exist:

1. The auxiliary trip shaft (6) must swing freely from its points of suspension and hang perfectly level with respect to the breaker parts.
2. The auxiliary shaft must be positioned so that each of its clearance cut-outs has such a position relative to its respective over-current device trip arm that the trip arm can operate without encountering interference from the shaft and contacts the shaft only at lever (7).
3. When the breaker is closed, lever (7) must hang in a position such that it touches neither the trip arm (8) or the adjusting screw in the trip paddle (10). The optimum condition is an equidistant position.
4. The latch (12) and the catch (16) must be so positioned relative to one another that when the breaker is closed and reset, the latch will clear the catch when the latch is rotated counterclockwise. The catch is mounted on the same supporting bracket as switch (1). This bracket may be shifted vertically by dismounting the switch and loosening the hardware which fastens the bracket to the mechanism side frame.

DRAWOUT BREAKER - FIG. 24

The drawout circuit breaker consists of a circuit breaker mounted in a drawout carriage which comprises the drawout mechanism. The drawout mechanism consists of guides (5), racking pins (3), racking handle (7), interlock lever (2) and an interlock arrangement which prevents the insertion and withdrawal of the breaker in the closed position. The drawout carriage is also equipped with a "test position" stop, where the secondary disconnects are engaged but the primary disconnects are safely parted. In this position the breaker may be operated for test purposes without energizing the primary circuit.



1. Switch	6. Auxiliary Shaft	11. Hanger	16. Catch
2. Plunger	7. Lever	12. Latch	17. Link
3. Reset Lever	8. Trip Arm	13. Trip	18. Screw
4. Mounting Bracket	9. Pin	14. Main Shaft	
5. Spring	10. Trip Paddle	15. Pin	

Fig. 23 Bell Alarm and Lockout Device

Older model breakers were equipped with rollers in place of guides on the breaker side frames, otherwise the drawout mechanisms are similar.

It is recommended that a fresh coat of G.E. lubricant D50H47 be applied to the primary disconnects at each inspection period.

For a complete description of the inserting and withdrawing the breaker from its enclosure, refer to GEH-2021A furnished with all AK breakers.

DISCONNECTS

PRIMARY DISCONNECTS

The primary disconnects are attached to the ends of the breaker studs on the rear side of the breaker base. Each disconnect assembly consists of two pair of opposed contact fingers. These are secured to the breaker stud by a bolt which passes through the assembly and the stud. When engaged with the stationary stud of the enclosure, the disconnect fingers exert a set amount of force against the stationary stud through the action of the compression springs. Retainers and spacers hold the contact fingers in correct alignment for engagement with the stud. The amount of force which the fingers exert against the stud is determined by degree to which the springs are compressed by the bolt and nut which hold the assembly together. If, for any reason, the disconnects must be taken apart, the position of the nut on the bolt should be carefully noted, so that in reassembling, the original amount of compression can be restored by replacing the nut at its former position on the bolt.

SECONDARY DISCONNECT, FIG. 25

The secondary disconnects serve as connections between breaker control circuit elements and external control circuits. They are used only on drawout type breakers. A terminal board serves the same purpose on stationary mounted and general purpose enclosure mounted breakers. The secondary disconnects allow removal of the breaker without the necessity of having to detach external connections.

The movable part of the secondary disconnect consists of an insulating body which holds a conducting spring loaded plunger to which a flexible lead is attached. As the breaker moves into its enclosure, the plunger is depressed by sliding onto the stationary disconnects of the enclosure.

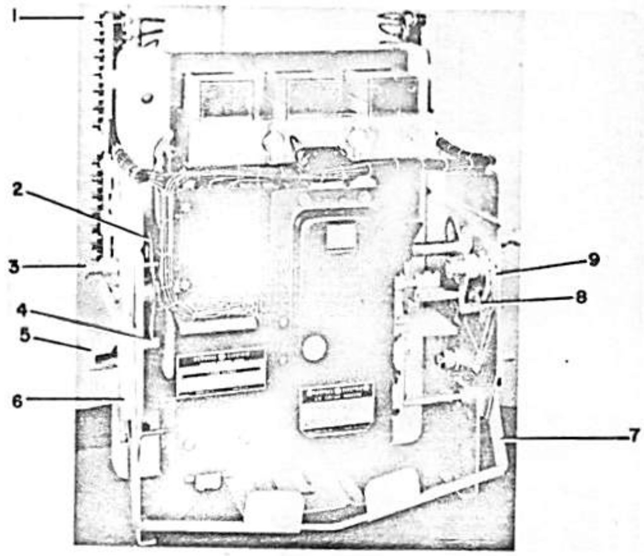
REPLACEMENT OF MOVABLE SECONDARY DISCONNECTS

1. Unfasten disconnect body from breaker back frame.

2. Open tabs which hold wires on inner side.

3. Pull contact tip loose from hollow tube.

4. Remove contact tip by cutting wire at its base.



1. Secondary Disconnect
2. Interlock Lever
3. Rack-Out Pin
4. Locking Pin
5. Guide
6. Handle Socket
7. Rack-Out Handle
8. Cam Slot
9. Trip Cam

Fig. 24 AK-1-25 Drawout Breaker

Fig. 24 (8021019)

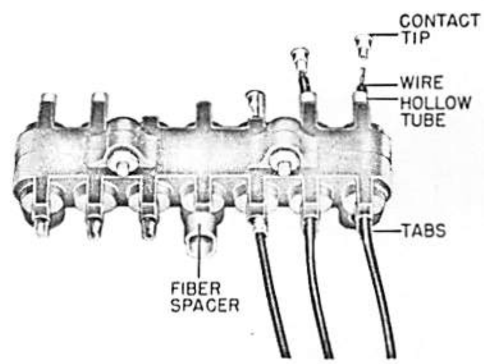


Fig. 25 Movable Secondary Disconnects

Fig. 25 (8017973)

5. Push wire through hollow tube of new disconnect assembly.

6. Strip insulation off end of wire to about 1/4 of an inch from end.

7. Place new contact tip on end of wire and crimp.

8. Pull wire through hollow tube until contact tip fits snugly against end of hollow tube.

9. Crimp tab on other side of assembly to hold wire in place.

10. Any hollow tubes which are not used should be pushed into the disconnect body and held in that position by placing fibre spacers over inner ends of tubes and spreading tabs.

11. When all wires have been connected, refasten the body of the assembly to the breaker back frame.

WELDING BREAKERS

The type AK-1-15Y1 and AK-1-25Y1 breakers are intended for the protection of resistance welding machines. They trip instantaneously at higher current settings than breakers provided with the regular instantaneous adjustable overcurrent tripping device. This type breaker differs from the regular breaker only in the provision that higher current settings may be obtained.

Standard calibration ranges for type AK-1-15Y1, Fig. 26, are as follows:

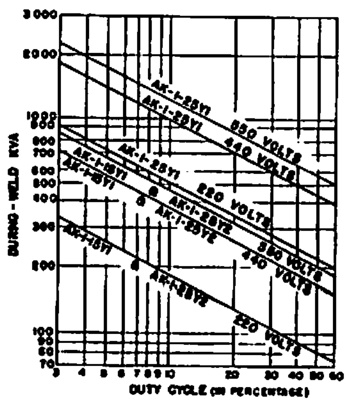
a. 300 to 800 amperes
b. 600 to 1500 amperes

Standard calibration ranges for type AK-1-25Y1, Fig. 26, are as follows:

a. 600 to 1500 amperes
b. 1400 to 4000 amperes
c. 2000 to 5000 amperes

Other ranges can be provided within reasonable limits where the highest calibration settings will not exceed approximately 2-1/2 times the lowest calibration setting.

These breakers are not given a continuous current rating since the duty imposed is intermittent and quite variable depending upon various types of welding to be done. The breakers are designed to safely carry "during-weld amperes" or "during-weld KVA" at welding periods not exceeding the corresponding "duty cycle" as tabulated below. ("Duty cycle" is the per cent of time that current flows in any one minute.



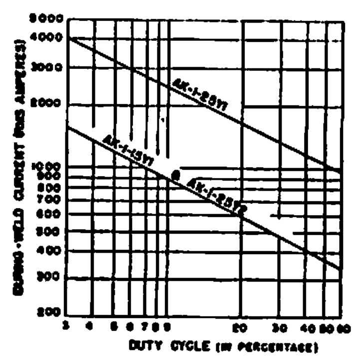


Fig. 26

Fig. 26 (267B332)

Duty Cycle (%)	During-weld Amp Rms	AK-1-15Y1 Breaker During-weld KVA			Duty Cycle (%)	During-weld Amp Rms	AK-1-25Y1 Breaker During-weld KVA		
		220 Volts	440 Volts	550 Volts			220 Volts	440 Volts	550 Volts
3	1530	337	674	841	3	4040	890	1780	2225
4	1325	292	584	729	4	3500	770	1540	1925
5	1185	261	522	652	5	3130	689	1378	1722
6	1080	238	475	594	6	2860	629	1258	1574
7	1000	220	440	550	7	2740	580	1161	1453
8	936	206	412	516	8	2640	544	1087	1360
9	884	194	388	486	9	2330	513	1025	1282
10	839	185	370	461	10	2215	487	974	1219
20	594	131	262	327	20	1566	345	689	861
30	484	108	215	266	30	1278	281	562	703
40	419	92	184	231	40	1107	244	487	609
50	375	83	165	206	50	990	218	436	545
60	342	75	150	188	60	903	199	398	497

Current and Duty Cycle Limits of Types AK-1-15Y1 and AK-1-25Y1 Breakers

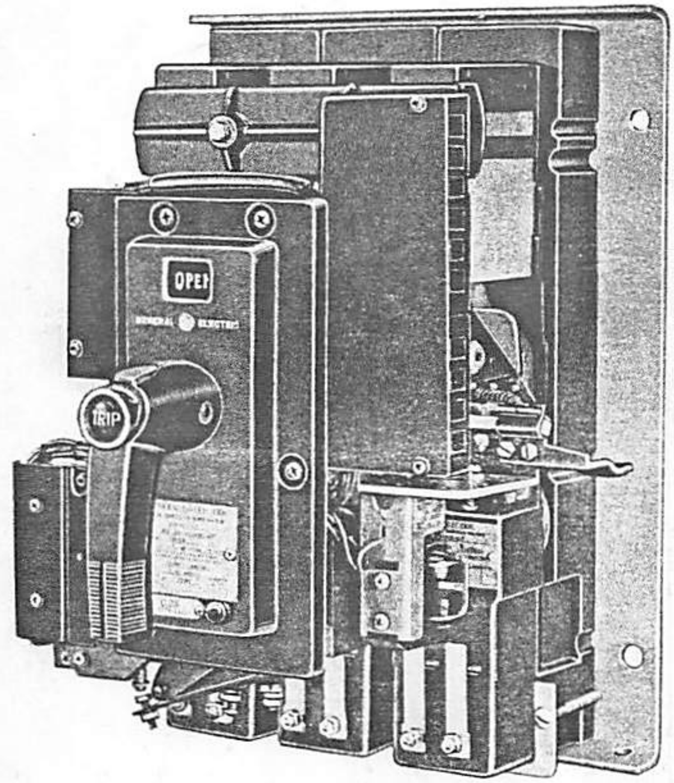
RENEWAL PARTS

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, GEF-3506.

In the absence of a Renewal Parts Bulletin, the described parts should be identified by giving the complete nameplate data of the circuit breaker or accessory.

Renewal parts which are furnished may not be identical with the original parts, since improvements are made from time to time. Parts which are furnished will be interchangeable.

AIR CIRCUIT BREAKERS



TYPE AK-1-15, 225 AMP
TYPE AK-1-25, 600 AMP

GENERAL ELECTRIC

SWITCHGEAR

CONTENTS

ILLUSTRATIONS

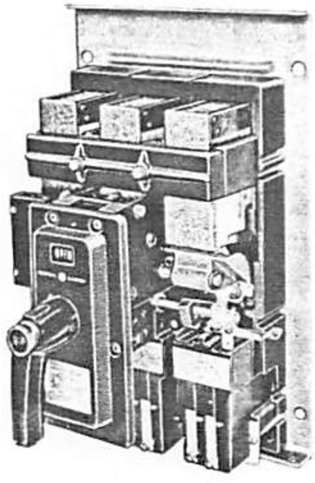


FIG. 1
TYPE AK-1-25 MANUALLY-OPERATED BREAKER

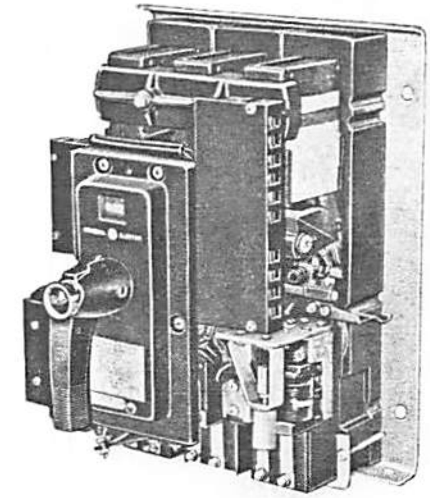


FIG. 2
TYPE AK-1-15 BREAKER WITH ELECTRICAL ATTACHMENTS

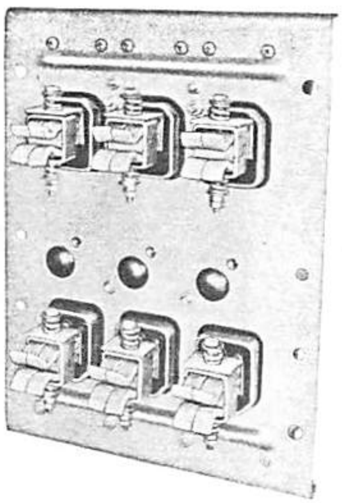


FIG. 3
REAR VIEW OF BREAKER WITH DISCONNECTS

FIG. 4
ENCLOSING CASE WITH BREAKER

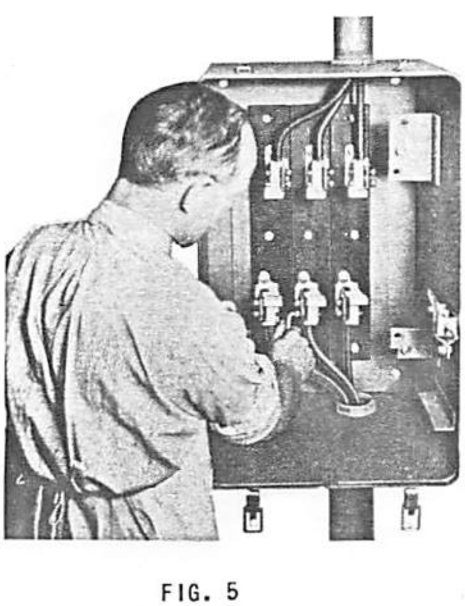


FIG. 5
ATTACHING CABLES TO SOLDERLESS CONNECTORS

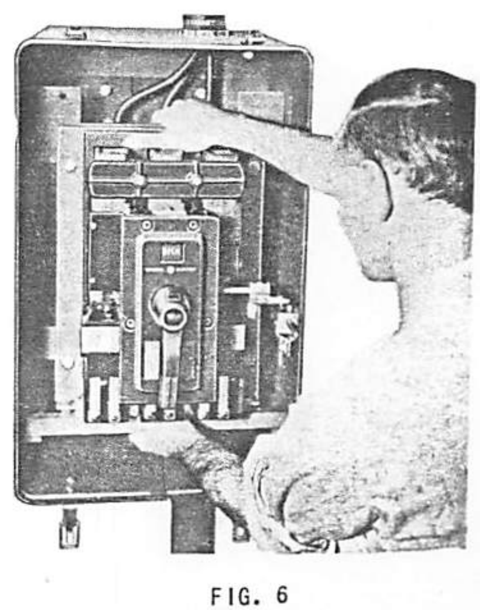


FIG. 6
MOUNTING BREAKER IN ENCLOSING CASE

8004135-(1). 8003938-(2). 8004794-(3). 8004138-(4). 8004134-(5), 8004133-(6)

AIR CIRCUIT BREAKERS

TYPES AK-1-15 AND AK-1-25

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.

I

GENERAL INFORMATION

1. SIMILARITY IN CONSTRUCTION

Types AK-1-15 and AK-1-25 air circuit breakers are essentially similar in construction with the exception that the AK-1-25 is built for higher continuous and interrupting ratings. This instruction book is based on Type AK-1-15 air circuit breaker, but it applies equally to type AK-1-25 after making the following allowances for ratings and construction:

Ratings

a. AK-1-25 current rating- 600 amperes (AK-1-15 current rating- 225 amperes).

b. Voltage rating is similar for both breakers; namely 600 volts a-c and 250 volts d-c.

c. AK-1-25 interrupting capacity - 25,000 amperes (AK-1-15 interrupting capicity - 15,000 amperes).

Construction-- Type AK-1-25 Compared with Type AK-1-15

a. The metal base is wider and longer.

b. The studs have been increased in width and thickness.

c. The pole units are wider and longer to provide for an additional movable and a stationary contact arm.

d. The insulating link for each pole unit has been increased in size to provide insulation for the additional contact arms.

e. The shunt has been increased in length and width.

f. An interior barrier has been added. Also, the interior and exterior barriers, as well as muffler, front cap, rear support and fiber straps for each pole unit have been increased in size to dissipate any increase in arcing.

g. A compound re-enforcing plate has been added to both sides of the two outside arc quenchers.

h. The main shaft has been lengthened in accordance with an increase in the width of the pole bases due to an increase in the number of contacts.

i. The flexible connection is attached with four screws instead of three screws.

j. The overcurrent and the reverse current tripping devices of the AK-1-25 breakers may have series coils up to 600 amperes (AK-1-15 breakers may have series coils up to 225 amperes).

2. APPLICATION

These circuit breakers are generally used for the protection and control of apparatus and branch circuits, including equipment in buildings, industries, power stations and for marine application within the ratings designated above.

The circuit breakers are furnished with two or three-pole units and are available with various automatic tripping devices and accessories for overcurrent, undervoltage and reverse current protection. The center pole of the two-pole breaker is provided for mechanical construction and may be utilized for electrical connections and a series overcurrent tripping device, when needed. No contacts or stud connections are located in the center pole of a two-pole breaker.

II

SHIPPING - UNPACKING - STORAGE

1. TRANSPORTATION DAMAGE

Immediately upon receipt of the circuit breaker, an examination should be made for any damage or loss sustained in transit. 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.

2. 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 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 have accumulated on the breaker parts.

3. STORAGE

If the circuit breaker is not installed at once, it should be stored in a clean dry place and preferably placed in a vertical position. It should be supported to prevent bending of studs or damage to the breaker parts. It is advisable not to cover the breaker with any packing of other material that absorbs moisture which may cause corrosion of breaker parts. A covering of paper will prevent dust from settling on the breaker parts.

III
INSTALLATION

1. LOCATION

The air circuit breaker should be installed in a clean dry place where it is readily accessible for operation, inspection and proper maintenance. Special enclosures are available for the installation of circuit breakers which may be subjected to dust and moisture or other unfavorable locations.

2. BREAKER CONNECTIONS

The connections to the circuit breaker studs should be firmly clamped or bolted in place to prevent excessive heating. The connecting cables or bus bars should have a current-carrying capacity sufficient to limit their temperature rise to that specified for the breakers. If these connecting cables or bus bars are not of sufficient size, heat will be conducted from them to the breaker so that the breaker cannot 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.

3. DEAD FRONT BREAKERS

Dead front circuit breakers are designed for mounting in a switchboard or an enclosing case. The mounting of dead front breakers consists in placing the breakers within the enclosed structure and connecting the power buses or cables and making the necessary control connections. The standard mounting depth from the back surface of the breaker base to the back side of the front panel is 8-3/4". Provision is made, when specified, for recessing breakers to a depth of 17-1/4" (see Fig. 31). The front cover of dead front breakers consists either of a hinged door with cut-out or a plate bolted to the panel. An adapter plate is used in addition to the front cover when the breaker is recessed. This plate is bolted to two angle irons furnished by the switchboard builder.

A terminal board on the right side of the breaker, Fig. 35, is used for making various control connections with breaker devices. An auxiliary switch on the left side of the breaker Fig. 16, is used for some control connections and for connecting various auxiliary accessories.

The structural surface to which the breaker is bolted must be flat through-out and the supporting structure must be of sufficient strength to hold the breaker firmly in place. Minimum cut-out dimensions must be maintained in order to have proper electrical clearance.

When disconnects, Figs. 32, 33 and 34 are used, the breaker is placed against the panel so that the disconnects fit over the stationary studs to which the power circuits are connected. Four 1/2" mounting bolts are then inserted into the holes for bolting the breaker to the panel. When the disconnects are not used, the power circuits are bolted to the breaker studs after bolting the breaker to the panel by using the four 1/2" mounting bolts. Breakers mounted in drawouts or an enclosing case (see below) are equipped with disconnects.

4. ENCLOSED BREAKER

The enclosed air circuit breaker is shipped in an enclosing case. Before the enclosed breaker is installed, first, remove the cover of the enclosure and the four mounting screws in the breaker base (Fig. 6). The breaker unit is then pulled forward to disengage disconnects and to remove it from the enclosing case. Knockouts at the top and bottom of the enclosing case must be removed in order that connections can be made with power cables and control equipment. Next, mount the enclosing case in the desired location and secure the cables in the solderless connectors of the enclosing case, and connect the control circuits (Fig. 5). Finally, return the removable breaker unit to the enclosing case and replace the four mounting screws and the cover to complete the installation.

IV
OPERATION AND MAINTENANCE

1. OPERATION

The circuit breaker may be closed manually with a pistol grip operating handle. Breakers equipped with a closing solenoid may be closed manually by using the operating handle, or electrically by means of a closing switch. To close the breaker manually, the operating handle must be moved approximately 90° in a clockwise direction (looking from the front). The handle will drop back automatically to the "Down" position after closing the breaker. The breaker may be tripped manually by pushing a trip button located in the front part of the operating handle, or automatically by any trip device with which the breaker is equipped. The breaker is automatically reset when tripped either manually or electrically. The breaker is "trip free" from the closing mechanism which assures that it cannot be closed as long as any trip device is functioning.

2. MAINTENANCE

BEFORE INSPECTION OR ANY MAINTENANCE WORK IS DONE, BE SURE THAT THE BREAKER IS IN THE OPEN POSITION. ALL ELECTRICAL POWER, BOTH PRIMARY AND CONTROL SOURCES, SHOULD ALSO BE DISCONNECTED.

Periodic inspection of the circuit breaker is recommended at least once a year. More frequent inspections are recommended, if severe load conditions, dust, moisture, or other unfavorable conditions exist. A complete inspection of the breaker, including contacts and arc quenchers, should always be made after the breaker has opened a severe short circuit.

After the breaker has been installed, as well as at the regular inspection periods, slowly operate it manually several times as described above and observe whether the contacts line up properly and make sure that all parts move freely without binding or excessive friction.

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.

If overheating, not caused by overcurrent, is observed, a complete inspection of the breaker should be made including connections, contacts and flexible connectors.

At all times it is important not to allow pencil lines, paint, oil or other foreign materials on the insulating surfaces of the breaker as they may cause low resistance between points of different potential and result in eventual electrical breakdown.

The electrically operated breaker should be opened and closed at rated voltage, to make sure that all control circuits are properly connected and that all electrical attachments are functioning properly. It should be remembered that the closing solenoid is rated for intermittent service only. Reasonable care, therefore, should be exercised when testing to avoid overheating of the closing solenoid by repeated operations.

The contacts should be inspected at the regular inspection periods and always after a known severe short circuit has been opened to ascertain whether the contacts are badly worn or pitted, in which case they should be dressed or replaced. It is necessary to remove the arc quenchers in order to properly inspect the contacts (see "Replacements" under Arc Quencher). For a more comprehensive discussion of contacts, see Contact Assembly.

3. LUBRICATION

In general, the circuit breaker requires little lubrication. Bearing points and latch surfaces should be lubricated at the regular inspection periods with a thin film of extreme temperature, high-pressure, light grease similar to Royco #20 (Royal Engineering Company, Hanover, N. J.) Hardened grease and dirt should be removed from latch and bearing surfaces by using kerosene. ALL EXCESS LUBRICANT SHOULD BE REMOVED WITH A CLEAN CLOTH IN ORDER TO AVOID ANY ACCUMULATION OF DIRT OR DUST.

V

SAFETY PRECAUTIONS

CARE MUST BE TAKEN WHEN THE CIRCUIT BREAKER IS BEING INSTALLED AND WHEN ANY INSPECTION OR MAINTENANCE WORK IS BEING DONE THAT THE BREAKER IS IN THE TRIPPED OR OPEN POSITION. ALL CONTROL AND POWER CIRCUITS ATTACHED TO THE BREAKERS, SHOULD ALSO BE DE-ENERGIZED.

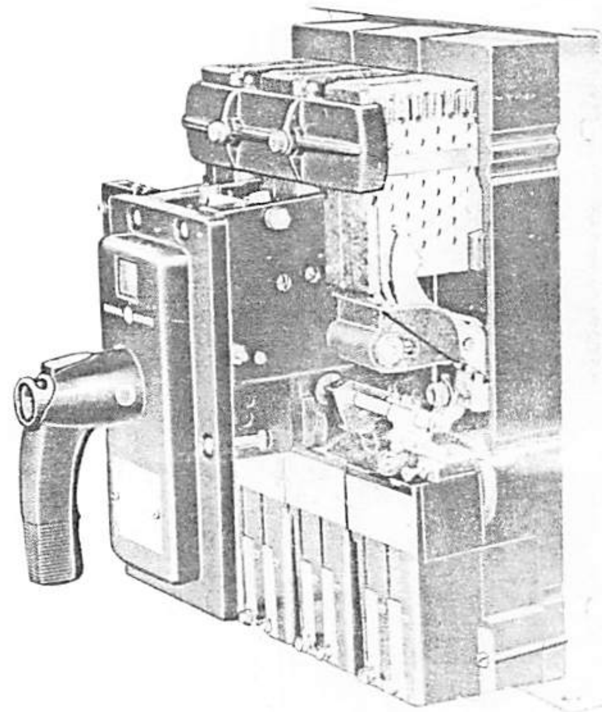


FIG. 7

TYPE AK-1-15 SHOWING ARC QUENCHER WITH OUTSIDE BARRIER AND SIDE OF MUFFLER REMOVED

VI

BASIC BREAKER COMPONENTS

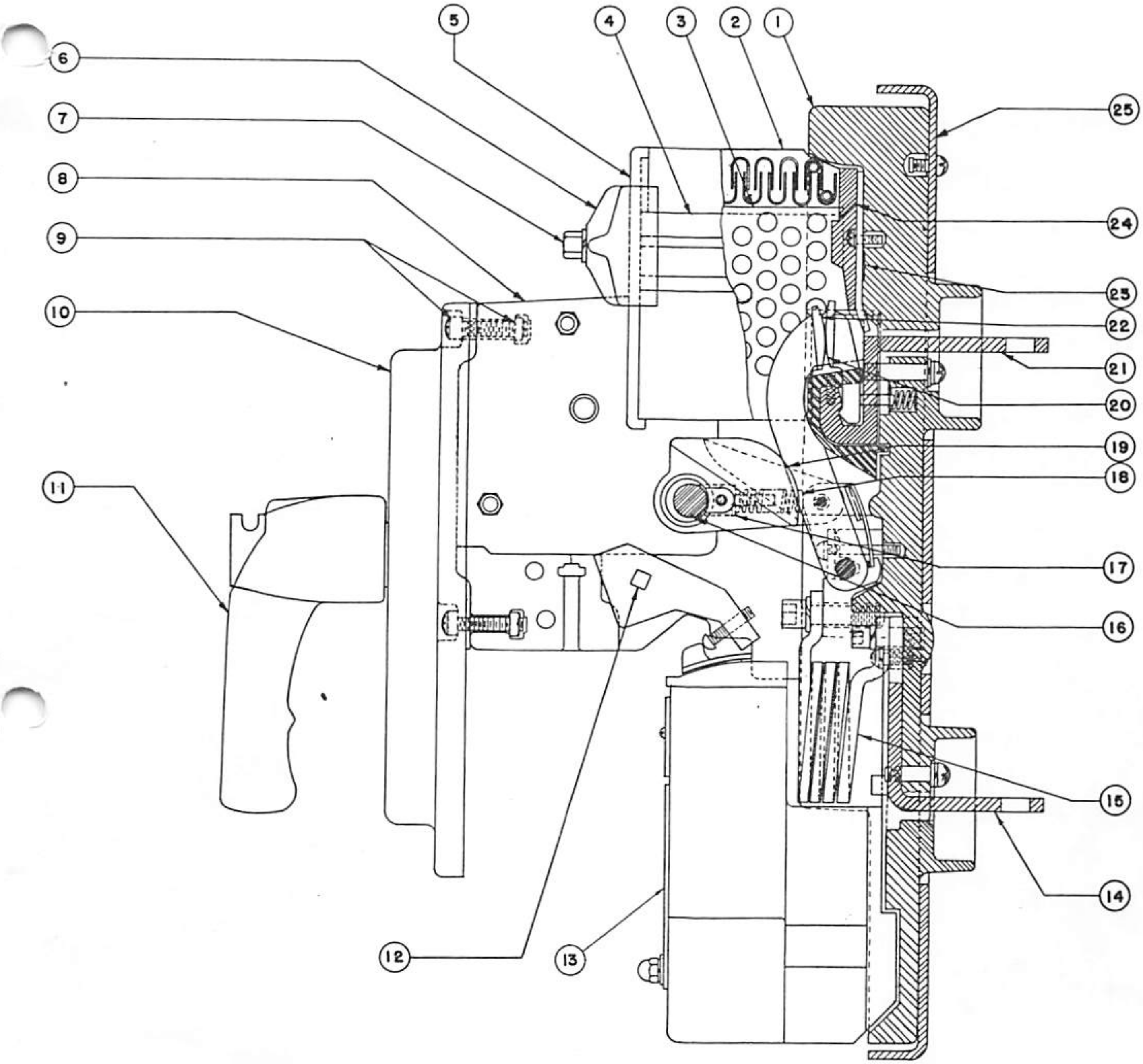
1. ARC QUENCHER FIGS. 7 AND 8

Each arc quencher has two compound inside barriers (3) containing a large number of perforations and two outside barriers (4) without perforations, as well as a front cap (5) and a rear support (24) held in place by a fiber strap (23). A clamp (6) is attached to the breaker base by two bolts (7). Clamp (6) holds all the arc quencher assemblies to their respective pole units. A muffler (2) is located on top of the compound barriers. The compound barriers and the muffler, together with the slots between the barriers, serve to extinguish the arc.

The arc quenchers should be inspected at the regular inspection period and parts replaced, if badly burned or corroded.

REPLACEMENTS--Arc Quencher, Fig. 8

1. Remove clamp (6) by removing two bolts (7).
2. Unclasp fiber strap (23).
3. Remove front cap (5), muffler (2), outside barriers (4), interior barriers (3) and rear support (24).



1 POLE UNIT BASE
2 MUFFLER
3 INSIDE BARRIER
4 OUTSIDE BARRIER
5 FRONT CAP
6 CLAMP
7 BOLT
8 OPERATING MECHANISM
9 MOUNTING SCREW & NUT
10 FRONT ESCUTCHEON
11 OPERATING HANDLE
12 TRIP SHAFT
13 OVERCURRENT TRIP DEVICE
14 LOWER STUD
15 SERIES COIL
16 MAIN SHAFT
17 CAP
18 OPENING SPRING
19 INSULATING LINK
20 STATIONARY CONTACT
21 UPPER STUD
22 MOVABLE CONTACT
23 FIBER STRAP
24 REAR SUPPORT
25 STEEL BASE

FIG. 8

RIGHT SIDE VIEW OF BREAKER ASSEMBLY

SK. T-6490325

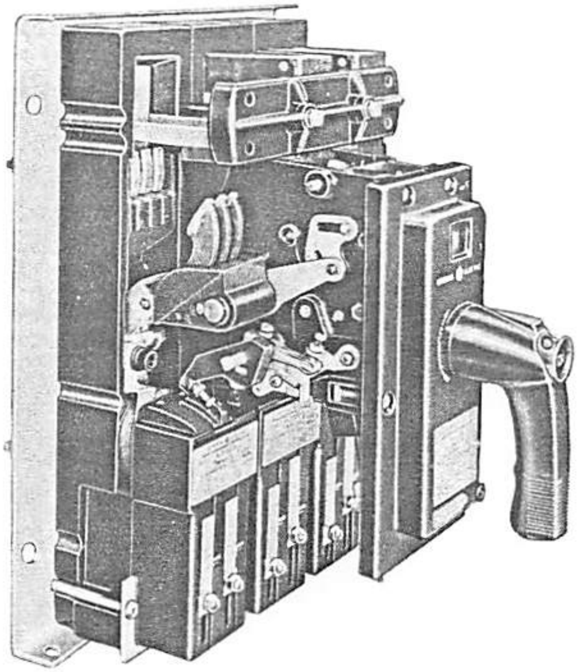


FIG. 9
TYPE AK-1-15 SHOWING CONTACT ARRANGEMENT WITH ARC QUENCHER AND AUXILIARY SWITCH REMOVED

4. Install new or disassembled parts in reverse order.

NOTE: In re-assembling the rear support (24) to the breaker, be sure and push the rear support toward the top of the pole unit so that the clearance in the rear support will accommodate the screw-head of the back plate.

2. CONTACT ASSEMBLY FIGS. 9 AND 10

The contact assembly of each pole unit consists of a stationary and a movable contact sub-assembly.

The stationary contact assembly consists of three parallel contact fingers (25) with silver alloy tips, the upper stud (24) and three pins (22) with compression springs (23) which provide continuous contact pressure between the contact fingers and the upper stud (24). A shunt (26) is used to prevent pitting at the pivot point of the stationary fingers when carrying high momentary currents. The stationary contact fingers are held in place by the upper stud cap (6).

The movable contact assembly consists of three parallel contact arms (4) with silver alloy tips, a contact carrier (21) with a spring (20) which provides continuous contact between the contact arms and pin (17). A clamp (16) secures pin (17) to the contact support (18). A flexible connection (14) is provided to prevent pitting at the pivot point of the movable contact arms when carrying high momentary currents.

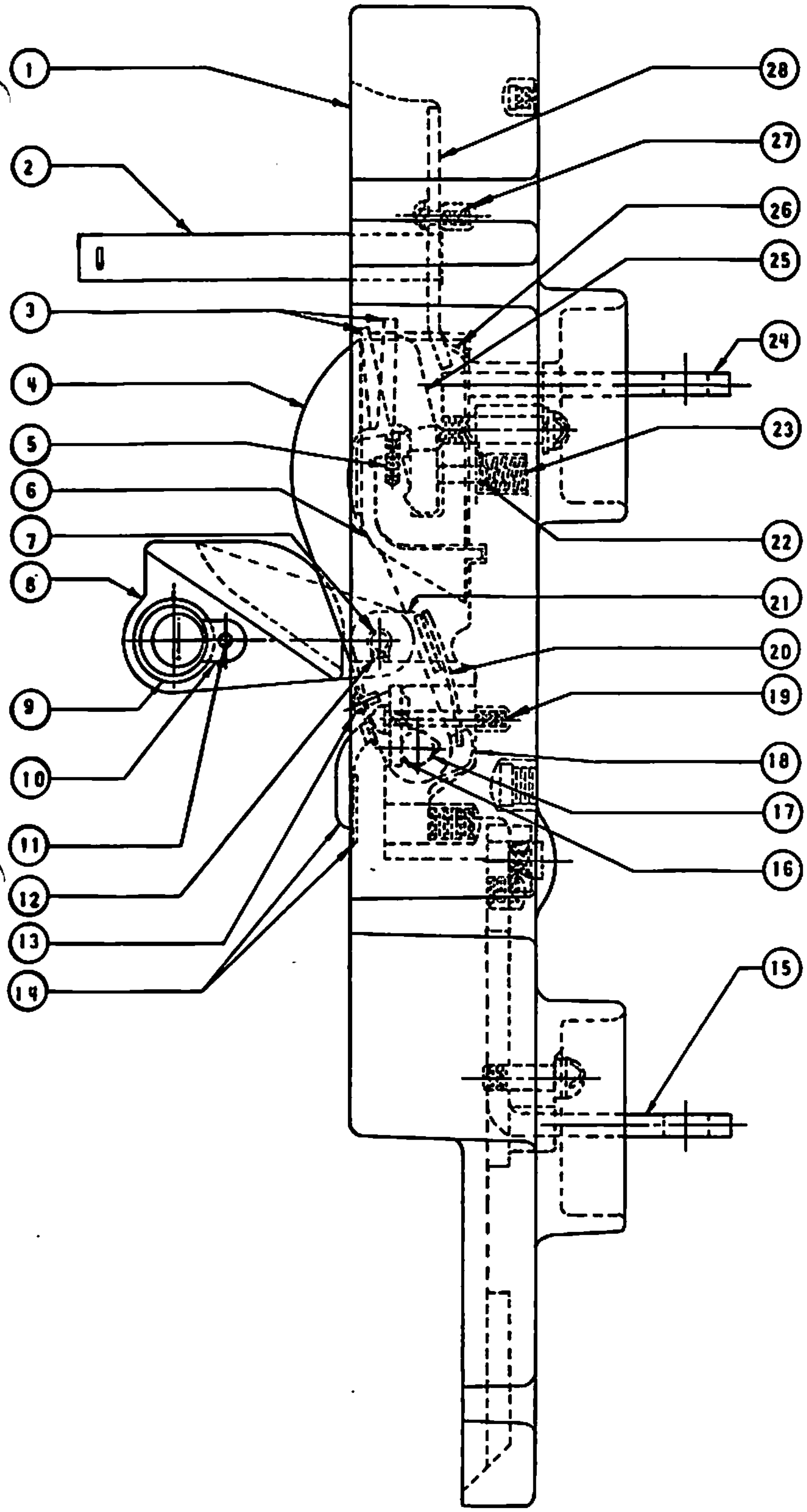
The movable contact assembly is connected to the main shaft (16), Fig. 8, by an insulating link (8) for operating the contacts when the contacts close. A definite amount of contact pressure (see "Measuring Contact Pressure") must be exerted by the movable contacts against the stationary contacts. A definite amount of contact wipe, or the distance that the stationary contacts are pushed to the rear by the movable contacts (see "Measuring Contact Wipe"), must result during the closing operation. Both contact pressure and contact wipe should be checked at the regular inspection period.

MEASURING CONTACT PRESSURE

1. Remove arc quencher (see "Replacements" under Arc Quencher).
2. Place a push-type scale against the upper end of the stationary contact tip (3) with the breaker closed.
3. Exert pressure against the push-type scale until the contacts just part. When the contacts part, the scale should register between 4 and 6 pounds.
4. Re-assemble parts in reverse order.

MEASURING CONTACT WIPE

1. Remove arc quencher (see "Replacements" under Arc Quencher).



1 POLE UNIT BASE
2 FIBER STRAP
3 CONTACTS
4 MOVABLE CONTACT ARM
5 SCREW
6 UPPER STUD CAP
7 PIN
8 INSULATING LINK
9 ECCENTRIC BUSHING
10 CLAMP
11 SCREW
12 TRUARC RETAINER
13 SCREW
14 FLEXIBLE CONNECTION & TERMINAL
15 LOWER STUD
16 CLAMP
17 PIN
18 CONTACT SUPPORT
19 SCREW
20 SPRING
21 CONTACT CARRIER
22 CONTACT PIN
23 SPRING
24 UPPER STUD
25 STATIONARY CONTACT FINGER
26 SHUNT
27 SCREW
28 STEEL PLATE

FIG 10
CONTACT ASSEMBLY

2. Ascertain the dimension between the inside surface of the pole base and the top edge of the stationary contact tip (3), (a) with the breaker open, (b) with the breaker closed.

3. Now ascertain the difference between the two measurements which should be approximately 7/32".

4. Re-assemble parts in reverse order.

ADJUSTING CONTACT WIPE AND CONTACT PRESSURE

1. Remove truarc washer from main shaft (16), Fig. 8, nearest the insulating link and contact assembly to be adjusted.

2. Loosen screw (11), Fig. 10, which secures the eccentric bushing to the insulating link to be adjusted.

3. Push the main shaft (16), Fig. 8, approximately half-way through the insulating link to be adjusted.

4. Apply an adjustable expansion tool to the bushing in the insulating link and turn the bushing, thereby moving the insulating link closer or farther away from the stationary contacts, as required.

5. Re-assemble parts in reverse order and make proper adjustments.

NOTE: To adjust the insulating link in the center pole unit, first, push the main shaft through the right hand insulating link and into the center link as described in items, 2 and 3 below. (Caution: Opening spring and cap will drop out). Adjust center insulating link as described in item 4 above. Re-assemble parts in reverse order being careful to replace opening spring and cap in their proper position.

If any of the contacts are badly corroded or pitted, thereby making it impossible to adjust for proper contact pressure or contact wipe, such stationary contacts or movable contact assemblies should be replaced. See "Replacements" below.

REPLACEMENTS-- Movable Contact Assembly, Fig. 10.

1. Remove front escutcheon (see "Replacements" under Front Escutcheon).

2. Disconnect external wiring to terminal board and auxiliary switch.

3. Remove arc quencher (see "Replacements" under Arc Quencher).

4. Remove truarc washer from one end of the main shaft and push main shaft through insulating link.

5. Remove four mounting bolts (2), Fig. 11, and lift entire operating mechanism from breaker.

Note: To remove the two lower mounting bolts (2), Fig. 11, on electrically-operated breakers proceed as follows.

   a. Move left hand trip paddle to the extreme left on the trip shaft. Also remove right hand trip paddles.

   b. Remove lower mounting bolts with off-set screwdriver and lift entire operating mechanism from the breaker.

6. Remove four screws (13) attaching the braid (14) to the movable contact arms.

7. Remove two screws and clamp (16).

8. Remove the movable contact assembly from the operating mechanism.

9. Remove the insulating link from the old movable contact assembly and reassemble this same link to the new movable contact assembly.

10. Remove braid (14) from new movable contact assembly.

11. Install new movable contact assembly and replace clamp (16).

12. Remove screw from left hand coil terminal.

13. Remove old braid.

14. Install new braid by re-assembling coil terminal screw and four screws (13) in movable contact assembly.

15. Replace items 3 and 4 in reverse order.

16. Adjust contact wipe and contact pressure (see above).

17. Replace items 1 and 2 in reverse order.

Stationary Contact (25)

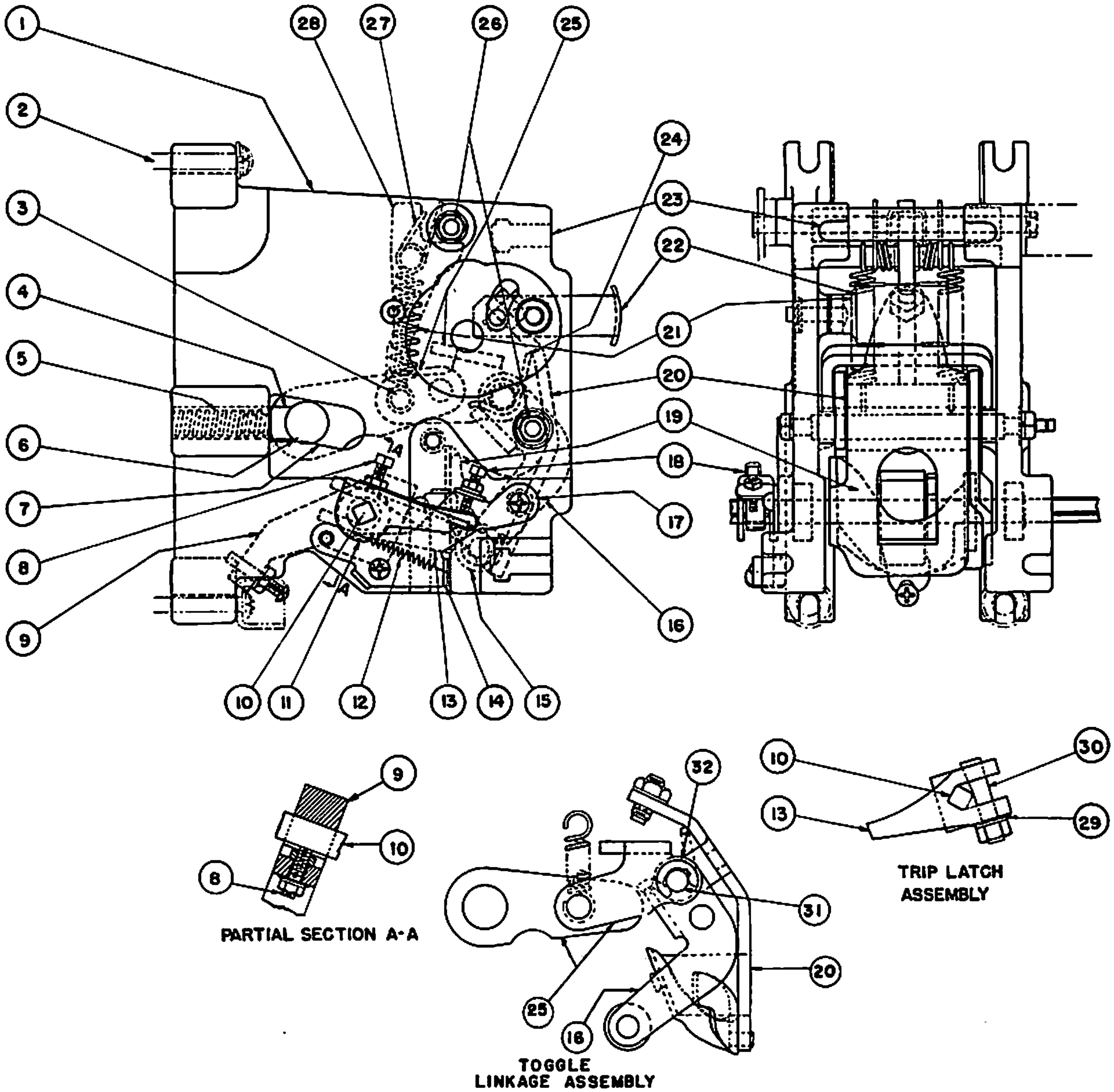
1. Remove arc quencher (see "Replacements" under Arc Quencher).

2. Remove the upper stud cap (6) by removing two screws (5).

3. Pry the stationary contact (25) from upper stud (24).

4. Replace the new stationary contact in reverse order. (It may be necessary to tap the new stationary contact into place by using a mallet).

5. Adjust contact wipe and contact pressure (see above).



1 MECHANISM FRAME
2 MOUNTING BOLT
3 PIN
4 CAP
5 SPRING
6 MAIN SHAFT
7 SLOT IN FRAME
8 SCREW
9 TRIP PADDLE
10 TRIP SHAFT
11 BUFFER PADDLE
12 SPRING
13 TRIP LATCH
14 STOP
15 ROLLER
16 CRANK
17 SUPPORT
18 ADJUSTING SCREW
19 CAM
20 CAM SUPPORT
21 SPRING
22 POSITION INDICATOR
23 RECESS FOR MOUNTING SCREW (SEE FIG 8)
24 TORSION SPRING
25 TOGGLE LINKS
26 BOLTS
27 SPRING
28 PROP
29 NUT AND WASHERS
30 BOLT
31. PIN
32. TRUARC WASHER

FIG. 11

OPERATING MECHANISM

SK. T-6490345

3. OPERATING MECHANISM FIGS. 11 AND 12

The operating mechanism, Fig. 11, is supported between two molded side frames in front of the middle pole unit. It consists primarily of a toggle linkage (25), cam (19), crank (16), latch (13), trip shaft (10) and roller (15). The mechanism is connected with insulating link (8), Fig. 10, which, in turn, is attached to the main shaft (6).

The breaker is closed manually by moving the operating handle approximately 90° clockwise (looking from the front), thereby straightening the toggle linkage and pushing back main shaft (6) and movable contacts to the closed position. A similar action results when the breaker is closed electrically by means of the closing solenoid (see Fig. 18). The breaker is held in the closed position by prop (28) supported on pin (3) and by latch (13) against roller (15) attached to crank (16).

The breaker mechanism is tripped by rotating trip shaft (10) and releasing trip latch (13) which causes the toggle linkage to collapse, thereby allowing the opening springs (21) to push forward the main shaft and movable contacts to the open position. Trip latch (13) is automatically reset during the opening operation. Stop (14) limits the rotation of trip shaft (10) and thus determines the amount of latch engagement.

ADJUSTMENTS--Latch (13) is adjusted at the factory to provide approximately 1/16" engagement between latch (13) and roller (15) when the breaker is closed. To adjust for proper latch engagement, first, loosen lock nut of adjusting screw (18) on the buffer paddle, to the left of the mechanism frame, and back off several turns on this same adjusting screw. Then close breaker and place 1/16" shim between end of adjusting screw (18) and buffer paddle (11). Now advance adjusting screw (18) until the breaker just trips. Tighten lock nut.

The adjusting screw on top of cam support (20) is used to provide between 1/32" and 1/16" clearance between latch (13) and roller (15) with the breaker in the open position. With this amount of clearance, the breaker mechanism will reset automatically during the closing operation, and, at the same time, provide the necessary overtravel for prop (28) to move on pin (3). If not enough clearance is provided between latch (13) and roller (15), the breaker mechanism will not reset. If too much clearance is provided, prop (28) will not move on top of pin (3) and the breaker will not reclose because cam support (20) will move against the inner surface of the front escutcheon during the closing operating. By applying an allen wrench to screw on top of the cam support (20), and either advancing or backing off on this same screw, as required, the proper adjustment can be made.

REPLACEMENTS--Operating Mechanism, Fig. 11.

1. See "Replacements" under Movable Contact Assembly, items 1 to 5.
2. Replace operating mechanism in reverse order.

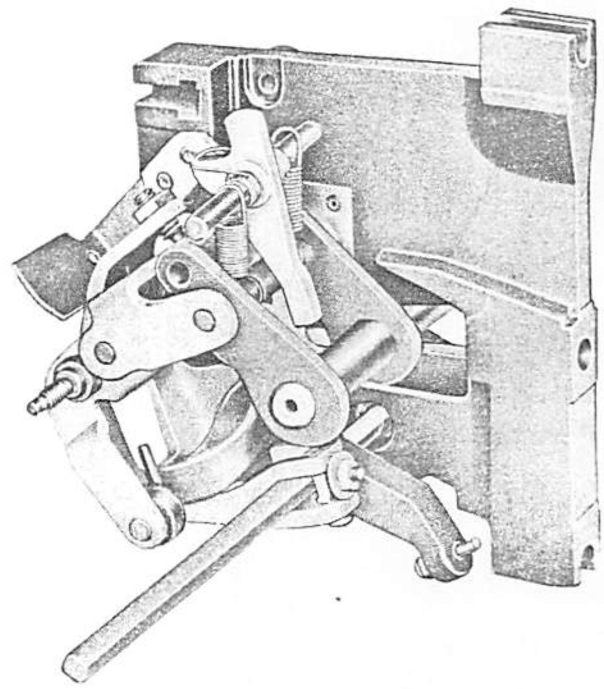


FIG. 12

PARTIAL VIEW OF OPERATING MECHANISM

Two Opening Springs (5)

1. Remove arc quencher (see "Replacements" under Arc Quencher).
2. Remove truarc washer from end of main shaft (16), Fig. 8, nearest to spring to be installed.
3. Push main shaft to opposite side of operating mechanism. (Cap (4) and spring (5) will back up into slot occupied by main shaft.)
4. Remove cap (4) and spring (5) from slot by using small screwdriver.
5. Install new springs in reverse order after assembling cap (4) to new spring and pushing cap and spring in place.

Tension Spring (21)

1. Remove operating mechanism (see "Replacements" under Movable Contact Assembly, items 1 to 5).
2. Remove paddles from the trip shaft on the right side of the breaker.
3. Remove truarc washer from right side of trip shaft.
4. Remove return spring (12).

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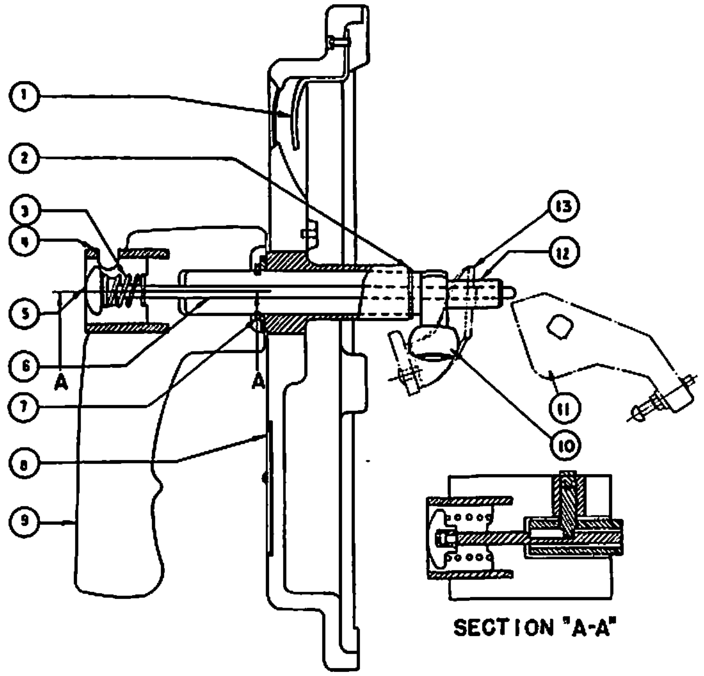


FIG. 13
FRONT ESCUTCHEON AND
OPERATING HANDLE ASSEMBLY

5. Remove top bolt (26).
6. Remove nut from right end of bottom bolt (26).
7. Remove right hand mechanism frame.
8. Remove tension spring (21).
9. Replace new tension spring in reverse order.

NOTE: To replace torsion springs (24 and 27), follow procedures for removing tension spring (21) as above and, in addition, remove the necessary truarc washers and pins.

4. FRONT ESCUTCHEON AND OPERATING HANDLE ASSEMBLY FIG. 13

The front escutcheon is mounted on front of the operating mechanism frame by four screws (9), Fig. 8. The front escutcheon and operating handle assembly consists of:

a. A pistol grip operating handle (9) attached to one end of the shaft (12) which extends through the front escutcheon.

b. A roller (10) attached to the other end of the shaft.

c. A trip button (5) screwed to the front end of trip rod (6) which is centered in the shaft.

The breaker is closed manually by turning the operating handle clockwise approximately 90° causing roller (10) to engage cam (13), thereby straightening a toggle linkage (25), Fig. 11, and closing the breaker. After closing the breaker, the operating handle will return automatically to the "Down" position. The trip button (5), in the front part of the operating handle, is pushed to the rear to trip the breaker manually.

The breaker may be locked in the tripped position by pushing the trip button to the rear and inserting a padlock through slot (4) in the metal ferrule.

REPLACEMENTS--Front Escutcheon Assembly

1. Remove four mounting screws (9), Fig. 8.
2. Now pull forward on the operating handle turning and tipping the front escutcheon slightly until dislodged from the breaker.
3. To remount the front escutcheon assembly, first, hold the trip shaft in a trip free position. Then pull the cam support (20), Fig. 11, slightly forward.
4. Insert the shaft (12) and roller (10) into the hole of the cam support so that the roller (10) drops behind cam (13).
5. Replace the four mounting screws to secure the front escutcheon assembly to the mechanism frame.

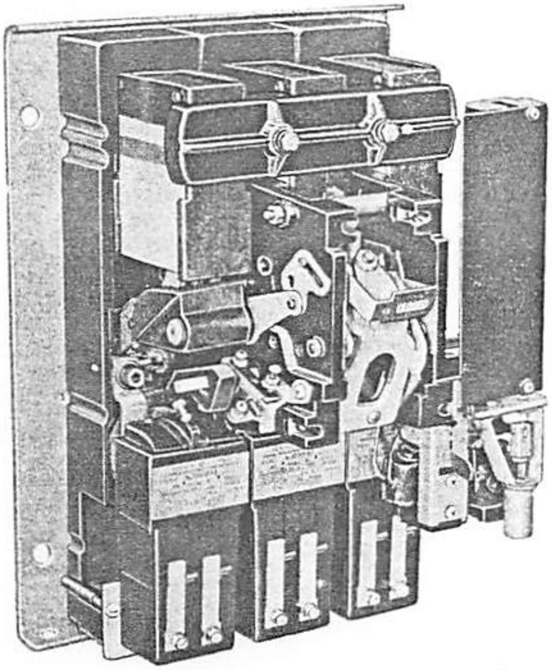


FIG. 14
LINKAGE FOR POSITION INDICATOR AND AUXILIARY SWITCH

REPLACING THE OPERATING HANDLE

1. Remove the short set screw from the tapped hole in the operating handle. (See Section A-A).
2. Back off a second longer set screw from the same tapped hole until it is moved clear of the shaft.
3. Pull forward on operating handle until trip rod (6) is released from the front escutcheon and shaft (12). Remove the trip rod and returning spring (3) from the operating handle by pushing the trip rod forward through the operating handle. (For removing shaft (12), see "Recessing the Standard Breaker" under Extension for Recessed Breakers, items 3 and 4.)
4. Re-assemble operating handle to front escutcheon and shaft (12) in reverse order.

Note: In replacing set screws in operating handle, it is important that the short set screw in item (1) above, is replaced after the long set screw in item (2) has been replaced.

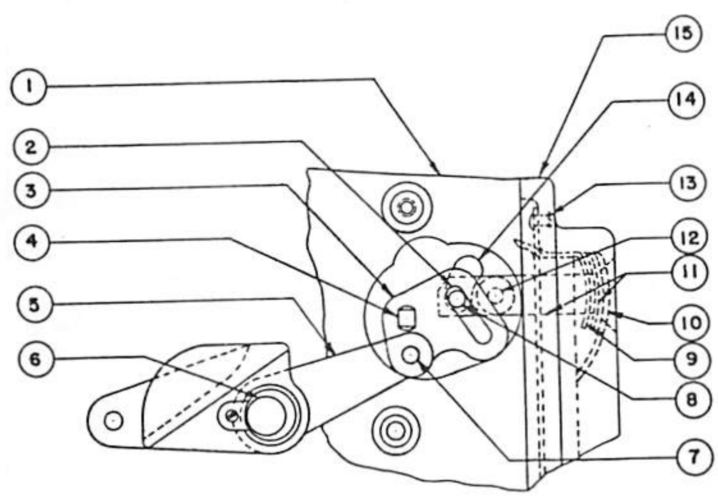
To provide for sufficient clearance between the long set screw and trip rod (6), the long set screw is advanced until it just binds the trip rod. Then back off on set screw one turn. After locking the long set screw with the short set screw, check trip rod (6) to see that it moves freely.

5. POSITION INDICATOR FIGS. 14 AND 15

The mechanism of the position indicator is mounted on the left side of the operating mechanism frame (looking from the front). It consists of a link (5) connected with the main shaft (6), crank (3) and shaft (4).

The stationary green target (9) is mounted behind a window (10) in the front escutcheon (15) and indicates when the breaker is in the open position. The red target (11) which indicates when the breaker is in the closed position, is actuated by the main shaft (6) through link (5) and crank (3), thereby moving the red target in front of the indicator window. Shaft (4) serves as a pivot for crank (3) which, in turn, also operates the rotary auxiliary switch (see "Rotary Auxiliary Switch" Fig. 16). When the breaker opens, the main shaft moves the crank upward causing the red target to drop below the window which allows the stationary green target to become visible.

REPLACEMENTS--The position indicator is a sub-assembly of the operating mechanism and is replaced when the operating mechanism is replaced.



1 OPERATING MECHANISM FRAME
2 SLOT IN CRANK
3 CRANK
4 SHAFT OF AUXILIARY SWITCH (SEE FIG. 16)
5 LINK
6 MAIN SHAFT
7 PIN IN CRANK
8 PIN IN INDICATOR ARM
9 GREEN TARGET (SEE FIG. 13)
10 WINDOW
11 RED TARGET AND INDICATOR ARM
12 PIVOT-INDICATOR ARM
13 RIVET
14 SLOT IN MECHANISM FRAME
15 FRONT ESCUTCHEON (SEE FIG. 13)

FIG. 15
POSITION INDICATOR

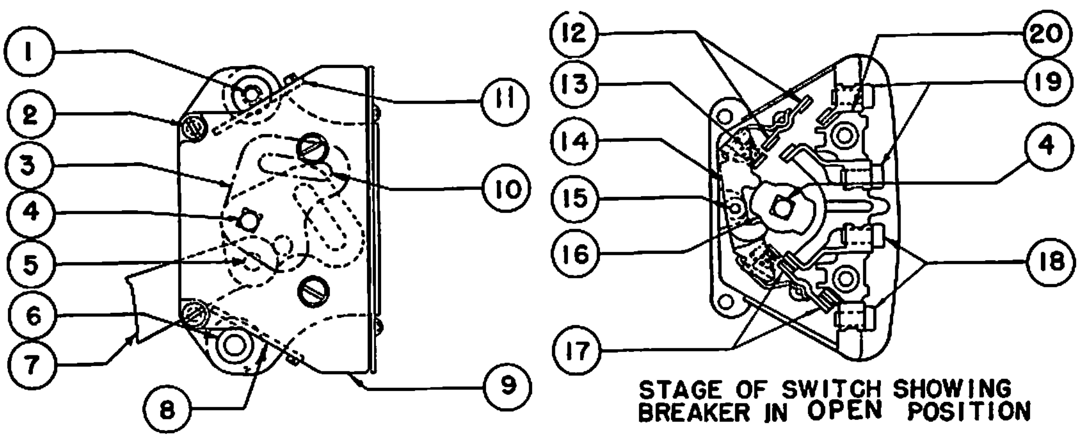
6. ROTARY AUXILIARY SWITCH FIGS. 16 AND 17

The auxiliary switch is mounted on the left side of the operating mechanism frame (looking from the front). The main shaft of the breaker operates a crank (3) when the breaker opens or closes which, in turn, actuates a shaft (4) extending through the various stages of the device, thereby opening and closing the "a" and "b" contacts of the auxiliary switch (the "a" contacts open when the breaker opens and the "b" contacts open when the breaker closes). The opening and closing operation of the contacts is determined by the arrangement of cams (16) assembled on the shaft (4) extending through the device.

ADJUSTMENTS--The contacts of any stage may be changed from "a" to "b" or vice versa. If changes are desired in the operating of the contacts, an approved drawing of the cam (16) arrangement should be obtained or a careful sketch made. In order to change an "a" contact to a "b" contact, it is necessary to remove the four tie bolts (2) and change the position of the particular cam 90° in relation to the shaft. Contacts should be cleaned occasionally to insure proper performance.

REPLACEMENTS--Rotary Auxiliary Switch, Fig. 16

1. Disconnect all leads to the auxiliary switch.
2. Remove mounting bolt (1) and screw (6) removing device from breaker.
3. If no approved sketch of the cam (16) arrangement is available, remove the end plate (9) from the device by removing the four tie bolts (2) and draw a sketch of the position of the particular cam in relation to the shaft.
4. Before installing the new device, see that the cams are in the same position as in the device that is being replaced.
5. Install the new device in reverse order.



STAGE OF SWITCH SHOWING BREAKER IN OPEN POSITION

1	MOUNTING BOLT	11	TOP COVER
2	TIE BOLT	12	"a" CONTACTS
3	CRANK	13	CONTACT SPRING
4	SHAFT	14	ROCKER ARM
5	PIN	15	PIN
6	SCREW	16	CAM
7	LINK (SEE FIG. 15)	17	"b" CONTACTS
8	BOTTOM COVER	18	"b" TERMINALS
9	END PLATE	19	"a" TERMINALS
10	SLOT (SEE FIG. 15)	20	BARRIERS

FIG. 16
ROTARY AUXILIARY SWITCH

8004004, 8004005, 8004006, 8004014, 8004799

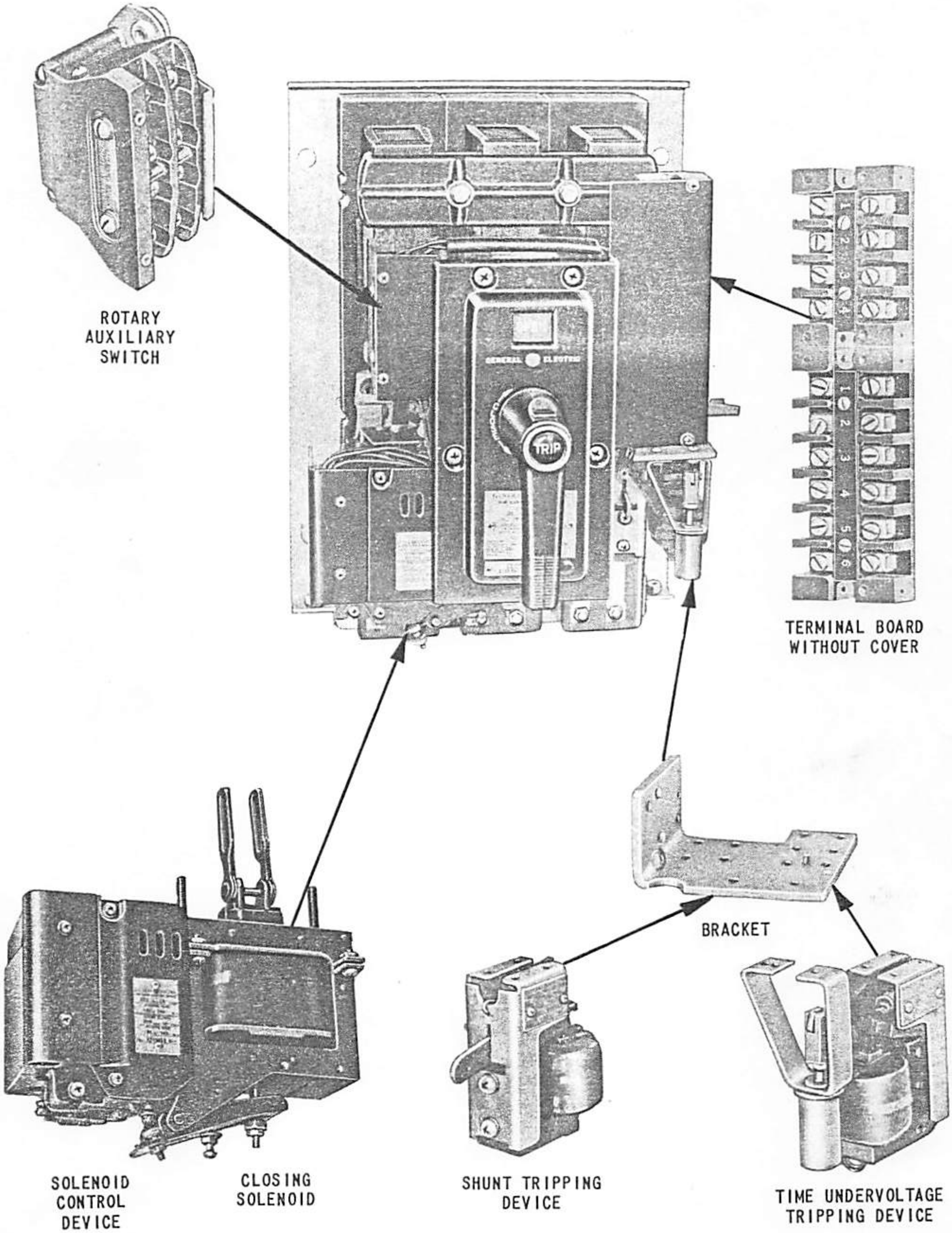
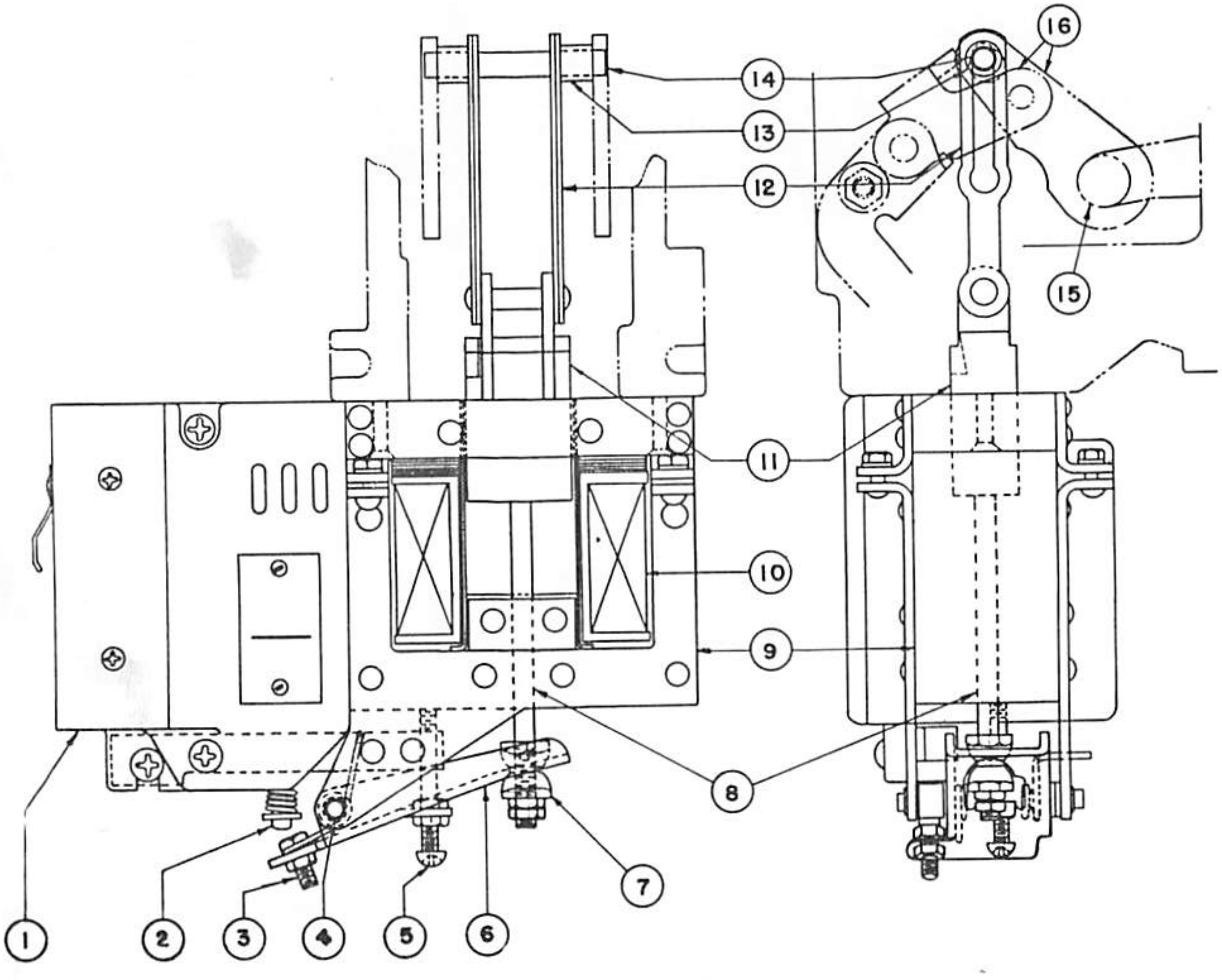


FIG. 17
ATTACHMENTS AND THEIR LOCATION ON ELECTRICALLY-OPERATED BREAKERS

8004004, 8004005, 8004008 8004014, 8004799



1 SOLENOID CONTROL DEVICE COVER
2 TRIP ROD OF SOLENOID CONTROL DEVICE
3 ADJUSTING SCREW
4 PIN
5 STOP SCREW
6 CUT-OFF LEVER
7 COLLAR
8 PLUNGER
9 MAGNET
10 COIL
11 ARMATURE
12 CLOSING LINK
13 SPACER
14 PIN
15 MAIN SHAFT
16 TOGGLE LINKAGE

FIG. 18
CLOSING SOLENOID

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VII

ELECTRICAL CLOSING COMPONENTS

A closing switch, a closing solenoid and a solenoid control device are provided for closing the breaker electrically.

1. CLOSING SWITCH FIG. 19

The closing switch is located in the lower right hand corner of the front escutcheon (1).

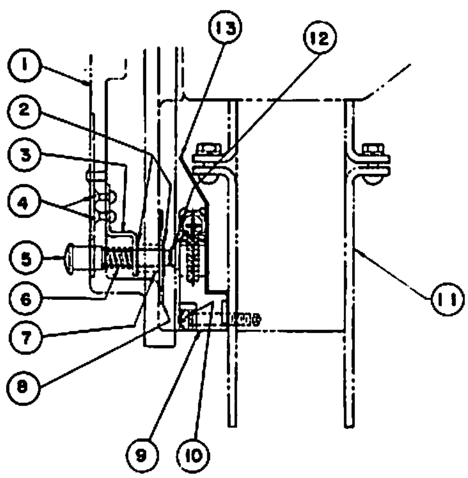
A push button extends through the front escutcheon and is supported by bracket (3). Spring (6) returns the push button to a neutral position after the movable contact (8) has momentarily engaged the stationary contacts (12). Two retainers (2) and spacer (7) are used to hold the movable contact in place.

The stationary contacts (12) and insulation strip (13) are attached to the closing solenoid by bracket (9) and screws (10). A remote closing switch is also available to close the circuit of the solenoid control device, thereby energizing the closing solenoid.

ADJUSTMENTS--The closing switch requires no attention, other than cleaning of contact occasionally.

2. CLOSING SOLENOID FIGS. 17 AND 18

The closing solenoid is located directly below the operating mechanism. It consists of a coil (10), magnet (9) and armature (11) with four closing links (12), a plunger (8) and cut-off lever (6).



1. FRONT ESCUTCHEON
2. RETAINERS
3. BRACKET
4. RIVETS
5. PUSH BUTTON
6. SPRING
7. SPACER
8. MOVABLE CONTACT
9. BRACKET
10. SCREW
11. CLOSING SOLENOID
12. STATIONARY CONTACT
13. INSULATION STRIP

FIG. 19
CLOSING SWITCH

The closing solenoid is connected in series with the main contacts of the solenoid control device (see Fig. 20A) and is energized or de-energized when the main contacts are closed or opened respectively. When the closing solenoid is energized, its armature (11) is drawn downward into the coil (10) pulling the four closing links (12) in the same direction and straightening the toggle linkage (16) of the operating mechanism, thereby closing the breaker. At the same time that the armature is drawn downward, the plunger (8) which is attached to the armature, engages one end of the cut-off lever. The other end of the cut-off lever moves upward and pushes the trip rod (2) of the solenoid control device (see also Fig. 20A), releasing latch (14), Fig. 20A, thereby opening the contacts of the solenoid control device, which, in turn, opens the circuit of the closing solenoid.

ADJUSTMENTS--An adjusting screw (3) in the cut-off lever (6) is used to provide the required overtravel of trip rod (2). In making this adjustment, first, close the breaker. Advance adjusting screw (3) so that the collar (7), screwed to the plunger (8), may be pulled downward as far as it will go. Then remove the cover in front of the terminals on the solenoid control device (1) and push the armature (1), Fig. 20A, as far downward as possible by taking a thin screwdriver in the left hand and inserting it in a slot on the left hand side of the upper part of the solenoid control device. (The screwdriver is inserted about 1-1/2" making approximately a 15° angle to the left and a 45° angle downward). Next, use the right hand to back off adjusting screw (3) to the point where the trip rod (2) releases latch (14), Fig. 20A. Then back off adjusting screw one additional turn to provide the required overtravel of trip rod (2).

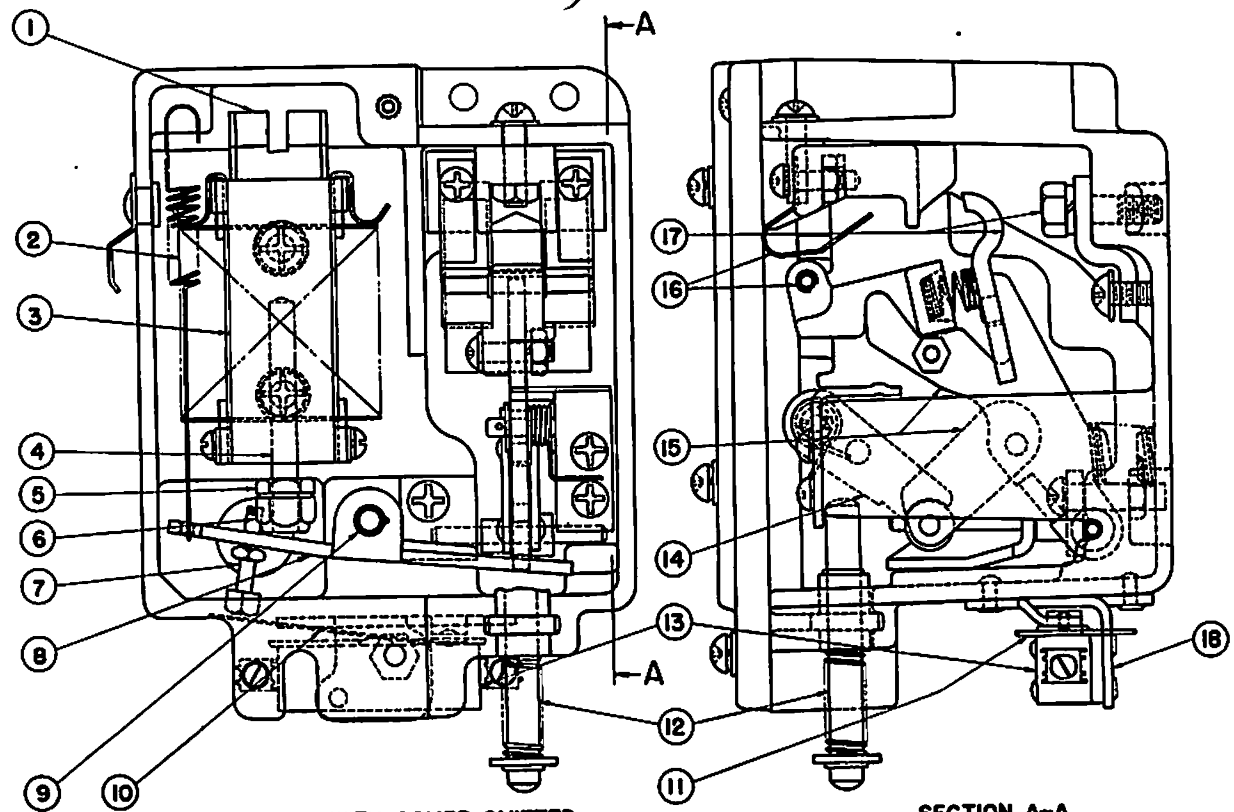
A stop screw (5) in the cut-off lever (6) is used to provide approximately 1/16" clearance, between the movable pin (14) and the upper edge of the slot of the closing links (12) when the breaker is in the open position. This clearance determines the proper position of the cut-off link when the breaker is open.

REPLACEMENTS--Closing Solenoid, Fig. 18

1. Remove solenoid control device (see "Replacements" under Solenoid Control Device).
2. Remove two nuts and collar (7) from plunger (8).
3. Remove four screws attaching lower part of magnet to upper part of magnet.
4. Remove two screws attaching upper part of magnet to the two side frames of the operating mechanism.
5. Install new closing solenoid in reverse order.

REPLACEMENTS--Coil (10)

1. Remove lower member of magnet (9), (See "Replacements" above under Closing Solenoid, items 1 to 3).
2. Remove coil (10).
3. Remove brass coil guides.
4. Install new coil in reverse order.



FRONT VIEW WITH COVER OMITTED

SECTION A-A

1 ARMATURE	10 SPRING
2 COIL	11 INSULATION
3 MAGNET	12 TRIP ROD
4 PLUNGER	13 SWITCH
5 LOCK NUT	14 TRIP LATCH
6 CAP NUT	15 TOGGLE LINKS
7 SCREW	16 SEAL-IN CONTACTS
8 LEVER	17 MAIN CONTACTS
9 PIN	18 BRACKET

FIG. 20A
SOLENOID CONTROL DEVICE

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3. SOLENOID CONTROL DEVICE FIGS. 17 AND 20A

The solenoid control device is mounted in a molded case to the left and below the operating mechanism (looking from the front). It consists primarily of a magnet (3), coil (2), armature (1) and two sets of contacts.

The coil becomes energized when the closing switch closes the circuit of the device. At the same time, armature (1) is drawn downward, engaging a lever (8), pivoted on pin (9) at the bottom of the molded case. As the armature (1) pushes one end of the lever downward, the other end moves upward, straightening a toggle linkage (15) and closing the seal-in contacts (16), as well as the main contacts (17). The seal-in contacts are connected in parallel with the closing switch and provide a path for shunting the current around the closing switch. The closing solenoid, at the end of its stroke, opens the seal-in and main contacts of the solenoid control device which, in turn, de-energizes the closing solenoid.

The closing switch must be opened to permit the control device to reset, thereby preventing pumping of the breaker during the closing operations. The seal-in contacts (16) assure the closing of the breaker even though the circuit is closed only for a very brief time by the closing switch.

ADJUSTMENTS--The cut-off lever (6), Fig. 18, is adjusted by using the adjusting screw (3) so that the control device is tripped just at the end of the stroke of the closing solenoid (see "Adjustments" under Closing Solenoid).

A contact wipe of 1/8" must be provided for the proper operation of the main contacts of the solenoid control device. To check this adjustment, first, remove the cover of the device. Then push the armature (1) down into the coil (2) as far as it will go. Next, loosen lock nut attached to the plunger, and turn the cap nut either in or out until the main contacts just make. Then advance the cap nut one and one-half turns. The cap nut must now be locked in place by tightening the lock nut.

The adjusting screw (7) in the lever (8), below the molded case, is used to adjust for the opening of the switch located on the bottom exterior surface of the molded case of the control device. These contacts should open after the seal-in contacts make and before the main contacts are completely wiped in. It is recommended that a continuity meter be connected across the terminals for checking the adjustment of these contacts. A diminution in intensity will be noticed when the contacts open. The adjusting screw should be turned in or out until this condition is fulfilled.

REPLACEMENTS--Coil (2)

1. Disconnect all leads to the device.
2. Remove two mounting screws on top of device.
3. Remove one mounting screw on bottom of device.
4. Remove device.
5. Remove front cover.
6. Remove insulation over terminals on back of the cover.
7. Disconnect leads to the coil.
8. Remove two screws on back of case, and remove solenoid of control device.
9. Remove two nuts from plunger.
10. Remove armature.
11. Remove brass guides after removing two screws attaching brass guides to magnet.
12. Remove coil.
13. Install new coil in magnet in reverse order. Also connect coil leads to the terminals on back of the cover.
14. Re-assemble solenoid in the molded case and replace cover.
15. Replace device on the breaker and connect leads.

Solenoid Control Device, Fig. 20A

Note: For replacing the solenoid control device, see "Replacements" items 1 to 4 under Coil (2) above.

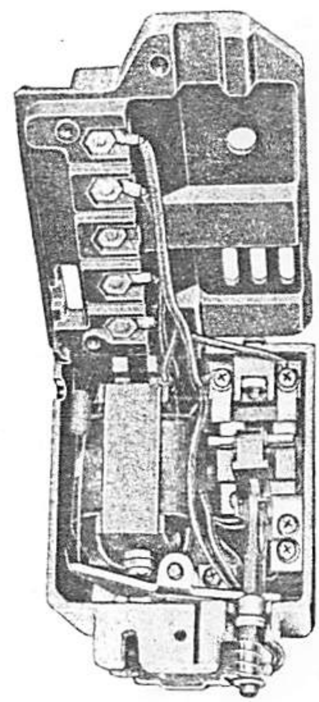
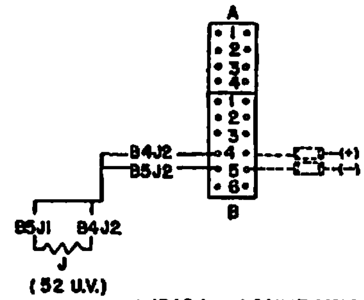
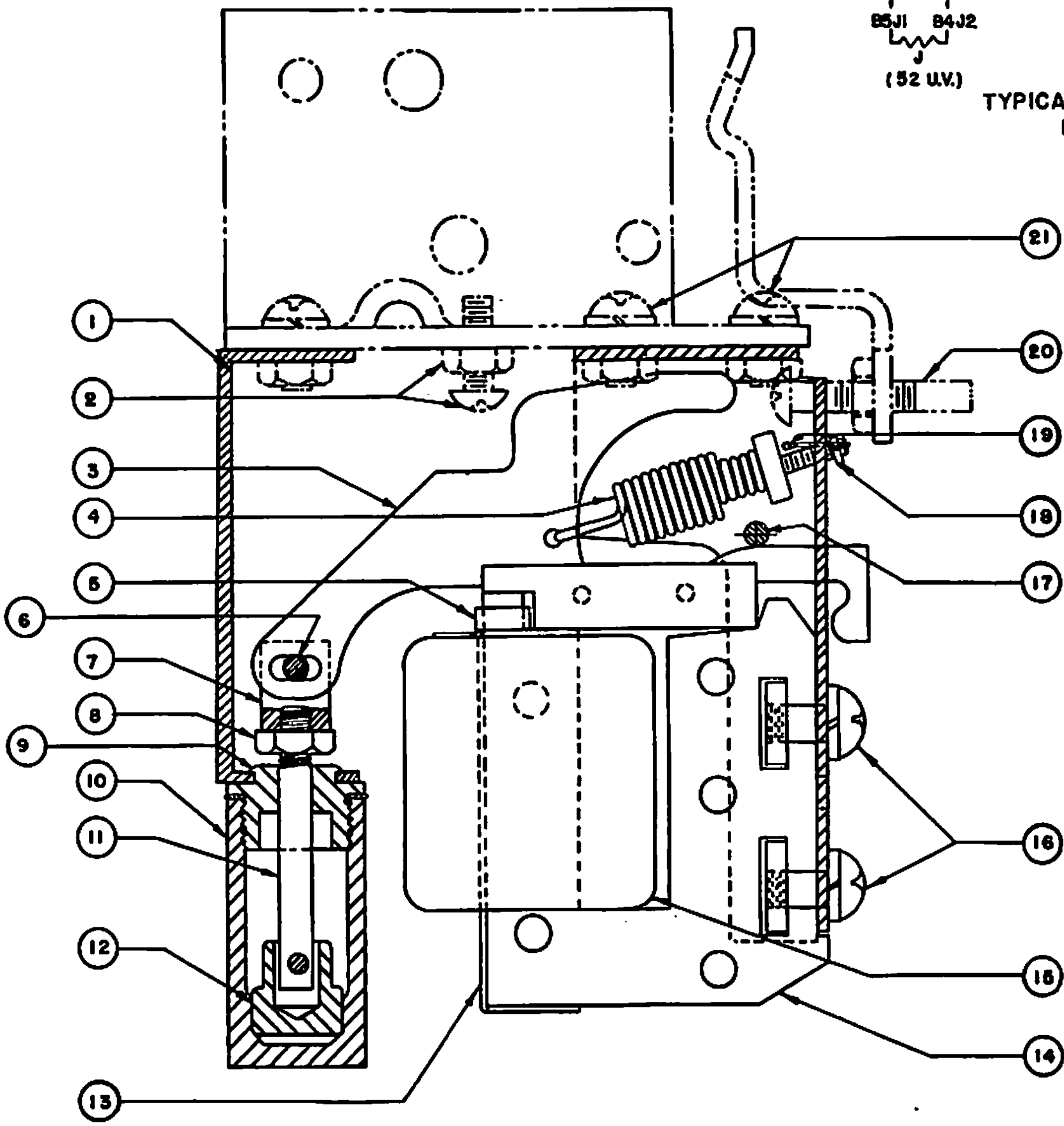


FIG. 20B
INTERNAL VIEW OF SOLENOID CONTROL DEVICE SHOWING WIRING



TYPICAL CONNECTION DIAGRAM



1. BRACKET
2. ADJUSTING SCREW & NUT
3. ARMATURE
4. SPRING
5. SHADING RING
6. PIN
7. CLEVIS
8. ADJUSTING NUT
9. CAP
10. CYLINDER
11. CONNECTION ROD
12. PLUNGER
13. CLAMP
14. MAGNET
15. COIL
16. SCREWS
17. PIN
18. ADJUSTING SCREW
19. LOCKING WIRE
20. ADJUSTING SCREW
21. MOUNTING SCREWS

FIG.21
TIME DELAY UNDERVOLTAGE TRIPPING DEVICE

VIII

PROTECTIVE DEVICES

TIME DELAY UNDERVOLTAGE TRIPPING DEVICE FIG. 21

The device is mounted to brackets by six screws to the right of the shunt trip device (looking from the front). The purpose of this device is to trip the breaker when the voltage falls below a pre-determined value. It consists of an armature (3), coil (15), magnet (14) and cylinder (10) containing plunger (12) which operates in oil.

When the voltage goes below a pre-determined value, spring (4) draws the armature and plunger upward causing the oil in the cylinder to flow downward through the clearance between the cylinder and the plunger. This flow of oil determines the extent of time delay before the breaker trips.

As soon as the plunger has been lifted out of the contracted part of the cylinder, the restraint of the armature will be easily overcome by the pull of spring (4), since the oil will now flow rapidly down to the bottom of the cylinder through the opening around the plunger and the wider part of the cylinder, causing the breaker to trip.

ADJUSTMENTS--An adjusting screw (20) in the trip lever is used to allow from 1/32" to 1/16" overtravel of the trip lever after tripping the breaker.

The adjusting screw (18) is used to adjust the armature pick-up to 80% of the normal voltage and to allow the armature to drop out between 30 and 60 per cent of normal voltage.

Adjusting nut (8) on connection rod (11) is intended for a minimum amount of adjustment of the time delay setting. In order that the amount of armature air gap may be limited to 1/4" to 5/16" after the breaker is in the tripped position, adjusting screw and nut (2) make it possible to maintain this air gap and, at the same time, serve as an armature stop when the breaker trips, due to a drop in voltage. This limitation of the armature air gap is important, otherwise the armature would not be attracted to the armature after normal voltage is restored. From 1/4" to 3/8" of oil should be maintained in the cylinder at all times. In order to make an inspection of the oil, the cylinder may be unscrewed from the cap. G.E. silicone oil 9981LT 40NV, or similar grade, should be used in the cylinder.

REPLACEMENTS--Time Delay Undervoltage Device, Fig. 21.

1. Disconnect coil leads (15).
2. Remove two screws from bracket (1). (Bracket (1) is omitted when the instantaneous undervoltage device is used).
3. Remove four mounting screws (21).
4. Remove the device.
5. Install the new device in reverse order.

Coil (15)

1. Disconnect the leads to the coil.
2. Remove two screws (16).
3. Remove magnet and coil assembly.
4. Straighten laminations around shading ring (5).
5. Remove shading ring.
6. Straighten lower end of coil clamp (13).
7. Remove coil.
8. Install new coil in reverse order.

2. INSTANTANEOUS UNDERVOLTAGE TRIPPING DEVICE

This undervoltage tripping device is constructed similarly to the time delay undervoltage tripping device with the exception that the cylinder (10), plunger (12), connecting rod (11), clevis (7), bracket (1) and adjusting nut (8), as shown in Fig. 21, are omitted.

ADJUSTMENTS--See "Adjustments" under Time Delay Undervoltage Tripping Device above.

REPLACEMENTS--See above "Replacements" under Time Delay Undervoltage.

3. SERIES OVERCURRENT TRIPPING DEVICE FIGS. 22A TO H, 23, 24 AND 25

Each series overcurrent tripping device is enclosed in a molded case and mounted by three screws and a bracket to the lower part of the pole unit base.

Various series overcurrent tripping devices are provided with the following tripping combinations:

1. Long-time, short-time and instantaneous tripping.
2. Long-time and instantaneous tripping.
3. Short-time and instantaneous tripping.
4. Instantaneous tripping
   (a) Adjustable
   (b) Non-adjustable

The long-time delay mechanism consists of an armature (21) which operates plunger (14) in a cylinder (15) containing silicone oil, and a calibration spring (19).

The short-time delay mechanism consists of an escapement composed of a driving segment (4), pinion (3), pallet (1), escape wheel (2) and a calibration spring (9).

The instantaneous mechanism consists of:

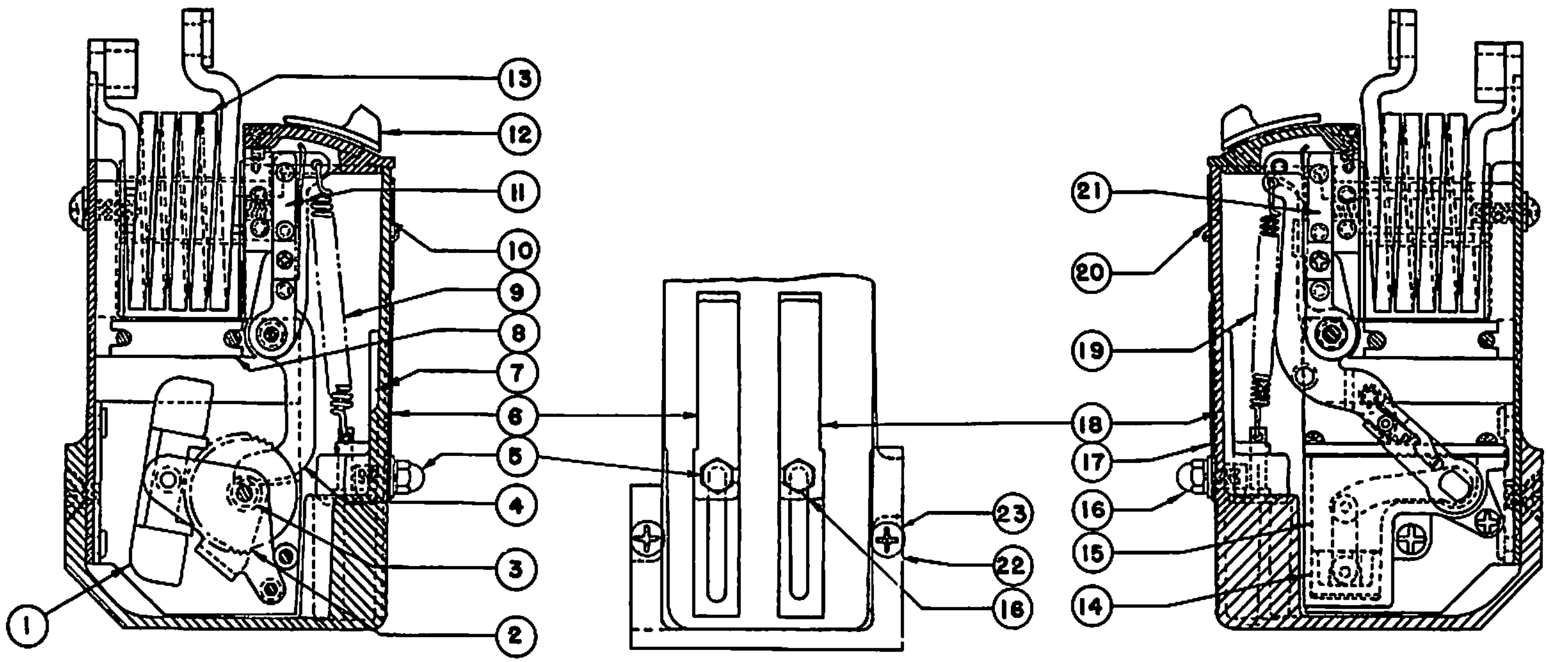


FIG. 22A
SHORT TIME DELAY
(LEFT SIDE VIEW)

FIG. 22B
SHORT TIME DELAY
AND
LONG TIME DELAY
(FRONT VIEW)

FIG 22C
LONG TIME DELAY
(RIGHT SIDE VIEW)

1	PALLET	11	ARMATURE	20	OPENING FOR CHECKING
2	ESCAPE WHEEL	12	TRIP ARM	21	ARMATURE
3	PINION	13	SERIES COIL	22	BRACKET
4	DRIVING SEGMENT	14	PLUNGER	23	SCREW
5	CALIBRATION CLAMP NUT	15	CYLINDER	24	SPACER
6	CALIBRATION PLATE	16	CALIBRATION CLAMP NUT	25	SPRING
7	CALIBRATION SLIDE			26	BRACKET
8	MAGNET	17	CALIBRATION PLATE	27	SCREW
9	CALIBRATION SPRING	18	CALIBRATION SLIDE	28	SCREW
10	OPENING FOR CHECKING	19	CALIBRATION SPRING	29	SCREW
				30	SPRING

SERIES OVERCURRENT TRIPPING DEVICES (A,B,C,D,E,F,G &H)

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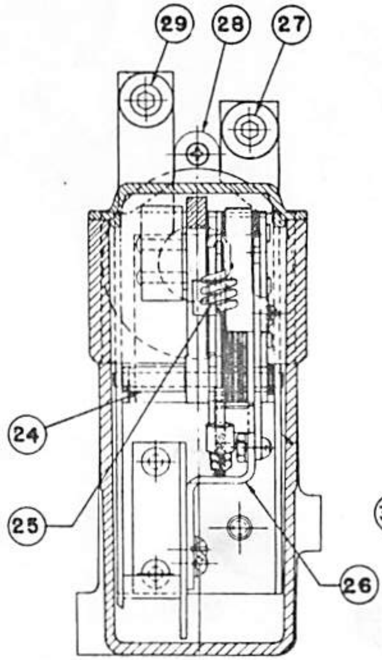


FIG. 22D
INSTANTANEOUS (NON-ADJUSTABLE)
TRIPPING DEVICE
(FRONT VIEW)

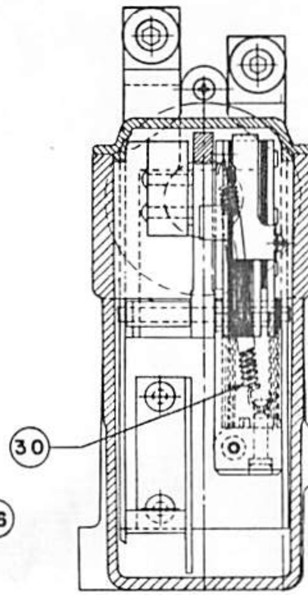


FIG. 22E
INSTANTANEOUS (ADJUSTABLE)
TRIPPING DEVICE
(FRONT VIEW)

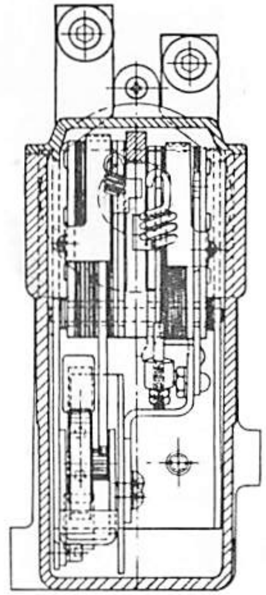


FIG. 22F
INSTANTANEOUS &
SHORT TIME TRIPPING DEVICE
(FRONT VIEW)

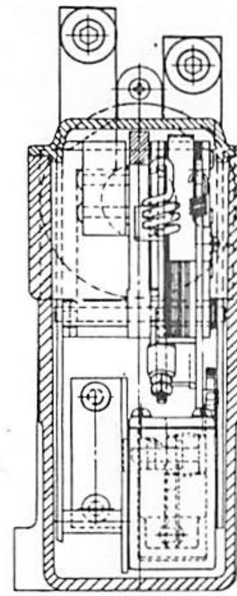


FIG. 22G
INSTANTANEOUS &
LONG TIME TRIPPING DEVICE
(FRONT VIEW)

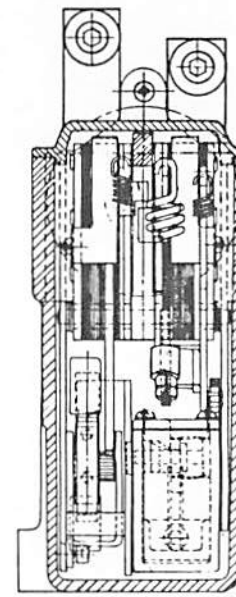


FIG. 22H
INSTANTANEOUS, SHORT
TIME & LONG TIME
TRIPPING DEVICE
(FRONT VIEW)

(a) An adjustable spring (30), armature (21), calibration slide (18) and calibration clamp nut (16).

(b) A non-adjustable spring (25), armature (21) and bracket (26).

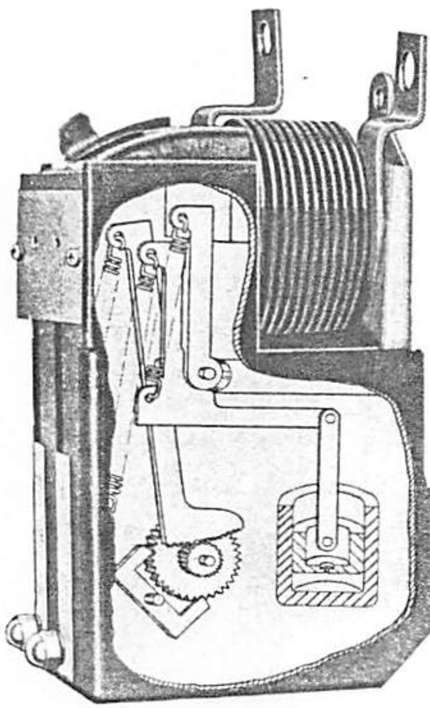


FIG. 23

SCHEMATIC VIEW SHOWING OVERCURRENT SHORT-TIME, LONG-TIME AND INSTANTANEOUS TRIPPING MECHANISM

All three tripping features are actuated by a magnet (8) and the series coil (13). The ranges of armature pick-up for the various types of overcurrent tripping are:

1. Long-time--approximately 80 to 160 percent breaker rating.

2. Short-time--approximately 500 to 1000 percent breaker rating.

3. Instantaneous

   (a) Adjustable--approximately 80 to 250 percent breaker rating.

   (b) Non-adjustable

   Without Long and Short-time
   400 to 1000 percent breaker rating or interrupting capacity, whichever is lower, with frame-size only.

   With Long-time
   400, 900 and 1500 percent breaker rating.

   With Long-time and Short-time
   400 to 5000 percent breaker rating or interrupting capacity, whichever is lower.

   With Short-time
   400 to 5000 percent breaker rating or interrupting capacity, whichever is lower.

Note: Non-adjustable instantaneous pick-up is set at the factory.

In long-time tripping, the armature is restrained by calibration spring (19). After the magnetic force, produced by an overcurrent condition, overcomes this restraining force, the armature movement is retarded by the flow of oil through an orifice in the plunger which produces an inverse time-delay characteristic.

In short-time tripping, the armature is restrained by calibration spring (9). After the magnetic force, produced by an overcurrent condition, overcomes this restraining force, the armature movement is retarded by an escapement mechanism which produces an inverse time-delay tripping characteristic.

Instantaneous Tripping:

(a) Adjustable instantaneous tripping takes place after the magnetic force produced by an overcurrent condition, overcomes the restraining force of calibration spring (30).

(b) Non-adjustable instantaneous tripping takes place after the magnetic force produced by an overcurrent condition, overcomes the restraining force of the non-adjustable spring (25).

Typical time-current characteristics are shown in Figs. 25A and 25B, which illustrate the time and current pick-up values of the three tripping features of the series overcurrent tripping device.

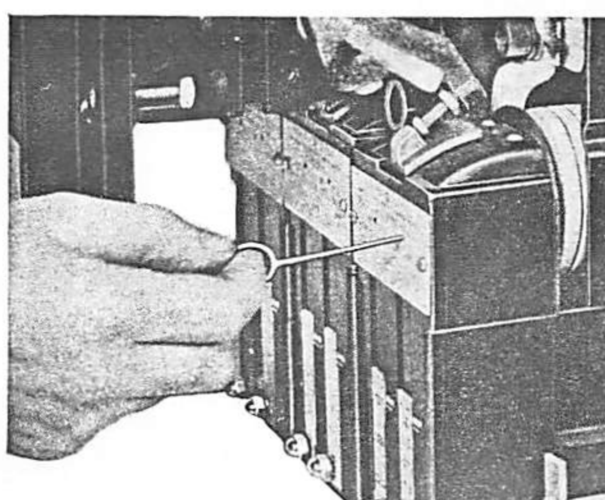


FIG. 24

ADJUSTING OVERCURRENT DEVICE FOR POSITIVE TRIPPING

8004204

8004011

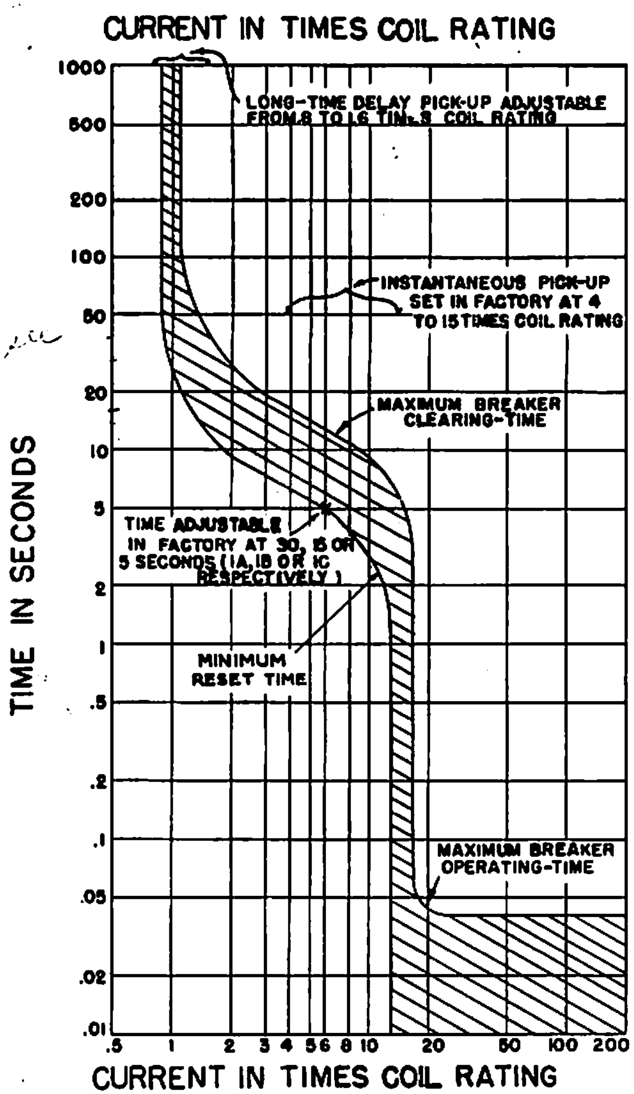


FIG. 25 A
LONG-TIME AND INSTANTANEOUS TRIPPING CHARACTERISTIC

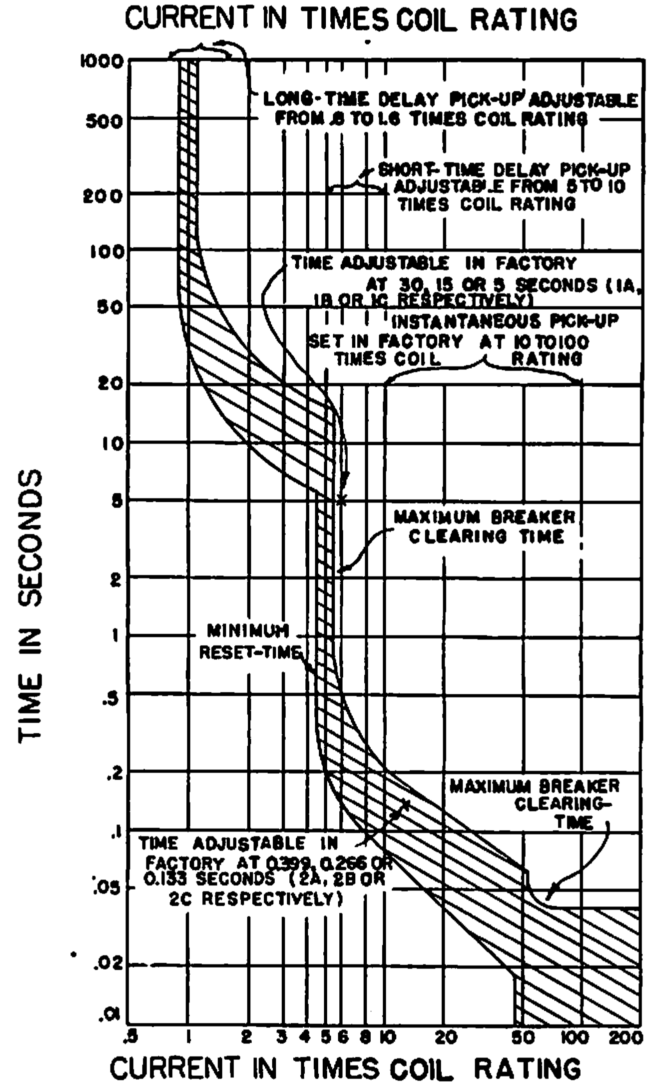


FIG. 25 B
LONG-TIME, SHORT-TIME AND INSTANTANEOUS TRIPPING CHARACTERISTIC

TYPICAL TIME-CURRENT CHARACTERISTICS
OF SERIES OVERCURRENT TRIPPING
STARTING COLD IN 25°C AMBIENT

Selective tripping is obtained when the breakers in the electrical distribution system are arranged on the basis of a progressive series of time and current pick-up. This will allow the breaker having the shorter time setting and the lower pick-up to trip out before the breaker having the longer time setting and the higher current pick-up, provided the fault is on that part of the line protected by the breaker having the lower setting. Hence, if a fault occurs in any part of the electrical system, only the breaker nearest to the fault will trip out.

In order to reduce the possibility of damaging the equipment and to provide maximum safety to the operator, the overload caused by a fault is removed in a minimum amount of time by selective tripping. Overloads producing current up to 5 or 10 times the breaker rating are removed in a matter of a few seconds, while currents in excess of this value are removed in a fraction of a second.

For the exact characteristics and setting of each breaker in a selective system, reference should be made to the co-ordination chart furnished for the particular system.

ADJUSTMENTS--Calibration nuts in front of the device are used to determine the desired pick-up for short-time, long-time and instantaneous tripping.

To adjust for approximately 1/32" overtravel of the armature:

1. Take a rod or wire and push the armature (21) against the magnet through holes in the nameplate (see Fig. 24).
2. Turn the adjusting screw in the trip paddle in or out until the breaker trips.
3. Advance the adjusting screw an additional 1/16" which provides the required amount of overtravel.

REPLACEMENTS--Series Overcurrent Tripping Device

1. Remove two screws (23) to detach bracket (22).
2. Remove screws (27) and (29) detaching device from flexible braid, contact support and upper stud.
3. Remove device after removing mounting screw (28).
4. Replace the new device in reverse order.
5. Adjust the new device (see above).

NOTE: No component parts of the overcurrent tripping devices are replaced. It will be necessary to install a new device when parts are worn or damaged. When a new device is installed, it must be adjusted as above.

4. REVERSE CURRENT TRIPPING DEVICE FIGS. 26 AND 27

The device is enclosed in a molded case and is mounted on the right pole base similarly to the series overcurrent tripping device (see under "Series Overcurrent Tripping Device"). In case the breaker is equipped with three overcurrent tripping devices, the reverse current tripping device is attached to a fourth pole base.

The reverse current tripping device consists of a series coil (1) with an iron core mounted between two pole pieces (7), also a potential coil (4) connected across a constant source of voltage and wound around a rotary-type armature (6). Calibration spring (3) determines the armature pick-up when a reversal of current occurs.

The device is designed for d-c current only and is used to trip the breaker when a reversal of current occurs which exceeds the calibration setting of the armature pick-up. As long as the flow of current through the breaker is in the normal direction, the magnetic flux of the series coil and the magnetic flux of the potential coil produce a torque which tends to rotate the armature counter-clockwise (looking from the right side of the breaker). The calibration spring also tends to rotate the armature in this same direction, and, at the same time, causes the armature to exert pressure against the stop screw (9) attached to a bearing plate on the right side of the device (looking from the right side of the breaker).

If the current through the series coil (1) is reversed, the armature (6) tends to move in the clockwise direction against the restraint of the calibration spring (3). When the current reversal exceeds the calibration setting, the armature revolves clockwise causing the trip rod (2) to move upward engaging the trip paddle (14) and tripping the breaker.

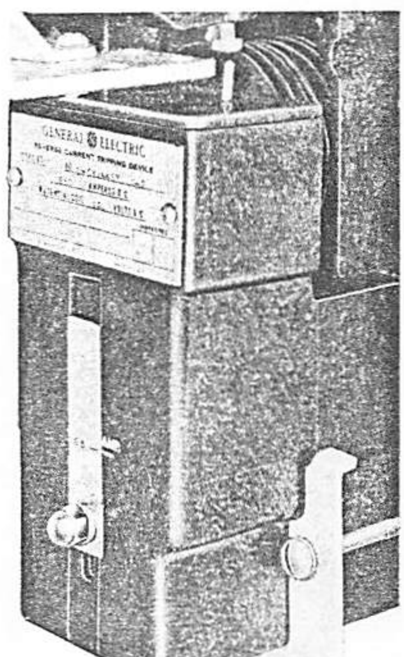
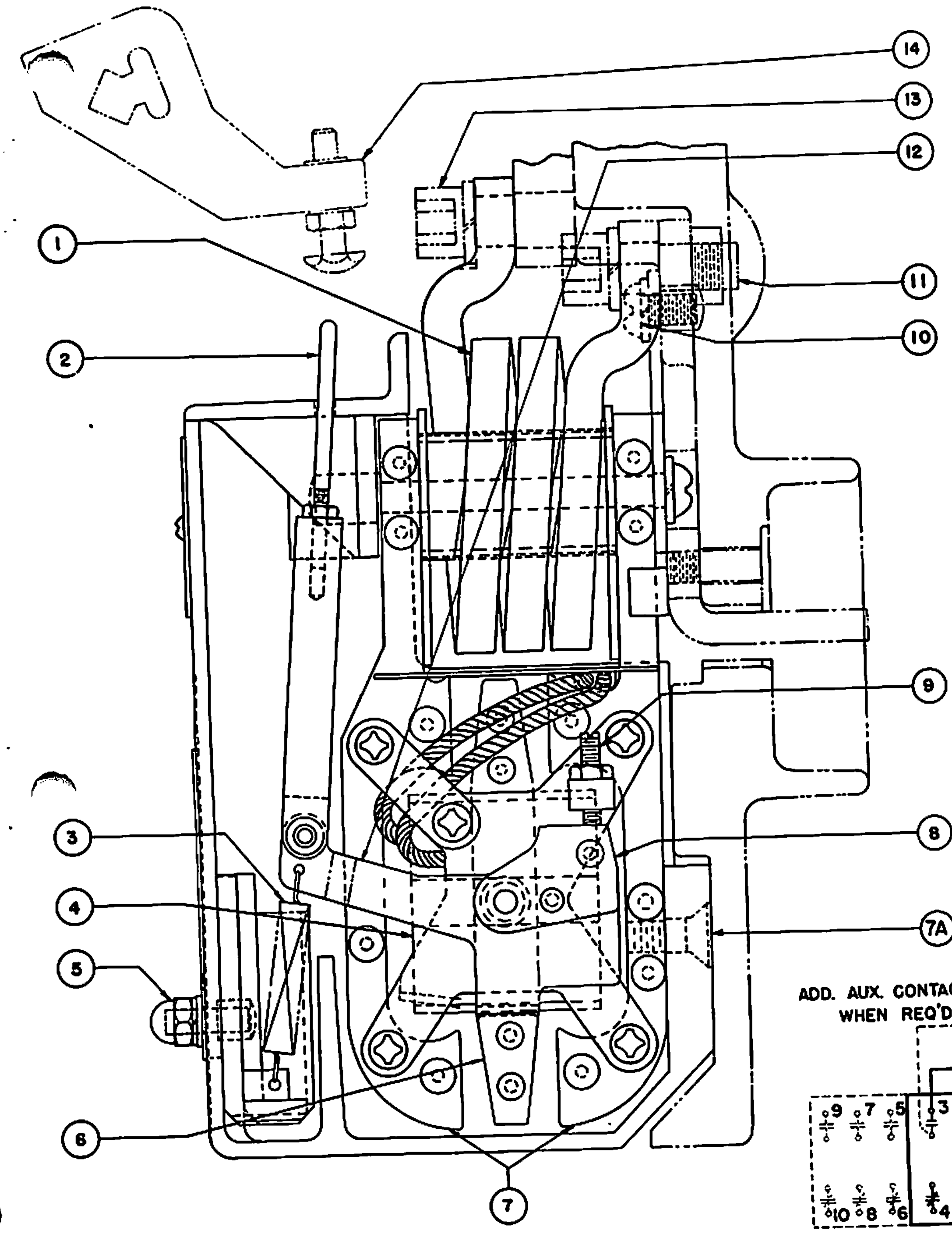


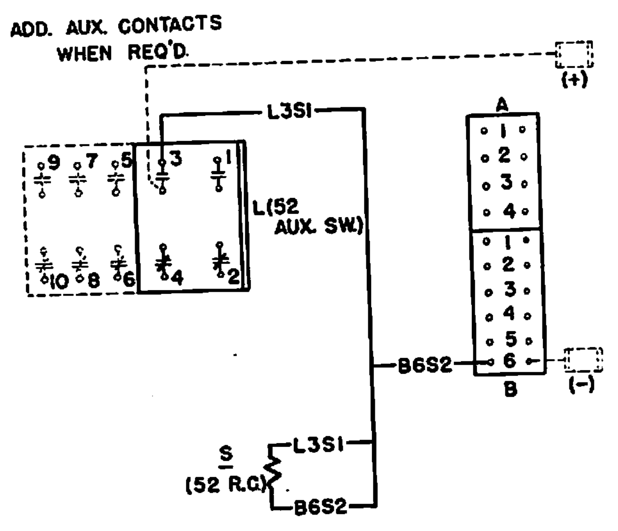
FIG. 26
REVERSE CURRENT TRIPPING DEVICE LOCATED ON BREAKER



1	SERIES COIL	7A	SCREWS
2	TRIP ROD	8	COUNTERWEIGHT
3	SPRING	9	STOP SCREW
4	POTENTIAL COIL	10	MOUNTING SCREW
5	CALIBRATION NUT	11	SCREW
6	ARMATURE	12	TRIP CRANK
7	POLE PIECES	13	SCREW

14 TRIP PADDLE

FIG. 27
REVERSE CURRENT TRIPPING DEVICE



TYPICAL CONNECTION DIAGRAM

A counterweight (8) is riveted to the armature which serves to counterbalance the trip rod assembly. This counterweight also serves as a stop for stop screw (9) on the bearing plate. This stop screw is used to maintain the proper air gap between the armature and the pole pieces when the current flows normally through the breaker (see "Adjustments" below). The potential coil should be connected with "a" contacts of the auxiliary switch so that the potential circuit will be opened when the breaker opens.

ADJUSTMENTS--No adjustment should be made in the field with the exception of checking for overtravel of the trip rod. Proper overtravel of the trip rod is provided, if the trip rod advances the trip paddle between 1/32" to 3/64" beyond the point where the breaker trips. To adjust for this amount of overtravel, lift the trip rod as high as possible after backing off adjusting screw in the trip paddle (14) so that it will not touch the trip rod (2). With the trip rod still pulled upward, advance adjusting screw in the trip paddle until the breaker trips. Then advance this same adjusting screw an additional 1-1/2 turns, thereby assuring positive tripping.

If any other adjustments are necessary, the device should be returned to the factory.

REPLACEMENTS--Reverse Current Tripping Device

1. Remove two screws to detach mounting bracket. See "Replacements" under Series Overcurrent Tripping Device.
2. Remove two screws (11) and (13) to detach series coil (1) from the contact block and lower stud.
3. Remove device after removing mounting screw (10).
4. Install the new device in reverse order.

NOTE: No renewal of parts for the device are supplied. After the new device has been installed, the adjusting screw in the trip paddle should be used to provide for the proper overtravel of the trip rod as described above under "Adjustments".

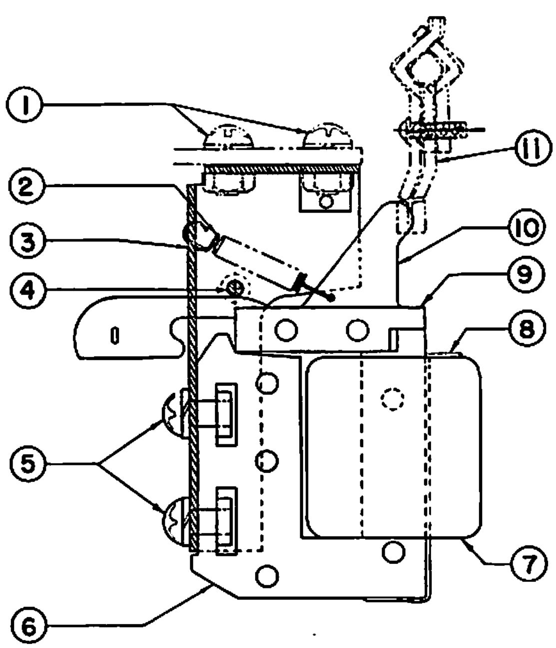
IX

MISCELLANEOUS

SHUNT TRIPPING DEVICE FIGS. 17 AND 28

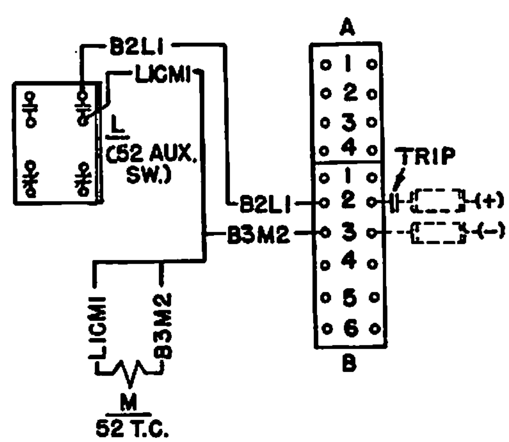
The shunt tripping device is mounted on a bracket attached to the right side of the operating mechanism frame (looking from the front). It consists of a coil (7), magnet (6), armature (9) and returning spring (2). A remote switch or relay contacts are used to close the circuit of the device causing the armature to engage the trip paddle (11), thereby tripping the breaker. The tension spring (2) is used to return the armature to a neutral position after the breaker trips.

The shunt trip device is connected with the "a" contacts of an auxiliary switch which open the cir-



1	SCREWS	6	MAGNET
2	SPRING	7	COIL
3	FRAME	8	CLAMP
4	PIN	9	ARMATURE
5	SCREWS	10	ARMATURE ARM
		11	TRIP PADDLE

FIG. 28
SHUNT TRIPPING DEVICE



TYPICAL CONNECTION DIAGRAM

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cuit when the breaker opens. This prevents overheating of the coil since the coil is designed for intermittent service only.

ADJUSTMENTS--From 1/32" to 1/16" overtravel of the armature is required when the breaker is tripped. If any adjustment is necessary to provide this amount of overtravel, the trip lever is bent in or out accordingly.

REPLACEMENTS--Shunt Trip Device, Fig. 28

1. Disconnect leads to coil (7).

2. Remove the device from bracket by removing four screws (1).

3. Install new device in reverse order.

NOTE: When a second shunt trip is used, the terminal board and bracket must be removed before the second shunt tripping device can be detached. See "Replacements" under Terminal Board.

Coil (7)

1. Disconnect leads to coil.

2. Remove two screws (5) removing magnet (6) and coil (7).

3. Remove clamp (8) after bending straight lower end of clamp.

4. Remove coil.

5. Install new coil in reverse order.

Spring (2)

1. Disconnect leads to coil (7).

2. Disconnect device from bracket by removing screws (1).

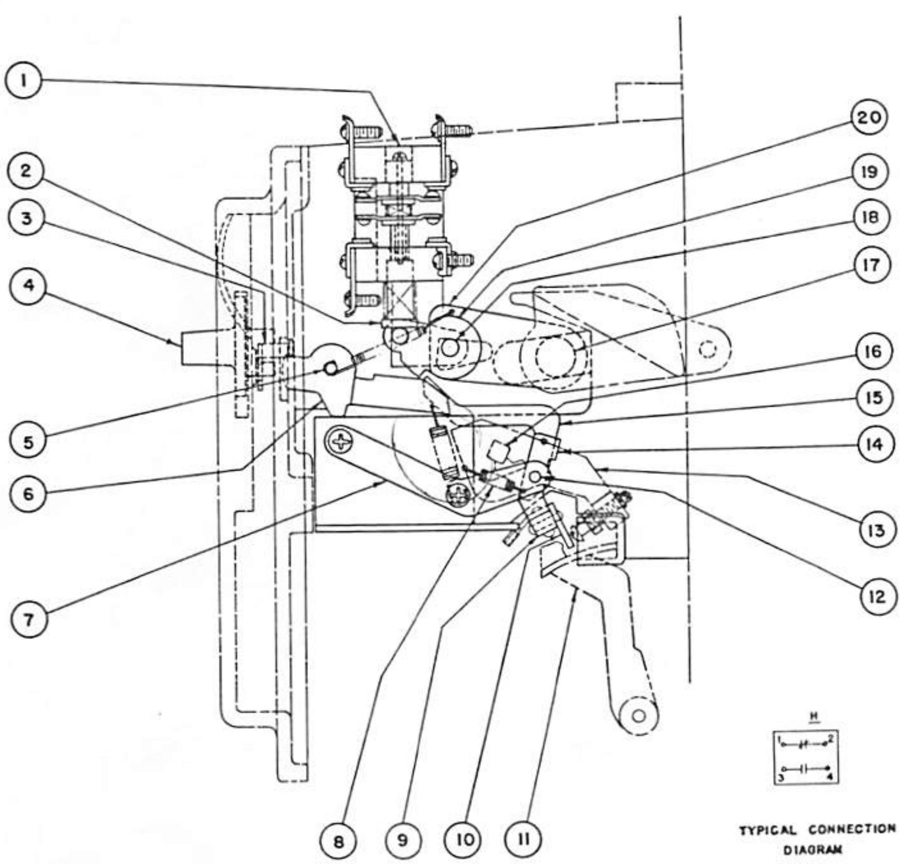
3. Remove spring (2).

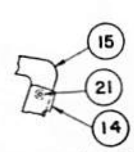
4. Install new spring in reverse order.

2. BELL ALARM DEVICE FIG. 29A

A bell alarm device is available which operates when an overcurrent trips the breaker. It consists primarily of a lever (10) riveted to auxiliary shaft (9), hanger (14) also riveted to auxiliary shaft (9), latch (15), catch (19), switch (1), reset link (3), reset arm (6), reset button (4) and mounting bracket (7).

Lever suspended between trip arm (11) and trip paddle (13) is actuated by trip arm (11) whenever an overcurrent occurs which trips the breaker, causing hanger (14), pivoted to pin (12) to revolve latch (15) counter-clockwise, thereby releasing catch (19). As the breaker opens, main shaft (17) moves link (20) forward, revolving catch (19) counterclockwise on pin (18), causing plunger (2) to drop and close the lower contacts of switch (1) which results in the ringing of a bell.





RIVET & SPACER (21) ADDED OTHERWISE SAME AS FIG. 20A.

FIG. 29A

BELL ALARM DEVICE

FIG. 29B

LOCKOUT DEVICE

In order to silence the bell, it is necessary to push down on reset button (4) in front of the breaker. The resetting of the bell alarm mechanism silences the bell.

The reset mechanism is operated by reset button (4) actuating link (3), which, in turn, revolves reset arm (6) on pin (5), thereby returning catch (19) to its lower position and moving plunger (2) upward, and opening the lower circuit of switch (1). At the same time, spring (8) returns latch (15) to its normal position so as to engage catch (19).

3. LOCKOUT DEVICE FIG. 29B

A lockout device is available which consists of the same mechanism employed in operating the bell alarm device with the addition of a spacer and a rivet (21) inserted in the right side hanger (14) and latch (15). This causes these two parts to operate as a unit, which results in keeping the trip paddle (13) in the tripped position whenever an overcurrent occurs which trips the breaker, thereby locking the breaker in the open position until the lockout mechanism is reset and the bell is silenced as above.

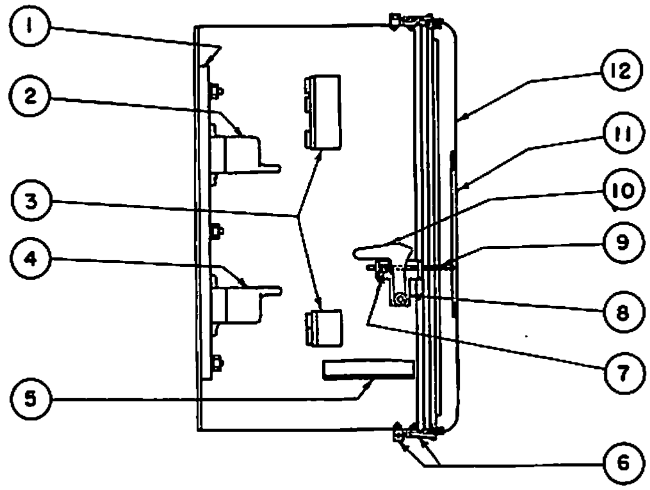
4. ENCLOSING CASE AND INTERLOCK DEVICE FIG. 30

The enclosing case has a cover (12) with a cutout (11), through which the front part of the escutcheon and the operating handle extend. The cover is attached to the enclosing case by four trunk-like latches (6).

The breaker rests on two supports (5) welded on opposite sides of the enclosing case. Four other supports (3) are used to secure the breaker by four mounting bolts after it has engaged the disconnects. An additional bolt in each of the four supports serves as a stop for mounting the breaker.

Three sub-bases (1) are bolted to the rear of the enclosing case to which the upper (2) and lower studs (4) are bolted. The studs have solderless connectors for securing the cables of the power circuits.

An interlock device is welded on the lower right hand side of the metal enclosure (looking from the front). The interlock serves to trip the breaker when the front cover is removed. It consists of a trip rod (9), extending through the cam (10) and held in place by bracket (8), also a compression spring (7) on the rear of the trip rod. When the cover is clamped on the enclosing case, spring (7) is compressed between the cam and the support. Then, when the cover is removed, spring (7) is released and the rear end of the cam moves upward engaging the trip paddle, thereby tripping the breaker.



1. SUB BASE
2. UPPER CONNECTOR
3. SUPPORTS
4. LOWER CONNECTOR
5. SUPPORT
6. LATCH
7. SPRING
8. BRACKET
9. TRIP ROD
10. CAM
11. OPENING FOR FRONT ESCUTCHEON
12. COVER

FIG. 30

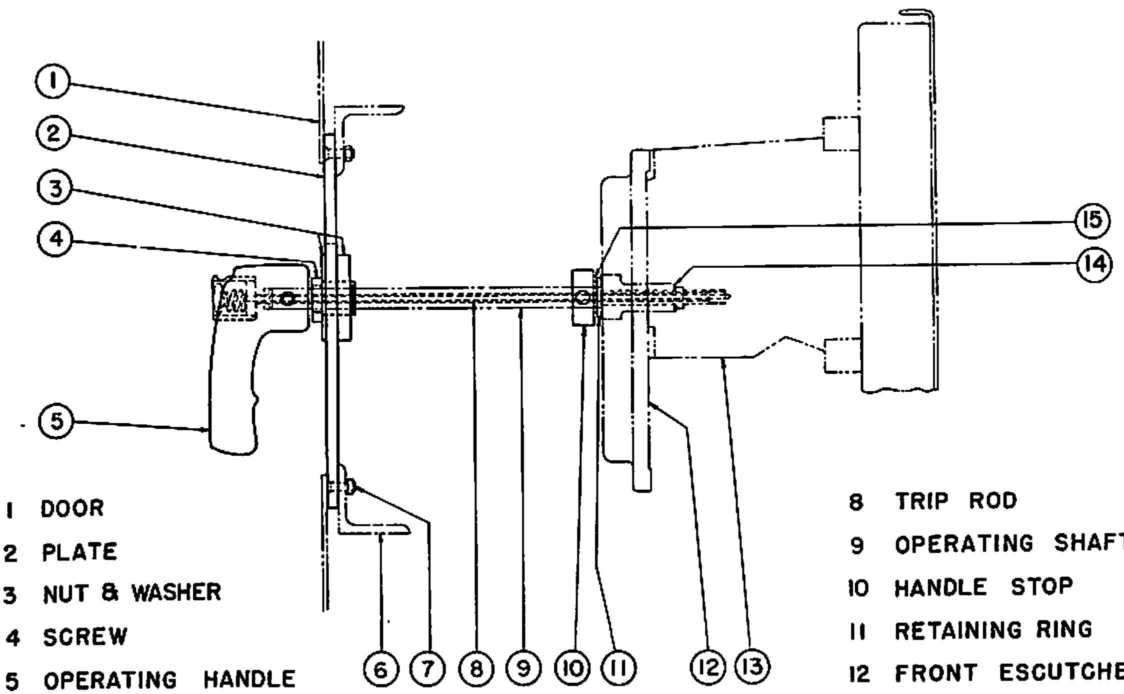
ENCLOSING CASE AND INTERLOCK

5. EXTENSION FOR RECESSED BREAKERS FIG. 31

A special shaft (9), trip rod (8) and adapter plate (2) is supplied to recess the breaker 17 1/4" from the rear of the front plate (2) of the switchboard to the rear of the breaker base. The special shaft and trip rod will replace the standard shaft and trip rod with which the breaker is equipped.

RECESSING THE STANDARD BREAKER

1. Remove the front escutcheon (see "Replacments" under Front Escutcheon and Operating Handle Assembly).
2. Remove the operating handle (see "Replacing Operating Handle" under Front Escutcheon and Operating Handle Assembly).
3. Remove retaining rings (11 and 14).
4. Push standard shaft to the rear, thereby removing it from front escutcheon.
5. Insert special shaft (9) through rear of front escutcheon.
6. Assemble washer (15) and retaining rings (11 and 14) to special shaft (9).
7. Assemble front escutcheon to breaker (see "Replacements" under Front Escutcheon and Operating Handle Assembly).
8. Assemble hand stop (10) to special shaft (9).
9. Attach front plate (2) to angle irons (6) by using four screws. (Angle irons are supplied by the switchboard builder).
10. Secure the front part of shaft (9) to plate (2) by using hollow hexagon screw (4) with nut and washer.
11. Lock hexagon screw (4) by using set screw. Attach operating handle and trip rod to shaft by reverse procedure when removing operating handle. (See "Replacing Operating Handle" under Front Escutcheon and Operating Handle Assembly.)
12. Disassemble trip button from standard trip rod and assemble it to special trip rod.



1 DOOR
2 PLATE
3 NUT & WASHER
4 SCREW
5 OPERATING HANDLE
6 ANGLE IRON
7 SCREW
8 TRIP ROD
9 OPERATING SHAFT
10 HANDLE STOP
11 RETAINING RING
12 FRONT ESCUTCHEON
13 OPERATING MECHANISM FRAME
14 RETAINING RING
15 WASHER

FIG. 31

EXTENSION FOR RECESSED BREAKERS

SK. P-6490-18

6. DISCONNECTS FIGS. 32, 33 AND 34

The disconnects are attached to the circuit breaker studs on the rear side of the breaker.

Each disconnect consists of four contact fingers (3) secured to each breaker stud (7) by screw (1) and retainers (6 and 8). A pair of springs (2) exert pressure on the contact fingers when engaging the stationary studs (4). Stop (5) and retainers (6 and 8) serve to maintain the proper alignment of the fingers when engaging the breaker studs.

Note: For instructions on mounting the breakers by means of disconnects, see "Dead Front Breakers" under Installation, Section III.

ADJUSTMENTS--When the proper amount of contact pressure is exerted against the stationary stud, the dimension from the top side of the upper washer to the bottom side of the lower washer on screw (1) should be approximately 3-1/32" using 5/8" springs, or 4-1/32" using 1-1/8" springs. (The corresponding dimension on Type AK-1-25 breakers should be approximately 3-29/32"). To adjust for proper contact pressure, the adjusting nut of any particular contact finger should be backed off or advanced, as required.

The disconnects are checked for the proper amount of spring pressure before leaving the factory.

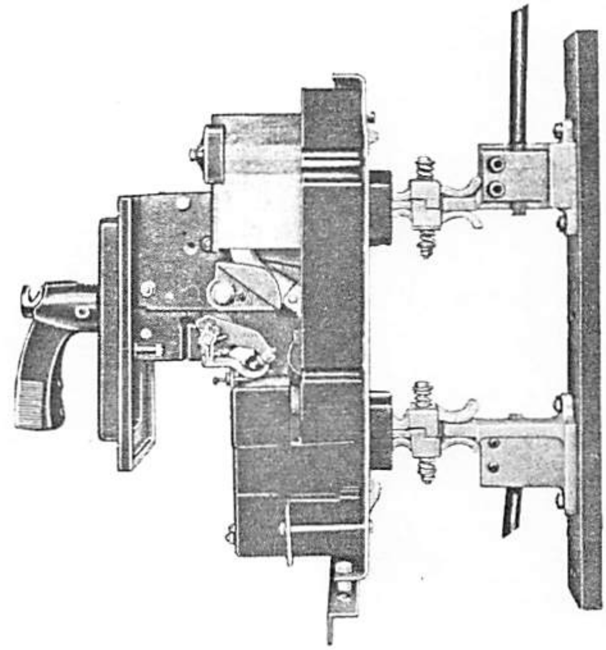
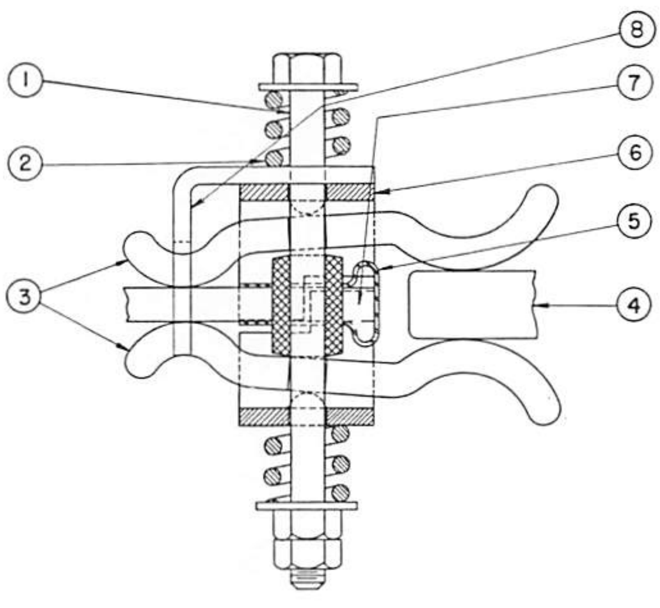
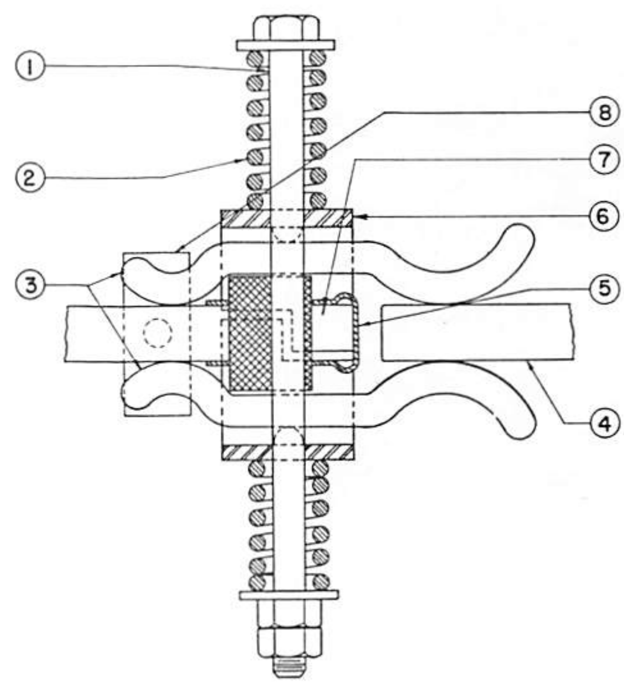


FIG. 32
DISCONNECTS ENGAGING STATIONARY STUDS



1 SCREW
2 SPRING
3 CONTACT FINGERS
4 STATIONARY STUD
5 STOP
6 RETAINER
7 BREAKER STUD
8 RETAINER

FIG. 33
DISCONNECT FOR MOUNTING TYPE AK-1-15 BREAKER



1 SCREW
2 SPRING
3 CONTACT FINGERS
4 STATIONARY STUD
5 STOP
6 RETAINER
7 BREAKER STUD
8 RETAINER

FIG. 34
DISCONNECT FOR MOUNTING TYPE AK-1-25 BREAKER

7. TERMINAL BOARD FIG. 35

The terminal board is attached to the right side of the breaker (looking from the front) by a bracket and two screws. It consists of a molded contact strip on which are arranged a number of binding screws for making connections with the various breaker devices which are externally controlled. It has a front cover to prevent dust and dirt from collecting on the terminal connections.

REPLACEMENTS--Terminal Board

1. Remove cover of terminal board by removing two screws.
2. Disconnect wiring to Terminal board.
3. Remove two screws attaching terminal board to bracket and remove terminal board.
4. Install terminal board in reverse order.

Bracket

1. Remove terminal board (see above).
2. Remove two screws from bracket and remove bracket.
3. Install bracket in reverse order.

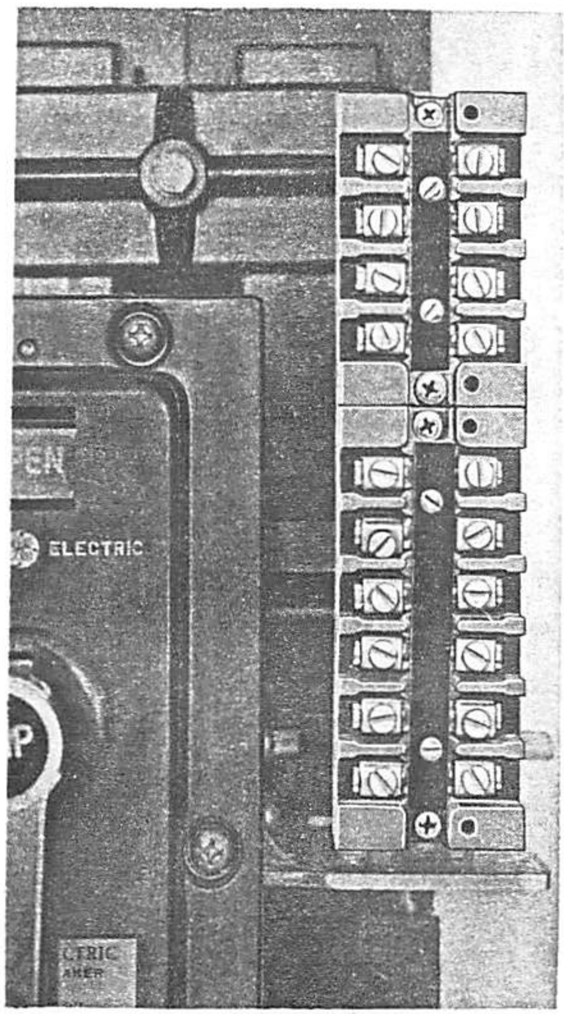
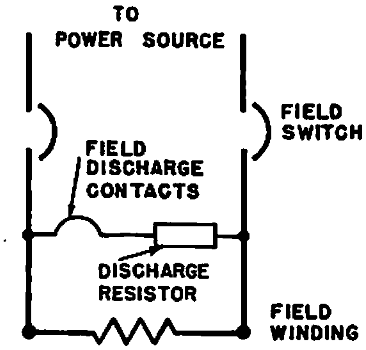


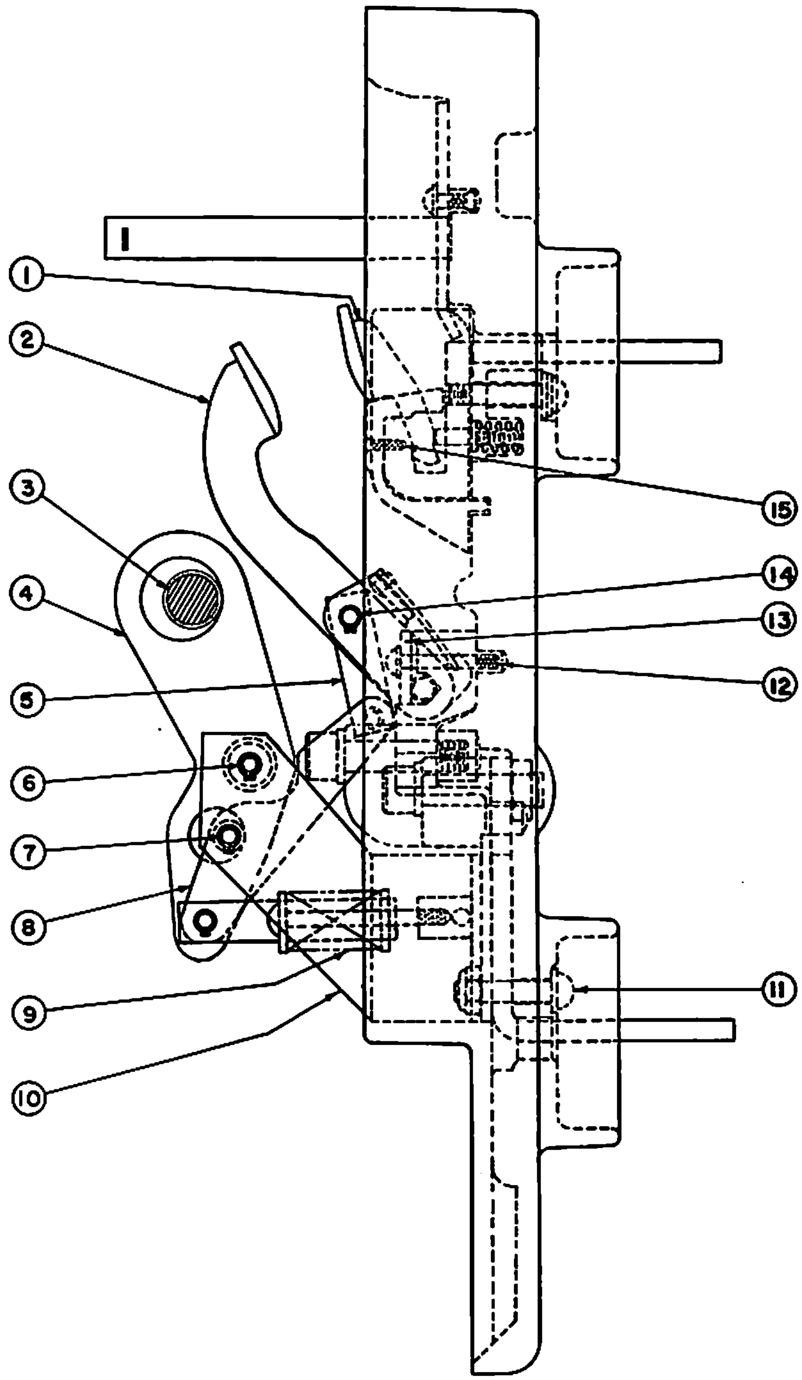
FIG. 35
TERMINAL BOARD WITH COVER REMOVED

8004136
SX M-6149685C



TYPICAL CONNECTION DIAGRAM

1. STATIONARY CONTACT
2. MOVABLE CONTACT
3. SHAFT
4. LINK
5. LINK
6. PIN
7. PIN
8. CRANK
9. SPRING
10. BRACKET
11. SCREW
12. SCREW
13. CLAMP
14. PIN
15. SCREW



FIELD DISCHARGE CONTACTS FIG. 36

SK. T-6490359

X

TYPE AKF-I FIELD SWITCH

1. GENERAL

A field switch with two parallel, stationary and movable discharge contacts is used to control the shunt field circuits of synchronous generators and non-synchronous motors. It is similar to a bi-polar air circuit breaker with field discharge contacts placed in the center pole base. It may be used with or without electrical closing attachments.

The closing of the field discharge contacts connects a discharge resistor across the field of the generator or motor. This makes it possible to open the field switch without inducing a high voltage in the field.

2. FIELD DISCHARGE CONTACTS FIG. 36

The field discharge contacts close before the contacts of the field switch open and likewise open after the field switch closes. The closing of the field discharge contacts is accomplished by crank (8) which also constitutes a part of the toggle linkage used in closing the field discharge contacts. Crank (8) is pivoted to pin (7) in bracket (10) and is connected to the main shaft (3) by means of insulating link (4) and by link (5) to movable contact (2). When the main shaft moves away from the pole base, the toggle linkage straightens and the field discharge contacts are closed by springs (9) attached to the lower part of crank (8) and bracket (10). The toggle linkage is so arranged that overlapping of the field discharge contacts and the contacts of the field switch takes place, thereby preventing an open circuited field.

Sufficient clearance between the upper stud and the upper part of the stationary contact support is provided so as to establish 1/2" contact wipe of both field switch and field discharge contacts.

ADJUSTMENTS--To measure the contact wipe of the field switch contacts, first, remove the arc quencher (see "Replacements" under Arc Quencher). Then use a scale to ascertain the distance the exterior contact point travels when the stationary contact is pushed back into the pole base as far as it will go, with the breaker in the open position. To adjust contact wipe, an eccentric bushing in insulating link (8), Fig. 10, is used to make the adjustment (see "Contact Wipe" under Contact Assembly).

REPLACEMENTS--Movable Contacts (2)

1. Remove arc quencher (see "Replacements" under Arc Quencher).
2. Remove Operating Mechanism (see "Replacements" under Operating Mechanism).
3. Remove pin (14).
4. Remove two screws (11) and remove field discharge mechanism.
5. Remove two screws (12) and two clamps (13).
6. Remove movable contacts.
7. Replace new contacts in reverse order.
8. Adjust contact wipe and contact pressure (see above).
9. Replace Operating Mechanism.
10. Replace Arc Quencher.

Stationary Contact (1)

1. Remove arc quencher (see "Replacements" under Arc Quencher).
2. Remove the upper stud cap by removing two screws (15).
3. Pry stationary contact (1) from the upper stud.
4. Replace the new stationary contact in reverse order.
5. Adjust contact wipe and contact pressure (see above). It may be necessary to tap the new stationary contacts in place.

XI

RENEWALS

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, GEF-3506.

In the absence of a Renewal Parts Bulletin, the described parts should be identified by giving the complete nameplate data of the circuit breaker or accessory.

Renewal parts which are furnished may not be identical with the original parts, since improvements are made from time to time. Parts which are furnished will be interchangeable.

XII

CONNECTION DIAGRAMS

Figs. 37 and 38 show typical elementary and typical connection diagrams respectively, for the control of electrically-operated breakers.

SK. T-6490359

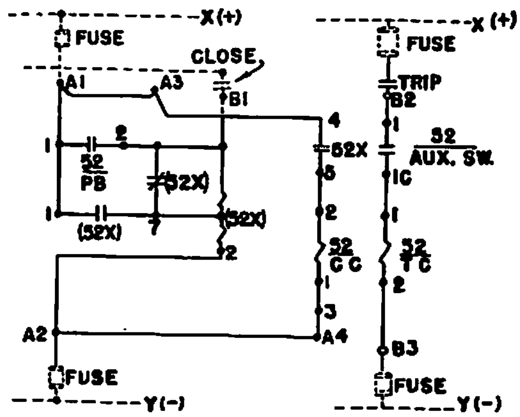
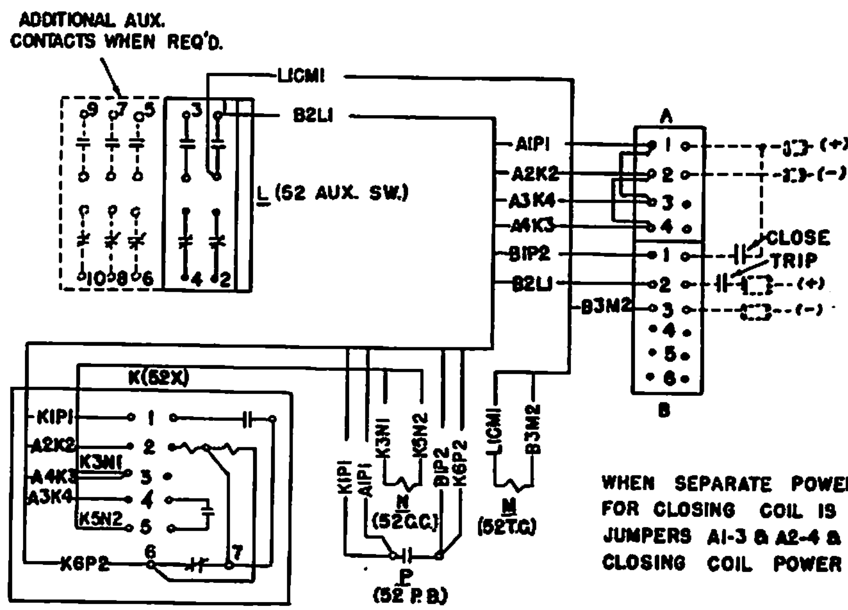


FIG. 37
TYPICAL ELEMENTARY DIAGRAM



WHEN SEPARATE POWER SOURCE FOR CLOSING COIL IS USED OMIT JUMPERS A1-3 & A2-4 & CONNECT CLOSING COIL POWER TO A3&A4

FIG. 38
TYPICAL CONNECTION DIAGRAM

LIST OF ABBREVIATIONS

A. TERMINAL BOARD LOCATED TOP RIGHT FRONT VIEW.
B. TERMINAL BOARD LOCATED TOP RIGHT FRONT VIEW.
L. AUX. SW. 52 - 2a - 2b STD. OR 5a - 5b SPECIAL (INCLUDES CONTACT FOR SHUNT TRIP. LAMPS ETC.) AUX.SW.
H. BELL ALARM OR LOCKOUT DEVICE - OPERATES WHEN BREAKER TRIPS ON OVERCURRENT, ONLY. HAND RESET. "a" OR "b" CONTACT.
K. SOLENOID CONTROL DEVICE (52X) CONSISTS OF AN OPERATING COIL WITH DOUBLE WINDING AND SHORTING SWITCH. A MAIN CONTACT AND SEAL-IN CONTACT. MAIN CONTACT AND SEAL-IN CONTACT CLOSE WHEN FIRST SECTION OF OPERATING COIL IS ENERGIZED BY CLOSING SWITCH. THE CONTACTS ARE OPENED MECHANICALLY WHEN THE BREAKER CLOSING SOLENOID "N" COMPLETES ITS STROKE. SHORTING SWITCH THEN OPENS INSERTING COMPLETE OPERATING COIL FOR CONTINUOUS ENERGIZATION, PROVIDING AN ANTI-PUMP FEATURE BY PREVENTING MAIN CONTACTS FROM RECLOSING AS LONG AS CLOSING SWITCH REMAINS CLOSED.
M. SHUNT TRIP $(52)_{TC}$
J. UNDERVOLTAGE TRIP DEVICE $(52)_{UV}$ TIME OR INSTANTANEOUS.
N. BREAKER CLOSING SOLENOID COIL $(52)_{CC}$
P. CLOSING SWITCH ON BREAKER $(52)_{PB}$
S. REVERSE CURRENT TRIP DEVICE FOR D.C. $(52)_{RC}$

SK. M-6496859

AK-I FIELD SWITCH CORRECTION

These instructions have been written to cover field switches in both 225 and 600 ampere frame size. This is an error, as only the 600 ampere frame size field switch is furnished.

TYPES AK-I-15YI AND AK-I-25YI BREAKERS

Types AK-1-15Y1 and AK-1-25Y1 are intended for the protection of resistance welding machines. They trip instantaneously at higher current settings than breakers provided with the regular instantaneous overcurrent tripping device as shown in Figs. 23A to 23H. Types AK-1-15Y1 and AK-1-25Y1 differ from the regular breakers only in the provision that higher current settings may be obtained.

Standard calibration ranges for type AK-1-15Y1, Fig. 39, are as follows:

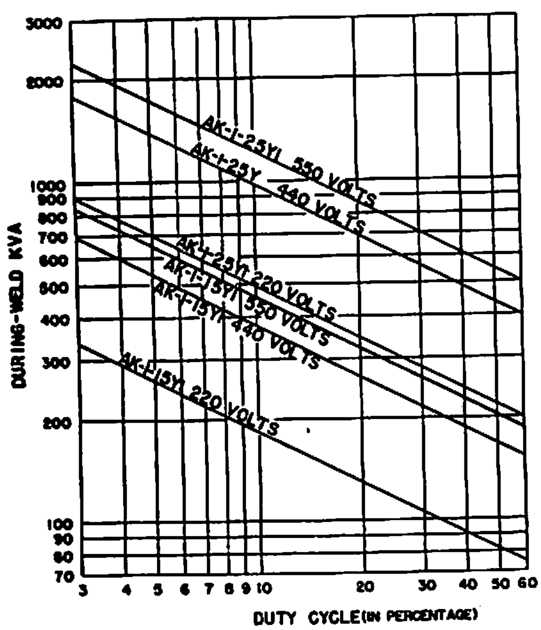
a. 200 to 500 amperes
b. 400 to 1000 amperes
c. 600 to 1500 amperes

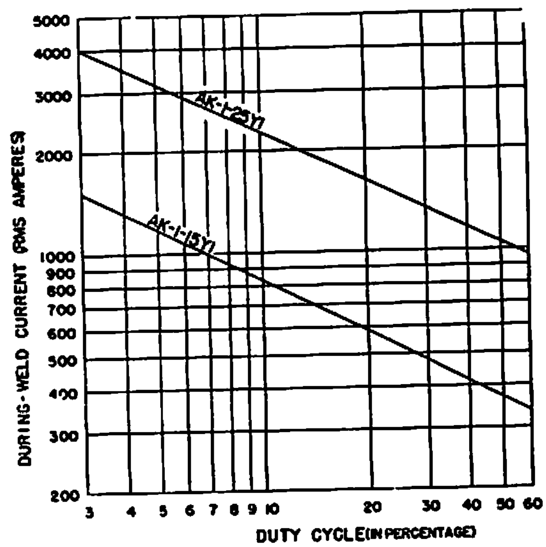
Standard calibration ranges for type AK-1-25Y1, Fig. 39, are as follows:

a. 600 to 150 amperes
b. 1400 to 4000 amperes
c. 2000 to 5000 amperes

Other ranges can be provided within reasonable limits where the highest calibration settings will not exceed approximately 2-1/2 times the lowest calibration setting.

These breakers are not given a continuous current rating since the duty imposed is intermittent and quite variable depending upon various types of welding to be done. The breakers are designed to safely carry "during-weld amperes" or "during-weld KVA" at welding periods not to exceed the corresponding "duty cycle" as tabulated in Fig. 39. ("Duty cycle is the percent of time that current flows in any one minute").





AK-1-15Y1 BREAKER

Duty Cycle (%)	During-weld Amp Rms	During-weld Kva 220 Volts	440 Volts	550 Volts
3	1530	337	674	841
4	1325	292	584	729
5	1185	261	522	652
6	1080	238	475	594
7	1000	220	440	550
8	936	206	412	516
9	884	194	388	486
10	839	185	370	461
20	594	131	262	327
30	484	108	215	266
40	419	92	184	231
50	375	83	165	206
60	342	75	150	188

AK-1-25Y1 BREAKER

Duty Cycle (%)	During-weld Amp Rms	During-weld Kva 220 Volts	440 Volts	550 Volts
3	4040	890	1780	2225
4	3500	770	1540	1925
5	3130	689	1378	1722
6	2860	629	1258	1574
7	2740	580	1161	1453
8	2640	544	1087	1360
9	2330	513	1025	1282
10	2215	487	974	1219
20	1566	345	689	861
30	1278	281	562	703
40	1107	244	487	609
50	990	218	436	545
60	903	199	398	497

FIG. 39

CURRENT AND DUTY CYCLE LIMITS OF TYPES AK-I-15YI AND AK-I-25YI BREAK

INSTRUCTIONS
MAINTENANCE

GEI-74624
SUPERSEDES GEH-1832B

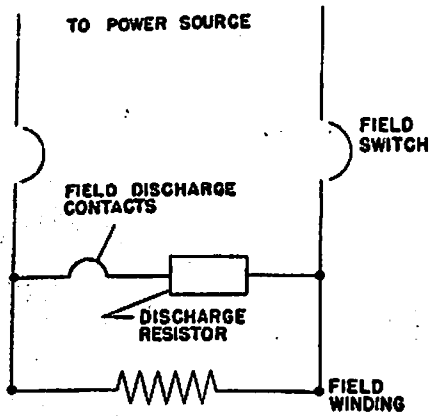
POWER CIRCUIT BREAKERS

Type AKF-1B-3 to 10
Electrically Operated

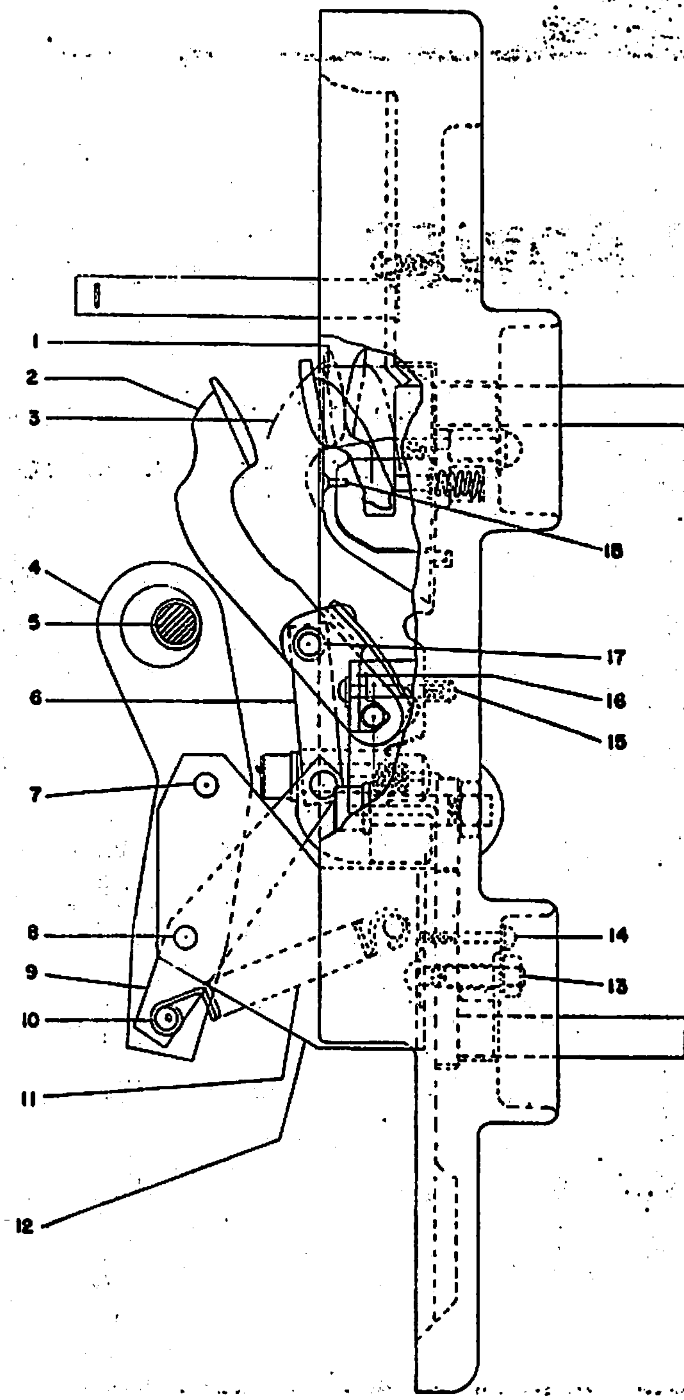
LOW VOLTAGE SWITCHGEAR DEPARTMENT

GENERAL ELECTRIC

PHILADELPHIA, PA.



TYPICAL CONNECTION DIAGRAM



1. Stationary Contact
2. Movable Contact
3. Breaker Contacts
4. Link
5. Main Shaft
6. Link
7. Pin
8. Pin
9. Crank
10. Eccentric Pin
11. Spring
12. Bracket
13. Holding Screw and Nut
14. Screw
15. Screw
16. Clamp
17. Pin
18. Screw

Fig. 1A Field Discharge Contacts (AKF-1B-3 to 5)

Fig. 1A (238C184)

POWER CIRCUIT BREAKERS
TYPE AKF-1B-3 TO 10
ELECTRICALLY OPERATED

The instructions contained herein are a supplement to instruction book GEI-74603 and are to be used in conjunction with GEI-74603.

The AKF breaker is a special type of AK breaker designed especially for use in controlling the shunt field circuits of synchronous generators and synchronous motors. These breakers are usually furnished without series overcurrent tripping devices and have a continuous rating of 600 amperes. The AKF is a two pole air circuit breaker with field discharge contacts placed in the center pole base.

The closing of the field discharge contacts connects a discharge resistor across the field of the generator or motor. This makes it possible to open the field switch without inducing a high voltage in the field.

The AKF breakers differ as follows:

1. The AKF-1B-4 is the same as the AKF-1B-3 except for the "Y" relay of the solenoid control system.
2. The AKF-1B-5 differs from the AKF-1B-3 in that it has a plastic front escutcheon and the same "Y" relay as the AKF-1B-4 breaker.
3. The AKF-1B-6 is the same as the AKF-1B-3 except that it has a different field discharge mechanism. It also has the same "Y" relay as the AKF-1B-4 breaker.
4. The AKF-1B-6 to 10 have same field discharge mechanism. (For a complete tabulation of nomenclature changes, see Page 3 of GEI-74603.)

AKF-1B-3, AKF-1B-4 AND AKF-1B-5 FIELD DISCHARGE MECHANISM FIGURE 1A

When an AKF-1B-3, AKF-1B-4 or AKF-1B-5 field breaker is operated, the field discharge contacts close before the main contacts of the breaker open; the field discharge contacts open after the main breaker contacts close. This overlap prevents an open circuited field.

Sufficient clearance between the upper stud and the upper part of the stationary contact support is provided so that a contact wipe of approximately one-half inch on both the field discharge and the main contacts may be established. The main shaft (5) of the breaker passes through a large hole in compound link (4) which is pivoted on pin (7) in bracket (12). Link (4) is coupled to crank (9) which is pivoted on pin (8)

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.

in bracket (12) by means of an eccentric pin (10). Compound link (6) is coupled between crank (9) and discharge contact (2). Bracket (12) is securely fastened to the pole unit by holding screws and nuts (13) and is dowelled in place by dowel screw (14). (Caution: No attempt should be made to move the supporting bracket (12). When the breaker trips, the main shaft (5) moves backward, away from the pole base. This allows the spring (11) to straighten the toggle linkage (6 and 9) thus forcing the discharge contact (2) closed.

During the closing operation of the breaker, the main shaft (5) moves forward toward the pole base. This causes link (4) which pivots on pin (7) to force crank (9) to pivot about pin (8) causing the toggle linkage (6 and 9) to collapse allowing the discharge contact (2) to open.

ADJUSTMENTS

With the discharge contacts open there should be a gap of approximately one inch between the movable and stationary contacts. This gap may be adjusted by loosening the nuts on either side of the eccentric pin (10) and rotating the pin until the desired gap is obtained. Be sure to tighten nuts securely after adjusting.

The overlap between the discharge contacts and the outside pole contacts should be between 1/8" and 1/4", measured at the point of contact.

Contact wipe on all contacts should be approximately 1/2". See "Pole Unit Assembly" in GEI-74603 for method of obtaining desired wipe and pressure on outer pole contacts.

REPLACEMENTS

Movable Contacts (2)

1. Remove arc quencher (see "Replacements" under "Arc Quencher", page 6 of GEI-74603).
2. Remove operating mechanism (see "Replacements" under "Operating Mechanism", Page 11 of GEI-74603).
3. Remove pin (17).
4. Remove two screws (13) and remove field discharge mechanism.
5. Remove two screws (15) and two clamps (16).
6. Remove movable contacts.
7. Replace new contacts in reverse order.
8. Adjust contact wipe and contact pressure (see above).
9. Replace operating mechanism.
10. Replace arc quencher.

Stationary Contacts (1)

1. Remove arc quencher (see "Replacements" under "Arc Quencher", Page 6 of GEI-74603.
2. Remove the upper stud cap by removing two screws (18).
3. Pry stationary contact (1) from the upper stud.
4. Replace the new stationary contact in reverse order.
5. Adjust contact wipe and contact pressure (see above). It may be necessary to tap the new stationary contacts in place.

AKF-1B-6 TO 10 FIELD DISCHARGE MECHANISM
FIGURE 1B

The main shaft (9) of the breaker passes through a large hole in arm (7), which is pivoted on pin (11) in bracket (13). When the breaker is closed, the main shaft (9) moves forward causing arm (7) to pivot about pin (11), thereby causing link (16) to move away from the breaker base. This moition causes link (14) to move downward pivoting about eccentric (17). The downward motion of link (14) is transmitted through link (12) to coupling (10) and link (6), thus causing the linkage to collapse. The field discharge contacts (27), which pivot about pin (21), open when the coupling (10) and link (6) collapse.

When the breaker is opened, the mechanism motion described above is reversed, so that the field discharge contacts close.

The contacts of the discharge mechanism are set so that one contact makes before the other. This is done to minimize wearing of the contacts due to arcing.

ADJUSTMENTS

With the discharge contacts open, the gap between the movable and stationary discharge contacts should be between 1-1/8" and 1-3/8", with the free movement tending to reduce the gap. This adjustment is obtained by loosening the nuts on either side of the eccentric (17) and rotating pin until the proper opening exists. Tighten the nuts securely after adjusting.

The extended stationary contact and the standard stationary contact should be staggered between 1/16" and 1/8". The extended contact finger on the center pole should close between 1/4" and 3/8" before the contacts on the outer poles break.

Both the breaker contacts and the discharge contacts should be adjusted to provide 1/16" overtravel when they are fully wiped in. Contact wipe should be approximately 1/2". However, this dimension is not critical, and wipe in excess of this amount is not significant. For method of adjusting wipe see "Pole Unit Assembly", Page 8 of GEI-74603).

REPLACEMENTS

Movable Contacts (2)

1. Remove arc quencher (see "Replacement" under "Arc Quencher", Page 6 of GEI-74603).
2. Remove operating mechanism (see "Replacement" under "Operating Mechanism", Page 11 of GEI-74603).
3. Remove screws which attach flexible lead (19) to the movable contact arms.
4. Remove clamp (20) and two screws (18). The field discharge mechanism is now free to be removed.
5. Remove pin (22) and movable contacts (2).
6. Replace contacts and re-assemble field discharge mechanism in reverse order.
7. Adjust contact wipe and pressure (see above).
8. Replace arc quenchers.

Stationary Contacts (1)

1. Remove movable contacts as described above.
2. Remove upper stud (25) by removing three screws (26).
3. Remove upper stud cap (5) by removing screws (4).
4. Remove pin (3) and stationary contacts (1).
5. Replace parts in reverse order.

NOTE: The stationary contacts on the outside pole units of the AKF-1B-6 to 10 are similar to the stationary contacts of the field discharge mechanism. When replacing the stationary contacts on the outside pole units, remove the movable contact assembly as described in GEH-74603 and then remove the stationary contacts as described above.

1. Contact Finger (Sta.)
2. Contact Arm (Mov.)
3. Pin (Contact Pivot)
4. Screw FL. PH. HD.
5. Upper Stud Cap
6. Coupling
7. Arm
8. Buffer
9. Main Shaft
10. Link
11. Pin
12. Link
13. Bracket
14. Link
15. Pin
16. Link
17. Eccentric
18. Screw RD. PH. HD.
19. Flexible Lead
20. Clamp
21. Pin (Mov. Cont. Pivot)
22. Pin (Insul.To.Mov.Cont.)
23. Screw RD. PH. HD.
24. Spring (Stat. Cont.)
25. Upper Stud
26. Screw RD. PH. HD.

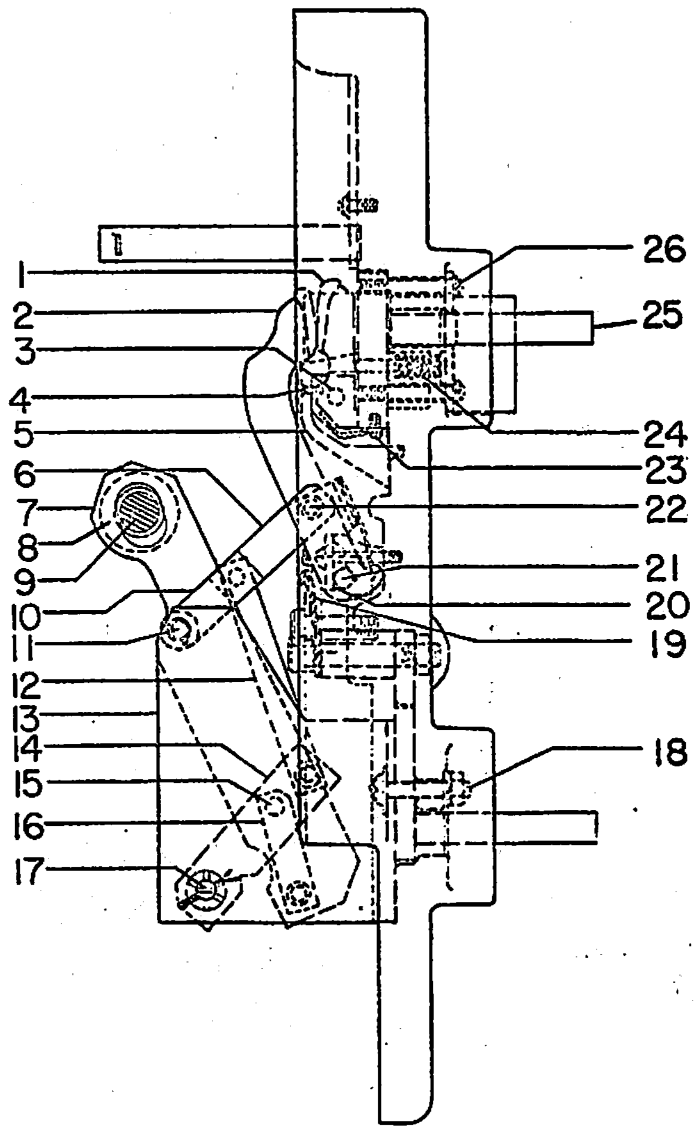


Fig. 1B (227D127)

Fig. 1B Field Discharge Contacts (AKF-1B-6 to 10)

GEH-1832B

INSTRUCTIONS

Switchgear

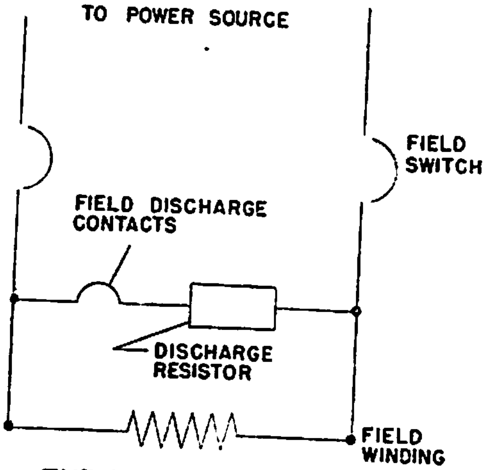
Types AKF-1B-3, AKF-1B-4, AKF-1B-5, and AKF-1B-6, Electrically Operated

AIR CIRCUIT BREAKERS

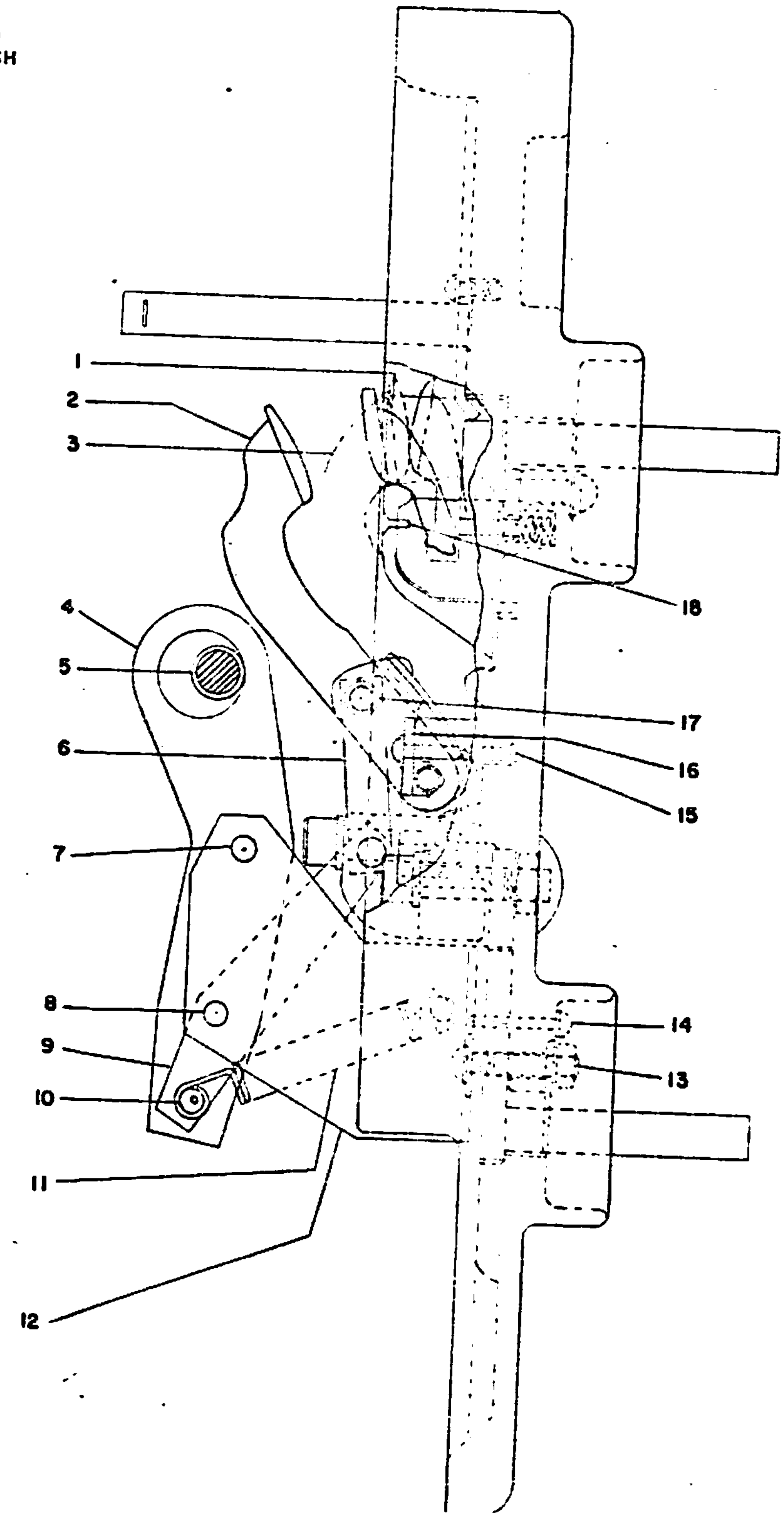
LOW VOLTAGE SWITCHGEAR DEPARTMENT

GENERAL ELECTRIC

PHILADELPHIA, PA.



TYPICAL CONNECTION DIAGRAM



1. Stationary Contact
2. Movable Contact
3. Breaker Contacts
4. Link
5. Main Shaft
6. Link
7. Pin
8. Pin
9. Crank
10. Eccentric Pin
11. Spring
12. Bracket
13. Holding Screw and Nut
14. Screw
15. Screw
16. Clamp
17. Pin
18. Screw

Fig. 1A Field Discharge Contacts

AIR CIRCUIT BREAKERS

TYPES AKF-1B-3, AKF-1B-4, AKF-1B-5 AND AKF-1B-6

ELECTRICALLY OPERATED

The instructions contained herein are a supplement to instruction book GEH-1807 and are to be used in conjunction with GEH-1807.

The AKF breaker is a special type of AK breaker designed especially for use in controlling the shunt field circuits of synchronous generators and synchronous motors. These breakers are usually furnished without series overcurrent tripping devices and have a continuous rating of 600 amperes. The AKF is a two pole air circuit breaker with field discharge contacts placed in the center pole base.

The closing of the field discharge contacts connects a discharge resistor across the field of the generator or motor. This makes it possible to open the field switch without inducing a high voltage in the field.

The AKF breakers differ as follows:

1. The AKF-1B-4 is the same as the AKF-1B-3 except for the "Y" relay of the solenoid control system.
2. The AKF-1B-5 differs from the AKF-1B-3 in that it has a plastic front escutcheon and the same "Y" relay as the AKF-1B-4 breaker.
3. The AKF-1B-6 is the same as the AKF-1B-3 except that it has a different field discharge mechanism. It also has the same "Y" relay as the AKF-1B-4 breaker.

AKF-1B-3, AKF-1B-4 AND AKF-1B-5 FIELD DISCHARGE MECHANISM FIGURE 1A

When an AKF-1B-3, AKF-1B-4 or AKF-1B-5 field breaker is operated, the field discharge contacts close before the main contacts of the breaker open; the field discharge contacts open after the main breaker contacts close. This overlap prevents an open circuited field.

Sufficient clearance between the upper stud and the upper part of the stationary contact support is provided so that a contact wipe of approximately one-half inch on both the field discharge and the main contacts may be established. The main shaft (5) of the breaker passes through a large hole in compound link (4) which is pivoted on pin (7) in bracket (12). Link (4) is coupled to crank (9) which is pivoted

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.

... pin (8) in bracket (12) by means of an eccentric pin (10). Compound link (6) is coupled between crank (9) and discharge contact (2). Bracket (12) is securely fastened to the pole unit by holding screws and nuts (13) and is dowelled in place by dowel screw (14). (Caution: No attempt should be made to move the supporting bracket (12)). When the breaker trips, the main shaft (5) moves backward, away from the pole base. This allows the spring (11) to straighten the toggle linkage (6 and 9) thus forcing the discharge contact (2) closed.

During the closing operation of the breaker, the main shaft (5) moves forward toward the pole base. This causes link (4) which pivots on pin (7) to force crank (9) to pivot about pin (8) causing the toggle linkage (6 and 9) to collapse allowing the discharge contact (2) to open.

ADJUSTMENTS

With the discharge contacts open there should be a gap of approximately one inch between the movable and stationary contacts. This gap may be adjusted by loosening the nuts on either side of the eccentric pin (10) and rotating the pin until the desired gap is obtained. Be sure to tighten nuts securely after adjusting.

The overlap between the discharge contacts and the outside pole contacts should be between 1/8" and 1/4", measured at the point of contact.

Contact wipe on all contacts should be approximately 1/2". See "Pole Unit Assembly" in GEH-1807 for method of obtaining desired wipe on outer pole contacts.

REPLACEMENTS

Movable Contacts (2)

1. Remove arc quencher (see "Replacements" under "Arc Quencher", GEH-1807).
2. Remove operating mechanism (see "Replacements" under "Operating Mechanism", GEH-1807).
3. Remove pin (17).
4. Remove two screws (13) and remove field discharge mechanism.
5. Remove two screws (15) and two clamps (16).
6. Remove movable contacts.
7. Replace new contacts in reverse order.
8. Adjust contact wipe and contact pressure (see above).
9. Replace operating mechanism.
10. Replace arc quencher.

Stationary Contacts (1)

1. Remove arc quencher (see "Replacements" under "Arc Quencher").
2. Remove the upper stud cap by removing two screws (18).
3. Pry stationary contact (1) from the upper stud.
4. Replace the new stationary contact in reverse order.
5. Adjust contact wipe and contact pressure (see above). It may be necessary to tap the new stationary contacts in place.

AKF-1B-6 FIELD DISCHARGE MECHANISM
FIGURE 1B

The main shaft (9) of the breaker passes through a large hole in arm (7), which is pivoted on pin (11) in bracket (13). When the breaker is closed, the main shaft (9) moves forward causing arm (7) to pivot about pin (11), thereby causing link (16) to move away from the breaker base. This motion causes link (14) to move downward pivoting about eccentric (17). The downward motion of link (14) is transmitted through link (12) to coupling (10) and link (6), thus causing the linkage to collapse. The field discharge contacts (27), which pivot about pin (21), open when the coupling (10) and link (6) collapse.

When the breaker is opened, the mechanism motion described above is reversed, so that the field discharge contacts close.

The contacts of the discharge mechanism are set so that one contact makes before the other. This is done to minimize wearing of the contacts due to arcing.

ADJUSTMENTS

With the discharge contacts open, the gap between the movable and stationary discharge contacts should be between 1-1/8" and 1-3/8", with the free movement tending to reduce the gap. This adjustment is obtained by loosening the nuts on either side of the eccentric (17) and rotating the pin until the proper opening exists. Tighten the nuts securely after adjusting.

The extended stationary contact and the standard stationary contact should be staggered between 1/16" and 1/8". The extended contact finger on the center pole should close between 1/4" and 3/8" before the contacts on the outer poles break.

Both the breaker contacts and the discharge contacts should be adjusted to provide 1/16" overtravel when they are fully wiped in. Contact wipe should be approximately 1/2". However, this dimension is not critical, and wipe in excess of this amount is not significant. For method of adjusting wipe see "Pole Unit Assembly" in GEH-1807.

REPLACEMENTS

Movable Contacts (2)

1. Remove arc quencher (see "Replacements" under "Arc Quencher" in GEH-1807).
2. Remove operating mechanism (see "Replacements" under "Operating Mechanism" in GEH-1807).
3. Remove screws which attach flexible lead (19) to the movable contact arms.
4. Remove clamp (20) and two screws (18). The field discharge mechanism is now free to be removed.
5. Remove pin (22) and movable contacts (2).
6. Replace contacts and re-assemble field discharge mechanism in reverse order.
7. Adjust contact wipe and pressure (see above).
8. Replace arc quenchers.

Stationary Contacts (1)

1. Remove movable contacts as described above.
2. Remove upper stud (25) by removing three screws (26).
3. Remove upper stud cap (5) by removing screws (4).
4. Remove pin (3) and stationary contacts (1).
5. Replace parts in reverse order.

NOTE: The stationary contacts on the outside pole units of the AKF-1B-6 are similar to the stationary contacts of the field discharge mechanism. When replacing the stationary contacts on the outside pole units, remove the movable contact assembly as described in GEH-1807 and then remove the stationary contacts as described above.

1. Contact Finger (Sta.)
2. Contact Arm (Mov.)
3. Pin (Contact Pivot)
4. Screw FL. PH. HD.
5. Upper Stud Cap
6. Coupling
7. Arm
8. Buffer
9. Main Shaft
10. Link
11. Pin
12. Link
13. Bracket
14. Link
15. Pin
16. Link
17. Eccentric
18. Screw RD. PH. HD.
19. Flexible Lead
20. Clamp
21. Pin (Mov.Cont.Pivot)
22. Pin (Insul.To Mov.Cont.)
23. Screw RD. PH. HD.
24. Spring (Stat. Cont.)
25. Upper Stud
26. Screw RD. PH. HD.

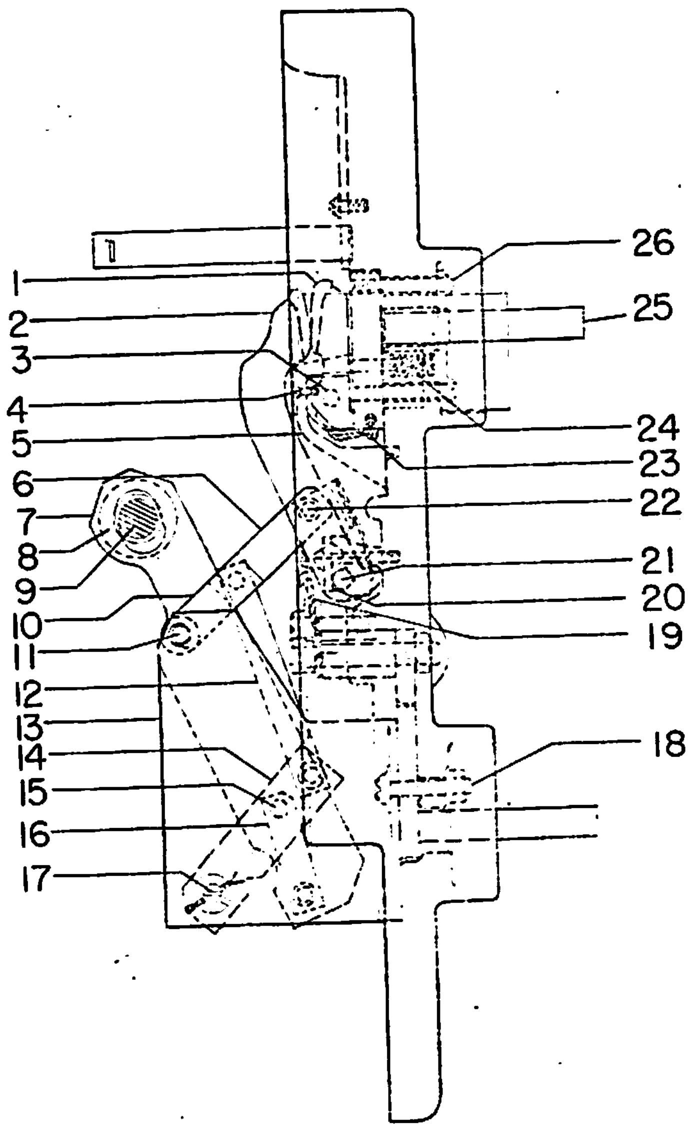


Fig. 18 Field Discharge Contacts

Fig. 18 (227D127)

ADB

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GENERAL ELECTRIC COMPANY, PHILADELPHIA, PA.

1-55

Handbook Reference No. 6735
Supersedes GEH-1832A

GEF-3506C
Supersedes GEF-3506B

RENEWAL PARTS

TYPES AK-1-15 AND AK-1-25 POWER CIRCUIT BREAKERS AND TYPE AKF-1B FIELD BREAKERS

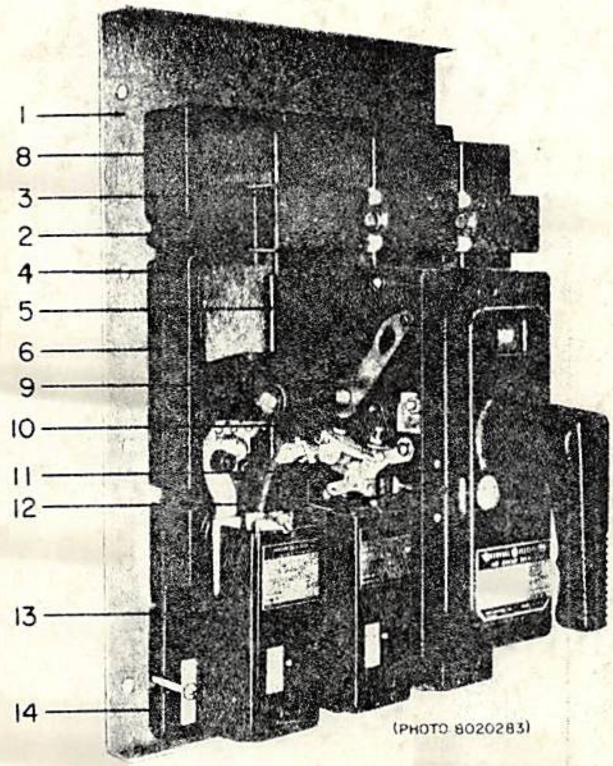


Fig. 1. Type AK-1-25-8 air circuit breaker, manually operated

NOTE: All reference to "right" and "left" designate the location of the part when facing the operating mechanism end of the breaker.

ORDERING INSTRUCTIONS

1. Always specify the complete nameplate data of the breaker.
2. Specify the quantity, catalog number (if listed), reference number (if listed), description, and this bulletin number.
3. CAUTION: When local facilities for breaker recalibration are not available, the breaker should be forwarded to the nearest G-E Service Shop, or to the General Electric Company, 6901 Elmwood Ave., Philadelphia 42, Pa.
4. Standard hardware, such as screws, bolts, nuts, washers, etc., is not listed in this bulletin. Such items should be purchased locally.
5. For prices, refer to the nearest office of the General Electric Company.

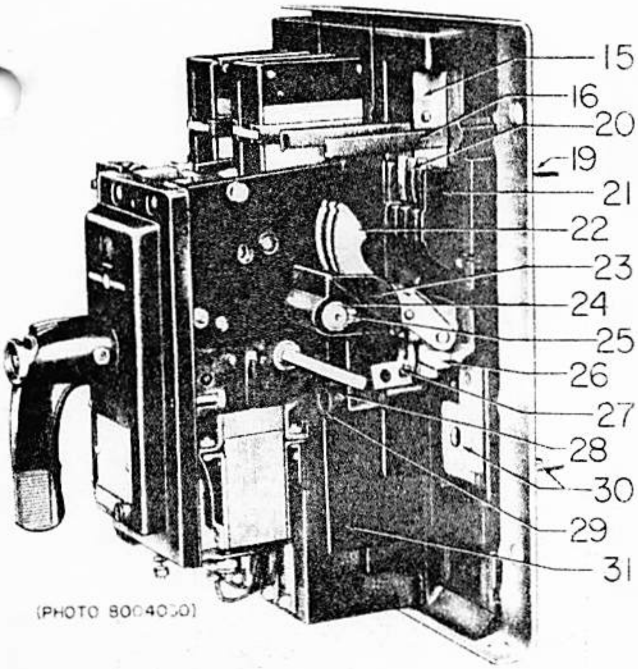


Fig. 2. Type AK-1-15 air circuit breaker, electrically operated. (shunt trip device, terminal board, and right pole overcurrent trip device and arc quencher removed)

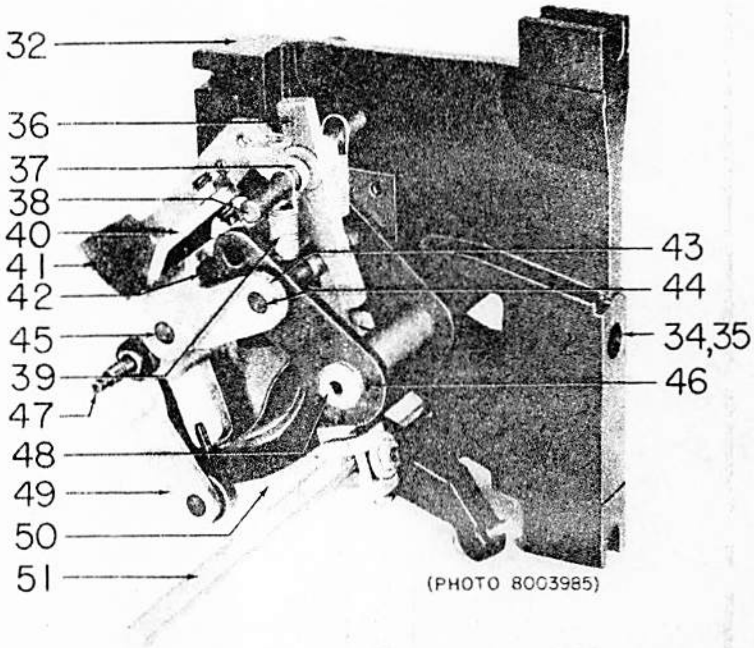


Fig. 3. Operating mechanism linkage for Type AK-1-15 air circuit breaker (right side frame removed)

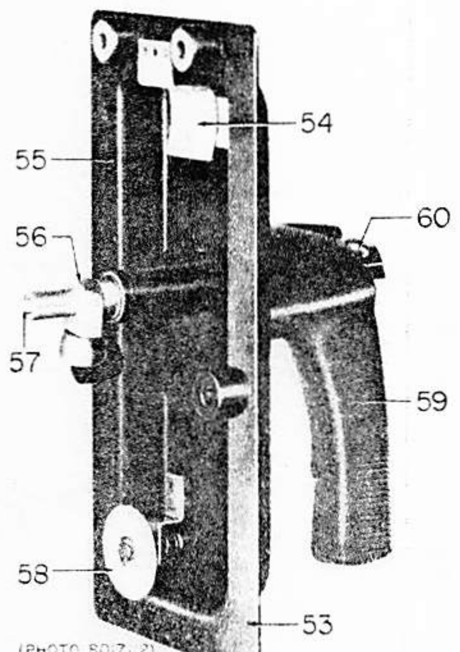


Fig. 4. Manual operating handle and escutcheon used on breakers up to and including -6 (ref. 52)

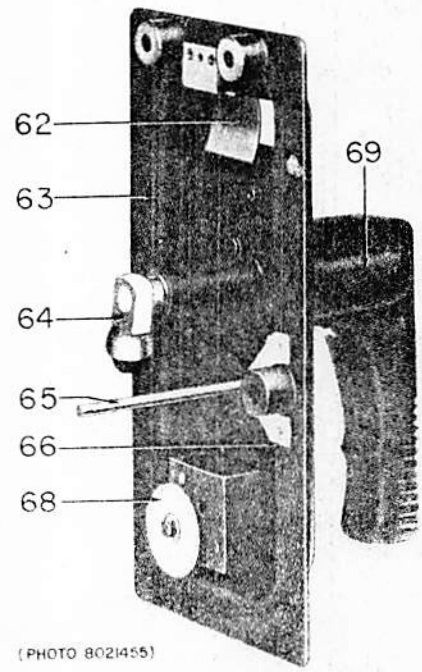


Fig. 5. Manual operating handle and escutcheon used on breakers from -7 to -9 (ref. 53)

Fig. No.	Ref. No.	Number Required for 3-pole Breaker																								Catalog Number	Description
		For Type AK-1-15												For Type AK-1-25													
		‡	A	-1	-2	-3	-4	-5	-6	-7	-8	-9	-10	‡	A	-1	-2	-3	-4	-5	-6	-7	-8	-9	-10		
1	1	1	3	3	3	3	3	3	3	3	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	6357045P3	Pole unit base
1	1	1	-	-	-	-	-	-	-	-	-	-	-	3	3	3	3	3	3	3	3	3	3	3	3	6357059P3	Pole unit base
1	2	-	-	-	-	-	-	-	-	-	-	-	-	4	4	4	4	4	4	4	4	4	4	4	4	6403453P2	Reinforcing barrier
1	3	1	1	1	1	1	1	1	1	1	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	6414297P1	Arc quencher clamp
1	3	-	-	-	-	-	-	-	-	-	-	-	-	1	1	1	1	1	1	1	1	1	1	1	1	6414299P1	Arc quencher clamp
1	4	3	3	3	3	3	3	3	3	3	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	6414042G3	Arc quencher assembly
1	4	-	-	-	-	-	-	-	-	-	-	-	-	3	3	3	3	3	3	3	3	3	3	3	3	6414042G4	Arc quencher assembly
1	5	3	3	3	3	3	3	3	3	3	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	6372758P2	Arc quencher cap
1	5	5	-	-	-	-	-	-	-	-	-	-	-	3	3	3	3	3	3	3	3	3	3	3	3	6403139P2	Arc quencher cap
1	6	3	3	3	3	3	3	3	3	3	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	6403130P1	Outside barrier, right
1	6	-	-	-	-	-	-	-	-	-	-	-	-	3	3	3	3	3	3	3	3	3	3	3	3	6403138P1	Outside barrier, right
1	6	3	3	3	3	3	3	3	3	3	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	6403130P2	Outside barrier, left
1	6	-	-	-	-	-	-	-	-	-	-	-	-	3	3	3	3	3	3	3	3	3	3	3	3	6403138P2	Outside barrier, left
	+7	6	6	6	6	6	6	6	6	6	6	6	6	-	-	-	-	-	-	-	-	-	-	-	-	6302324P1	Inside barrier
	+7	-	-	-	-	-	-	-	-	-	-	-	-	9	9	9	9	9	9	9	9	9	9	9	9	6403140P1	Inside barrier
1	8	3	3	3	3	3	3	3	3	3	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	9921666G1	Muffler
1	8	-	-	-	-	-	-	-	-	-	-	-	-	3	3	3	3	3	3	3	3	3	3	3	3	9921666G2	Muffler
1	9	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	6444907P1	§Indicator link
1	9	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	6248891P1	¶Indicator link
1	10	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	6317634G1	Buffer paddle assembly
1	11	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	6403366	Return spring
1	12	3	3	3	3	3	3	3	3	3	-	-	-	3	3	3	3	3	3	3	3	3	-	-	-	386A100G1	Trip paddle for EC-1 trip device
1	12	-	-	-	-	-	-	-	-	-	3	3	3	-	-	-	-	-	-	-	-	-	3	3	3	276B274G1	Trip paddle for EC-2 trip device
1	13	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	Ø	Overcurrent trip device
1	14	3	3	3	3	3	3	3	3	3	-	-	-	3	3	3	3	3	3	3	3	3	3	3	3	6555445P1	Clamp for EC-1 trip device
1	14	-	-	-	-	-	-	-	-	-	3	3	3	-	-	-	-	-	-	-	-	-	3	3	3	386A163P1	Clamp for EC-2 trip device
2	15	3	3	3	3	3	3	3	3	3	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	6444011P1	Plate
2	15	-	-	-	-	-	-	-	-	-	-	-	-	3	3	3	3	3	3	3	3	3	3	3	3	6444084P1	Plate
2	16	3	3	3	3	3	3	3	3	3	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	6403513P1	Fibre strap
2	16	-	-	-	-	-	-	-	-	-	-	-	-	3	3	3	3	3	3	3	3	3	3	3	3	6403513P2	Fibre strap
	•+17	9	9	9	9	9	9	9	9	9	9	9	9	12	12	12	12	12	12	12	12	12	12	12	12	6372917	Stationary contact spring
	•+18	9	9	9	9	9	9	9	9	9	9	9	9	-	-	-	-	-	-	-	-	-	-	-	-	6248887P1	Stationary contact pin
	•+18	-	-	-	-	-	-	-	-	-	-	-	-	12	12	12	12	12	12	12	12	12	12	12	12	6248887P2	Stationary contact pin
2	19	3	3	3	3	3	3	3	3	3	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	6372778G1	Upper stud
2	19	-	-	-	-	-	-	-	-	-	-	-	-	3	3	3	3	3	3	3	3	3	3	3	3	6403109G3	Upper stud
2	•20	9	9	9	9	9	9	9	9	9	9	9	9	12	12	12	12	12	12	12	12	12	12	12	12	6372777G1	Stationary contact
2	21	3	3	3	3	3	3	3	3	3	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	6317569P5	Upper stud cap
2	21	-	-	-	-	-	-	-	-	-	-	-	-	3	3	3	3	3	3	3	3	3	3	3	3	6317613P5	Upper stud cap
2	•22	3	3	3	3	3	3	3	3	3	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	6317995G1	Moving contact
2	•22	-	-	-	-	-	-	-	-	-	-	-	-	3	3	3	3	3	3	3	3	3	3	3	3	6317995G2	Moving contact
2	23	3	3	3	3	3	3	3	3	3	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	6317551P4	Insulating link
2	23	-	-	-	-	-	-	-	-	-	-	-	-	2	2	2	2	2	2	2	2	2	2	2	2	6317719P4	Insulating link, outside poles
2	23	-	-	-	-	-	-	-	-	-	-	-	-	1	1	1	1	1	1	1	1	1	1	1	1	6317611P4	Insulating link, center pole
2	24	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	6444251P1	Eccentric bushing
2	25	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	6444066P1	Clamp
2	26	3	3	3	3	3	3	3	3	3	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	6555759P1	Contact support
2	26	-	-	-	-	-	-	-	-	-	-	-	-	3	3	3	3	3	3	3	3	3	3	3	3	6555759P3	Contact support
2	27	3	3	3	3	3	3	3	3	3	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	6372794G1	Flexible connection
2	27	-	-	-	-	-	-	-	-	-	-	-	-	3	3	3	3	3	3	3	3	3	3	3	3	6372794G2	Flexible connection
2	28	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	6444378P1	Insulating tube
2	29	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	6444195P2	Insulating cap
2	30	3	3	3	3	3	3	3	3	3	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	6372780P1	Lower stud
2	30	-	-	-	-	-	-	-	-	-	-	-	-	3	3	3	3	3	3	3	3	3	3	3	3	6403135G2	Lower stud
2	31	2	2	2	2	2	2	2	2	2	2	2	2	-	-	-	-	-	-	-	-	-	-	-	-	6403651P1	Insulation
2	31	-	-	-	-	-	-	-	-	-	-	-	-	2	2	2	2	2	2	2	2	2	2	2	2	6403652P1	Insulation
2	32	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	6403511G2	Side frame, left
	+33	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	6403509G1	Side frame, right

* Recommended for stock for normal maintenance.

\+ Not shown.

§ For manual breaker without auxiliary switch.

¶ For manual breaker with auxiliary switch or for electric breaker.

‡ Original breaker had no suffix letter or numeral.

Ø When ordering specify complete nameplate data of device being replaced. The only part furnished for the EC-2 device is the case (Cat. No. 242C645P1).

Fig. No.	Ref. No.	Number Required for 3-pole Breaker — For Type AK-1-15												For Type AK-1-25												Catalog Number	Description
		‡	A	-1	-2	-3	-4	-5	-6	-7	-8	-9	-10	‡	A	-1	-2	-3	-4	-5	-6	-7	-8	-9	-10		
3	34	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	6372922	Opening spring
3	35	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	6248846P2	Opening spring cap
3	36	1	-	1	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	6403546P1	Prop, manual and electrical breakers
3	36	-	1	-	1	1	1	1	1	1	1	1	1	-	1	-	1	1	1	1	1	1	1	1	1	372A215P1	Prop, electric breakers
3	36	-	1	-	1	1	1	1	1	1	1	1	1	-	1	-	1	1	1	1	1	1	1	1	1	6403546P1	Prop, manual breaker
3	37	1	-	1	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	6372924	Prop, return spring, manual and electric breakers only
3	37	-	1	-	1	1	1	1	1	1	1	1	1	-	1	-	1	1	1	1	1	1	1	1	1	6372924	Prop, return spring, manual breakers only
3	38	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	6444012P1	Prop, pin
3	39	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	6372914	Reset spring
3	40	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	6372742G1	Cam
3	41	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	6372784G1	Indicator assembly, moving
3	42	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	412A253	Cam return spring
3	42	-	-	-	-	1	1	1	1	1	1	1	1	-	-	-	-	1	1	1	1	1	1	1	1	365A331	Cam return spring
3	43	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	6372739P1	Toggle link
3	44	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	6444010P1	Pin
3	45	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	6444044P1	Pin
3	46	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	6248832P3	Link
3	47	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	6447336P1	Pin
3	48	1	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6372808P6	Main shaft, stationary or drawout breakers
3	48	-	-	-	-	-	-	-	-	-	-	-	-	1	1	1	1	-	-	-	-	-	-	-	-	6372808P7	Main shaft, stationary or drawout breakers
3	48	-	-	-	-	1	1	1	1	1	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	6372808P6	Main shaft, stationary breaker only
3	48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	1	1	6372808P7	Main shaft, stationary breaker only
3	48	-	-	-	-	1	1	1	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	362A427P2	Main shaft, drawout breaker only
3	48	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1	1	1	1	1	1	1	1	362A427P1	Main shaft, drawout breaker only
3	49	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	6372772G1	Crank and roller
3	50	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	6317758P1	Trip latch
3	51	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	6372809P3	Trip shaft
	52	1	1	1	1	1	1	1	1	-	-	-	-	1	1	1	1	1	1	1	1	-	-	-	-	(See Note)	Front escutcheon assembly
	53	-	-	-	-	-	-	-	-	1	1	1	1	-	-	-	-	-	-	-	-	1	1	1	1	(See Note)	Front escutcheon assembly Manual with a trip button
4	54	1	1	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	6372788P1	Indicator
4	54	-	-	1	1	1	1	1	1	-	-	-	-	-	-	1	1	1	1	1	1	1	-	-	-	6372788P3	Indicator
4	55	1	1	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	(See Note)	Front escutcheon
4	56	1	1	1	1	1	1	1	1	-	-	-	-	1	1	1	1	1	1	1	1	-	-	-	-	6372807G1	Shaft and roller
4	57	1	1	1	1	1	1	1	1	-	-	-	-	1	1	1	1	1	1	1	1	-	-	-	-	6248845P1	Trip roller
4	58	1	1	1	1	1	1	1	1	-	-	-	-	1	1	1	1	1	1	1	1	-	-	-	-	6319448G1	Closing switch
4	59	1	1	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	6317570P2	Handle
4	59	-	-	1	1	1	1	1	1	-	-	-	-	-	-	1	1	1	1	1	1	-	-	-	-	275B887P1	Handle
4	60	1	1	1	1	1	1	1	1	-	-	-	-	1	1	1	1	1	1	1	1	-	-	-	-	6248844P4	Trip button
	+61	1	1	1	1	1	1	1	1	-	-	-	-	1	1	1	1	1	1	1	1	-	-	-	-	6403396	Trip button return spring
5	62	-	-	-	-	-	-	-	-	1	1	1	1	-	-	-	-	-	-	-	-	1	1	1	1	6372788P3	Indicator
5	63	-	-	-	-	-	-	-	-	1	1	1	1	-	-	-	-	-	-	-	-	1	1	1	1	(See Note)	Front escutcheon
5	64	-	-	-	-	-	-	-	-	1	1	1	1	-	-	-	-	-	-	-	-	1	1	1	1	457A644G1	Shaft and roller
5	65	-	-	-	-	-	-	-	-	1	1	1	1	-	-	-	-	-	-	-	-	1	1	1	1	117A538G1	Trip rod and button
5	66	-	-	-	-	-	-	-	-	1	1	1	1	-	-	-	-	-	-	-	-	1	1	1	1	117A539P1	Trip rod support
	+67	-	-	-	-	-	-	-	-	1	1	1	1	-	-	-	-	-	-	-	-	1	1	1	1	6401282	Trip button return spring
5	68	-	-	-	-	-	-	-	-	1	1	1	-	-	-	-	-	-	-	-	-	1	1	1	-	6319448G4	Closing switch
5	69	-	-	-	-	-	-	-	-	1	1	1	1	-	-	-	-	-	-	-	-	1	1	1	1	276B191P1	Handle
6	70	1	-	1	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	6319467G1	Solenoid control device. A-C
6	70	1	-	1	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	6319467G3	Solenoid control device. D-C
	*+71	1	-	1	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	(See page 7)	Coil
	+72	2	-	2	-	-	-	-	-	-	-	-	-	2	-	2	-	-	-	-	-	-	-	-	-	6403075P1	Main stationary contact

‡ Original breaker model has no suffix letter or numeral.
+ Not shown.
* Recommended for stock for normal maintenance.
NOTE: When replacing complete front escutcheon assembly or escutcheon plate, ordering information must include complete nameplate reading of breaker involved and must also indicate whether manually or electrically operated to enable factory to select proper superseding new design assembly.

Fig. No.	Ref. No.	Number Required for 3-pole Breaker: For Type AK-1-15												For Type AK-1-25												Catalog Number	Description
		‡	A	-1	-2	-3	-4	-5	-6	-7	-8	-9	-10	‡	A	-1	-2	-3	-4	-5	-6	-7	-8	-9	-10		
	+73	1	-	1	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	6403076P1	Main moving contact
	+74	2	-	2	-	-	-	-	-	-	-	-	-	2	-	2	-	-	-	-	-	-	-	-	-	6404345P1	Seal-in stationary contact
	+75	1	-	1	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	6444848	Seal-in moving contact pin
	+76	1	-	1	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	6444849P1	Seal-in moving contact pin
	+77	1	-	1	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	6302797	Main contact spring,A-C
	+78	1	-	1	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	6302791	Main contact spring, D-C
	+79	1	-	1	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	6403351	Beam return spring, A-C
	+80	1	-	1	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	6302795	Beam return spring, D-C
6	81	1	-	1	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	CR-1070-C122-A3	Switchette
6, 7	*82	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	(See page 7)	Closing solenoid coil
7	83	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	6372797P1	Armature guide
6, 7	84	1	-	1	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	6403836G1	Armature and link assembly
6, 7	84	-	1	-	1	1	1	1	1	1	1	1	1	-	1	-	1	1	1	1	1	1	1	1	1	372A354G1	Armature and link assembly
7	85	-	1	-	1	1	-	-	-	-	-	-	-	1	-	1	1	-	-	-	-	-	-	-	-	(See page 7)	"Y" relay complete
7	85	-	-	-	-	-	1	1	1	1	1	1	1	-	-	-	-	-	1	1	1	1	1	1	1	(See page 7)	"Y" relay complete
7	*86	-	1	-	1	1	-	-	-	-	-	-	-	-	1	-	1	1	-	-	-	-	-	-	-	(See page 7)	Coil
7	*86	-	-	-	-	-	1	1	1	1	1	1	1	-	-	-	-	-	1	1	1	1	1	1	1	(See page 7)	Coil
7	87	-	1	-	1	1	1	1	1	1	1	1	1	-	1	-	1	1	1	1	1	1	1	1	1	(See page 7)	"X" relay complete
7	*88	-	1	-	1	1	1	1	1	1	1	1	1	-	1	-	1	1	1	1	1	1	1	1	1	(See page 7)	Coil
7	*89	-	1	-	1	1	1	1	1	1	1	1	1	-	1	-	1	1	1	1	1	1	1	1	1	6960045G11	Contact kit (complete set)
14	90	-	1	-	1	1	1	1	1	1	1	1	1	-	1	-	1	1	1	1	1	1	1	1	1	9921661P4	Prop switch
8	91	-	1	-	1	1	1	1	1	1	1	1	1	-	1	-	1	1	1	1	1	1	1	1	1	377A892G1	Maintenance operating handle

* Recommended for stock for normal maintenance.
‡ Original breaker model had no suffix letter or numeral.
\+ Not shown.

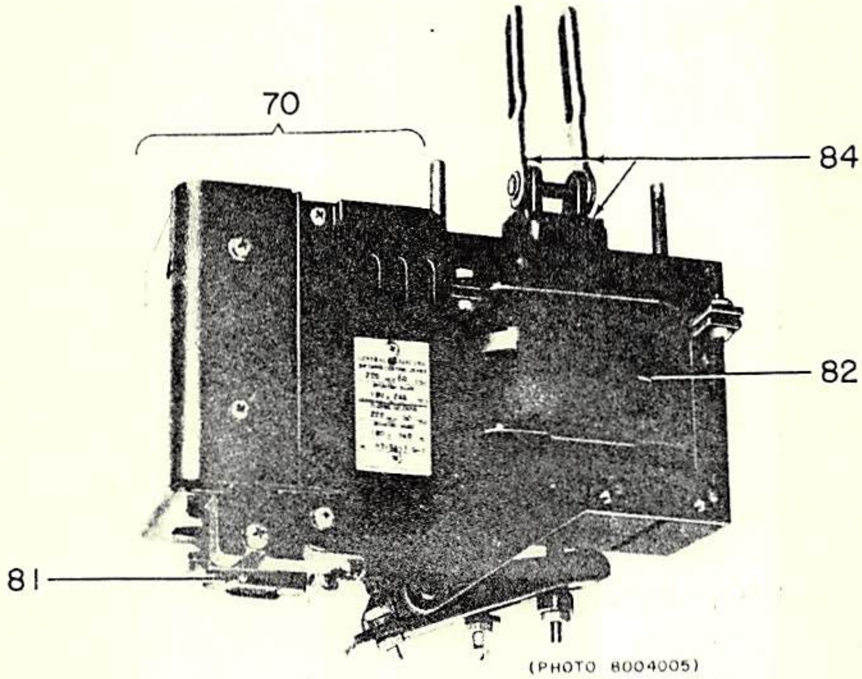


Fig. 6. Solenoid operating mechanism with obsolete control device

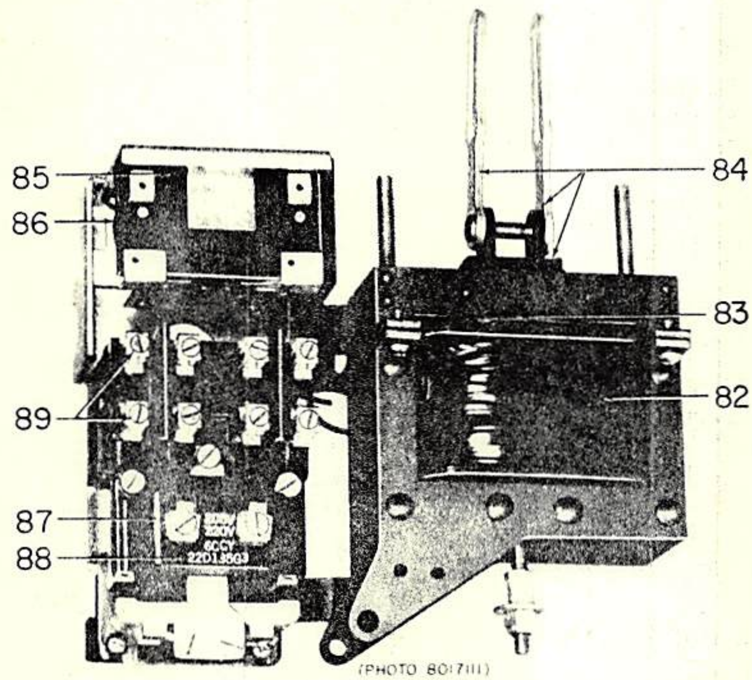


Fig. 7. Solenoid operating mechanism with modern X-Y relay control unit

Fig. 8. Maintenance operating handle (ref. 91)

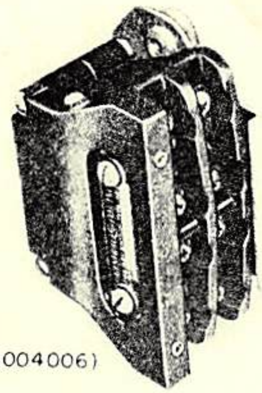
Rating		Catalog Number			
			Closing Solenoid Coil (Ref. 82)		
				FIELD BREAKERS and 4-Pole	
Volts	Cycles	Control Device Coil (Ref. 71)	3-Pole Breakers	-A- to -5	-6 to -10
48	D-C	6275081 G38	6275014 G32	6275014 G7	6275014 G23
125	D-C	G36	G7	G24	G24
250	D-C	G37	G10	G10	G15
115	25	G47	G9	- - - - - - -	- - - - - - -
208	25	G48	G29	- - - - - - -	- - - - - - -
230	25	G48	G6	- - - - - - -	- - - - - - -
460	25	G41	G1	- - - - - - -	- - - - - - -
575	25	G43	G31	- - - - - - -	∡6275014 G31
115	50	G44	G23	- - - - - - -	- - - - - - -
208	50	G39	G30	- - - - - - -	- - - - - - -
230	50	G39	G9	- - - - - - -	- - - - - - -
380	50	G34	G25	- - - - - - -	- - - - - - -
460	50	G40	G16	- - - - - - -	- - - - - - -
575	50	G42	G15	- - - - - - -	- - - - - - -
115	60	G32	G13	- - - - - - -	6275014 G27
208	60	G33	G19	- - - - - - -	G28
230	60	G33	G3	6275014 G7	G8
460	60	G34	G25	- - - - - - -	- - - - - - -
575	60	G35	G6	- - - - - - -	- - - - - - -

∡ Used on -10 only.

Volts	Cycles	Catalog Number				
		"X" Relay for: AK-1-15, A-2 to -9 AK-1-25, A-2 to -9		§ "Y" Relay for: AK-1-15, -4 to -9 AK-1-25, -4 to -9		"Y" Relay for AK-1-15-10 AK-1-25-10
		Relay Complete (Ref. 87)	Coil only (Ref. 88)	Relay Complete (Ref. 85)	Coil only (Ref. 86)	Relay Complete (Ref. 85)
125	DC	CR-2810-A14AC2	22D135G2	176L162G10	366A716G4	295B444P3
250	DC	CR-2810-A14AC3	22D135G3	176L162G11	366A716G5	295B444P4
115	25	CR-2810-A14AC17	22D135G17	176L162G20	366A716G2	295B444P7
208	25	CR-2810-A14AC18	22D135G18	176L162G26	366A716G6	295B444P10
230	25	CR-2810-A14AC18	22D135G18	176L162G21	366A716G3	295B444P13
115	50	CR-2810-A14AC7	22D135G7	176L162G16	366A716G1	295B444P5
208	50	CR-2810-A14AC8	22D135G8	176L162G25	366A716G2	295B444P5
230	50	CR-2810-A14AC8	22D135G8	176L162G17	366A716G2	295B444P11
460	50	CR-2810-A14AC9	22D135G9	176L162G18	366A716G3	295B444P14
115	60	CR-2810-A14AC2	22D135G2	176L162G12	366A716G1	295B444P5
208	60	CR-2810-A14AC3	22D135G3	176L162G24	366A716G2	295B444P8
230	60	CR-2810-A14AC3	22D135G3	176L162G13	366A716G2	295B444P11
460	60	CR-2810-A14AC4	22D135G4	176L162G14	366A716G3	295B444P14

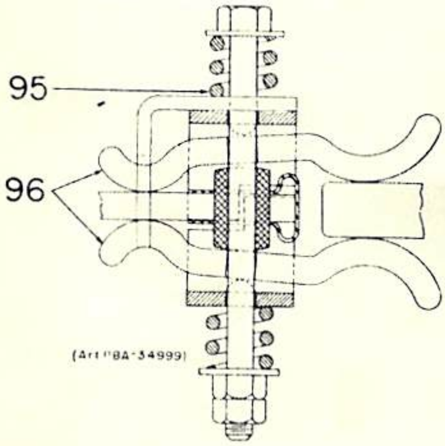
§ Coils for "Y" relays on AK-1-15-2, -3 and AK-1-25-2, -3 are no longer available. If necessary to replace this coil the complete "Y" relay as listed for AK-1-15-4 to -9 or AK-1-25-4 to -9 should be ordered.

14.00 each



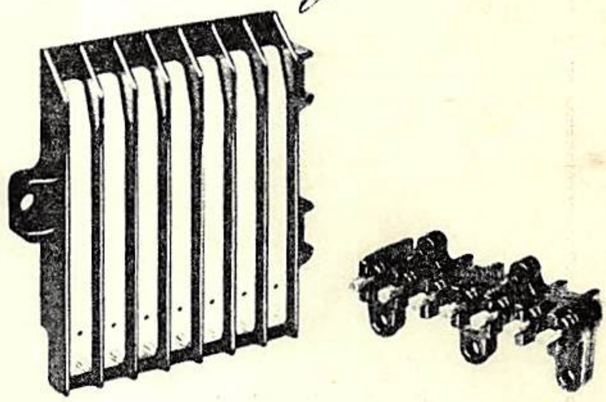
(PHOTO 8004006)

Fig. 9. Auxiliary switch 2 stages (ref. 92)



(Art 8A-34999)

Fig. 10. Primary disconnect (ref. 93, 94)



(PHOTO 8016254)

Fig. 11. Secondary disconnect. Stationary, left; moving, right (ref. 97, 98)

Ref. No.	Catalog Number	Description
92	6578110G2	Auxiliary switch (2 stages, 4 contacts)
‡92A	6578110G5	Auxiliary switch (5 stages, 10 contacts)
93	†845C276G1	Primary disconnect (AK-1-15 only)
94	†845C276G3	Primary disconnect (AK-1-25 only)
95	¶412A222	Spring
96	§453A100P2	Contact
97	Δ6523600G2	Secondary disconnect, stationary, for drawout breaker
98	Δ386A110G2	Secondary disconnect, movable, for drawout breaker
99	(See page 9)	Shunt trip device
*100	(See page 9)	Coil
101	365A325	Spring
102	(See page 9)	Undervoltage device
*103	(See page 9)	Coil
104	6172594	Spring
105	6444315P1	Gasket (time delay device)
106	6403126P1	Cylinder (time delay device)
107	6403128G1	Plunger and link (time delay device)

* Recommended for stock for normal maintenance.
† Includes two assemblies – for one complete breaker pole.
¶ Four required per pole.
§ Eight required per pole.
Δ Breaker may have up to four.
‡ Not shown

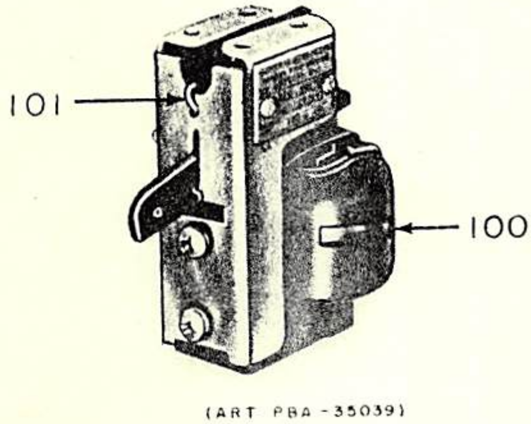


Fig. 12. Shunt trip device (ref. 99)

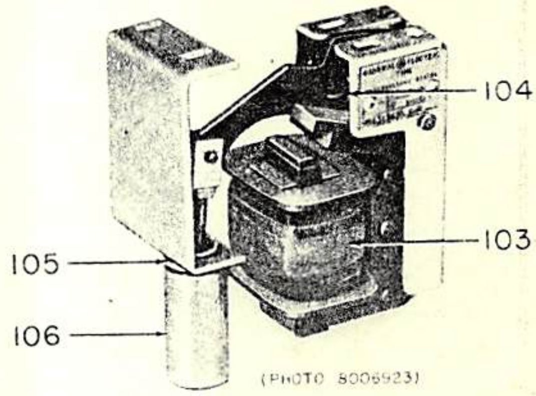
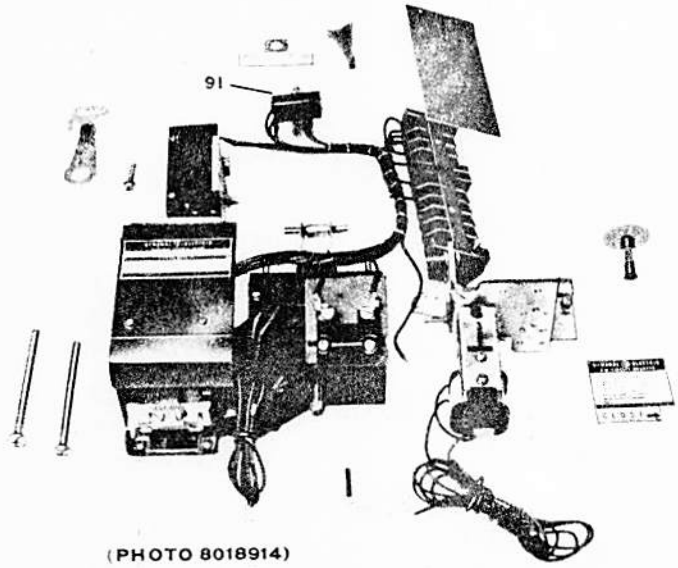


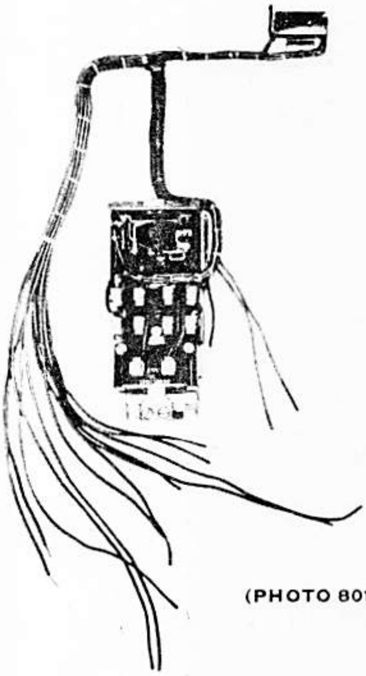
Fig. 13. Time delay under-voltage device (ref. 102)

Rating		Catalog Number			
		Shunt Trip Device		Undervoltage Device	
Volts	Cycles	Device less Coil (Ref. 99)	Coil Only (Ref. 100)	Device less Coil (Ref. 102)	Coil Only (Ref. 103)
12	D-C	6319456G1	6275081G25	6319456G9 (inst.) - or - 6319456G10 (time)	----------
24			6275081G55		6275081G15
48			6275081G28		6275081G9
125			6275081G29		6275081G18
155			----------		6275081G57
250			6275081G30		6275081G19
115	25		6275081G26	6319456G7 (inst.) - or - 6319456G8 (time)	6275081G12
208			6275081G29		6275081G10
230			6275081G29		6275081G10
460			6275081G7		6275081G17
575			6275081G5		6275081G21
115	50		6275081G24		6275081G4
208			6275081G26		6275081G12
230			6275081G26		6275081G12
460			6275081G4		6275081G3
575			6275081G29		6275081G8
115	60		6275081G25		6275081G26
208			6275081G26		6275081G27
230			6275081G26		6275081G7
460			6275081G27		6275081G31
575			6275081G7		6275081G20



(PHOTO 8018914)

Fig. 14. Material required to convert manual breaker to electric operation with X-Y control scheme



(PHOTO 8016193)

Fig. 15. Material required to convert electrically operated breaker from obsolete control device scheme to modern X-Y control scheme (two mounting brackets not shown)

*Conversion Kits for Electric Operation

Ref. No.	Catalog Number	Conversion	
		From -	To -
	STATIONARY BREAKERS		
108A	176L137G1	†Manual operation	New style electric operation (X-Y scheme), with § closing switch
108B	176L137G5	†Manual operation	New style electric operation (X-Y scheme), without closing switch
109A	176L137G2	¶Old style electric operation (using "control device")	New style electric operation (X-Y scheme), with § closing switch
109B	176L137G6	¶Old style electric operation (using "control device")	New style electric operation (X-Y scheme), without closing switch
	DRAWOUT BREAKERS		
108C	176L137G3	†Manual operation	New style electric operation (X-Y scheme), with § closing switch
108D	176L137G7	†Manual operation	New style electric operation (X-Y scheme), without closing switch
109C	176L137G4	¶Old style electric operation (using "control device")	New style electric operation (X-Y scheme), with § closing switch
109D	176L137G8	¶Old style electric operation (using "control device")	New style electric operation (X-Y scheme), without closing switch

*Includes all necessary parts to convert breaker. NOTE: When ordering, be sure to include complete nameplate reading of breaker, and specify voltage and frequency to be used.

†All AK-1-15 and AK-1-25 breakers through -10.

¶AK-1-15, AK-1-15-1, AK-1-25, and AK-1-25-1 only. Later breakers have new style parts.

§Closing switch mounts on breaker front escutcheon.

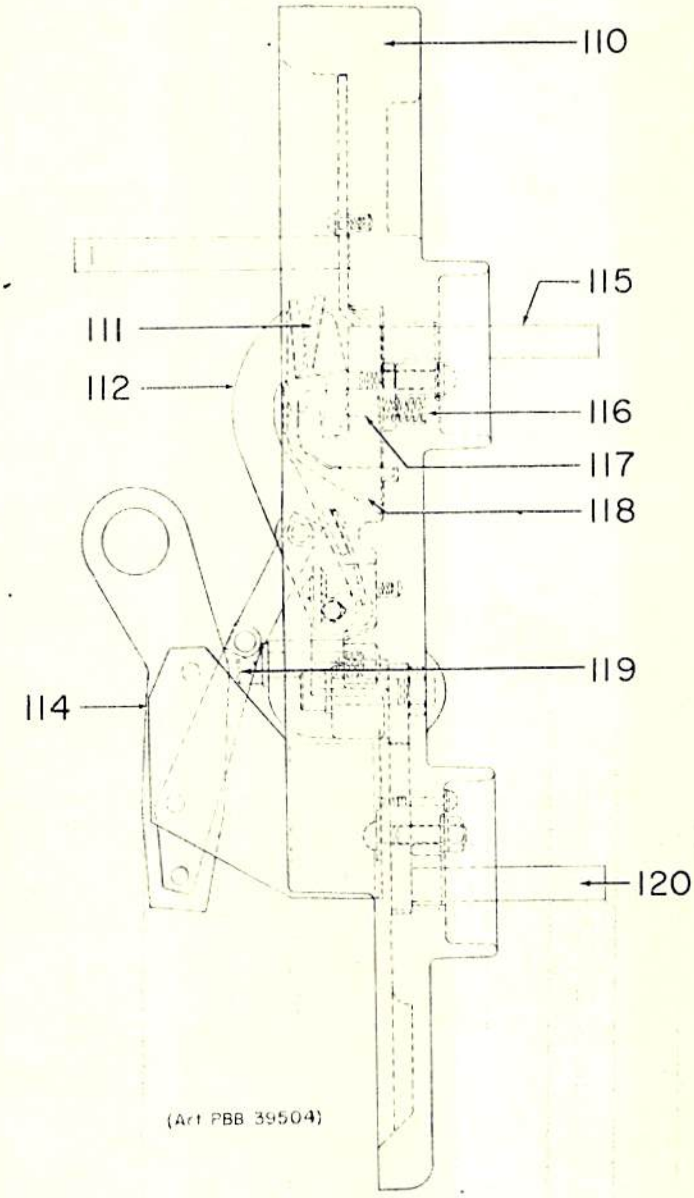


Fig. 16. Field discharge (middle) pole of type AKF-1B field breaker

Ref. No.	TYPES AKF-1B TO AKF-1B-5				TYPES AKF-1B-6 TO AKF-1B-10				Description
	Center Pole		Each Outside Pole		Center Pole		Each Outside Pole		
	Catalog Number	No. Req.	Catalog Number	No. Req.	Catalog Number	No. Req.	Catalog Number	No. Req.	
110	6357059P3	1	6357059P3	1	238C167P1	1	238C167P1	1	Pole unit base
111	6372777G2	2	6372777G2	4	372A363G2 372A363G3	1 1	372A363G2	4	Stationary contact
112	6317995G3	1	6317995G2	1	6317995G5	1	6317995G6	1	Moving contact assembly
†113	- - - - - -	-	6317719P4	1	- - - - - -	-	6317719P4	2	Insulating link
114	6319474G1	1	- - - - - -	1	695C138G1	1	- - - - - -	-	Discharge switch assembly
115	6403109G4	1	6403109G4	1	372A359G2	1	372A359G2	1	Upper stud
116	6403324	2	6372917	4	365A349	2	365A315	4	Stationary contact spring
117	6248887P2	2	6248887P2	4	372A367P2	2	372A367P2	4	Spring pin
118	393A557P1	1	393A557P1	1	393A557P1	1	393A557P1	1	Upper stud cap
119	6403321	1	- - - - - -	-	(None used)	-	(None used)	-	Discharge switch spring
120	6403135G2	1	6403135G2	1	6403135G2	1	6403135G2	1	Lower stud

† Not shown

The following tools are recommended for proper maintenance of the AK-1-15 and AK-1-25 Air Circuit Breakers. NOTE: Obtain from local hardware firm; do not order on General Electric Co.

SCREW DRIVERS

Short heavy, slotted screw
Standard, slotted screw
Long thin, slotted screw
Phillips, No. 1
Phillips, No. 2 (8 in. shaft)
Phillips, No. 3

PLIERS

Gas, 8 in.
Pointed nose, side cutting, 6 in.
Waldes Truarc, No. 2, straight
Waldes Truarc, No. 2, 90 degree

END WRENCHES

Adjustable, 8 in.
1/4 in. - 5/16 in., open ends
5/16 in. - 11/32 in., open ends
3/8 in. - 7/16 in., open ends
1/2 in. - 9/16 in., open ends
5/8 in. - 3/4 in., open ends

SOCKET WRENCHES (1/2 IN. DRIVE)

Ratchet handle
10 in. extension bar
6 in. extension bar
7/16 in. socket
9/16 in. socket
5/8 in. socket
3/4 in. socket
13/16 in. socket
15/16 in. socket

ALLEN HEAD WRENCHES

1/16 in., for No. 6 screw
5/64 in., for No. 8 screw
3/32 in., for No. 10 screw
1/8 in., for 1/4 in. screw
5/16 in., for 3/8 in. screw

MISCELLANEOUS

Ball peen hammer, 8 ounce
"Spintite" wrench, 3/8 in.
Open box wrench, 6 point, 5/8 in.

LOW VOLTAGE SWITCHGEAR DEPARTMENT
GENERAL ELECTRIC
PHILADELPHIA, PA.

12-62 (2M)

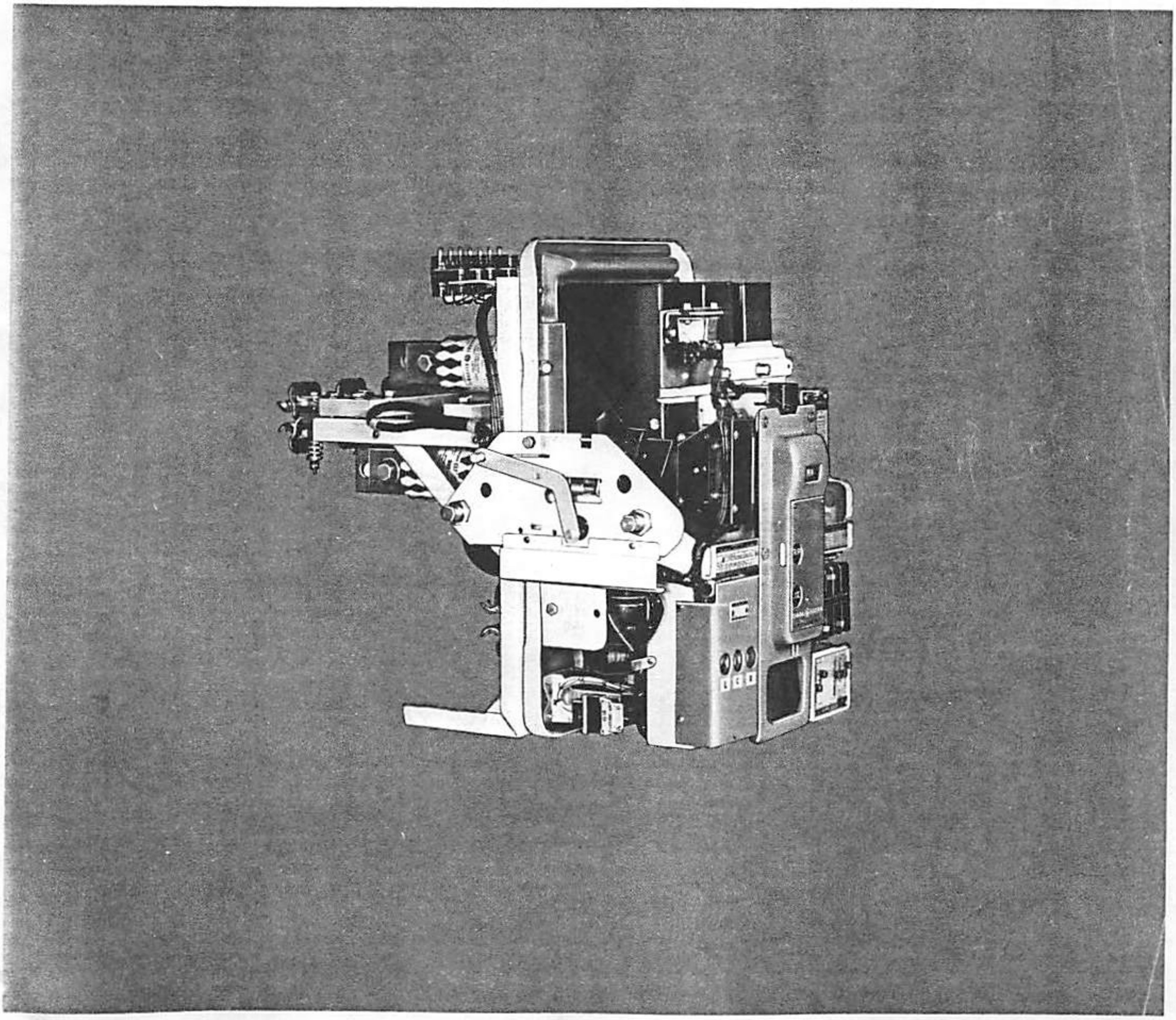
GEI-50299E*

[M]aintenance
[Inst]ructions

Power Circuit Breakers

Types AK-2/2A-15
AK-2/3/2A/3A-25
AKU-2/3/2A/3A-25

*Includes Supplement GEI-86153



GENERAL ELECTRIC

CONTENTS

POWER CIRCUIT BREAKERS

Types AK-2-15 and AK-2/3-25

INTRODUCTION

The instructions contained herein provide information for performing maintenance procedures and for replacing AK-2/3-15/25 breaker components and accessories. For information regarding the receiving, handling, storage and installation of these breakers, refer to GEK-7302 furnished with all AK breakers.

OPERATION

ELECTRICAL OPERATION
Figure 1

The electrically operated breaker closes whenever the closing solenoid coil is energized. This causes an upward movement of the solenoid armature, which initiates the mechanical closing action. The closing signal may be given either by a remote switch or relay, or by a closing button in the front escutcheon if the breaker is so equipped. Either action (refer to the elementary of the wiring diagram) energizes the coil of the X relay through the bb contacts of cutoff switch G and the normally closed contacts of the Y relay. When the X relay or contactor is energized, it closes its contacts. One of these (X1-2) seals in the X coil. The other three sets of contacts, which are arranged in series, activate the closing solenoid.

The breaker control scheme has an anti-pump feature which allows only one closure of the breaker for a single operation of the closing switch no matter how long the switch may be held closed. This prevents the repeated operations that would ensue if one of the automatic trip devices was activated at the time of closing. The Y relay, together with the cut-off switch, provides the anti-pump feature. The mechanical action of closing operates the cut-off switch, reversing the position of the contacts from that shown on the diagram. This energizes the Y relay, if contact is still maintained at the closing switch, with the result that the X relay circuit is opened by Y contacts 5-6. This prevents the X relay from again becoming energized. Y contact 1-2 seals in the Y coil as long as contact is maintained at the closing switch.

Electrically operated breakers may also be closed by means of the maintenance handle which is furnished with the breaker. This is a separate tool and is simply a lever which permits an operator to push upwards on the closing solenoid armature. Two small hooks on one end of maintenance handle are engaged in slots (9A) Figure 5, located in the lower portion of the front escutcheon (8A) Figure 5. Rotation of the long end of the handle downwards forces the shorter end of the handle upwards against the bottom of the solenoid armature, and closes the breaker.

The breaker may be tripped open by any one of a number of electrical tripping devices which will be described in detail later in these instructions. An individual breaker may have none or any combination of these devices. They are the overcurrent tripping device, shunt tripping device, undervoltage tripping device, reverse current tripping device, and open fuse lockout device. All of them effect tripping by displacing the trip latch of the mechanism. The trip latch is rigidly attached to a trip shaft which runs through the breaker from left to right. Whenever the trip shaft is rotated in a counterclockwise direction looking from the right, the latch is displaced. The tripping devices are all equipped with strikers or trip arms which act against trip paddles rigidly fastened to the trip shaft, causing it to rotate on its bearings in a direction to trip the breaker.

The reverse current device and the shunt tripping device each have a set of auxiliary switch "a" contacts in their circuits. (An "a" contact is open when the breaker contacts are open.) This prevents their operation unless the breaker is closed.

The undervoltage device coil is normally continually energized. When the control voltage is low or non-existent, as when the breaker has been pulled out for inspection or maintenance, the breaker is rendered trip-free by the undervoltage device. If it is desired to close the breaker, the device armature must be tied down or blocked closed against the magnet. The open fuse lockout device is used on all AKU breakers and breaker fuse combinations. The purpose of this device is to trip the breaker upon the blowing of any one of the breaker fuses.

MANUAL OPERATION

The manually operated breaker is closed by first rotating the handle in a counterclockwise direction through 90 degrees, then rotating it clockwise back to its normal vertical position. The counterclockwise stroke resets the mechanism, readying it for the clockwise closing stroke.

The breaker may be tripped manually by pushing the manual trip button. This action pushes

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.

a rod against a trip paddle of the trip shaft, rotating it, and causing the mechanism trip latch to be displaced. This allows the mechanism linkage to collapse through the action of the mechanism operating springs.

CAUTION: If the breaker is tripped manually while the operating handle is in the reset position, the handle should be lowered by the right hand while operating the trip button with the left hand.

ELECTRICAL WITH MANUAL OPERATION

This operating mechanism provides both manual and electrical closing. The operating mechanism is similar to the mechanism of the standard electrical breaker with the addition of the manual handle, cam and mechanism connecting link. The solenoid connecting link and manual cam connecting link are both connected to the closing spring pin at the top of the mechanism, thus compressing the springs when force is provided by either means of breaker closing.

The breaker is manually closed by rotating the closing handle 90 degrees counterclockwise. No reset stroke is necessary as is the case with the standard manual breaker. Electrical closing may be performed either locally or remotely in the same manner as the standard electrical breaker.

Tripping is accomplished by the manual trip button on the escutcheon or by any of the electrical tripping devices available for use on the standard breakers.

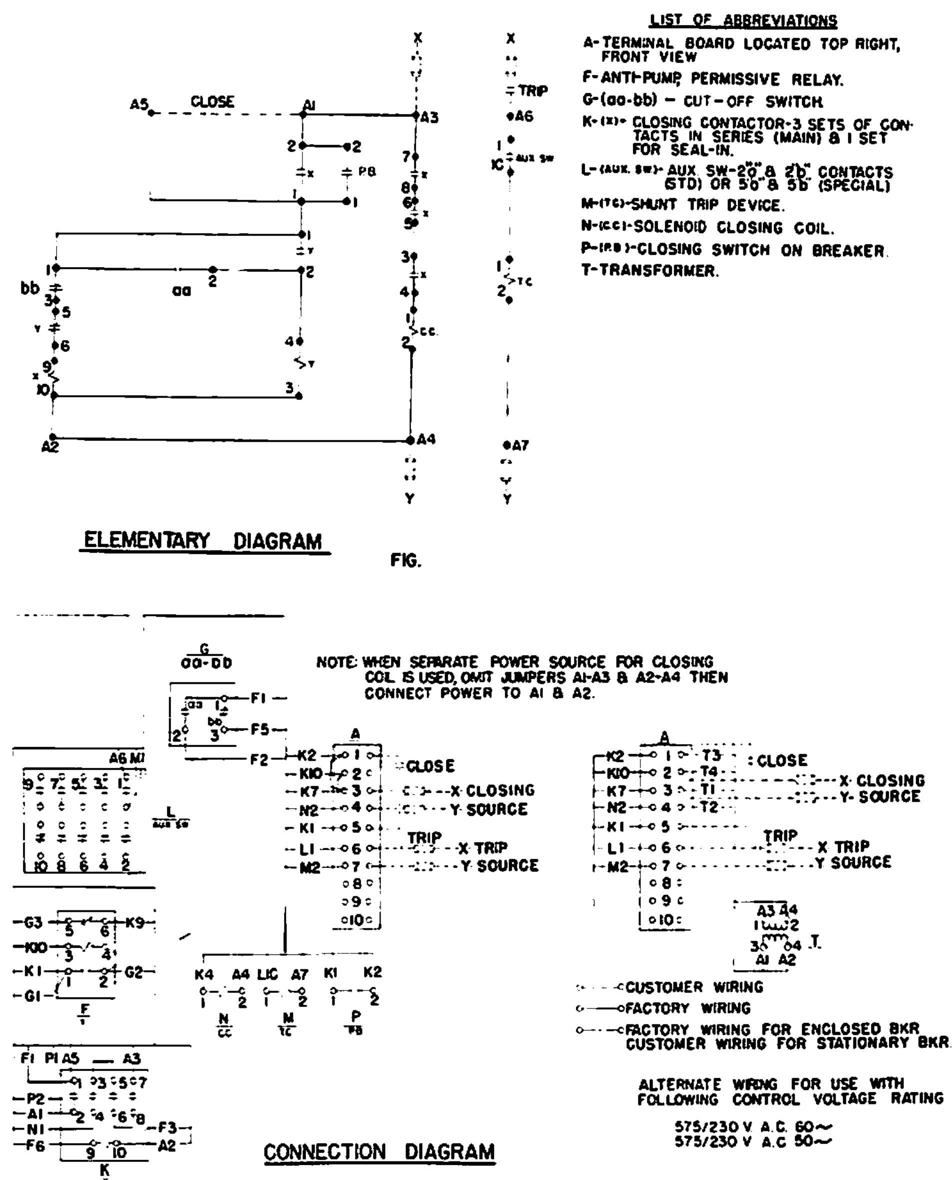


Figure 1. (695C160-1) & (695C159-1) Typical Wiring Diagram

MAINTENANCE

INSPECTION

BEFORE INSPECTION OR ANY MAINTENANCE WORK IS DONE, BE SURE THAT THE BREAKER IS IN THE OPEN POSITION. ALL ELECTRICAL POWER, BOTH PRIMARY AND CONTROL SOURCES, SHOULD ALSO BE DISCONNECTED.

Periodic inspection of the circuit breaker is recommended at least once a year. More frequent inspections are recommended, if severe load conditions, dust, moisture, or other unfavorable conditions exist.

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.

At all times it is important not to permit pencil lines, paint, oil or other foreign materials to remain on the insulating surfaces of the breaker as they may cause low resistance between points of different potential and result in eventual electrical breakdown.

Always inspect the breaker after a short circuit current has been interrupted.

At the time of periodic inspection, the following checks should be made after the breaker has been de-energized.

1. Manually operate the breaker several times checking for obstructions or excessive friction.
2. Electrically operate the breaker several times (if breaker has electrical control) to ascertain whether the electrical attachments are functioning properly.
3. Remove and inspect the arc quencher. Breakage of parts or extensive burning will indicate need for replacement.
4. Check contact condition and wipe
5. Check latch engagement.
6. Check operation of tripping devices, including overcurrent trip devices, making sure all have positive tripping action. (Discernible movement in tripping direction beyond point of tripping.)

(For detailed information on breaker features listed, refer to appropriate sections of these instructions.)

SEPARATION OF FRONT AND BACK FRAMES

Figure 3

Many maintenance operations will either require or be greatly facilitated by separating the front frame and mechanism of the breaker from the back frame or base, which consists of the current carrying parts of the breaker and their supporting structure. The procedure for this operation is as follows:

1. Remove the arc quenchers (see section on "Arc Quenchers").
2. Disconnect the two insulated connecting links (6), between the mechanism and the crossbar (10), by removing the tie bolt (7), and slipping the ends of the links off the ends of the shouldered pin, (5) Figure 5 in the mechanism.
3. If the breaker is a drawout type, with secondary disconnects, Figure 2, remove the secondary disconnect supporting bracket from the breaker back frame. Also remove any wiring bundle retainers that may be attached to the back frame.
4. Remove one elastic stop nut from each of two studs (3), which tie the upper ends of the mechanism frame to the back frame of the breaker.
5. Remove the two elastic stop nuts (9/16" Hex.) which fasten the wrap around portion of the front frame to the back frame. One of these is located on each side of the breaker, about 2/3 of the distance down from the top edge of the back frame.

   On drawout breakers for AKD Equipment, the bottom plate must be removed by first removing two #8-36 screws located at the front of the bottom plate and then freeing the plate from the slots located in the bottom of the back frame.
6. The two frames are now disconnected. However, care should be exercised in separating them to avoid damage to the trip shaft arms and paddles. While the back frame is held steady, lift the front frame and mechanism up and out so that the trip paddles on the trip shaft clear the trip arms of the overload trip devices.

   Reassembly of the two breaker halves is accomplished by following the procedure outlined in reverse order.

LUBRICATION

In general, the circuit breaker requires very little lubrication. Bearing points and sliding surfaces should be lubricated very lightly at the regular inspection periods with a thin film of extreme temperature, high pressure, light grease, similar to G.E. Spect. No. D50H15 or RPM No. 5. Hardened grease and dirt should be removed from latch and bearing surfaces by the use of a safe cleaning solvent such as kerosene. Latch surfaces should be left clean and dry and not be lubricated.

ALL EXCESS LUBRICANT SHOULD BE REMOVED WITH A CLEAN CLOTH IN ORDER TO AVOID ANY ACCUMULATION OF DIRT OR DUST.

At each maintenance period, all silver to silver friction points, such as primary disconnects, should be cleaned and given a fresh coat of G.E. Spec. No. D50H47 lubricant.

TROUBLESHOOTING

The following table lists several typical symptoms of breaker malfunction, together with their causes and remedies. If, at any time, these symptoms are observed, their cause should be determined and the necessary corrective action should be taken.

TROUBLE	CAUSE	REMEDY
Overheating AK-2/3 Breakers	Contacts not aligned	Adjust contacts.
	Contacts dirty, greasy or coated with dark film	Clean contacts
	Contacts badly burned or pitted	Replace contacts
	Current carrying surfaces dirty	Clean surfaces of current carrying parts
	Corrosive atmosphere	Relocate or provide adequate enclosure
	Insufficient bus or cable capacity	Increase capacity of bus or cable
	Bolts and nuts at terminal connections not tight	Tighten, but do not exceed elastic limit of bolts or fittings.
	Current in excess of breaker rating	Check breaker application or modify circuit by decreasing load
	Excessive ambient temperature	Provide adequate ventilation
Failure to trip AK-2 Breakers	Travel of tripping device does not provide positive release of tripping latch	Re-adjust or replace tripping device and check mechanism latch adjustment
	Worn or damaged trip unit parts	Replace trip unit
	Bind in overcurrent trip device	Replace overcurrent trip device
False Tripping AK-2 Breakers	Overcurrent trip device pick up too low	Check application of overcurrent trip device
	Overcurrent trip device time setting too short	Check application of overcurrent trip device
	Bind in overcurrent trip device	Replace overcurrent trip device
Failure to Close and Latch AK-2/3 Breakers	Binding in attachments preventing resetting of latch	Re-align and adjust attachments
	Latch out of adjustment	Adjust latch
	Latch return spring too weak or broken	Replace spring
	Hardened or gummy lubricant	Clean bearing and latch surfaces
	Closing solenoid burned out	Replace solenoid coil
	Solenoid control device not functioning properly	Re-adjust or replace device
False Tripping AK-3 Breakers	Captive Thump screw on Power Sensor loose fail-safe circuitry reverts characteristic to minimum setting and maximum time delay	Tighten thumb screw on desired setting
	Tap setting dial on Power Supply incorrectly set	Set dial to correspond with Power Sensor coil tap
	External Ground Sensor Coil improperly connected	Refer to Figure 22, page 29 for polarity and connections. Check continuity of shield and conductors connecting the external Ground Sensor coil.
Failure to Trip AK-3 Breakers	Loose or disconnected power sensor disconnect plugs	Tighten or reconnect disconnect plugs
	Loose or broken power sensor coil tap connections	Tighten or reconnect tap connections

BASIC BREAKER COMPONENTS

DISCONNECTS

PRIMARY DISCONNECTS

The primary disconnects are attached to the ends of the breaker studs on the rear side of the breaker base. Each disconnect assembly consists of two pair of opposed contact fingers. These are secured to the breaker stud by a bolt which passes through the assembly and the stud. When engaged with the stationary stud of the enclosure, the disconnect fingers exert a set amount of force against the stationary stud through the action of the compression springs. Retainers and spacers hold the contact fingers in correct alignment for engagement with the stud. The amount of force which the fingers exert against the stud is determined by degree to which the springs are compressed by the bolt and nut which hold the assembly together. This pressure is factory set between 60 and 70 pounds. If, for any reason, the disconnects must be taken apart, the position of the nut on the bolt should be carefully noted, so that in reassemblying, the original amount of compression can be restored by replacing the nut at its former position on the bolt.

SECONDARY DISCONNECT, FIGURE 2.

The secondary disconnects serve as connections between breaker control circuit elements and external control circuits. They are used only on drawout type breakers. A terminal board serves the same purpose on stationary mounted and general purpose enclosure mounted breakers. The secondary disconnects allow removal of the breaker without the necessity of having to detach external connections.

The movable part of the secondary disconnect consists of an insulating body which holds a conducting spring loaded plunger to which a flexible lead is attached. As the breaker moves into its enclosure, the plunger is depressed by sliding onto the stationary disconnects of the enclosure.

REPLACEMENT OF MOVABLE SECONDARY DISCONNECTS

1. Unfasten disconnect body from breaker back frame.
2. Open tabs which hold wires on inner side.
3. Pull contact tip loose from hollow tube.
4. Remove contact tip by cutting wire at its base.
5. Push wire through hollow tube of new disconnect assembly.
6. Strip insulation off end of wire to about 1/4 of an inch from end.
7. Place new contact tip on end of wire and crimp.
8. Pull wire through hollow tube until contact tip fits snugly against end of hollow tube.
9. Crimp tab on other side of assembly to hold wire in place.
10. Any hollow tubes which are not used should be pushed into the disconnect body and held in that position by placing fibre spacers over inner ends of tubes and spreading tabs.

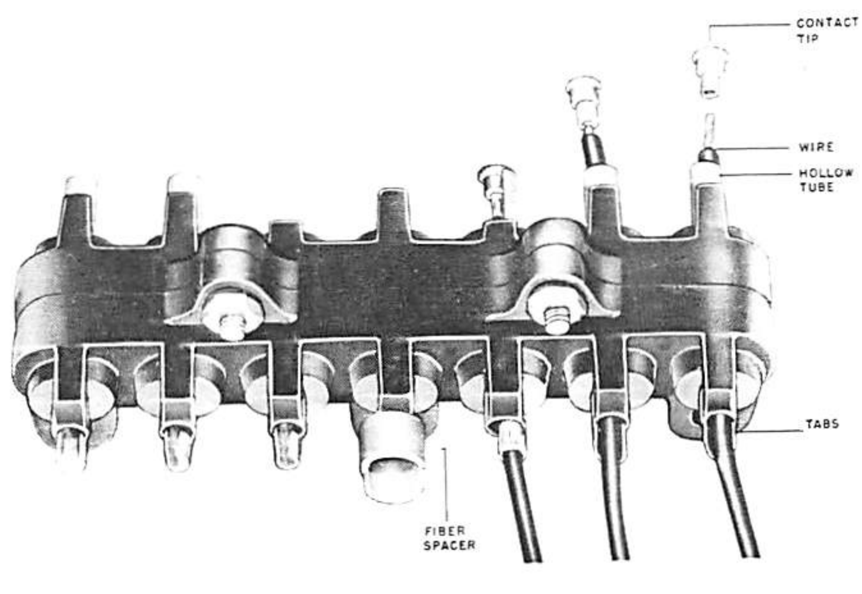


Figure 2. (8017973) Movable Secondary Disconnects

11. When all wires have been connected, refasten the body of the assembly to the breaker back frame.

ARC QUENCHER

The arc quencher is an integral riveted assembly composed of two ceramic side plates, a series of steel plates, and a muffler. The assembly is covered by a wrap around of insulating material which inhibits any sidewise emission of gases. The steel plates are held in position and supported by the ceramic sides which are grooved vertically to provide recesses for the vertical edges of the steel plates. The bottom edges of the latter form an inverted "V" along the path of the arc that may be drawn between the breaker contacts during interruption. The steel plates have the effect of breaking up the arc, and cooling it and the gases that result from interruption. The entire assembly provides a "chimney" effect which directs the hot, ionized gases upwards through the steel plates and mufflers and allows their safe and controlled escape at a cooler temperature.

The muffler at the top of the assembly is a serpentine shaped strip of perforated, copper plated steel. It is important that the perforations of the muffler be kept open, since their closure could tend to prevent the escape of the gases along the desired path. At the regular maintenance inspection, it would be well to check their condition and open any of the perforations that appear to be clogged.

If any very extensive burning or corrosion is noted in the arc quencher, it should be replaced. Replacement is also indicated if any breaks or cracks are noted in the ceramic material.

REPLACEMENT

Removal of the arc quencher is simply a matter of lifting the assembly up and out, after the steel retainer across the front of the arc quenchers has been removed. The upper edge of the steel arc runner, fastened to the back plate of the breaker, fits into a recess in the back portion of the arc quencher which locates it in its proper position upon replacement. Make sure the steel retainer is replaced and fastened firmly to its mounting studs after the arc quenchers have been replaced.

BREAKER CONTACT STRUCTURE

The copper current carrying parts of the breaker are all mounted on a common base of insulating material made of polyester glass mat. The copper of each pole consist of an upper stud and pivot, stationary contacts, two movable contact arms, a movable contact pivot, and the lower stud.

The upper stud branches into two pivot surfaces on its inner end on the forward or front side of the breaker base. Each of these convex pivot surfaces mates with the concave pivot surface on the rear side of the stationary contacts. Each of the stationary contacts pivot in a horizontal plane approximately at their mid-points. The end of the contact opposite to the contact tip end is formed into the shape of a small hook. A tension spring engages this hook and provides the necessary contact pressure at the pivot and also at the point of contact with the movable contact arm. When the breaker contacts open, a projection on the contact tip end of the stationary contact bears against a stop pin restricting the movement of the stationary contact. This arrangement results in a continual high force existing between the mating pivot surfaces.

The movable contact arms pivot in a vertical plane, each making contact with a pair of stationary contacts, and thus providing four low resistant parallel paths of current for each breaker pole. The movable contacts rotate about a burnished, silver plated, copper pin which, in turn, is held by a pivot support. Each side of the pivot support bears against the lower, outer surface of the contact arm and supplies a second low resistance path through the pivot. A "U" shaped spring clip made of silver plated conducting material provides an additional current path and protects the other contact surfaces of the pivot against pitting when in motion. It also contributes to the force tending to increase the contact pressure between the lower ends of the movable contacts and the pivot support.

The movable contact pivot support is mounted securely to the breaker base. If, as is normally the case, the pole is equipped with an overcurrent trip device, one of the terminals of the series coil of the trip unit is fastened to the lower end of the pivot support. The other terminal of the coil fastens to the lower stud.

CONTACT ADJUSTMENTS

The only adjustment to be made on the breaker contacts is that of contact wipe. This may be described as the distance the movable and stationary move while they are touching one another in the process of breaker closing. The amount of contact wipe can be measured by comparing the position of the front surface of the stationary contact when the breaker is open to its position when the breaker is closed, in reference to some absolutely stationary part of the breaker. The most convenient stationary part of the breaker to use as a reference point is the steel arc runner above and behind the stationary contacts.

The amount of wipe the contacts should have is nominally 1/8 of an inch. A plus or minus tolerance of 1/32 of an inch is allowed.

The means of adjusting contact wipe is provided by an eccentric pin which passes through the center of the movable contact assembly. Each end of this pin has a free, projecting, hexagon shaped section which is easily accessible to a small, open end, 1/4 inch wrench. Two cantilever springs, which bear on each end against a portion of the hexagon section of the pin, lock the adjusting pin in place and provide index stops for the process of adjustment. The right hand hexagon shaped end of the pin is numbered from 1 to 6, which provides a reference for making wipe adjustments.

When contacts are to be adjusted, the recommended procedure is as follows:

1. With the breaker in the open position and using the numbers on the right end of each adjusting pin as a reference, set each pin in the same position. In many cases, the number 3 is a good beginning point. The proper view of the number on the adjusting pin is obtained by viewing the breaker from the front and the adjusting pin from approximately a 15 degree angle with respect to the movable contacts. Note that the numbers on the pin are not in numerical sequence as the pin is rotated.

2. By measurement, establish the position of the front surfaces of the stationary contacts with reference to the steel arc runners above and behind the contacts.

3. Close the breaker, and establish the amount of wipe by again measuring as in step two, and comparing the measurements with those taken with the breaker open.

4. If any set of contacts lead or lag the others, open the breaker and advance or retard the adjusting pin to the next higher or lower number. Moving the adjusting pin to a higher number will increase the contact wipe and moving to a lower number will decrease the contact wipe.

   NOTE: No attempt should be made to move the adjusting pin when the breaker is closed. Besides being more difficult, the additional force required to move the pin will tend to round off the flats of the hex section of the pin.

5. When all the contacts have the recommended wipe of 3/32 to 5/32 of an inch, the contact adjustments are complete.

CONTACT REPLACEMENT

Figure 3

The normal situation that will exist in the matter of contact replacement will call for replacement of all the movable and stationary contacts at the same time. This will be the case where long use of the breaker in service has resulted in extensive wear or erosion of the silver alloy contact tips. A commonly used "rule of thumb" is that contact replacement is indicated if less than one-half of the original thickness (1/8 of an inch) of the contact tip material remains.

GENERAL PREPARATION

1. Remove arc quencher retainer (1), Figure 5 by loosening the two captured nuts with a 7/16" wrench.

2. Lift off the three arc quenchers.

3. Remove the U shaped insulation (5) Figure 3 from each pole by lifting it and disengaging the rivet heads thru the keyholed slots in the insulation.

4. As an aid to future reassembly of the movable contacts, note the position of all stationary insulation barriers with respect to barriers mounted on the cross bar.

REMOVAL OF MOVABLE CONTACTS (18) Figure 3.

1. Screw the threaded end of the steel rod lightly into pivot pin (11) on the right pole.

2. With a pair of long nosed pliers, unhook safety pin type spring clip (9) and extract pin (11) and remove spring clip (9).

3. Grasp movable contact assembly and remove it from its seat on the cross bar.

4. Repeat procedure 1, 2, and 3 above on the left pole.

5. Move the cross bar downward to disengage it from the contact wipe adjusting pin (15) on the center pole, then move the cross bar toward the front of the breaker.

6. Remove the split pin retaining the center pole pivot pin.

7. Remove the pivot pin and movable contact assembly.

REMOVAL OF STATIONARY CONTACTS (21) Figure 3.

1. Slip the blade of a heavy screw driver between the two upper contacts and force the contacts toward their pivot point sufficiently far to disengage the contact stop surface from the pin.

2. The contact can then be removed by disengaging the end of the contact from its spring.

3. The two lower contacts can be similarily removed.

REPLACEMENT OF STATIONARY CONTACTS (21) Figure 3.

1. Coat the contact pivot area only of each of the four contacts with a thin coat of D50H47 grease. Use only D50H47 grease.

2. Note the difference between the two types of

stationary contacts and be sure to locate them in the breaker with the upper and lower contacts having their stop projecting surfaces as shown in the section AA, Figure 3. The upper left and lower right contacts are identical as are the lower left and upper right contacts.

3. By placing the hook on the end of the contact through the loop of the contact spring, the contact can be pushed toward the pivot surface and slipped behind the stop pin. Install all stationary contacts in all poles.

REPLACEMENT OF MOVABLE CONTACTS (18) Figure 3.

1. Coat the pivot area only of the new movable contacts with a thin coat of D50H47 grease.

2. Assemble the center pole movable contacts, align the pivot pin holes with the bullet nosed rod, and install the pivot pin and split pin.

3. Move the cross bar assembly into position and insert the eccentric contact wipe adjust-

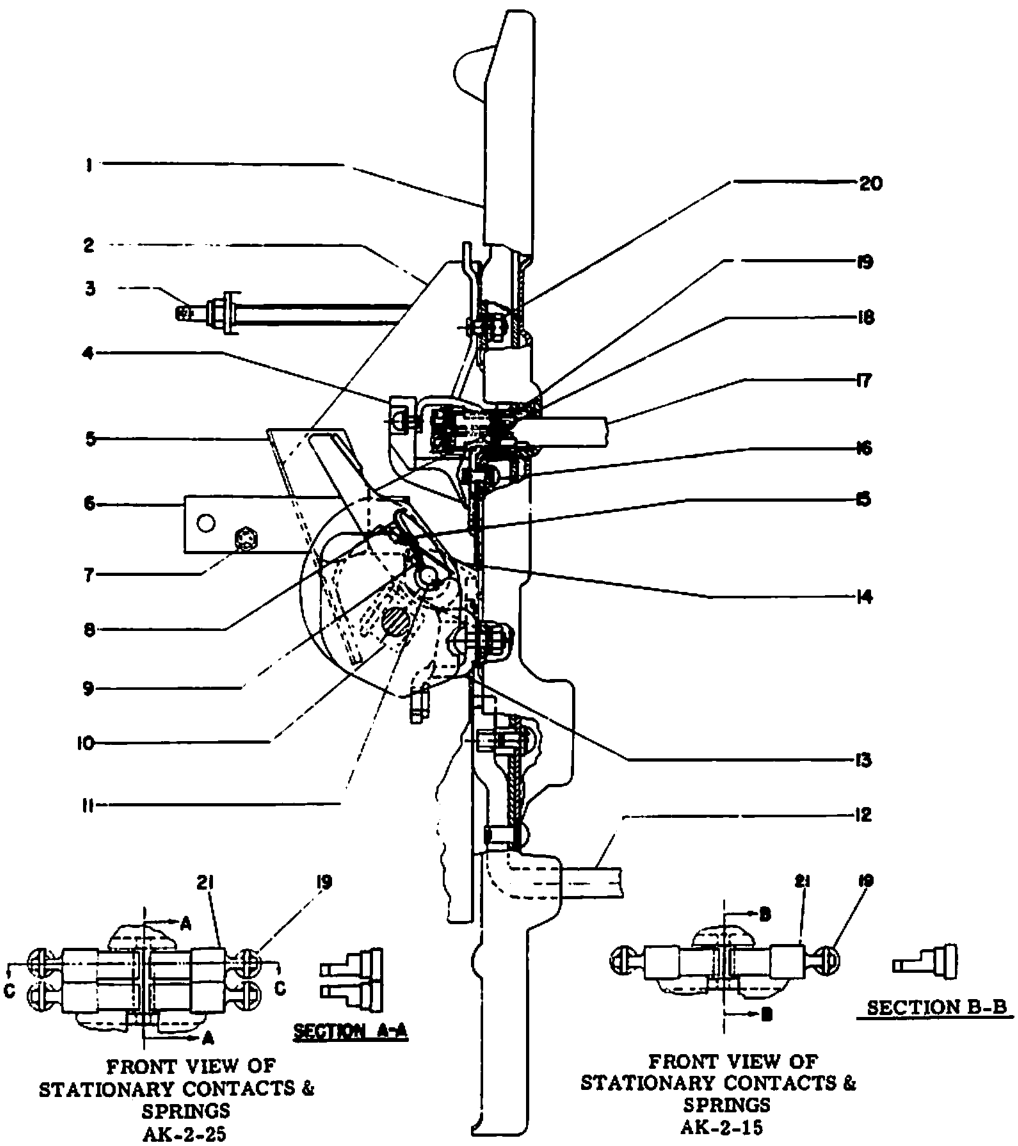


Figure 3. (549D409-2) Contact Assembly

1. Breaker Base
2. Insulation
3. Insulated Stud
4. Upper Stud Barrier
5. Insulation
6. Links (Insulated)
7. Tie Bolt
8. Spring
9. Spring Clip (Retainer)
10. Cross Bar
11. Pivot Pin
12. Lower Stud
13. Contact Pivot Support
14. Spring
15. Contact Wipe Adjustment Pin
16. Screw
17. Upper Stud & Arc Runner
18. Movable Contact
19. Spring
20. Nut
21. Stationary Contacts

ment pin (15) on the center pole into position. Be sure the stationary insulation barriers are correctly located.

4. Align the cross bar with the left and right pole pivot supports and install the left and right pole movable contacts. Use the bullet nosed steel pin to aid in aligning the holes in the cross bar, the contacts and the pivot supports.

5. Install the left and right pole pivot pins while threading them through the spring clips and lock the spring clips (9). Be sure the pivot pins are fully inserted.

6. Adjust the contact wipe to 1/8" ± 1/32" by adjusting the eccentric contact wipe adjusting pin (15). The breaker must be open to adjust the wipe. In the event acceptable wipe cannot be obtained by moving the contact wipe adjusting pin (15), from the movable contact forward or backward as necessary to bring the wipe within the range of the contact wipe adjusting pin (15). Do not exceed the recommended settings for wipe; otherwise the breaker may not close completely. When viewed from the top with the breaker closed, the movable contact should be centrally located with respect to the stationary contacts. If the movable contacts are not centrally located as shown in section CC, form the movable contacts until they are nominally centered.

   If the moving contacts are not centered with 1/8" separation when closed against the fixed contacts, they should be bent laterally (after opening the breaker contacts). To do this without squeezing the two movable contact arms together, a 1/8" spacer plate should be inserted between them; then the pair can be grasped with pliers and bent in the desired direction for centering.

   New contacts should be adjustable using eccentric numbers 1, 2, or 3. These numbers are the ones visible when viewing the breaker from the front, not from above. (The higher numbers should be reserved for tightening at future maintenance readjustments after wear.) Also, if higher numbers are used, where adequate wipe is obtainable at settings 1, 2, or 3, it is possible that the stationary contacts will bottom, producing excessive back force on the breaker closing mechanism so that the toggle link will not pass center. As a result,the breaker will not complete its stroke, and inadequate pressure and wipe will result; burn-up of contacts from just load current will follow.

   If the required wipe of new contacts cannot be obtained with eccentric number of 3 or lower, bending of the contact arms toward the closed position is required. This should be done individually, using an 8" Crescent or 1/2 - 5/8" tapered open end wrench to grasp the contact and a 10" Crescent or the 1" - 1-1/8" tapered open-end wrench to grasp the pivot portion of the arm. The soft copper arm will bend with little difficulty. Both arms should be bent identically.

   Operate breaker several times, and recheck wipe to make sure bending of movable arms did not occur in these operations.

7. Operate the breaker manually several times to assure proper functioning occurs, then replace the U shaped insulation (5) Figure 3 and arc quenchers. When replacing the arc quenchers be sure the quencher is seated downward completely and that the quencher clamp covers the knobs protruding through the arc quencher insulation.

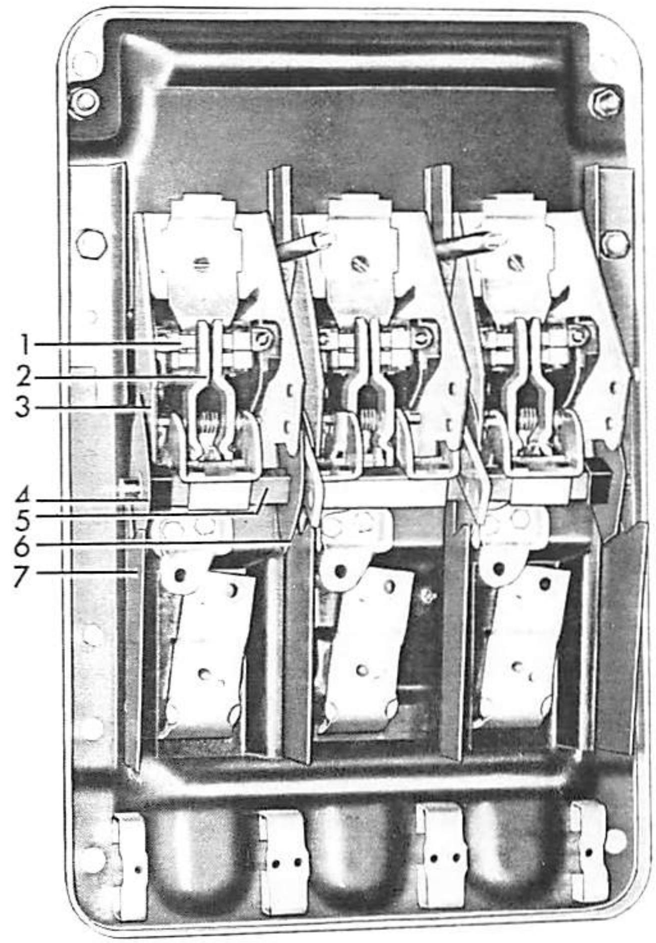


Figure 4. (8039851) AK-2-25 Back Frame - Location of Crossbar and Pole Shields

1. Stationary Contacts
2. Movable Contacts
3. Upper Stud Asbestos Shield
4. Crossbar Plastic End Shield
5. Crossbar Assembly
6. Crossbar Asbestos Inner Shield
7. Lower Stud Asbestos Shield

CONTACT SPRINGS
(19) Figure 3

A minimum force of 5 lbs and a maximum force of 9 lbs. should be required to begin movement of a single stationary contact from the open position towards the closed position. This may be checked by using a push scale applied at the point at which the movable contact touches the stationary contact. If these pressures are not obtained or if the spring is damaged, replacement is required.

In order to replace the contact spring the upper stud (17) must be removed. The hardware which fastens the stud to the breaker base consists of two screws (16), and nut (20). When These are removed, the stud may be withdrawn from the base in a forward direction. After the stud has been removed, it is a simple matter to disconnect the two ends of the spring (19) and replace it with a new one.

MECHANISM

The breaker mechanism is a spring actuated, over-center toggle type of mechanism. As the closing force is applied, either by movement of the operating handle or the closing solenoid armature, energy is stored in the operating springs. After the springs have gone over center, movement of the output crank of the mechanism is still blocked for a time by a cam arrangement. As the springs are further extended, the blocking cam moves away from the output crank, and the springs are allowed to discharge part of their stored energy, closing the breaker contacts.

This assures a fast-snapping closing action regardless of the speed at which the closing handle is operated.

The breaker mechanism is tripped by the displacement of the trip latch (7), Figure 6. Looking at the breaker from the right hand side as in Figure 5, the tripping movement of the latch is counter-clockwise. Operation of any of the automatic trip devices or the trip push button causes the latch to move in the tripping direction. When the latch moves off the trip latch roller (7), the remaining force in the operating spring causes the mechanism toggle to collapse, resulting in the opening of the breaker contacts.

ADJUSTMENT

Since all the mechanism adjustments are carefully set by experienced factory personnel after assembly at the factory, it should normally not be necessary to make any adjustments in the field. At the time of installation, and also in the course of a maintenance inspection, if the breaker functions properly through several repeated operations, it is best to assume that adjustments are satisfactory.

If the breaker mechanism does not function properly, it is best to first perform the available remedial measures listed in the "Trouble Shooting" chart of these instructions. One of the remedies listed is that of proper mechanism latch engagement, the amount of engagement between the latch (7) and latch roller (5), Figure 6. This is the only adjustment that is required on the breaker mechanism, and proper latch engagement is obtained in the following manner:

(NOTE - Before making latch adjustments, check to make sure that the buffer paddle which stops against the end of the latch adjustment screw is rigidly fastened to the trip shaft. Hold the trip shaft (8), Figure 5, steady and attempt to move the buffer paddle. If any relative movement between the two is noted, tighten the fasteners holding the buffer paddle to the trip shaft.)

Latch Adjustment - Manual Breaker

1. Locate the latch adjustment screw on the lower, outer side of the right-hand mechanism side frame. This screw is threaded through a nylon insert locknut which, in turn, is welded to a projecting bracket on the side frame.

2. Rotate the closing handle 90 degrees counter-clockwise, setting the closing mechanism in the reset position. Turn the adjusting screw into the locknut until the closing mechanism trips open, the closing handle returning to its normal vertical position. NOTE: KEEP HANDS CLEAR OF THE CLOSING HANDLE WHEN MAKING THIS ADJUSTMENT.

3. Withdraw the adjusting screw from the locknut 1/4 turn at a time, attempting to close the breaker after each 1/4 turn, and observing whether the contacts move toward closing before tripping occurs. If the contacts move before tripping occurs, you have established the position of the adjusting screw where the latch and latch roller begin to engage. In some cases, it may be necessary to turn the adjusting screw less than 1/4 turn in order to establish the position where the contacts begin to move before tripping occurs. When this position is established, note the position of the slot in the head of the adjusting screw.

4. Withdraw the adjusting screw three and one-half turns from the position noted in step 3. This sets the proper amount of latch engagement.

Latch Adjustment - Electrical Breaker

1. Locate the latch adjustment screw on the lower, outer side of the right mechanism side frame. This screw is threaded through a nylon insert locknut which, in turn, is welded to a projecting bracket on the side frame.

2. With the breaker in the open position turn the adjusting screw into the locknut one complete turn at a time, closing the breaker after each complete turn of the adjusting screw, until

the breaker will not close. Use the maintenance closing handle whenever closing or attempting to close the breaker during this entire operation.

3. Withdraw the adjusting screw from the locknut 1/4 turn at a time, attempting to close the breaker after each 1/4 turn, and observing whether the contacts move toward closing before tripping occurs. If the contacts move toward closing before tripping occurs, you have established the position of the adjusting screw where the latch and latch roller begin to engage. In some cases, it may be necessary to turn the adjusting screw less than 1/4 turn to establish the position where the contacts move before tripping occurs. When this position is established, note the position of the slot in the head of the adjusting screw.

4. Withdraw the adjusting screw three and one-half turns from the position noted in step 3. This sets the proper amount of latch engagement.

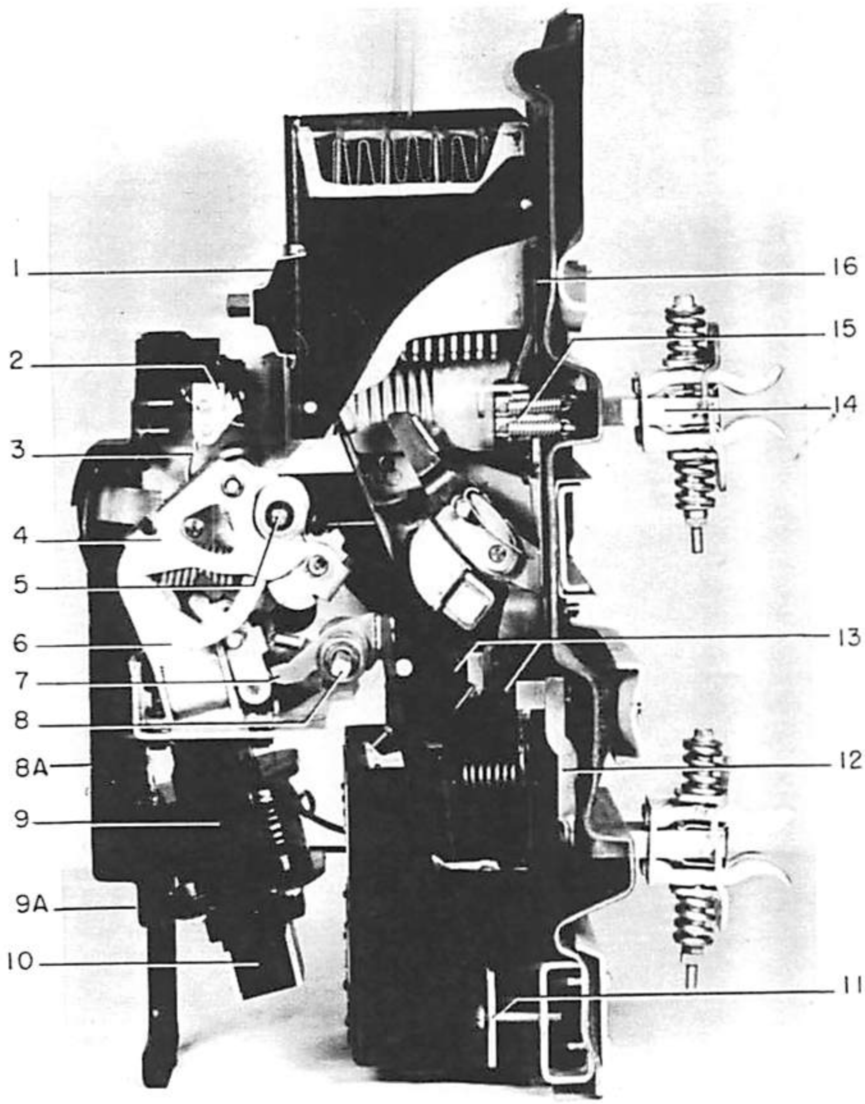


Figure 5. (8024457) Cut Away Model of Electrically Operated AK-2 Breaker

1. Arc Quencher Retainer
2. Cutoff Switch
3. Cutoff Switch Actuator
4. Spring Carrier
5. Shoulder Pin
6. Connecting Link
7. Trip Latch Roller
8. Trip Shaft
8A. Front Escutcheon
9. Closing Solenoid
9A. Location of Slots for Maintenance Handle
10. Closing Solenoid Armature
11. Cover Retainer of Overload Device
12. Lower Stud
13. Socket Head Screws
14. Upper Stud
15. Stationary Contacts and Springs
16. Arc Runner

Should the mechanism continue to function improperly after the proper latch engagement has been set and the corrective measures listed in the "Trouble Shooting" chart carried out, it is generally recommended that no attempt be made to repair the mechanism interior but that a replacement mechanism assembly be obtained from the factory.

REPLACEMENT

1. If the breaker is electrically operated, remove the front escutcheon by taking four screws from flange. If the breaker is a drawout type, two small round head screws must also be removed from the bottom edge of the escutcheon. (For removal of front escutcheon from manually operated breakers, see procedure described below.)

2. Remove arc quenchers (See "Arc Quencher").

3. Disconnect the two insulated connecting links between the mechanism and the contacts as in step 2 of the procedure for "Separation of Front and Back Frames".

4. Remove the two elastic stop nuts, which fasten the upper extensions of mechanism frame to studs connecting with rear frame.

5. Remove four screws which fasten the bottom of the mechanism frame to the horizontal cross member of the front frame.

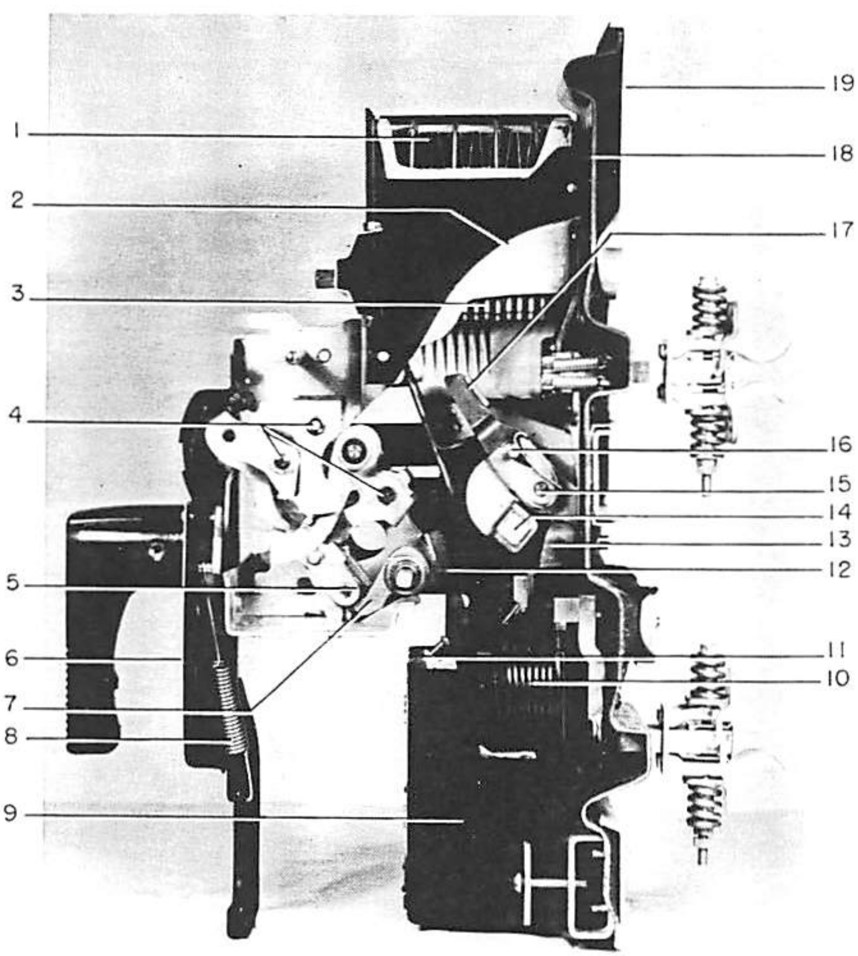


Figure 6. (8024516) Cut Away Model of Manually Operated AK-2 Breaker

1. Arc Quencher Muffler
2. Ceramic Side Plates
3. Steel Plates
4. Fixed Centers in Mechanism
5. Latch Roller
6. Escutcheon
7. Trip Latch
8. Handle Return Spring
9. Overload Device
10. Series Coil of Overload Device
11. Trip Arm of Overload Device
12. Trip Paddle
13. Movable Contact Pivot Support
14. Crossbar
15. Movable Contact Pivot
16. Contact Wipe Adjustment Pin
17. Movable Contact
18. Moulded Compound Bar
19. Steel Back Plate

6. If the breaker is manually operated, and has no auxiliary switch, it is now free to be lifted clear of the breaker. If it has an auxiliary switch, this may be disconnected from the mechanism as described under "Auxiliary Switch - Replacement, elsewhere in these instructions.

7. If the breaker is electrically operated, it will be necessary to disconnect the mechanism from the solenoid armature. In order to do this, raise the mechanism as far as the travel of the armature will permit and remove the screw which binds together the two extensions of the armature. After this is removed, the armature extensions must be spread apart to release them from the link connecting with the mechanism. This can be done by threading a #10-32 screw at least 1-3/4 inches long into the top hole of the armature extension. This hole is just above the one from which the binding screw has been removed. As the end of the screw butts against the far extension, the two extensions will be spread open, releasing the mechanism link.

8. The replacement mechanism may be installed by reversing the order of procedure for disassembly. After reassembly, check the operation of the breaker and, if necessary, adjust the latch engagement.

REMOVAL OF FRONT ESCUTCHEON OF MANUAL BREAKERS

1. Remove set screw fastening the plastic handle to steel operating shaft and remove the operating
2. Open and remove annealed (soft) retainer and two flat washers from shaft.
3. Remove four screws from flange of escutcheon If the breaker is a drawout type, two small round head screws must also be removed from the bottom edge of the escutcheon.
4. Push steel operating shaft through escutcheon bushing.
5. Remove handle reset spring (8) Figure 6, and escutcheon is free of breaker.
6. Handle and escutcheon assembly can be assembled most easily by exactly reversing the procedure for disassembly. In replacing the escutcheon it may be necessary to use pliers to pull the operating shaft fully into the escutcheon in order to have space enough to replace the flat washers and the soft retainer. The latter may be closed on its groove in the shaft by ordinary gas pliers. After replacement, check operation of breaker.

AUXILIARY SWITCH

The auxiliary switch is mounted on the left side of the operating mechanism frame. Its operating shaft is linked to the output crank of the breaker mechanism. Through a cam arrangement, the operating shaft of the switch controls the open and closed positions of the individual contact pairs. Each stage of the switch, which is usually two-stage or five-stage, contains one "a" and one "b" set of contacts. An "a" pair of contacts is always in the same position as the main breaker contacts. That is, open when the breaker contacts are open, and closed when the breaker contacts are closed. Just the oposite is true of the "b" contacts. The terminals of the switch are covered by a sheet of insulating material held in place by two screws fastened along its left edge. When this is removed, the terminals are exposed. The upper pairs of terminals are those which connect to "a" switches. The lower terminals connect to "b" switches.

REPLACEMENT

1. Remove auxiliary switch cover.
2. Disconnect leads to switch terminals.
3. Remove two screws which fasten switch to side of mechanism frame.
4. Remove switch by moving towards left.
5. Before mounting replacement switch, turn the crank end of the switch operating shaft in position to engage the hole in the link connecting with with the breaker mechanism. Be sure the bearing washer is in place between the mechanism link and the switch operating shaft.
6. Complete mounting by following disassembly steps in reverse order.

ELECTRICAL CONTROL COMPONENTS

These consist of the following:

1. Closing solenoid
2. "X" contactor (relay)
3. "Y" permissive relay
4. Cut-off switch
5. Closing switch
6. Shunt-trip device

The last two of these components may or may not be present in the control arrangement.

CLOSING SOLENOID

The closing solenoid consists of a magnet, armature and coil. This assembly is located directly beneath the breaker mechanism to which it is connected by a link which ties the upper end of the armature to the spring carrier of the mechanism. (See Figure 5.)

When voltage is applied to the coil, the magnetic force generated pulls the armature up into the coil and magnet assembly. This, in turn, rotates the spring carrier about its pivot, extending the mechanism spring and causing its line of action to move "over center", resulting in a closing operation.

REPLACEMENT

The only replacement operation that might conceivably be required on this assembly is that of the solenoid coil. To replace this, proceed as follows:

1. Remove escutcheon by unfastening four flat head screws in flange.
2. Remove closing switch. (See "Closing switch".)
3. Cut off or disconnect the coil leads.
4. Remove four screws which fasten lower section of magnet to upper section.
5. Allow lower section of magnet and coil to slide downward until clear of armature.
6. Reassemble with new coil by reversing order of procedure.

"X" CONTACTOR

The "X" contactor is a heavy-duty relay which performs the function of closing the circuit of the breaker solenoid during electrical operations. Three of the four sets of contact of the device are arranged in series to minimize the duty required of any one contact. As explained under "Operation", the fourth contact is used to "seal-in" the "X" coil.

The "X" contactor is located on the right beneath the horizontal front frame member. It is mounted on three studs which fasten it to a mounting bracket which is suspended from the frame. Rubber bushings on the mounting studs provide anti-vibration and anti-shock protection for the relay. The relay contacts and their terminals are covered by a molded piece of insulation which fits over spring clips that hold the cover in place.

REPLACEMENT

Removal of the complete device is accomplished by removing the cover, disconnecting the leads from the terminals, and removing the nuts from the three mounting studs. If the replacement unit includes the mounting bracket, the relay need not be removed from the old bracket. This can be taken off the breaker simply by removing the two screws which fasten it to the breaker frame. If the breaker is a drawout type, the supporting bracket of the "Y" relay may be temporarily displaced to provide access to the screws.

Since the expendable parts of the "X" contactor are the contacts and the coil, ease of replacement of these parts has been designed into the relay. Methods of procedure are as follows:

Contacts

1. Remove relay cover.
2. Remove terminal binding screw of stationary contact to be replaced.
3. Lightly pinch with pliers (pointed end) the split section of the contact which enters the hole in the compound body of the device and lift out the stationary contact.
4. With the fingers, pull forward on the spring guide of the movable contact, compressing the contact spring as far as possible.
5. With the spring thus held, grip the end of the contact strip with pointed pliers, turn it through 90 degrees on its long axis, and withdraw it.
6. Replace new contacts by reversing the procedure.

Coil

1. Remove relay cover.
2. Turn the two retaining spring clips on the ends of the device through 90 degrees about their pivots.
3. Pull out the two halves of the body of the device which carry the stationary contacts. When these are clear of the frame, the armature and movable contact assembly will move aside, exposing the coil.
4. Remove the terminal screws of the coil and pull it free of its retaining spring clips.
5. Place new coil on pole piece inside of the spring clips and fasten terminals to leads.
6. Just start the replacement of one of the compound blocks which hold the stationary contacts into its groove in the frame.
7. Position the armature and movable contact assembly to allow the entrance of the second stationary contact block.
8. When these parts are all properly aligned, with the stationary contacts under the movable contacts, push them into their guiding grooves in the frame until they bottom.

9. Rotate the retaining spring clips to the locked position, making sure that each clip is in its proper recess, and replace the device cover.

"Y" RELAY

As described under "Operation", the "Y" relay is a permissive relay which limits to one the number of breaker closures possible on one closing signal.

On drawout breakers, the "Y" relay mounting bracket is fastened to the right hand side member of the breaker frame by two mounting screws. On terminal board breakers, it is fastened to the rear side of the terminal board support. The relay itself is fastened to an intermediate bracket which is detachable from the main support. The junctures between the relay and the intermediate bracket and between the two brackets are rubber cushioned against vibration and shock.

REPLACEMENT

If replacement of the "Y" relay becomes necessary, it may be detached from its supporting brackets by removal of the fastening hardware. The leads to the relay should be cut off as closely as possible to the soldered connections so that enough wire will remain for connection to the new relay. Sufficient original wire is allowed for this purpose.

After the old relay has been removed, the wire leads to the relay should be stripped of insulation to about 1/4 of an inch from the ends. A good mechanical connection should be made before soldering.

After all connections are completed, the relay may should again be mounted to the breaker by means of its supporting brackets and hardware.

After replacement has been completed, the relay may be checked electrically in the following manner:

1. Apply closing voltage to terminal board or secondary disconnects.

2. Push button of closing switch and hold closed.

3. Continuing to hold push button in closed position, manually trip the breaker open.

4. If the breaker stays open, and makes no attempt to close, the "Y" relay is functioning properly.

5. While releasing the close button, observe the "Y" relay. It should open as the closing switch is released.

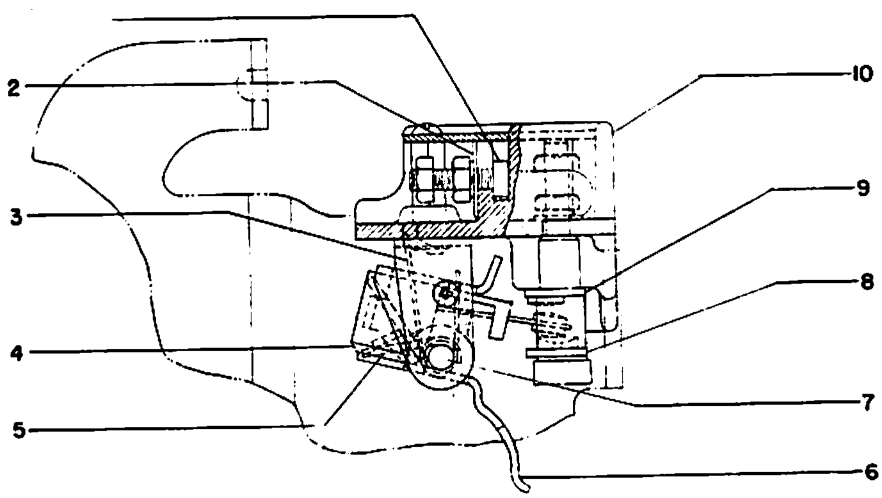


Figure 7. (695C162) Cut-Off Switch

1. Screw
2. Washer
3. Spring
4. Movable Contact Assembly
5. Spring
6. Actuator
7. Pivot Pin
8. Contact (BB)
9. Contact (AA)
10. Support

CUT-OFF SWITCH

Figure 7.

As explained under "Operation", the function of the cut-off switch is to de-energize the "X" contactor coil and energize the "Y" relay coil as the breaker mechanism moves from the opened to the closed position.

The switch is operated by the movement of a mechanism link against the switch actuator (6). This causes the actuator and movable contact assembly (4) to rotate counterclockwise about pin (7), opening the "bb" contacts (8) and closing the "aa" contacts at (9). Overtravel of the actuator (6) beyond the point of making contact at (9) is absorbed by spring (5) which couples the movable contact (4) to the actuator. Spring (3) resets the switch after the breaker contacts open and the breaker mechanism resets.

The point at which the cutoff switch operates during the breaker closing cycle is after the spring charged mechanism has been driven over-center. This assures that the cutoff switch cannot operate too early in the breaker closing cycle, thus the X and Y relays are de-energized and energized, respectively, at the proper time and the circuits anti-pump feature is maintained. When the closing mechanism is driven over-center, the force of the previously charged closing springs is released, closing the breaker.

REPLACEMENT

The cut-off switch is located above the breaker mechanism. It is fitted between the upper portions of the steel side plates that make up the mechanism frame. A raised horizontal ridge on each side of the molded body of the switch fits into a corresponding groove in each of the steel side plates. A round head screw on each side fastens the switch and side plate together. Replacement of the switch is accomplished by the following procedure:

1. Remove the cover on the top of the switch by taking out the two screws which hold it in place.
2. After taking careful note of the connection arrangements, disconnect the leads from the switch terminals.
3. Remove the two screws, one on each side, which fasten the switch to the mechanism side plates. Note that the one on the right hand side also holds a wiring cleat and spacer which serves to hold the wires clear of the link connecting the mechanism and the breaker position indicator.
4. Remove the front escutcheon from the breaker.
5. Slide the cut-off switch out from between the steel side plates by pulling straight forward.
6. Mount the replacement switch by reversing the order of procedure.

CLOSING SWITCH

Figure 8.

The closing switch is mounted on the upper flange of the closing solenoid coil. A hole in the escutcheon (3) permits access to the switch button (4). When the button is pressed, movable contact (5) deflects and impinges upon stationary contact (2). This energizes the "X" relay coil which seals itself in, and, in turn, energizes the closing solenoid.

REPLACEMENT

1. Remove escutcheon (3).
2. Disconnect leads from switch terminals.
3. Deflect the left end of hinge (7) to the left so that the movable contact (5) may be disengaged from the switch assembly.
4. Removal of the two screws (10) from speed-nuts (9) completes the disassembly of the switch.
5. Reassembly with new parts is a matter of reversing the described procedure. In reassembling, be sure the tab on the left end of hinge (7) is bent to the right far enough to avoid any possibility that movable contact (5) might become free of the assembly.

SHUNT TRIP DEVICE

Figure 9.

The shunt trip device is mounted underneath the horizontal cross frame member, just to the left of the front escutcheon. It is composed of a magnet, coil and armature. The armature has an extended arm or striker (11) which bears against the trip paddle (12) on the trip shaft when the coil (8) is energized. This displaces the trip latch in the breaker mechanism, opening the breaker contacts.

The trip device is generally activated by a remote switch or relay which closes the shunt trip coil circuit.

In order to avoid unnecessary heating of the coil of the device, an auxiliary switch "a" contact is wired in series with the coil. This prevents the energization of the coil if the breaker is open.

REPLACEMENT

The entire shunt trip device may be dismounted by disconnecting the coil leads and removing nuts (1). However, the only part of the device that might conceivably need replacement during the life of the breaker is the coil (8). This

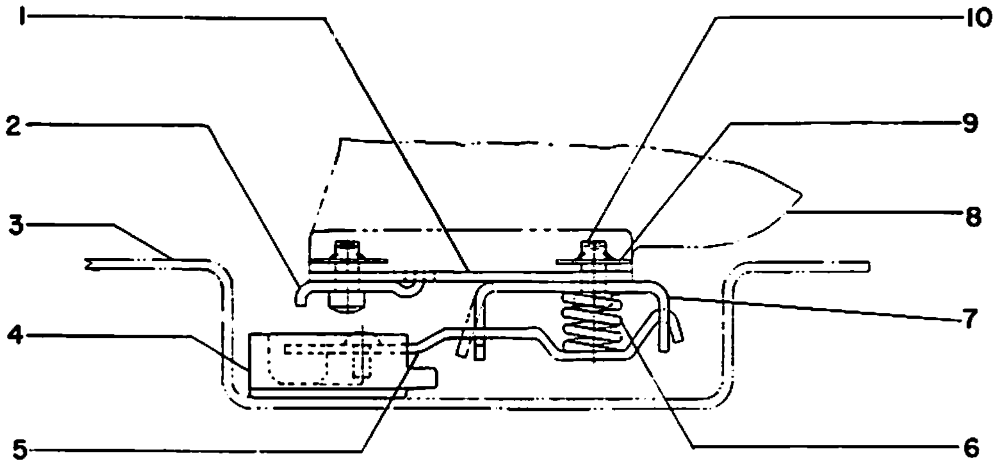


Figure 8. (805B905) Closing Switch (Top View)

1. Insulation
2. Stationary Contact
3. Front Escutcheon
4. Push Button
5. Movable Contact
6. Spring
7. Hinge
8. Closing Solenoid
9. Speed Nut
10. Screw

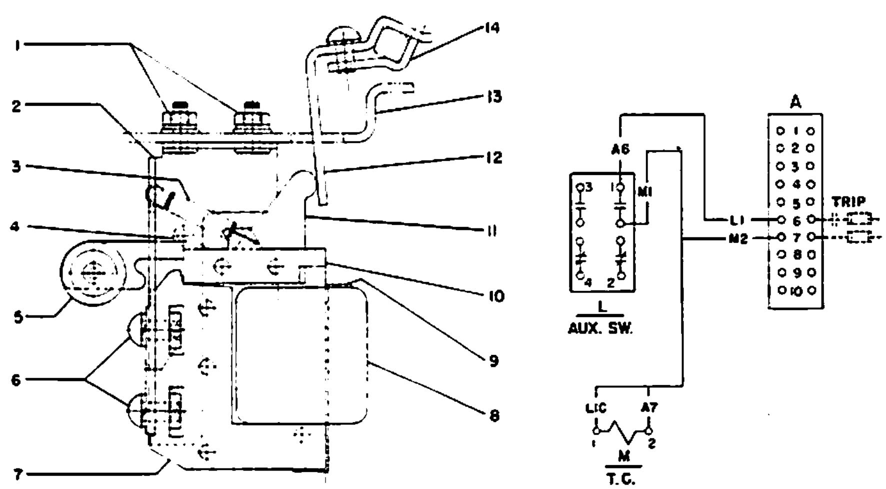


Figure 9. (695C161) Shunt Trip Device

1. Nut
2. Frame
3. Spring
4. Rivet
5. Weight
6. Screws
7. Magnet
8. Coil
9. Clamp
10. Armature
11. Armature Arm
12. Trip Paddle
13. Mechanism Frame
14. Trip Shaft Clamp

may be replaced without removing the device from the breaker by proceeding as follows:

1. Disconnect leads of coil (8).
2. Remove two screws (6) which fasten magnet (7) and coil to the frame (2).
3. Having removed the magnet from the device, straighten the end of clamp (9).
4. Remove the coil from the magnet.
5. Install new coil, again forming end of clamp (9) as shown.
6. Reassemble to frame.
7. Connect coil leads.

ADJUSTMENT

The only adjustment required on the shunt trip device is that which ensures positively that the breaker will trip when the device is activated. In order to be sure of this, armature arm (11) must travel from 1/32 to 1/16 of an inch beyond the point at which the breaker trips. A good method of checking this is to hold a 1/32nd shim between the magnet and armature at (10), and with the breaker closed, push upwards at (5), closing the armature against the magnet. If the breaker trips, there is sufficient overtravel. If adjustment is necessary, trip paddle (12) may be formed towards or away from armature arm (11).

PROTECTIVE DEVICES

An AK-2/3 breaker may be equipped with the following protective devices:

1. Overcurrent trip (Magnetic) AK-2
2. Power Sensor Trip (Static) AK-3
3. Reverse Current Trip AK-2
4. Under Voltage Trip & Lockout Device
5. Bell Alarm and/or Lockout device
6. Open Fuse lockout device.
7. AKD-5 Interlock AK-2A/AK-3A

OVERCURRENT TRIP DEVICE
(Magnetic)

The typical overcurrent trip device consists of a magnetic structure, a series current coil, and a pivoted armature.

When current flow through the series coil generates a magnetic field strong enough, the armature overcomes the restraining force of a calibration spring attached to it, and closes against the magnet. This trips the breaker by means of an extension on the armature which strikes against a trip paddle on the trip shaft.

Depending on the type of individual device, the movement of the armature may be delayed for a time by a timing device. If a relatively long time-delay (seconds or minutes) is desired, the velocity of armature movement is governed by a piston moving through an oil dashpot. If only a short-time delay (cycles or milli-seconds) is required, movement is controlled by an escapement gear and pallets arrangement.

An AK-2-15/25 breaker may be equipped with either the EC-2 or EC-1 overcurrent trip device. The majority of applications will require the use of the EC-2 device. The EC-1 device is normally used when the short-time delay feature is required, or when the trip device is used to operate a special over-current alarm switch.

Most circuit breakers are equipped with series overcurrent trip devices either of the dual magnetic type (instantaneous and time delay tripping) or instantaneous alone. Breakers are designed to carry up to 100% of the continuous current rating of their trip devices. Any attempt to carry higher currents for a prolonged period will cause over-heating and possible damage.

EC-2 OVERCURRENT TRIP DEVICE

The Type EC-2 overcurrent tripping device is available in three forms:

1. Dual overcurrent trip, with long-time delay and high-set instantaneous tripping.
2. Low-set instantaneous tripping.
3. High-set instantaneous tripping.

The dual trip has adjustable long-time and instantaneous pick-up settings and adjustable time settings. Both forms of instantaneous trips have adjustable pick-up settings.

DUAL OVERCURRENT TRIP, WITH LONG-TIME DELAY AND HIGH-SET INSTANTANEOUS TRIPPING.

By means of the adjustment knob (5), Figure 10, which can be manipulated by hand, the current pick-up point can be varied from 80 to 160 percent of the series coil rating. The indicator and a calibration plate (4), Figure 10, on the front of the case provide a means of indicating the pick-up point setting in terms of percentage of coil rating. The calibration plate is indexed at percentage settings of 80, 100, 120, 140 and 160.

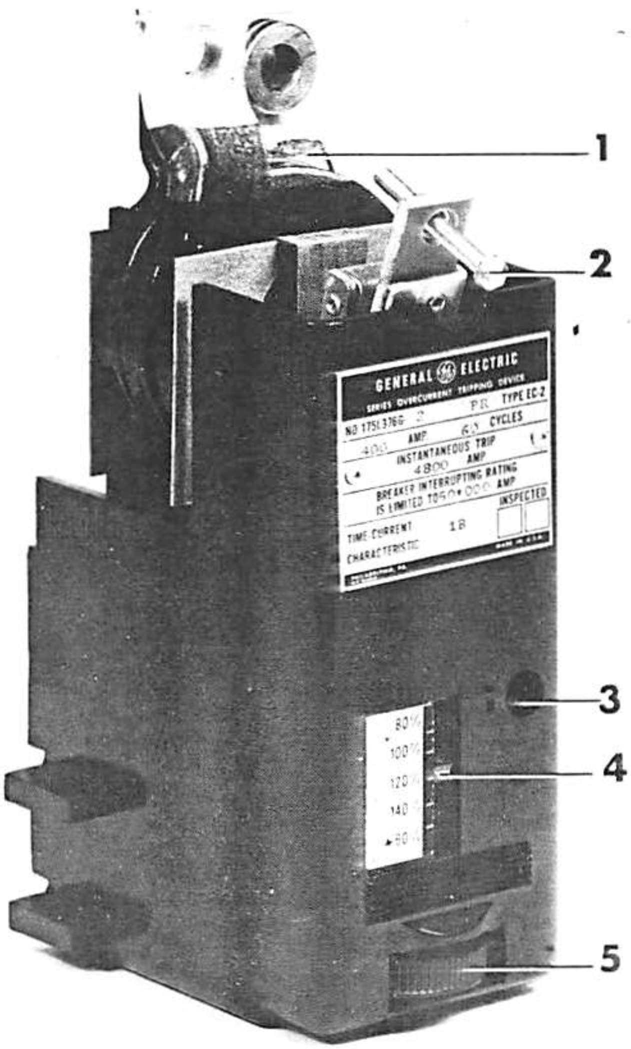


Figure 10. (8024842) EC-2 Overcurrent Trip

1. Series Coil
2. Trip Adjustment Screw
3. Opening for Time Adjustment
4. Pickup Indicator & Calib. Plate
5. Pickup Adjustment Knob

The long-time delay tripping feature can be supplied with any one of three time-current characteristics which correspond to the NEMA standards maximum, intermediate and minimum long-time delay operating bands. These are identified as 1A, 1B and 1C characteristics, respectively. Approximate tripping time for each of these, in the same order are 30, 15 and 5 seconds at 600% of the pick-up value of current. (See time-current characteristic curves 286B201A, B, and C).

The tripping time may be varied within the limits shown on the characteristic curves by turning the time adjustment screw (5), Figure 11. Turning in a clockwise direction increases the tripping time; counter-clockwise motion decreases it. The dashpot arm (7), Figure 11 is indexed at four points, maximum - 2/3 - 1/3 - minimum from the left, as viewed in Figure 11. When the index mark on the connecting link (8), Figure 11, lines up with a mark on the dashpot arm, the approximate tripping time as shown by the characteristic curve is indicated. The 1A and 1B characteristic devices are shipped with this setting at the 2/3 mark and the 1C characteristic at the 1/3 mark. The standard characteristic curves are plotted at the same settings.

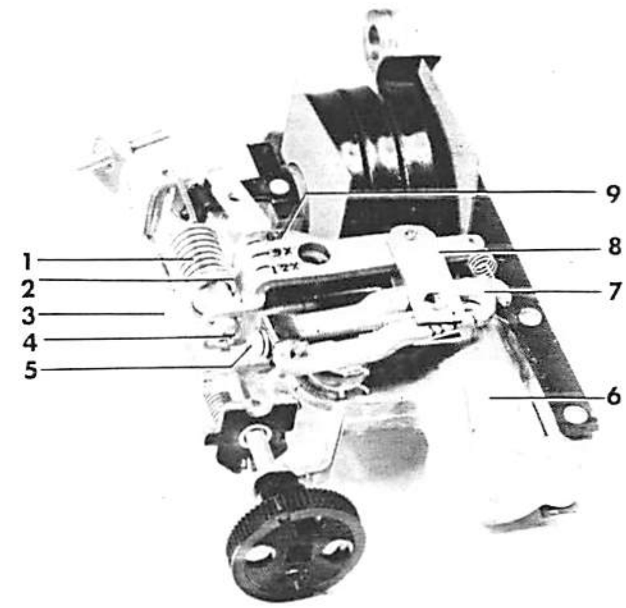
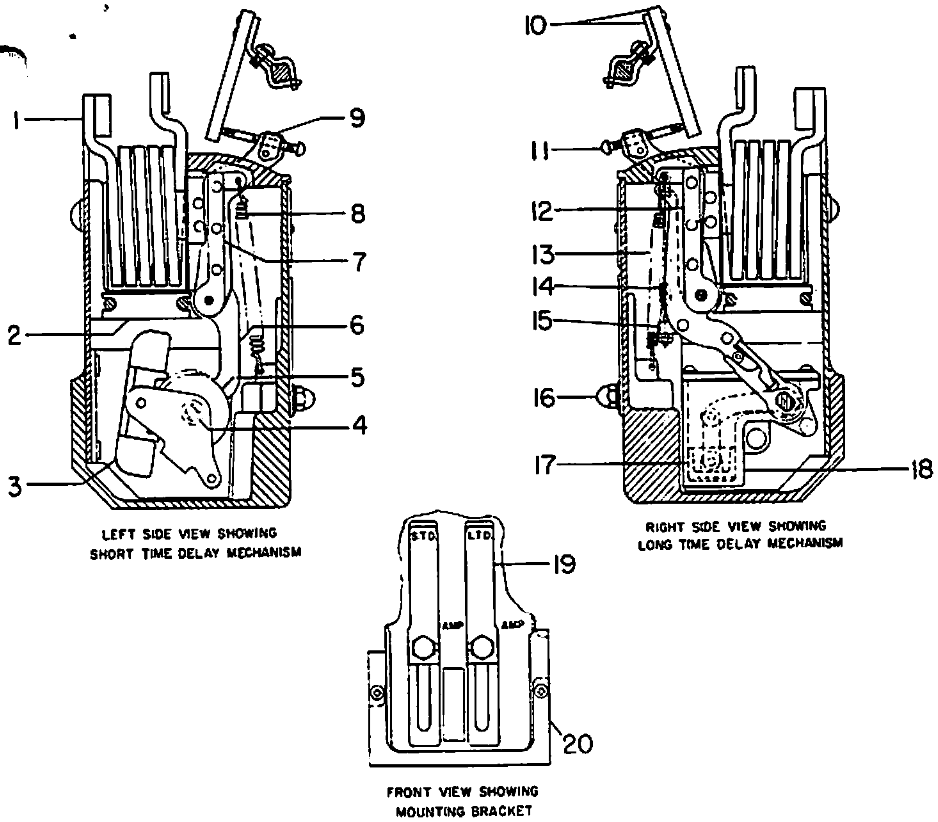


Figure 11. (8024843) EC-2 Overcurrent Trip With Cover Removed.

1. Instantaneous Calibration Spring
2. Movable Nut (Index Pointer)
3. Time-Delay Calibration Spring
4. Instantaneous Pickup Adjustment Screw
5. Time-Delay Adjustment Screw
6. Oil Dashpot
7. Dashpot Arm
8. Connecting Link
9. Instantaneous Pickup Calibration Marks

Time values are inversely proportional to the effective length of the dashpot arm. Therefore, the linkage setting that gives the shortest time value is the one at which dimension "A" Figure 11, is greatest. The time adjustment screw (5), Figure 11, may be turned by inserting a Phillips head screwdriver through the hole in the front of the case, but if it is desired to relate the linkage setting to the index marks on the linkage it will be necessary to remove the case. This may be done by removing the two mounting screws, one on each side of the case, which may be taken off without disturbing the trip unit itself.



1. Series Coil
2. Magnet
3. Pallet
4. Pinion
5. Escape Wheel
6. Driving Segment
7. S.T.D. Armature
8. S.T.D. Calibration Spring
9. Trip Arm
10. Trip Paddle
11. Trip Paddle Adjusting Screw
12. L.T.D. Armature
13. L.T.D. Calibration Spring
14. Instantaneous Trip Spring (High Set)
15. Spring Holder
16. Calibration Clamp Nut
17. Plunger
18. Cylinder (Dashpot)
19. Calibration Plate
20. Clamping Bracket

Figure 12. (695C189) EC-1 Type Overcurrent Trip Device

NOTE: Forcing the adjusting screw to either extreme position may cause binding of the device and should be avoided.

INSTANTANEOUS LOW-SET TRIPPING

The low-set instantaneous pick-up point may be varied by the adjustment knob (5), Figure 10. The calibration in this case usually ranges from 80% to 250% of the series coil rating, the calibration plate being indexed at values of 80%, 100%, 200% and 250% of the rating.

INSTANTANEOUS HIGH-SET TRIPPING

The high set instantaneous pick-up value may have one of the following three ranges: 4 to 9 times coil rating; 6 to 12 times coil rating or 9 to 15 times coil rating. The pick-up setting may be varied by turning the instantaneous trip adjusting screw (4), Figure 11.

Three standard calibration marks will appear on the operating arm at (9), Figure 11, and the value of these calibration marks will be indicated by stampings on the arm as follows:

4X		6X		9X
6X	or	9X	or	12X
9X		12X		15X

At the factory, the pick-up point has been set at the nameplate value of the instantaneous trip current. (Usually expressed in times the ampere rating of the trip coil.) The variation in pick-up setting is accomplished by varying the tensile force on the instantaneous spring. Turning the adjustment screw changes the position of the movable nut (2), Figure 11, on the screw. The spring is anchored to this movable nut so that when the position of the nut is changed, there is a corresponding change in the spring load. As the spring is tightened, the pick-up point is increased. The top edge of the movable nut (2), Figure 11 serves as an index pointer and should be lined up with the center of the desired calibration mark, punched slots on operating arm, to obtain the proper instantaneous trip setting.

EC-1 OVERCURRENT TRIP DEVICE

The EC-1 device can be provided with the following tripping combination

1. Long time delay, short time delay and instantaneous -tripping.
2. Long time and short time delay tripping only.
3. Long time delay and instantaneous tripping.
4. Short time delay and instantaneous tripping.
5. Short time delay tripping only.
6. Instantaneous tripping only.
   a. Adjustable (Low set)
      or
      Non-adjustable (High set)

SHORT TIME DELAY TRIPPING, Figure 12.

The armature (7) is retained by calibrating spring (8). After the magnetic force, produced by an overcurrent condition, overcomes this restraining force, the armature movement is further retarded by an escapement mechanism which produces an inverse time delay characteristic. The mechanism is shown in the left side view of Figure -12.

The pickup for this device can be field set between limits having a ratio of 2-1/2 to 1 in the range of 200 to 1000% of the coil rating.

LONG TIME DELAY TRIPPING, Figure 12

The armature (12), is retained by the calibration spring (13). After the magnetic force, produced bs an overcurrent condition, overcomes this restraining force, the armature movement is further retarded by the flow of silicone oil in a dashpot, which produces an inverse time delay characteristic. The mechanism is shown in the right side view of Figure 12.

INSTANTANEOUS TRIPPING, Figure 12.

a. Adjustable instantaneous tripping takes place after the magnetic force produced by an overcurrent condition, overcomes the restraining force of the adjustable calibration spring (13).

b. Nonadjustable instantaneous tripping takes place after the magnetic force produced by an overcurrent condition overcomes the restraining force of a nonadjustable spring (14).

ADJUSTMENTS, EC-1 AND EC-2

In addition to the pick-up settings and time-delay adjustments already described, overcurrent trip devices must be adjusted for positive tripping. This adjustment is made at the factory on new breakers, but must be made in the field when the breaker mechanism or the overcurrent trip devices have been replaced.

Positive tripping is achieved when adjustment screw (2), Figure 10, is in such a position that it will always carry the trip paddle on the trip shaft beyond the point of tripping the mechanism, when the armature closes against the magnet.

In order to make the adjustment, first unscrew trip screw (2), Figure 10, until it will not trip the breaker even though the armature is pushed against the magnet. . Then, holding the armature in the closed position, advance the screw until it just trips the breaker. After this point has been reached, advance the screw two additional full turns. This will give an overtravel of 1/16 of an inch and will make sure that activation of the device will always trip the breaker.

Adjustment screw (2), Figure 10, can best be manipulated by an extended 1/4 inch hex socket wrench.

In order to gain access to the adjustment screw on the center pole overload device, it will be necessary to remove the nameplate from the front escutcheon of the breaker. This will reveal a hole, centrally located in the escutcheon, by means of which the extended socket wrench can engage the adjustment screw.

REPLACEMENT, EC-1 and EC-2

Replacement of either the EC-1 or EC-2 overcurrent trip device is accomplished by the following procedure:

1. Separate the breaker's front and back frames as described in the section under "Maintenance".
2. Remove the steel clamps which fasten the cover of the device to the back of the breaker. NOTE: Pickup settings on the cover of each device are calibrated for the specific device. When replacing covers, replace on associated device.
3. Remove the 3/8 inch hexagon headed bolts which fasten the coil of the overload device to the breaker copper.
4. Remove the round head screw which fastens the frame of the overload to the breaker base.
5. After reassembling breaker with new overload device, adjust for "positive trip" as described under "Adjustments" of this section.

REVERSE CURRENT TRIP DEVICE
Figure 13.

The reverse current trip device sometimes used with d-c breakers will trip the breaker open if the direction of current flow is reversed.

This device is similar in appearance and is mounted in the same way as the overcurrent trip.

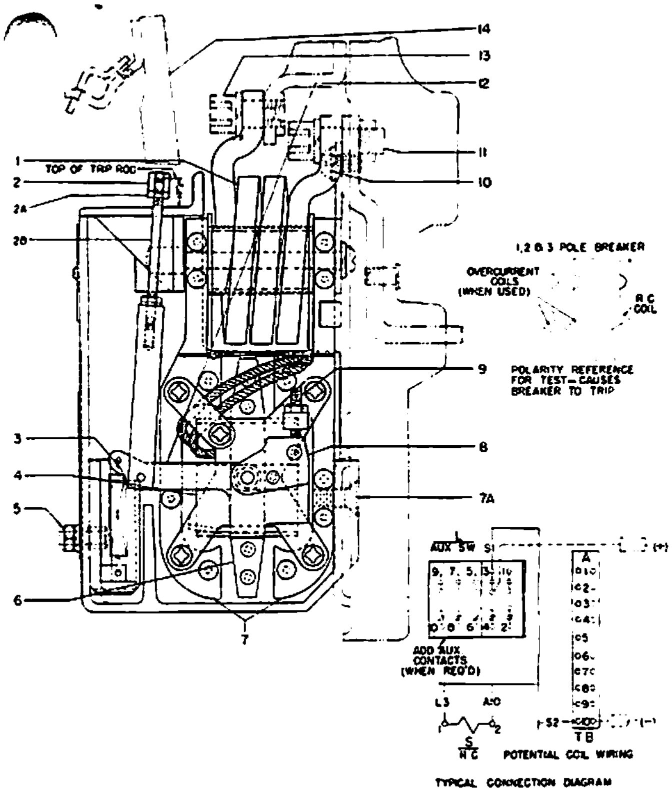


Figure 13. (286B209) Reverse Current Tripping Device

1.	Series Coil	7A.	Screws
2.	Adjusting Nut	8.	Counterweight
2A.	Locking Nut	9.	Stop Screw
2B.	Trip Rod	10.	Mounting Screw
3.	Spring	11.	Screw (Lower Stud)
4.	Potential Coil	12.	Trip Crank
5.	Calibration Nut	13.	Screw (Lower Stud)
6.	Armature	14.	Trip Paddle
7.	Pole Pieces		

The device consists of a series coil (1), with an iron core mounted between two pole pieces (7) and a potential coil connected across a constant source of voltage and mounted around a rotary type armature (6). Calibration spring (3) determines the armature pick-up value when a reversal of current occurs.

As long as the flow of current through the breaker is in the normal direction, the magnetic flux of the series coil and the magnetic flux of the potential coil produce a torque which tends to rotate the armature counterclockwise. The calibration spring (3) also tends to rotate the armature in the same direction. This torque causes the armature to rest against stop screw (9) attached to a bearing plate on the right side of the device.

If the current through the series coil (1) is reversed, armature (6) tends to move in a clockwise direction against the restraint of calibration spring (3). When the current reversal exceeds the calibration setting, the armature will move in a clockwise direction. This causes trip rod (2B) to move upwards against trip paddle (14), tripping the breaker open.

ADJUSTMENTS

The only adjustment to be made on the reverse current device is to make sure that the trip rod has a minimum overtravel of 1/32 of an inch beyond the point of tripping the breaker. The only occasion this adjustment should have to be made is when an old device is being replaced by a new one.

The new device will be factory adjusted so that the top end of the trip rod (2B) will extend 1/2 inch above the top of the device case, and no additional adjustments of the trip rod should be required. To obtain the proper 1/32 of an inch overtravel, close the breaker and proceed as follows:

1. Loosen the locking nut (2A).
2. Manually lift the trip rod and vary the position of the adjusting nut (2), thus establishing the position of the adjusting nut where the breaker is just tripped. (NOTE - Be sure that all parts of the person are kept clear of moving breaker parts when tripping the breaker.
3. With this position of the adjusting nut established, advance the adjusting nut upward one and one half turns.
4. Tighten the locking nut and the minimum 1/32 of an inch overtravel of the trip rod should be obtained.

REPLACEMENT

Replacement of the ED-1 Reverse Current Device is accomplished by means of the same procedure as that followed in the case of the EC Overcurrent Trip Devices. There is, however, one additional step to the taken. This consists of disconnecting the leads of the potential coil. These are connected to a small two point terminal board mounted between two of the phases on the breaker base. After the new device has been installed, adjust for overtravel of the trip rod as described above.

POWER SENSOR TRIP

GENERAL DESCRIPTION

All AK-3 Type Air Circuit Breakers contain Power Sensor Overcurrent Trip Devices. The Power Sensor Trip functions with solid state components with the exception of the Magnetic Trip Device which is used to trip the breaker on signal from the Power Sensor Unit. The Power Sensor Overcurrent Trip Device consists of four major components.

1. The magnetic coils around the breaker conductors (Figure 14).
2. The Power Supply which provides both the tripping energy and the comparison basis for overcurrent detection (Figure 15).
3. The Power Sensor Unit with the various pick-up settings and time delay selection taps (Figure 16).
4. The Magnetic Trip Device which physically trips the breaker (Figure 17).

In addition to the phase overcurrent protection, a ground fault sensing feature may be provided. The Ground Sensing Device works on the principle that the instantaneous value of current flowing in the three conductors (or; in four conductors on four wire systems) must add to zero unless ground current is flowing. Therefore, if the electrical system is a four wire wye system with the neutral grounded at the transformer, the fourth sensing coil (Figure 18) must be included on the neutral conductor with its secondary combined with the secondaries of the three phase sensors which are mounted on the breaker. On Draw-out breakers, the output of the external neutral sensor must enter the breaker by a control disconnect (Figure 19) which is mounted low and on the center-line on the back of the breaker. Refer to Figure 20 for Power Sensor Cabling diagram.

MAINTENANCE

When mal-functioning of the Power Sensor Trip is indicated the trouble should be traced to one or more of these four components involved, and that component should be replaced as a unit. The following steps should be taken to detect a mal-functioning unit.

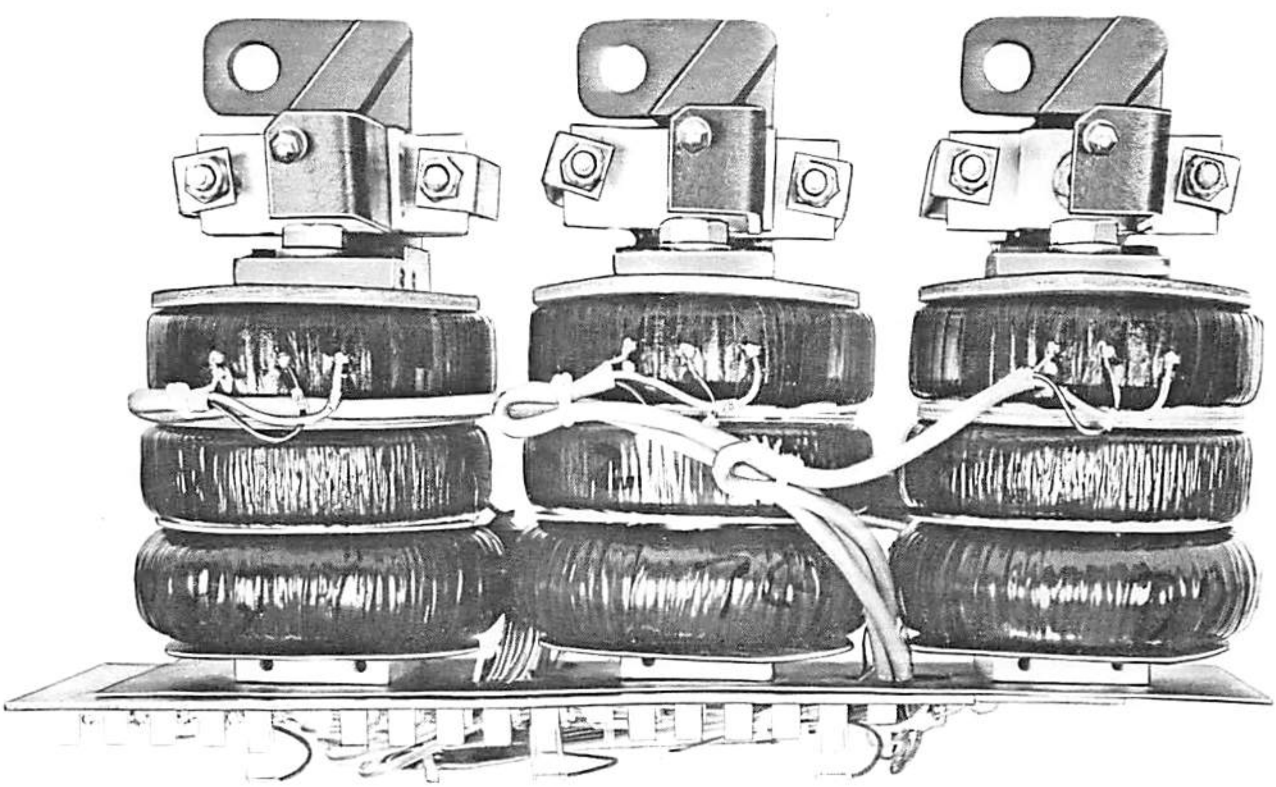


Figure 14. (8041866) Magnetic Coils

NOTE: No adjustment to the taps controlling [illegible] up or timing should be made with the breaker carrying current.

In the event the Power Sensor Device must be made non-operative to allow the breaker to continue carrying current without over-current protection, it is recommended that the leads to the tripping solenoid be removed to completely eliminate the possibility of the breaker tripping. Do not close breaker with power on the main contacts while the disconnect plug to the magnetic coils is disconnected

1. Check for the existence of overcurrent or ground fault conditions that may be causing the breaker to trip as a proper response to these abnormal circuit conditions.

2. The possibility of the breaker being trip free by mechanical interferences along the trip shaft or inadvertent shunt trip operations should be positively eliminated before investigating the Power Sensor. Successful operations in the test position should be obtained before proceeding with the Power Sensor trouble shooting.

3. A PST-1 Power Sensor Test Kit must be available. (Figure 21). Check the Power Sensor Unit for correct function for each pick-up setting and one point on each time delay characteristic. Then check for the correct operation of each phase of the Power Supply Unit. This procedure is described in the instruction manual (GEK-7301) for the PST-1 Test Kit, and GEK-7309 Power Sensor Instructions. If the test results for this test do not deviate more than 10% from the published curves, proceed to step 4. If the deviation is more than 10% contact the factory for possible replacement of the Power Sensor Unit.

4. If the breaker is equipped with ground fault protection, determine whether the false tripping is the result of falsely answering an overcurrent trip or a ground trip signal. This may be determined by temporarily eliminating the ground trip signal by shorting out the ground signal points 1 and 5 at the ground signal terminal board on the back frame bottom of the breaker. Terminals 1 and 5 can be identified by the 0.15UF capacitor connected

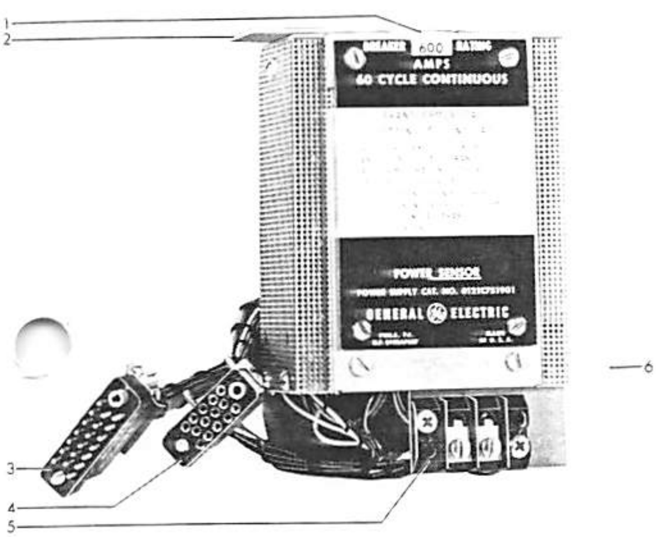


Fig. 15. (8039850) Power Supply

1. Rating Disc
2. Mounting Bracket
3. Male Disconnect Plug
4. Female Disconnect Plug
5. Terminal Block
6. Mounting Bracket

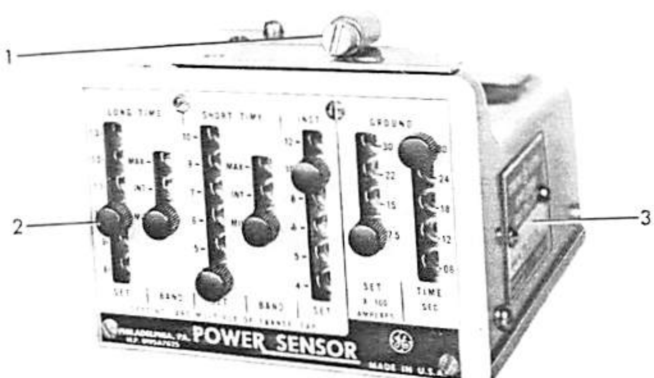


Figure 16. (8041864) Power Sensor Unit

1. Mounting Screw
2. Captive Thumb Screw
3. Name Plate

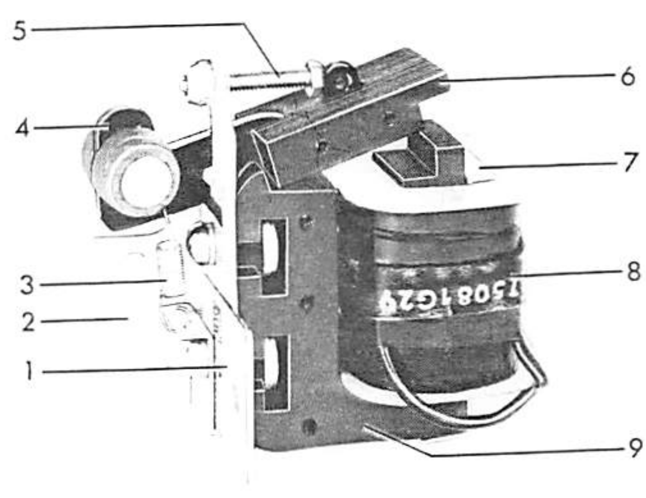


Figure 17. (8041863) Magnetic Trip Device

1. Name Plate
2. Mounting Bracket
3. Spring
4. Trip Arm
5. Adjusting Screw
6. Armature
7. Clamp
8. Coil
9. Magnet

between them. See drawing 138B2454 (Figure 22) with the breaker restored to service with the ground fault detector deactivated, establish whether there is false tripping due to over-current.

FALSE TRIPPING CAUSED BY FAULTY GROUND FAULT DETECTION

If the breaker is equipped for four wire service (fourth C.T. remotely mounted, Figure 18) it is important that the shielding be effective by having continuity from the disconnect plug at the Power Sensor Unit to the external C.T. and further, that this shield be isolated from the signal conductors. It is also important that continuity exists through the ground signal circuit. Check these conditions as follows; referring to Figure 22.

1. Remove connection plug at Power Sensor Unit and check continuity between A and C (Signal). Letters are located on end of plug.
2. Check to be sure no continuity exists between R and A, or between R and C.
3. Temporarily connect jumper from shield to either terminal at remote C.T. and check to assure the shield is continuous from Power Sensor Plug to remote C.T. by checking for continuity between R and A. If continuity does not now exist, shield is not continuous and point of discontinuity must be found. Check the control disconnect as the possible point of discontinuity. Remove jumper at remote C.T. after shield continuity is established.

Note the polarity marks on the ground sensors. Be sure the external ground C.T. senses the neutral current associated with the particular breaker load current and that polarity marks are in accordance with 138B2454 (Figure 22). If the breaker bottom studs connect to the source, the external C.T. must also have its polarity mark toward the source.

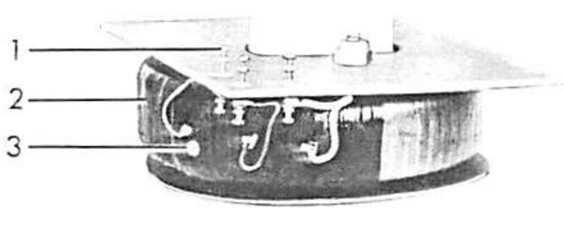


Figure 18. (8041867) Ground Sensor Coil (Remotely Located)

1. Terminal
2. External Ground Sensor Coil
3. White Polarity Dot

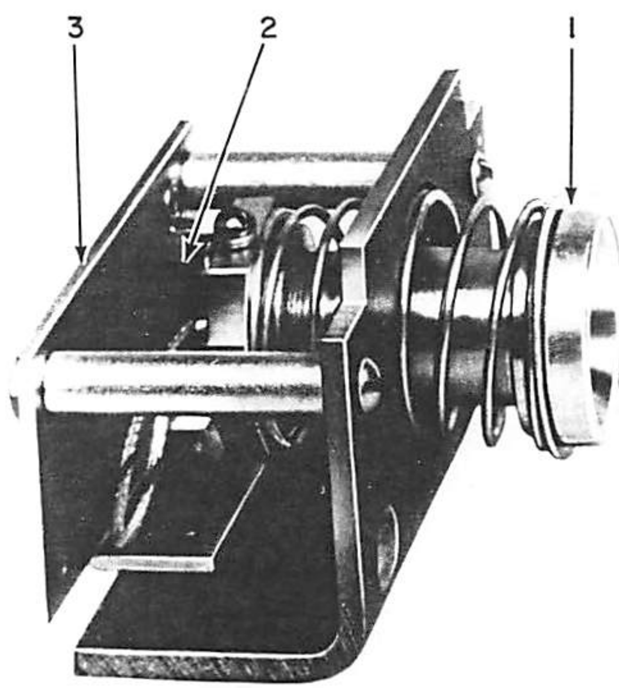


Figure 19. (8918380A) Control Disconnect Plug

1. Female Disconnect Plug
2. Terminal Board
3. Mounting Bracket

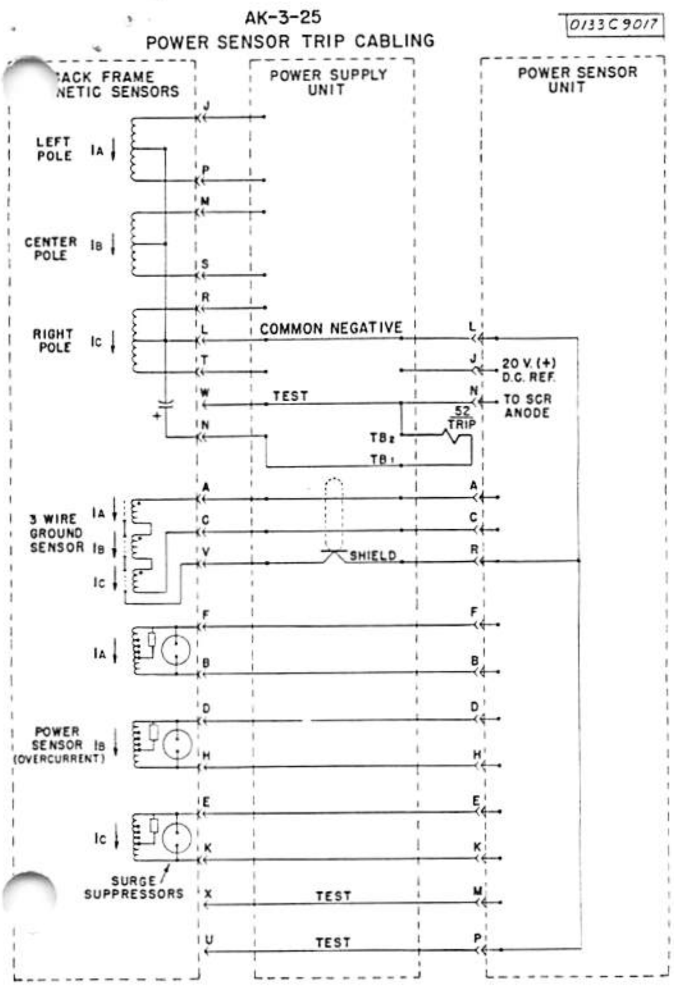


Figure 20. (0133C9017) Power Sensor Cabling Diagram

Figure 21. (8039962) Power Sensor Test Kit

TESTING MAGNETIC COILS

After the PST-1 Test Kit has been used to determine the adequacy of performance of the Power Sensor Unit, it may be advisable or required to test the magnetic coils by the use of a hi-current Low voltage type test set. In this event, only one test per phase need be made. This test should be made at some convenient multiple of pick-up setting such as 300% for comparison with published time-current curves.

In the event the breaker is equipped with ground sensor, the ground sensor will cause tripping on single phase testing unless the signal is shorted at the terminal board (Figure 22). Jumper points 1 and 5 during overcurrent test.

The above considerations should indicate which of the four major components is faulty and in need of replacement.

REPLACEMENT OF POWER SENSOR COMPONENTS

POWER SENSOR UNIT (Figure 16).

1. Loosen screw connecting the unit to the front frame.
2. Slide unit forward.
3. Remove control plug by alternately loosening the two retaining screws.
4. Replace in reverse order.

MAGNETIC TRIP DEVICE (Figure 17).

1. Remove trip solenoid wires from the terminal board on power supply.
2. Remove four screws holding power supply to breaker frame.
3. Pull power supply forward until restricted by wiring.
4. Remove two bolts holding trip device to breaker frame.
5. Lift out trip device.
6. Replace in reverse order.

POWER SUPPLY (Figure 15).

1. Remove magnetic trip wires from the terminal board on POWER SUPPLY
2. Remove four screws holding power supply to breaker frame.

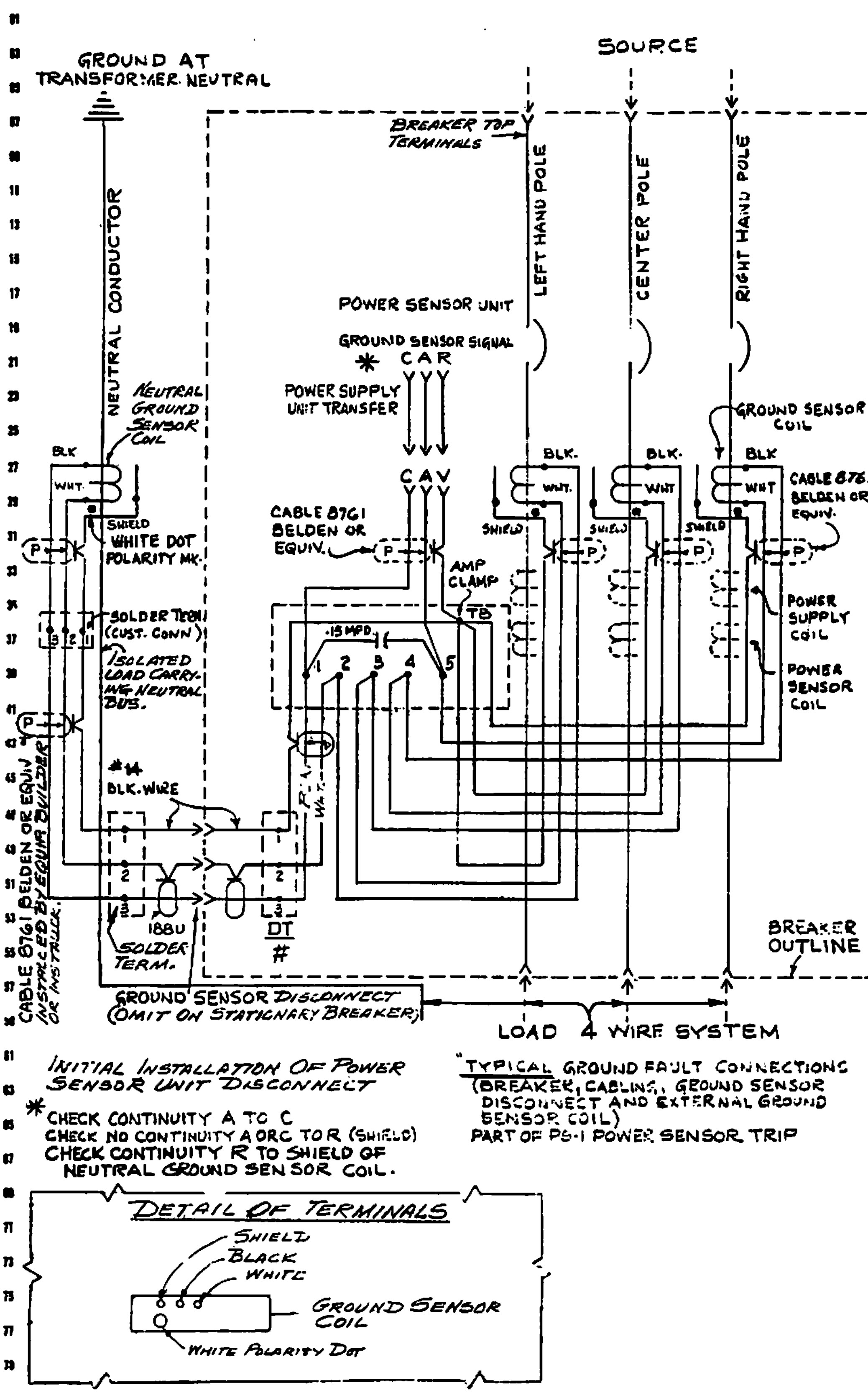


Figure 22. (138B2454) Ground Fault Wiring Diagram

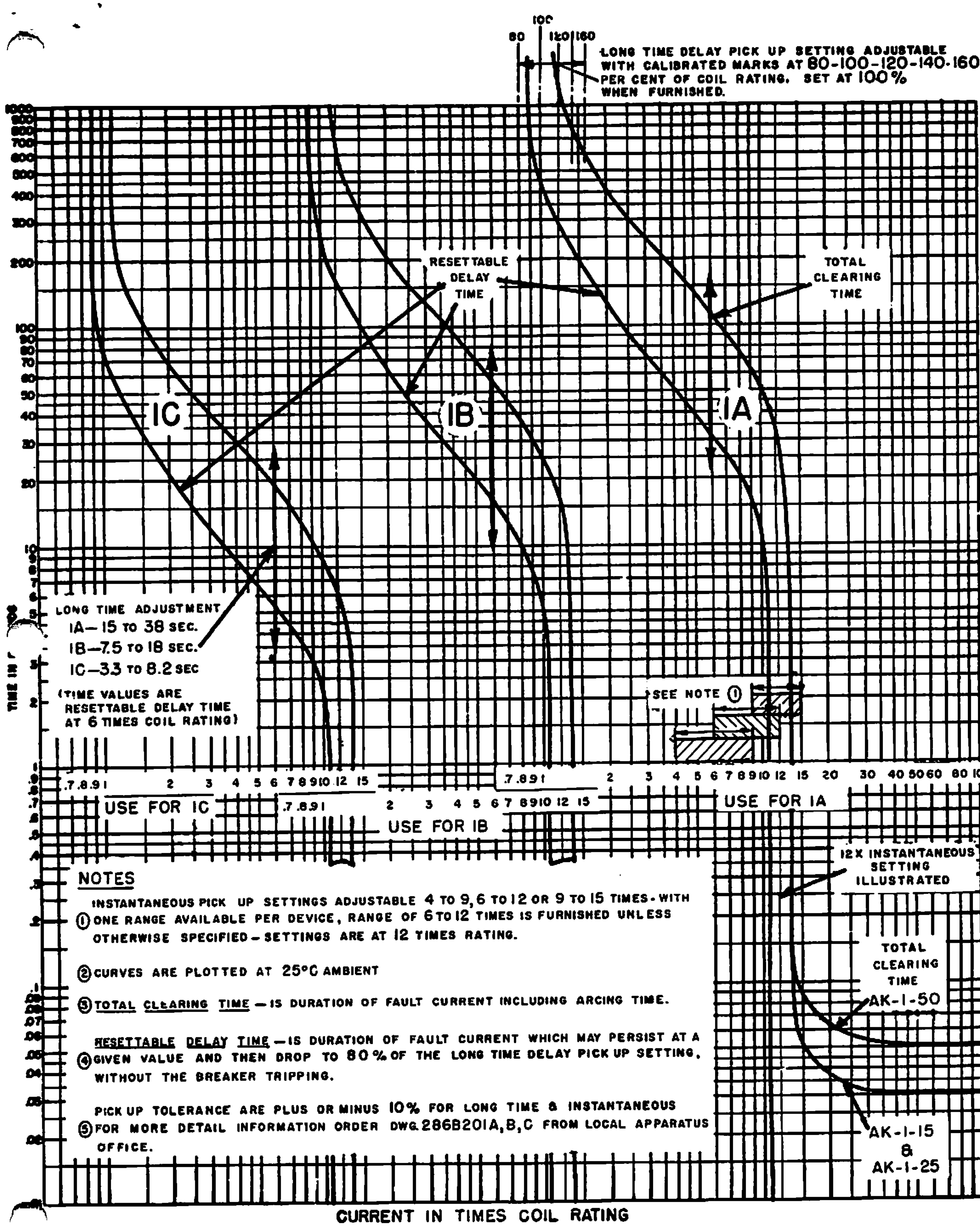


Figure 23. (286B209) Time-Current Characteristic - EC Devices

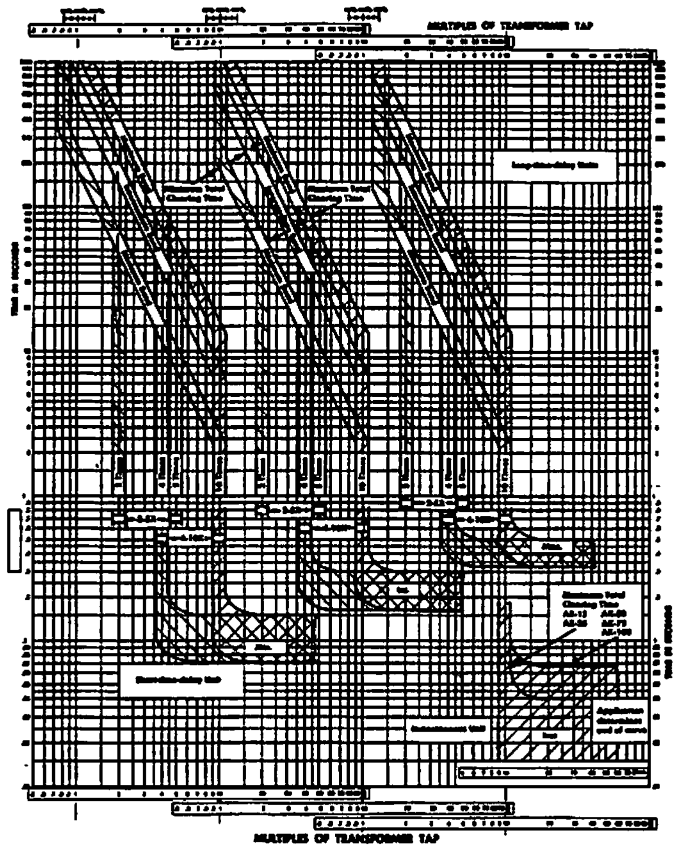


Figure 24. (109HL687) Time Curve

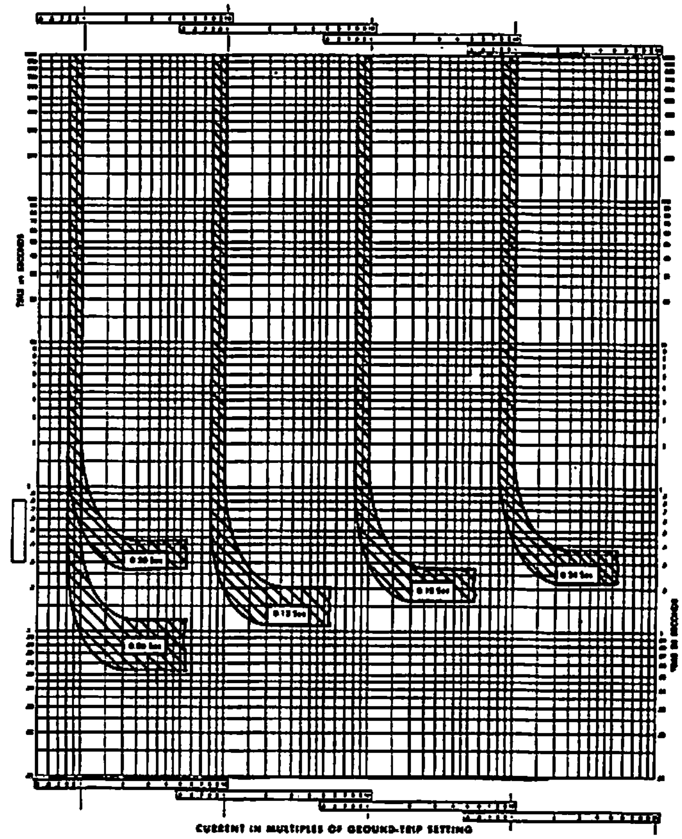


Figure 25. (109HL689) Time Curve

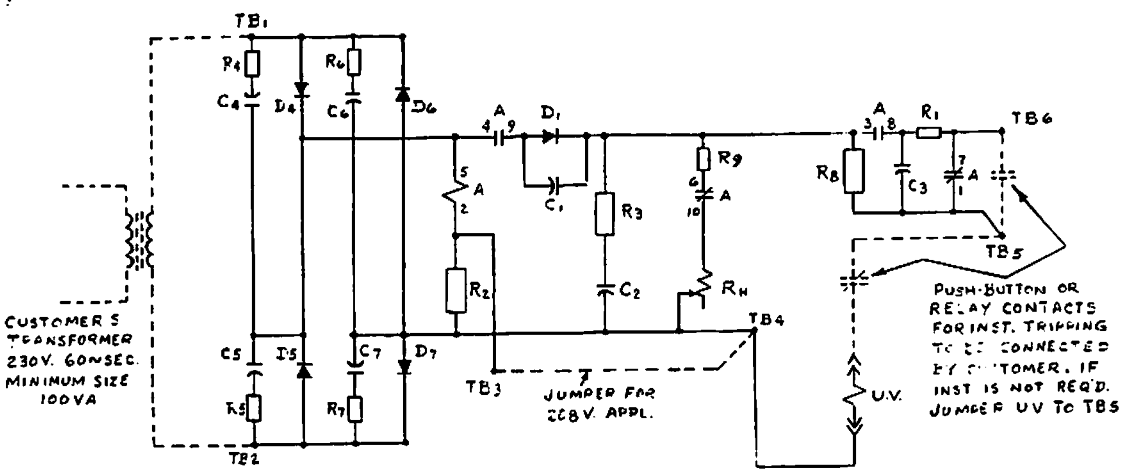
3. Remove four screws holding escutcheon to mechanism frame and remove escutcheon.
4. Disconnect control plug to power sensor coils and power sensor unit.
5. Remove cable clamps holding cabling in place.
6. Remove power supply unit with attached cabling.
7. Replace in reverse order.

SENSOR COILS (Figure 14).

1. Separate the breaker front and back frame as described in the section under "Maintenance".
2. Remove two screws holding sensor coil disconnect plug bracket to back frame.
3. Remove bolt holding resistor bracket to back frame.
4. Remove 2 screws holding capacitor bracket to back frame.
5. Unsolder three leads at ground disconnect and pull wire through hole in back frame. On stationary breakers with fourth wire ground disconnect, unsolder leads at external ground coil and pull wire through hole in back frame.
6. Remove primary disconnects per instructions under disconnects.
7. Remove three 3/8 hexagon headed bolt connecting coils to breaker copper.
8. With the back frame in the vertical position, and supported, grasp the outside coils and lift coil assembly from back frame. When carrying or moving sensor coil assembly, always support the outside coils.

SELECTIVE TRIPPING

Selective overcurrent tripping is the application of circuit breakers in series so that only the circuit breaker nearest the fault opens. Anyone or combination of two or more of the preceding over-current devices may be used in a selective system. The breaker having the shorter time setting and lower pickup will trip before the



A - 250V DC RELAY

C_1, C_4, C_5, C_6, C_7 - .10uf ±10% 600 WVDC

C_2 - 550uf 350 WVDC

C_3 - 1000 uf 200 WVDC

D_1, D_4, D_5, D_6, D_7 - IN560 - 600 ma @ 30°C

R_1 - 15 Ω 2W ±5%

R_2 - 1500 Ω 5W ±5%

R_3 - 75 Ω 5W ±5%

R_4, R_5, R_6, R_7 - 10 Ω ½W

R_8 - 2750 Ω 20W ±5%

R_H - 0-25,000 Ω 25 W

R_9 - 500 Ω 3W ±5%

breaker having the longer setting and higher pick-up, provided the fault is on the part of the line protected by the breaker having the lower setting.

For the exact characteristics and setting of each breaker in a selective system, reference should be made to a coordination chart for the particular system. (Figures 23, 24, and 25)

STATIC TIME DELAY UNDERVOLTAGE TRIPPING DEVICE

The Static Time Delay Undervoltage Tripping Device consists of an undervoltage device mounted on the breaker, a static time delay box mounted separately from the breaker and a control power transformer which is also mounted separately from the breaker when the reference voltage is other than DC., 208V AC or 230V AC. Refer to wiring diagram 0102C3698 (Figure 26).

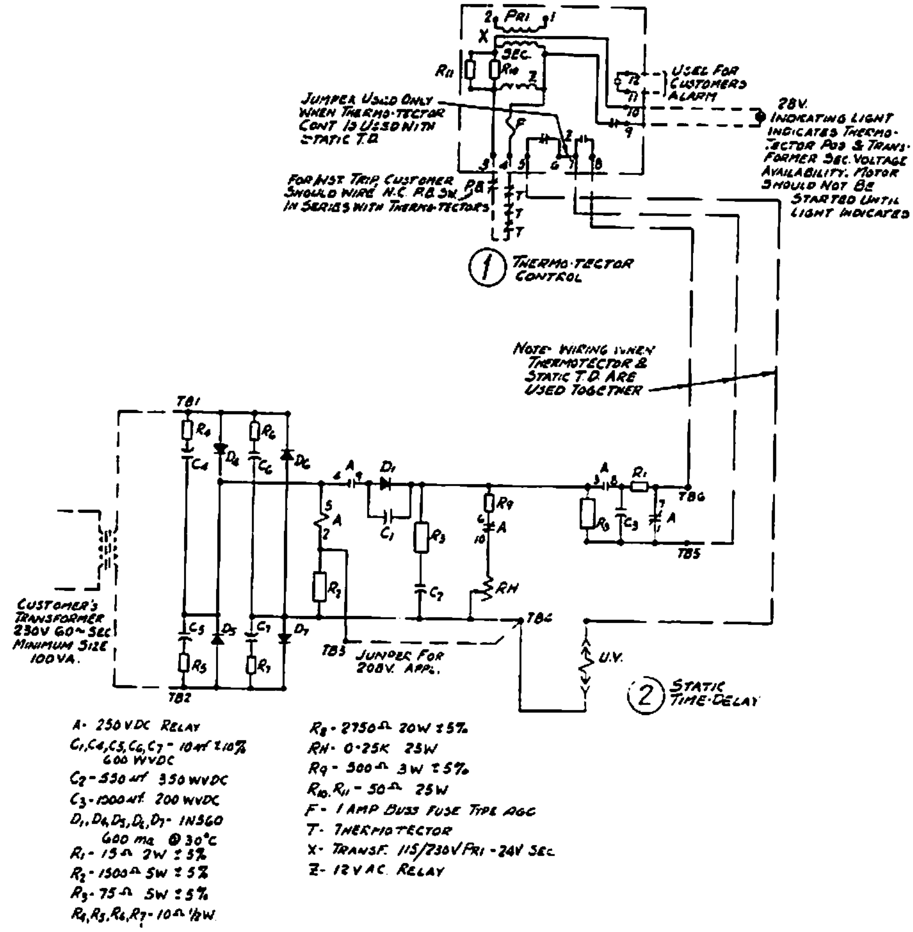
The voltage 208V AC or 230V AC, to be monitored is connected to terminals #1 and #2 of the time delay box. The undervoltage device on the breaker is always connected through either its secondary disconnects or terminal board, to terminals #4 and #5 of the time delay box.

The undervoltage device is set to pickup at approximately 80% of bus voltage and drop out between 30% and 60%.

The undervoltage device coil circuit is continuously rated and will remain picked up as long as the voltage remains above the predetermined drop out voltage. The time delay is field adjustable between 1 and 5 seconds, it is factory set at the minimum setting, and once the time delay is established, it is consistent.

No more than one undervoltage device should be connected to a static time delay box.

The Static Time Delay Undervoltage can also be furnished in conjunction with the termotector control package, as shown on wiring diagram 0102C3699 (Figure 27). Overheating of the motor windings causes the termotector, imbedded in the motor windings, to open and allow the "Z" relay of the control box to instantaneously trip the



breaker through a normally closed "Z" contact in series with the undervoltage device mounted on the breaker.

WARNING - Do not use bell set to check continuity of bridge circuit in static time delay box, only a volt-ohm meter or vacuum tube volt meter should be used.

In the event the device fails to pick-up, the following checks are recommended to determine whether the magnetic device on the breaker or the static time delay unit is the faulty component.

A. Check input voltages across terminals 1 & 2 on static box. These voltages should be as follows:

   1. Device 177L316 G-12-208 or 230 volts A.C.

   2. Device 177L316 G-14-125 volts D.C.

   3. Device 177L316 G-15-250 volts D.C.

B. Check output voltages on terminals 4 & 5 with the under voltage device connected. The approximate voltages are as follows:

   1. 208 Volt A.C. 177L316 G-12-110 volts D.C.

      230 Volt A.C. 177L316 G-12-120 volts D.C.

   2. 125 Volt D.C. 177L316 G-14 50 volts D.C.

   3. 250 Volt D.C. 177L316 G-15-100 volts D.C.

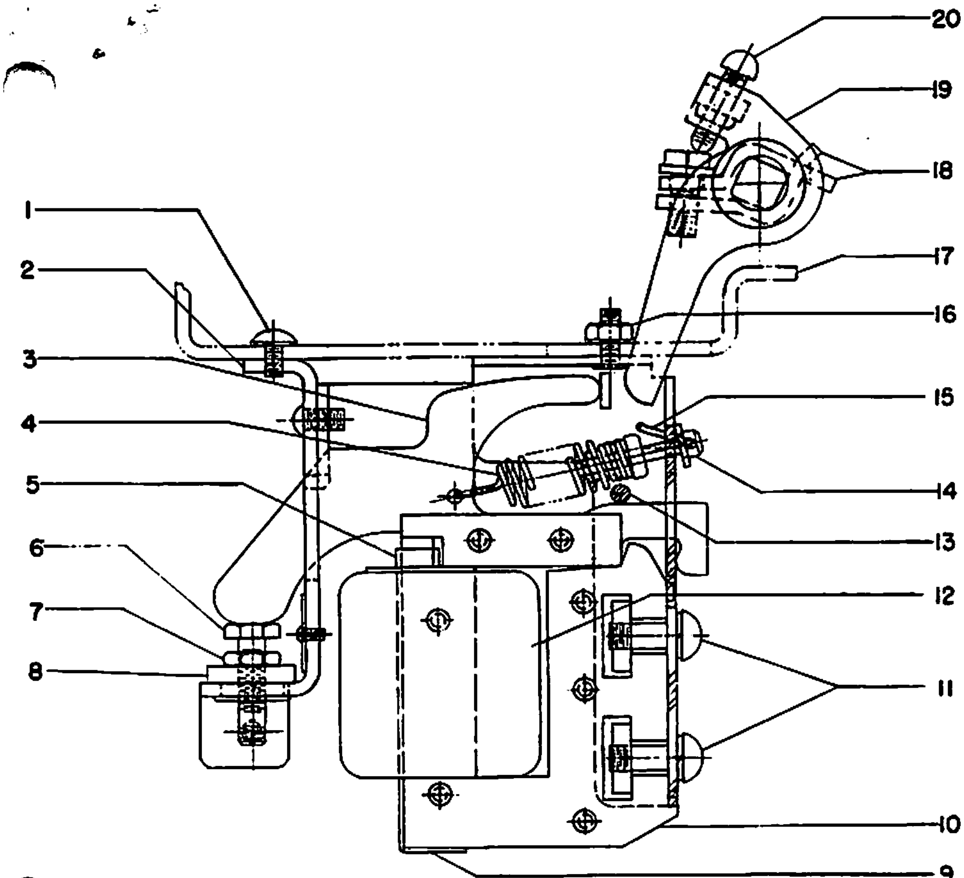
C. The resistance of the under-voltage coils are as follows:

   1. 6275080 G-59 - 1830 Ohms.

   2. 6275081 G-61 - 440 Ohms.

REPLACEMENT

The entire device may be dismounted by disconnecting the coil leads and removing screw (1) and nuts 16. Normally, only the coil (12) will ever need replacement. This may be removed from the device by taking out screws (11) which will free both the magnet (10) and the coil. Straight-



1. Mounting Screw
2. Frame
3. Armature
4. Spring
5. Shading Ring
6. Adjusting Screw
7. Locking Nut
8. Bushing
9. Clamp
10. Magnet
11. Screws
12. Coil
13. Rivet
14. Adjusting Screw
15. Locking Wire
16. Mounting Nut
17. Mechanism Frame
18. Trip Paddle Clamps
19. Trip Paddle
20. Adjusting Screw

Figure 28. (0152C9206) Undervoltage Tripping Device

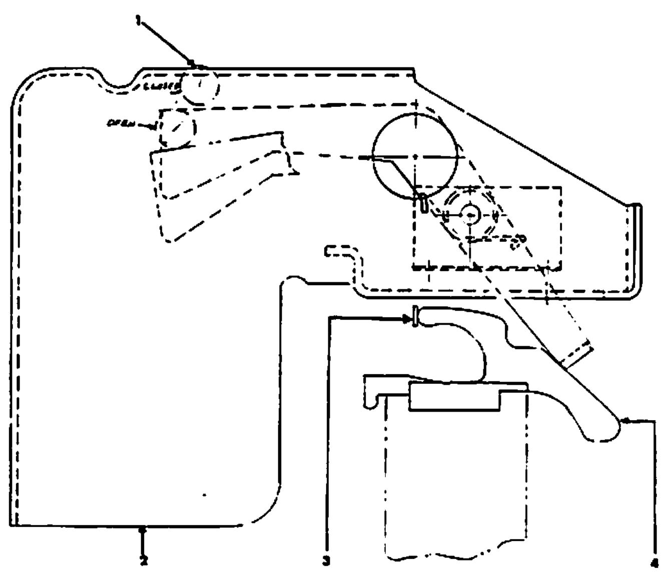


Figure 29. (0101C7842) Undervoltage Lockout Device

1. Cross Bar
2. Left Side Frame
3. Trip Paddle
4. Undervoltage Armature

ening of the bend in clamp (9) will separate the coil from the magnet. The coil leads, of course, must be disconnected.

INSTANTANEOUS UNDERVOLTAGE TRIPPING DEVICE

The instantaneous undervoltage device is mounted in the same location and manner as the static time-delay device and its construction is similar.

The adjustments and replacement of t is device are the same as those described above for the static time-delay undervoltage device.

UNDERVOLTAGE LOCKOUT DEVICE
(Figure 29)

The undervoltage lockout device holds an open breaker trip-free when the coil of the device is deenergized. When the breaker is in the closed position, linkage operated by the breaker mechanism cam positions itself to mechanically hold the undervoltage device armature in the closed air gap position to prevent tripping the breaker in the event the undervoltage device coil is deenergized. This feature when used in conjunction with normally-closed auxiliary contacts of an alternate breaker presents a convenient method of mechanically interlocking two or more breakers to assure that no two breakers may be closed at the same time.

BELL ALARM SWITCH AND/OR LOCKOUT ATTACHMENTS

(Figure 30)

The bell alarm device is mounted on top of the horizontal cross frame member just to the left of the mechanism frame when the breaker is viewed from the front. This device operates a switch with two sets of contacts, one normally open, the other normally closed. The switch may be used to open or close an external circuit, giving a bell or light indication of a protective trip device operation.

If the breaker is tripped open by any means other than the manual trip button or the shunt trip device, the bell alarm mechanism is activated. The alarm is shut off and the bell alarm and lockout mechanism is reset by operation of the manual trip button or shunt trip device. If the device is a bell alarm only, the bell alarm mechanism is also reset simply by closing the breaker.

OPERATION

Lever (2) is connected to the breaker mechanism so that when the breaker opens lever (2) rotates counterclockwise about pin (14). The motion is transmitted through links (1) and (13) to paddle (12) which operates bell alarm switch (11). If the device has the lockout feature, the movement of link (13) also causes lockout link (8) to slide in a direction that results in its striking trip paddle (5) which, by displacement of the breaker mechanism trip latch, makes it impossible to reset the breaker mechanism until the bell alarm mechanism is reset.

Link (6) serves as a latch in the bell alarm mechanism. If it is displaced, link (10) is free to rotate about its lower pin. This deprives the linkage of its normally fixed center of rotation about pin (15) and defeats both the bell alarm and the lockout operation. Operation of either the manual trip button or the shunt trip device will displace latch (6) and have this effect. Thus if the breaker is tripped by either of these means, the bell alarm and/or lockout will not operate. Also, operation of either of these devices will reset the switch and inactivate the lockout.

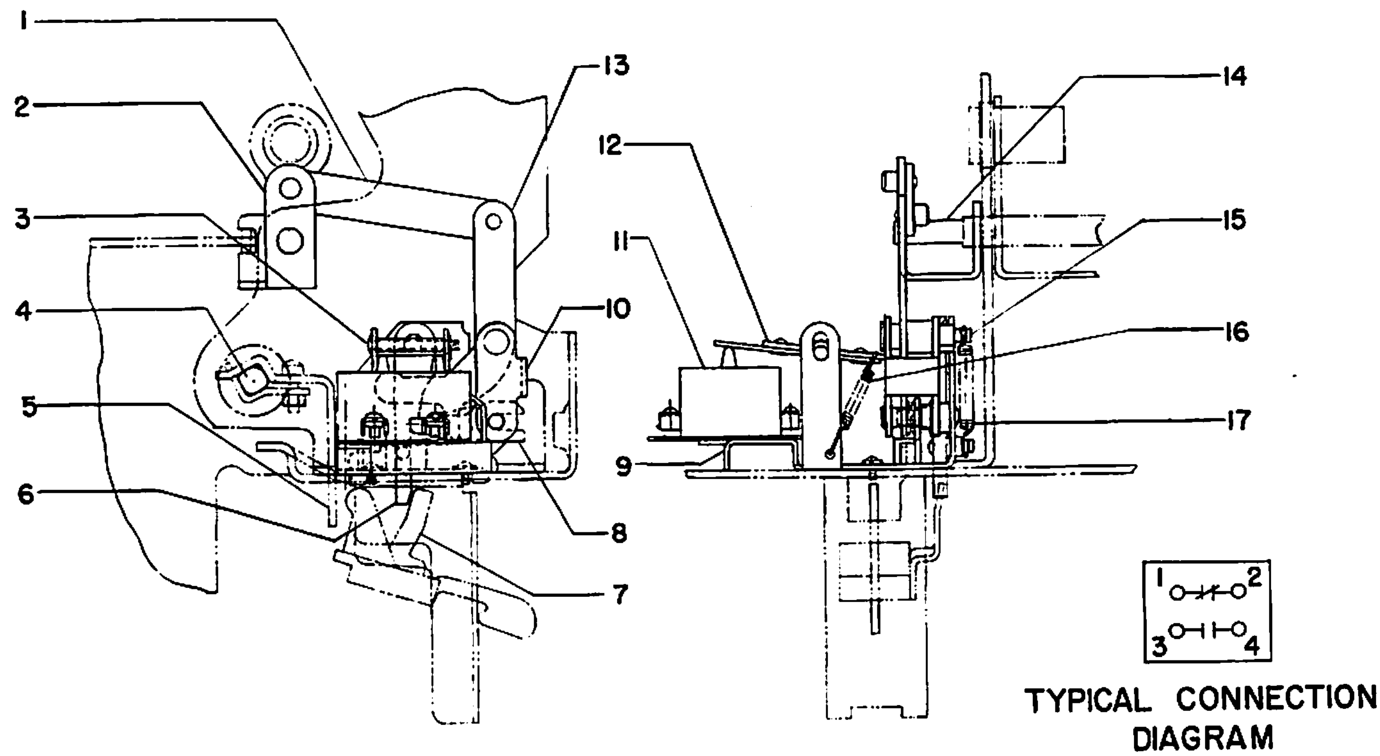


Figure 30. (695C158) Bell Alarm and Lockout Device

1. Link
2. Lever
3. Pin
4. Trip Shaft
5. Trip Paddle
6. Link
7. Trip Arm
8. Lockout Link
9. Frame
10. Link
11. Switch
12. Paddle
13. Link
14. Pin
15. Pin
16. Springs
17. Spring

OPEN FUSE LOCKOUT DEVICE
(Figure 31)

The Open Fuse Lockout Device consists of two or three separately operated devices (one per phase). Each wired in parallel to corresponding breaker fuses. This device is furnished on all AKU breakers. The purpose of this device is to trip the breaker upon the blowing of any one of the breaker fuses and render the breaker trip free until the blown fuse is replaced and the associated coil assembly reset.

OPERATION, Figure 31.

When any one of the breaker fuses blow, the coil (6) in that phase is energized and the armature (5) closes. With the armature closed, leaver (2) slips under the armature and latches it in the closed position. The latched closed armature holds the breaker in the trip free position until it is released by pushing the associated reset button (1). The coil is deenergized as soon as the breaker opens.

ADJUSTMENTS

1. Set top cylindrical collor (not shown) to engage the trip shaft paddle in the tripped position.
2. Check that each armature holds the breaker trip free when the armature position is limited in reset by the lower latch surface on the indicator.
3. With the breaker in the closed position, the top collor must clear the trip shaft paddle by more than 1/32 inch.

REPLACEMENT

1. Remove three mounting screws at top of device.
2. Remove coil leads from fuses and work wire harness back to the device. Remove device from breaker.
3. Replace new unit in reverse order and check procedure under ADJUSTMENTS.

AKD-5 INTERLOCK
(Figure 32)

The rackout mechanism is interlocked so that the circuit breaker must be open before the operating handle can be inserted. When the breaker is closed, the interlock link (1) operated by the breaker cross bar blocks the interlock linkage on the rackout mechanism.

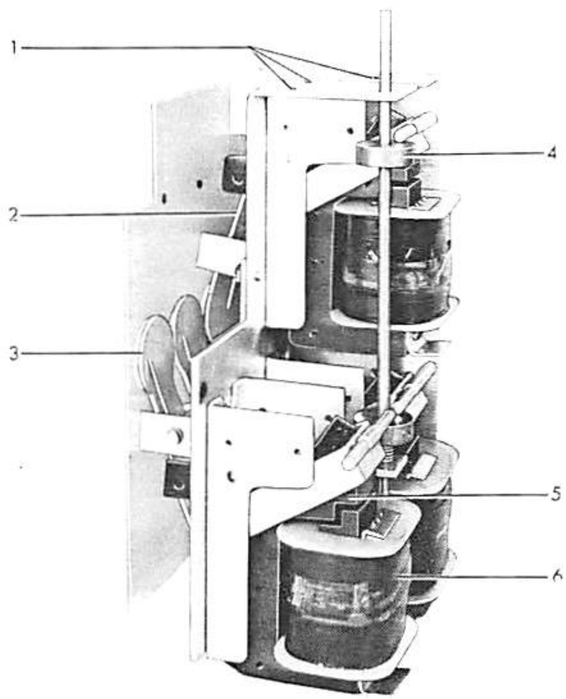


Figure 31. (8041865) Open Fuse Lockout Device

1. Mounting Holes
2. Lever
3. Reset Button
4. Collor
5. Armature
6. Coil

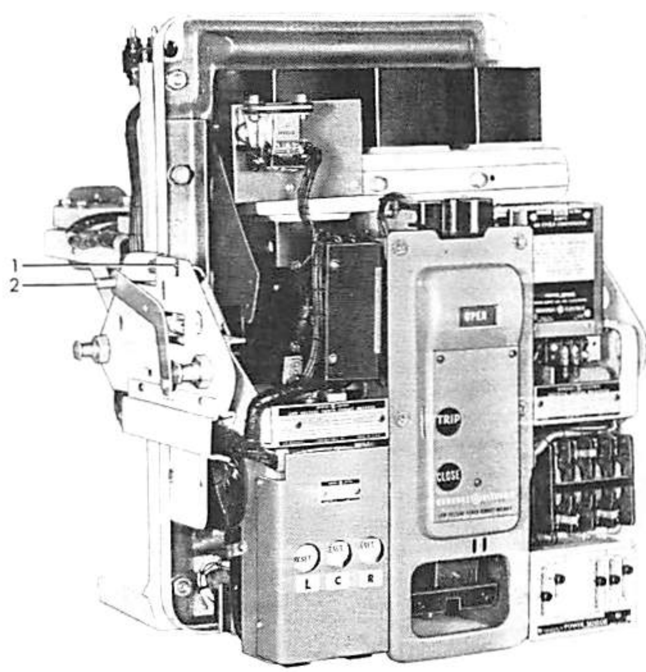


Figure 32. (8039852) AKD-5 Interlock

1. Rackout Mechanism Interlock
2. Trip Interlock

MISCELLANEOUS

Changes in breaker requirements may occasionally bring about the necessity of adding or changing breaker components or accessories in the field. The AK-2 breaker has been designed so that such additions or conversions are simple and easy to make, requiring only a minimum of time or skill on the part of the operator.

Special instructional drawings are available which will further simplfy the addition of such accessories to breakers which were originally shipped without them.

These drawings will accompany the necessary material when it is shipped from the factory. They will also be available upon request. The drawings and the accessory additions which they cover are listed below.

When an accessory is added to a breaker, it is recommended that the section of instructions contained herein covering that particular accessory be reviewed, in addition to referring to the following instructional drawing. Any adjustments described in these instructions should be carefully made after the device has been assembled on the breaker.

Conversion of breakers from manual to electrical operation is also covered on an instructional drawing. This operation consists simply of separation of the front and back frames of the breaker as described under "Maintenance" in these instructions and the reassembly of the existing back frame with the new front frame.

Addition of	Covered By
Shunt Trip Device	698C900
Auxiliary Switch	698C901
Undervoltage Device	698C902
Bell Alarm & Lockout Device	698C904
Drawout Mechanism	698C922
Conversion to Elec. Oper.	698C904

MAINTENANCE TOOLS

The following tools are recommended for proper maintenance of AK-2-15 and AK-2/3-25 breakers. (NOTE: Obtain from local hardware firm; do not order on General Electric Company.)

Screw Drivers

Long thin, slotted screw
Standard, slotted screw
Phillips, No. 2, (8" shaft)

Pliers

Waldes Truarc, No. 2 straight
Long Nose, side cutting, 6"

End Wrenches

Adjustable, 8"
1/4" open end

Allen Head Wrenches

5/16" for 3/8" screw
1/8" for 1/4" screw

Socket Wrenches (3/8" drive)

Ratchet Handle
12" extension bar
3/8" socket
9/16" socket
7/16" socket (long)

Miscellaneous Tools

1/4" Spintite (long shank)
7/16" Spintite
8/32 screw (at least 2" long)

RENEWAL PARTS

When ordering renewal parts, address the nearest Sales Office of the General Electric Company, specifying the quantity required. Complete nameplate data of the breaker involved should be given as well as an accurate description of the parts required. If the parts needed are illustrated in this book, refer to the figure number and part number involved.

Renewal Parts which are furnished may not be identical to the original parts since from time to time design changes may be made. The parts supplied, however, will be interchangeable with the original parts.

Renewal Parts Bulletin

Bulletin	Breaker Type
GEF-4149F	AK-2-15/25 AK-3-25

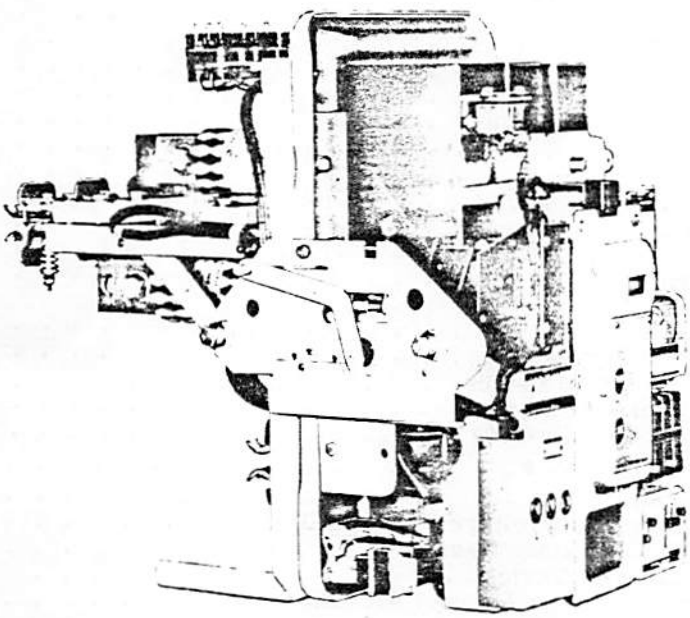
GEI-50299D
INCLUDES SUPPLEMENT GEI-93863A

INSTRUCTIONS

POWER CIRCUIT BREAKERS

TYPES

AK-2/2A-15 AK-2/3/2A/3A-25 AKU-2/3/2A/3A-25



GENERAL ELECTRIC

CONTENTS

POWER CIRCUIT BREAKERS

Types AK-2-15 and AK-2/3-25

INTRODUCTION

The instructions contained herein provide information for performing maintenance procedures and for replacing AK-2/3-15/25 breaker components and accessories. For information regarding the receiving, handling, storage and installation of these breakers, refer to GEK-7302 furnished with all AK breakers.

OPERATION

ELECTRICAL OPERATION
Figure 1

The electrically operated breaker closes whenever the closing solenoid coil is energized. This causes an upward movement of the solenoid armature, which initiates the mechanical closing action. The closing signal may be given either by a remote switch or relay, or by a closing button in the front escutcheon if the breaker is so equipped. Either action (refer to the elementary of the wiring diagram) energizes the coil of the X relay through the bb contacts of cutoff switch G and the normally closed contacts of the Y relay. When the X relay or contactor is energized, it closes its contacts. One of these (X1-2) seals in the X coil. The other three sets of contacts, which are arranged in series, activate the closing solenoid.

The breaker control scheme has an anti-pump feature which allows only one closure of the breaker for a single operation of the closing switch no matter how long the switch may be held closed. This prevents the repeated operations that would ensue if one of the automatic trip devices was activated at the time of closing. The Y relay, together with the cut-off switch, provides the anti-pump feature. The mechanical action of closing operates the cut-off switch, reversing the position of the contacts from that shown on the diagram. This energizes the Y relay, if contact is still maintained at the closing switch, with the result that the X relay circuit is opened by Y contacts 5-6. This prevents the X relay from again becoming energized. Y contact 1-2 seals in the Y coil as long as contact is maintained at the closing switch.

Electrically operated breakers may also be closed by means of the maintenance handle which is furnished with the breaker. This is a separate tool and is simply a lever which permits an operator to push upwards on the closing solenoid armature. Two small hooks on one end of maintenance handle are engaged in slots (9A) Figure 5, located in the lower portion of the front escutcheon (8A) Figure 5. Rotation of the long end of the handle downwards forces the shorter end of the handle upwards against the bottom of the solenoid armature, and closes the breaker.

The breaker may be tripped open by any one of a number of electrical tripping devices which will be described in detail later in these instructions. An individual breaker may have none or any combination of these devices. They are the overcurrent tripping device, shunt tripping device, undervoltage tripping device, reverse current tripping device, and open fuse lockout device. All of them effect tripping by displacing the trip latch of the mechanism. The trip latch is rigidly attached to a trip shaft which runs through the breaker from left to right. Whenever the trip shaft is rotated in a counterclockwise direction looking from the right, the latch is displaced. The tripping devices are all equipped with strikers or trip arms which act against trip paddles rigidly fastened to the trip shaft, causing it to r on its bearings in a direction to trip the bre

The reverse current device and the shunt tripping device each have a set of auxiliary switch "a" contacts in their circuits. (An "a" contact is open when the breaker contacts are open.) This prevents their operation unless the breaker is closed.

The undervoltage device coil is normally continually energized. When the control voltage is low or non-existent, as when the breaker has been pulled out for inspection or maintenance, the breaker is rendered trip-free by the undervoltage device. If it is desired to close the breaker, the device armature must be tied down or blocked closed against the magnet. The open fuse lockout device is used on all AKU breakers and breaker fuse combinations. The purpose of this device is to trip the breaker upon the blowing of any one of the breaker fuses.

MANUAL OPERATION

The manually operated breaker is closed by first rotating the handle in a counterclockwise direction through 90 degrees, then rotating it clockwise back to its normal vertical position. The counterclockwise stroke resets the mechanism, readying it for the clockwise closing stroke.

The breaker may be tripped manually by pushing the manual trip button. This action pushes

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.

a rod against a trip paddle of the trip shaft, rotating it, and causing the mechanism trip latch to be displaced. This allows the mechanism linkage to collapse through the action of the mechanism operating springs.

CAUTION: If the breaker is tripped manually while the operating handle is in the reset position, the handle should be lowered by the right hand while operating the trip button with the left hand.

ELECTRICAL WITH MANUAL OPERATION

This operating mechanism provides both manual and electrical closing. The operating mechanism is similar to the mechanism of the standard electrical breaker with the addition of the manual handle, cam and mechanism connecting link. The solenoid connecting link and manual cam connecting link are both connected to the closing spring pin at the top of the mechanism, thus compressing the springs when force is provided by either means of breaker closing.

The breaker is manually closed by rotating the closing handle 90 degrees counterclockwise. No reset stroke is necessary as is the case with the standard manual breaker. Electrical closing may be performed either locally or remotely in the same manner as the standard electrical breaker.

Tripping is accomplished by the manual trip button on the escutcheon or by any of the electrical tripping devices available for use on the standard breakers.

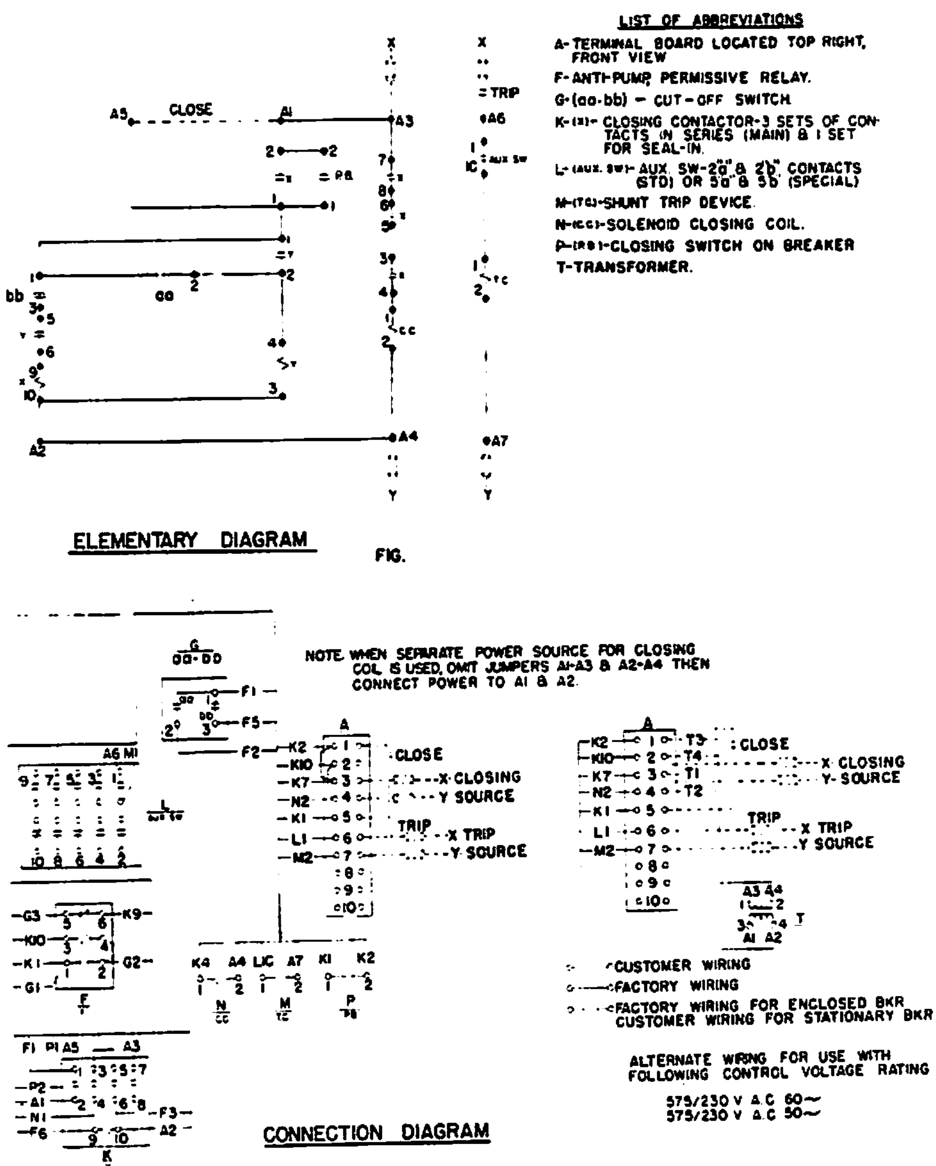


Figure 1. (695C160-1) & (695C159-1) Typical Wiring Diagram

MAINTENANCE

INSPECTION

BEFORE INSPECTION OR ANY MAINTENANCE WORK IS DONE, BE SURE THAT THE BREAKER IS IN THE OPEN POSITION. ALL ELECTRICAL POWER, BOTH PRIMARY AND CONTROL SOURCES, SHOULD ALSO BE DISCONNECTED.

Periodic inspection of the circuit breaker is recommended at least once a year. More frequent inspections are recommended, if severe load conditions, dust, moisture, or other unfavorable conditions exist.

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.

At all times it is important not to permit pencil lines, paint, oil or other foreign materials to remain on the insulating surfaces of the breaker as they may cause low resistance between points of different potential and result in eventual electrical breakdown.

Always inspect the breaker after a short circuit current has been interrupted.

At the time of periodic inspection, the following checks should be made after the breaker has been de-energized.

1. Manually operate the breaker several times checking for obstructions or excessive friction.
2. Electrically operate the breaker several times (if breaker has electrical control) to ascertain whether the electrical attachments are functioning properly.
3. Remove and inspect the arc quencher. Breakage of parts or extensive burning will indicate need for replacement.
4. Check contact condition and wipe
5. Check latch engagement.
6. Check operation of tripping devices, including overcurrent trip devices, making sure all have positive tripping action. (Discernible movement in tripping direction beyond point of tripping.)

(For detailed information on breaker features listed, refer to appropriate sections of these instructions.)

SEPARATION OF FRONT AND BACK FRAMES

Figure 3

Many maintenance operations will either require or be greatly facilitated by separating the front frame and mechanism of the breaker from the back frame or base, which consists of the current carrying parts of the breaker and their supporting structure. The procedure for this operation is as follows:

1. Remove the arc quenchers (see section on "Arc Quenchers").
2. Disconnect the two insulated connecting links (6), between the mechanism and the crossbar (10), by removing the tie bolt (7), and slipping the ends of the links off the ends of the shouldered pin, (5) Figure 5 in the mechanism.
3. If the breaker is a drawout type, with secondary disconnects, Figure 2, remove the secondary disconnect supporting bracket from the breaker back frame. Also remove any wiring bundle retainers that may be attached to the back frame.
4. Remove one elastic stop nut from each of two studs (3), which tie the upper ends of the mechanism frame to the back frame of the breaker.
5. Remove the two elastic stop nuts (9/16" Hex.) which fasten the wrap around portion of the front frame to the back frame. One of these is located on each side of the breaker, about 2/3 of the distance down from the top edge of the back frame.

   On drawout breakers for AKD Equipment, the bottom plate must be removed by first removing two #8-36 screws located at the front of the bottom plate and then freeing the plate from the slots located in the bottom of the back frame.

6. The two frames are now disconnected. However, care should be exercised in separating them to avoid damage to the trip shaft arms and paddles. While the back frame is held steady, lift the front frame and mechanism up and out so that the trip paddles on the trip shaft clear the trip arms of the overload trip devices.

   Reassembly of the two breaker halves is accomplished by following the procedure outlined in reverse order.

LUBRICATION

In general, the circuit breaker requires very little lubrication. Bearing points and sliding surfaces should be lubricated very lightly at the regular inspection periods with a thin film of extreme temperature, high pressure, light grease, similar to G.E. Spect. No. D50H15 or RPM No. 5. Hardened grease and dirt should be removed from latch and bearing surfaces by the use of a safe cleaning solvent such as kerosene. Latch surfaces should be left clean and dry and not be lubricated.

ALL EXCESS LUBRICANT SHOULD BE REMOVED WITH A CLEAN CLOTH IN ORDER TO AVOID ANY ACCUMULATION OF DIRT OR DUST.

At each maintenance period, all silver to silver friction points, such as primary disconnects, should be cleaned and given a fresh coat of G.E. Spec. No. D50H47 lubricant.

TROUBLESHOOTING

The following table lists several typical symptoms of breaker malfunction, together with their causes and remedies. If, at any time, these symptoms are observed, their cause should be determined and the necessary corrective action should be taken.

TROUBLE	CAUSE	REMEDY
Overheating AK-2/3 Breakers	Contacts not aligned	Adjust contacts.
	Contacts dirty, greasy or coated with dark film	Clean contacts
	Contacts badly burned or pitted	Replace contacts
	Current carrying surfaces dirty	Clean surfaces of current carrying parts
	Corrosive atmosphere	Relocate or provide adequate enclosure
	Insufficient bus or cable capacity	Increase capacity of bus or cable
	Bolts and nuts at terminal connections not tight	Tighten, but do not exceed elastic limit of bolts or fittings.
	Current in excess of breaker rating	Check breaker application or modify circuit by decreasing load
	Excessive ambient temperature	Provide adequate ventilation
Failure to trip AK-2 Breakers	Travel of tripping device does not provide positive release of tripping latch	Re-adjust or replace tripping device and check mechanism latch adjustment
	Worn or damaged trip unit parts	Replace trip unit
	Bind in overcurrent trip device	Replace overcurrent trip device
False Tripping AK-2 Breakers	Overcurrent trip device pick up too low	Check application of overcurrent trip device
	Overcurrent trip device time setting too short	Check application of overcurrent trip device
	Bind in overcurrent trip device	Replace overcurrent trip device
Failure to Close and Latch AK-2/3 Breakers	Binding in attachments preventing resetting of latch	Re-align and adjust attachments
	Latch out of adjustment	Adjust latch
	Latch return spring too weak or broken	Replace spring
	Hardened or gummy lubricant	Clean bearing and latch surfaces
	Closing solenoid burned out	Replace solenoid coil
	Solenoid control device not functioning properly	Re-adjust or replace device
False Tripping AK-3 Breakers	Captive Thump screw on Power Sensor loose fail-safe circuitry reverts characteristic to minimum setting and maximum time delay	Tighten thumb screw on desired setting
	Tap setting dial on Power Supply incorrectly set	Set dial to correspond with Power Sensor coil tap
	External Ground Sensor Coil improperly connected	Refer to Figure 22, page 29 for polarity and connections. Check continuity of shield and conductors connecting the external Ground Sensor coil.
Failure to Trip AK-3 Breakers	Loose or disconnected power sensor disconnect plugs	Tighten or reconnect disconnect plugs
	Loose or broken power sensor coil tap connections	Tighten or reconnect tap connections

BASIC BREAKER COMPONENTS

DISCONNECTS

PRIMARY DISCONNECTS

The primary disconnects are attached to the ends of the breaker studs on the rear side of the breaker base. Each disconnect assembly consists of two pair of opposed contact fingers. These are secured to the breaker stud by a bolt which passes through the assembly and the stud. When engaged with the stationary stud of the enclosure, the disconnect fingers exert a set amount of force against the stationary stud through the action of the compression springs. Retainers and spacers hold the contact fingers in correct alignment for engagement with the stud. The amount of force which the fingers exert against the stud is determined by degree to which the springs are compressed by the bolt and nut which hold the assembly together. This pressure is factory set between 60 and 70 pounds. If, for any reason, the disconnects must be taken apart, the position of the nut on the bolt should be carefully noted, so that in reassemblying, the original amount of compression can be restored by replacing the nut at its former position on the bolt.

SECONDARY DISCONNECT, FIGURE 2.

The secondary disconnects serve as connections between breaker control circuit elements and external control circuits. They are used only on drawout type breakers. A terminal board serves the same purpose on stationary mounted and general purpose enclosure mounted breakers. The secondary disconnects allow removal of the breaker without the necessity of having to detach external connections.

The movable part of the secondary disconnect consists of an insulating body which holds a conducting spring loaded plunger to which a flexible lead is attached. As the breaker moves into its enclosure, the plunger is depressed by sliding onto the stationary disconnects of the enclosure.

REPLACEMENT OF MOVABLE SECONDARY DISCONNECTS

1. Unfasten disconnect body from breaker back frame.
2. Open tabs which hold wires on inner side.
3. Pull contact tip loose from hollow tube.
4. Remove contact tip by cutting wire at its base.
5. Push wire through hollow tube of new disconnect assembly.
6. Strip insulation off end of wire to about 1/4 of an inch from end.
7. Place new contact tip on end of wire and crimp.
8. Pull wire through hollow tube until contact tip fits snugly against end of hollow tube.
9. Crimp tab on other side of assembly to hold wire in place.
10. Any hollow tubes which are not used should be pushed into the disconnect body and held in that position by placing fibre spacers over inner ends of tubes and spreading tabs.

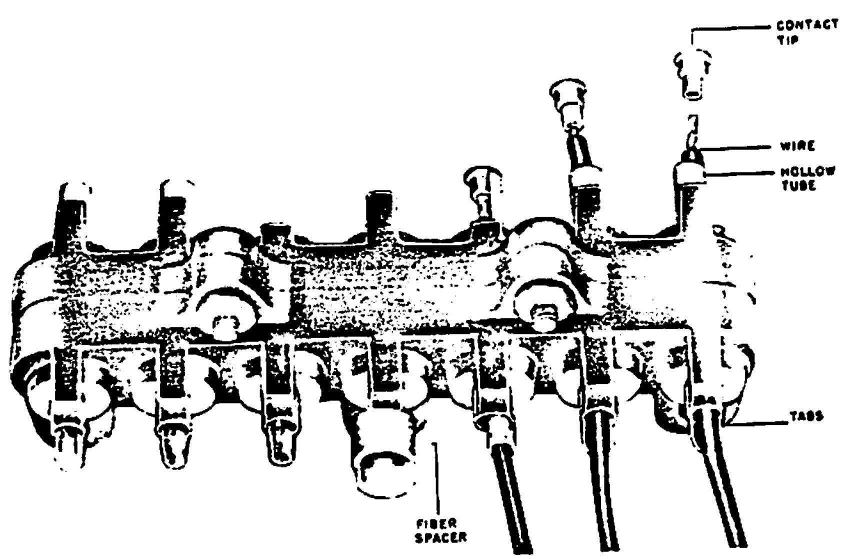


Figure 2. (8017973) Movable Secondary Disconnects

11. When all wires have been connected, refasten the body of the assembly to the breaker back frame.

ARC QUENCHER

The arc quencher is an integral riveted assembly composed of two ceramic side plates, a series of steel plates, and a muffler. The assembly is covered by a wrap around of insulating material which inhibits any sidewise emission of gases. The steel plates are held in position and supported by the ceramic sides which are grooved vertically to provide recesses for the vertical edges of the steel plates. The bottom edges of the latter form an inverted "V" along the path of the arc that may be drawn between the breaker contacts during interruption. The steel plates have the effect of breaking up the arc, and cooling it and the gases that result from interruption. The entire assembly provides a "chimney" effect which directs the hot, ionized gases upwards through the steel plates and mufflers and allows their safe and controlled escape at a cooler temperature.

The muffler at the top of the assembly is a serpentine shaped strip of perforated, copper plated steel. It is important that the perforations of the muffler be kept open, since their closure could tend to prevent the escape of the gases along the desired path. At the regular maintenance inspection, it would be well to check their condition and open any of the perforations that appear to be clogged.

If any very extensive burning or corrosion is noted in the arc quencher, it should be replaced. Replacement is also indicated if any breaks or cracks are noted in the ceramic material.

REPLACEMENT

Removal of the arc quencher is simply a matter of lifting the assembly up and out, after the steel retainer across the front of the arc quenchers has been removed. The upper edge of the steel arc runner, fastened to the back plate of the breaker, fits into a recess in the back portion of the arc quencher which locates it in its proper position upon replacement. Make sure the steel retainer is replaced and fastened firmly to its mounting studs after the arc quenchers have been replaced.

BREAKER CONTACT STRUCTURE

The copper current carrying parts of the breaker are all mounted on a common base of insulating material made of polyester glass mat. The copper of each pole consist of an upper stud and pivot, stationary contacts, two movable contact arms, a movable contact pivot, and the lower stud.

The upper stud branches into two pivot surfaces on its inner end on the forward or front side of the breaker base. Each of these convex pivot surfaces mates with the concave pivot surface on the rear side of the stationary contacts. Each of the stationary contacts pivot in a horizontal plane approximately at their mid-points. The end of the contact opposite to the contact tip end is formed into the shape of a small hook. A tension spring engages this hook and provides the necessary contact pressure at the pivot and also at the point of contact with the movable contact arm. When the breaker contacts open, a projection on the contact tip end of the stationary contact bears against a stop pin restricting the movement of the stationary contact. This arrangement results in a continual high force existing between the mating pivot surfaces.

The movable contact arms pivot in a vertical plane, each making contact with a pair of stationary contacts, and thus providing four low resistant parallel paths of current for each breaker pole. The movable contacts rotate about a burnished, silver plated, copper pin which, in turn, is held by a pivot support. Each side of the pivot support bears against the lower, outer surface of the contact arm and supplies a second low resistance path through the pivot. A "U" shaped spring clip made of silver plated conducting material provides an additional current path and protects the other contact surfaces of the pivot against pitting when in motion. It also contributes to the force tending to increase the contact pressure between the lower ends of the movable contacts and the pivot support.

The movable contact pivot support is mounted securely to the breaker base. If, as is normally the case, the pole is equipped with an overcurrent trip device, one of the terminals of the series coil of the trip unit is fastened to the lower end of the pivot support. The other terminal of the coil fastens to the lower stud.

CONTACT ADJUSTMENTS

The only adjustment to be made on the breaker contacts is that of contact wipe. This may be described as the distance the movable and stationary move while they are touching one another in the process of breaker closing. The amount of contact wipe can be measured by comparing the position of the front surface of the stationary contact when the breaker is open to its position when the breaker is closed, in reference to some absolutely stationary part of the breaker. The most convenient stationary part of the breaker to use as a reference point is the steel arc runner above and behind the stationary contacts.

The amount of wipe the contacts should have is nominally 1/8 of an inch. A plus or minus tolerance of 1/32 of an inch is allowed.

The means of adjusting contact wipe is provided by an eccentric pin which passes through the center of the movable contact assembly. Each end of this pin has a free, projecting, hexagon shaped section which is easily accessible to a small, open end, 1/4 inch wrench. Two cantilever springs, which bear on each end against a portion of the hexagon section of the pin, lock the adjusting pin in place and provide index stops for the process of adjustment. The right hand hexagon shaped end of the pin is numbered from 1 to 6, which provides a reference for making wipe adjustments.

When contacts are to be adjusted, the recommended procedure is as follows:

1. With the breaker in the open position and using the numbers on the right end of each adjusting pin as a reference, set each pin in the same position. In many cases, the number 3 is a good beginning point. The proper view of the number on the adjusting pin is obtained by viewing the breaker from the front and the adjusting pin from approximately a 15 degree angle with respect to the movable contacts. Note that the numbers on the pin are not in numerical sequence as the pin is rotated.

2. By measurement, establish the position of the front surfaces of the stationary contacts with reference to the steel arc runners above and behind the contacts.

3. Close the breaker, and establish the amount of wipe by again measuring as in step two, and comparing the measurements with those taken with the breaker open.

4. If any set of contacts lead or lag the others, open the breaker and advance or retard the adjusting pin to the next higher or lower number. Moving the adjusting pin to a higher number will increase the contact wipe and moving to a lower number will decrease the contact wipe.

   NOTE: No attempt should be made to move the adjusting pin when the breaker is closed. Besides being more difficult, the additional force required to move the pin will tend to round off the flats of the hex section of the pin.

5. When all the contacts have the recommended wipe of 3/32 to 5/32 of an inch, the contact adjustments are complete.

CONTACT REPLACEMENT
Figure 3

The normal situation that will exist in the matter of contact replacement will call for replacement of all the movable and stationary contacts at the same time. This will be the case

where long use of the breaker in service has resulted in extensive wear or erosion of the silver alloy contact tips. A commonly used "rule of thumb" is that contact replacement is indicated if less than one-half of the original thickness (1/8 of an inch) of the contact tip material remains.

GENERAL PREPARATION

1. Remove arc quencher retainer (1), Figure 5 by loosening the two captured nuts with a 7/16" wrench.

2. Lift off the three arc quenchers.

3. Remove the U shaped insulation (5) Figure 3 from each pole by lifting it and disengaging the rivet heads thru the keyholed slots in the insulation.

4. As an aid to future reassembly of the movable contacts, note the position of all stationary insulation barriers with respect to barriers mounted on the cross bar.

REMOVAL OF MOVABLE CONTACTS (18) Figure 3.

1. Screw the threaded end of the steel rod lightly into pivot pin (11) on the right pole.

2. With a pair of long nosed pliers, unhook safety pin type spring clip (9) and extract pin (11) and remove spring clip (9).

3. Grasp movable contact assembly and remove it from its seat on the cross bar.

4. Repeat procedure 1, 2, and 3 above on the left pole.

5. Move the cross bar downward to disengage it from the contact wipe adjusting pin (15) on the center pole, then move the cross bar toward the front of the breaker.

6. Remove the split pin retaining the center pole pivot pin.

7. Remove the pivot pin and movable contact assembly.

REMOVAL OF STATIONARY CONTACTS (21) Figure 3.

1. Slip the blade of a heavy screw driver between the two upper contacts and force the contacts toward their pivot point sufficiently far to disengage the contact stop surface from the pin.

2. The contact can then be removed by disengaging the end of the contact from its spring.

3. The two lower contacts can be similarily removed.

REPLACEMENT OF STATIONARY CONTACTS (21) Figure 3.

1. Coat the contact pivot area only of each of the four contacts with a thin coat of D50H47 grease. Use only D50H47 grease.

2. Note the difference between the two types of

stationary contacts and be sure to locate them in the breaker with the upper and lower contacts having their stop projecting surfaces as shown in the section AA, Figure 3. The upper left and lower right contacts are identical as are the lower left and upper right contacts.

3. By placing the hook on the end of the contact through the loop of the contact spring, the contact can be pushed toward the pivot surface and slipped behind the stop pin. Install all stationary contacts in all poles.

REPLACEMENT OF MOVABLE CONTACTS (18) Figure 3.

1. Coat the pivot area only of the new movable contacts with a thin coat of D50H47 grease.
2. Assemble the center pole movable contacts, align the pivot pin holes with the bullet nosed rod, and install the pivot pin and split pin.
3. Move the cross bar assembly into position and insert the eccentric contact wipe adjust-

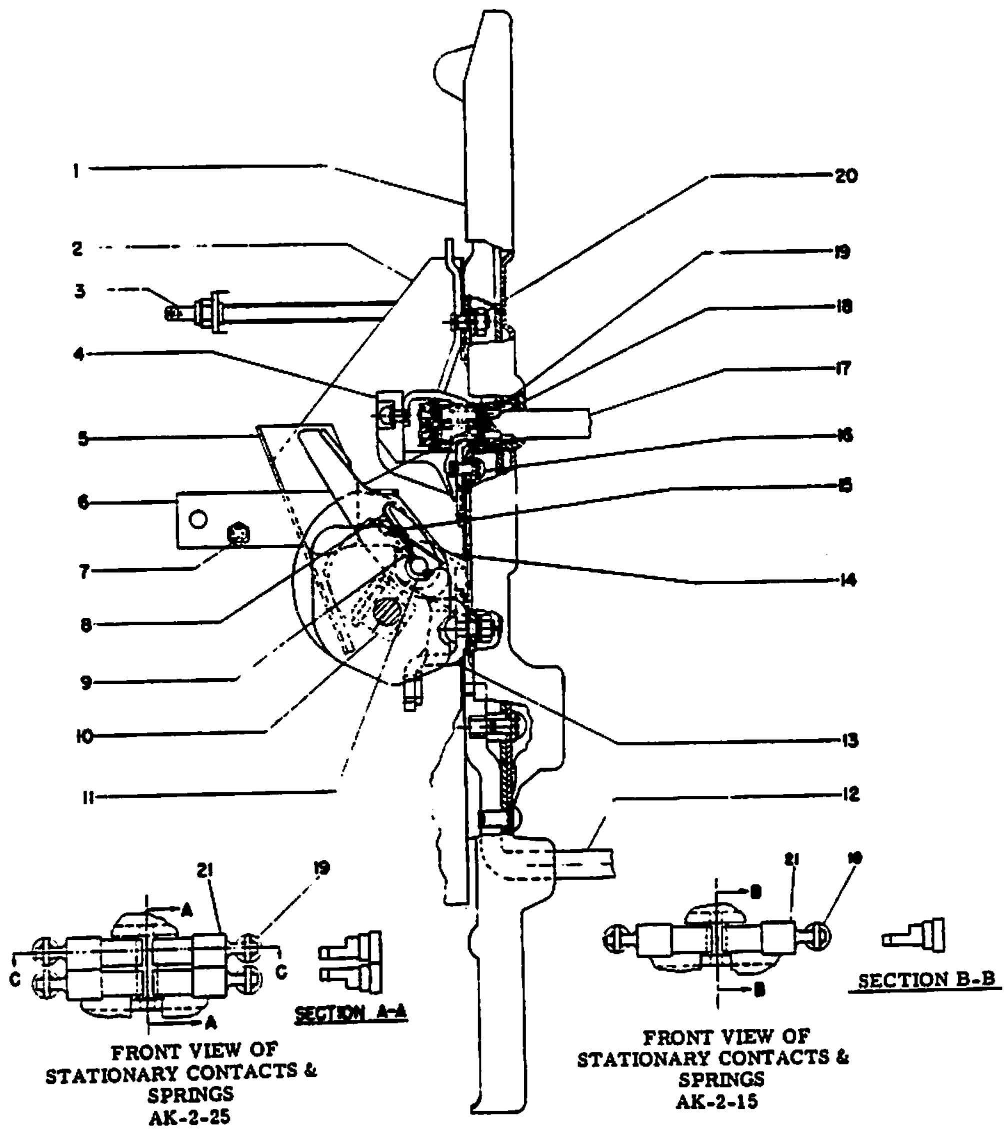


Figure 3. (549D409-2) Contact Assembly

1. Breaker Base
2. Insulation
3. Insulated Stud
4. Upper Stud Barrier
5. Insulation
6. Links (Insulated)
7. Tie Bolt
8. Spring
9. Spring Clip (Retainer)
10. Cross Bar
11. Pivot Pin
12. Lower Stud
13. Contact Pivot Support
14. Spring
15. Contact Wipe Adjustment Pin
16. Screw
17. Upper Stud & Arc Runner
18. Movable Contact
19. Spring
20. Nut
21. Stationary Contacts

ment pin (15) on the center pole into position. Be sure the stationary insulation barriers are correctly located.

4. Align the cross bar with the left and right pole pivot supports and install the left and right pole movable contacts. Use the bullet nosed steel pin to aid in aligning the holes in the cross bar, the contacts and the pivot supports.

5. Install the left and right pole pivot pins while threading them through the spring clips and lock the spring clips (9). Be sure the pivot pins are fully inserted.

6. Adjust the contact wipe to 1/8" ± 1/32" by adjusting the eccentric contact wipe adjusting pin (15). The breaker must be open to adjust the wipe. In the event acceptable wipe cannot be obtained by moving the contact wipe adjusting pin (15), from the movable contact forward or backward as necessary to bring the wipe within the range of the contact wipe adjusting pin (15). Do not exceed the recommended settings for wipe; otherwise the breaker may not close completely. When viewed from the top with the breaker closed, the movable contact should be centrally located with respect to the stationary contacts. If the movable contacts are not centrally located as shown in section CC, form the movable contacts until they are nominally centered.

If the moving contacts are not centered with 1/8" separation when closed against the fixed contacts, they should be bent laterally (after opening the breaker contacts). To do this without squeezing the two movable contact arms together, a 1/8" spacer plate should be inserted between them; then the pair can be grasped with pliers and bent in the desired direction for centering.

New contacts should be adjustable using eccentric numbers 1, 2, or 3. These numbers are the ones visible when viewing the breaker from the front, not from above. (The higher numbers should be reserved for tightening at future maintenance readjustments after wear.) Also, if higher numbers are used, where adequate wipe is obtainable at settings 1, 2, or 3, it is possible that the stationary contacts will bottom, producing excessive back force on the breaker closing mechanism so that the toggle link will not pass center. As a result, the breaker will not complete its stroke, and inadequate pressure and wipe will result; burn-up of contacts from just load current will follow.

If the required wipe of new contacts cannot be obtained with eccentric number of 3 or lower, bending of the contact arms toward the closed position is required. This should be done individually, using an 8" Crescent or 1/2 - 5/8" tapered open end wrench to grasp the contact and a 10" Crescent or the 1" - 1-1/8" tapered

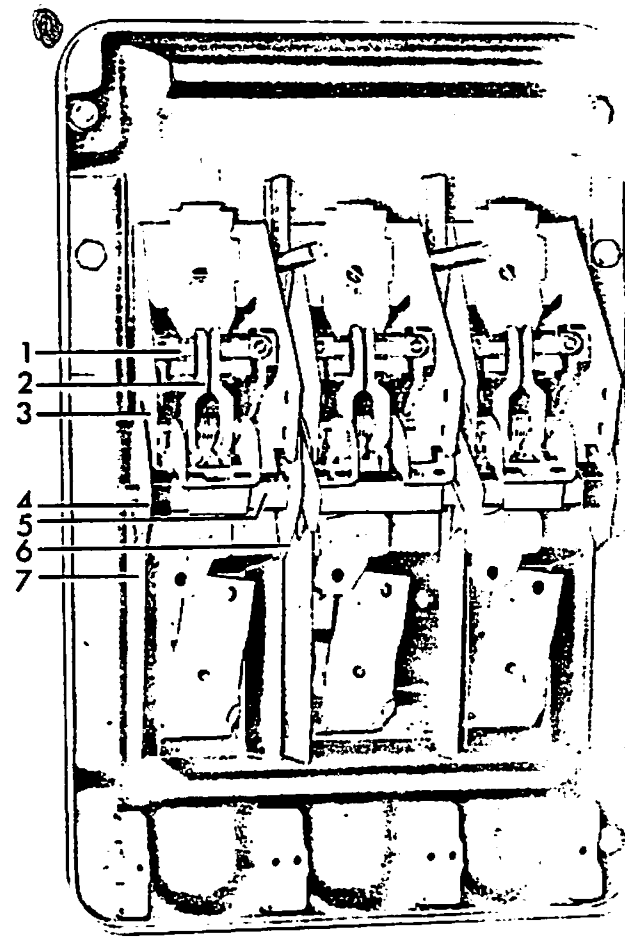


Figure 4. (8039851) AK-2-25 Back Frame - Location of Crossbar and Pole Shields

1. Stationary Contacts
2. Movable Contacts
3. Upper Stud Asbestos Shield
4. Crossbar Plastic End Shield
5. Crossbar Assembly
6. Crossbar Asbestos Inner Shield
7. Lower Stud Asbestos Shield

open-end wrench to grasp the pivot portion of the arm. The soft copper arm will bend with little difficulty. Both arms should be bent identically.

Operate breaker several times, and recheck wipe to make sure bending of movable arms did not occur in these operations.

7. Operate the breaker manually several times to assure proper functioning occurs, then replace the U shaped insulation (5) Figure 3 and arc quenchers. When replacing the arc quenchers be sure the quencher is seated downward completely and that the quencher clamp covers the knobs protruding through the arc quencher insulation.

CONTACT SPRINGS
(19) Figure 3

A minimum force of 5 lbs and a maximum force of 9 lbs. should be required to begin movement of a single stationary contact from the open position towards the closed position. This may be checked by using a push scale applied at the point at which the movable contact touches the stationary contact. If these pressures are not obtained or if the spring is damaged, replacement is required.

In order to replace the contact spring the upper stud (17) must be removed. The hardware which fastens the stud to the breaker base consists of two screws (16), and nut (20). When These are removed, the stud may be withdrawn from the base in a forward direction. After the stud has been removed, it is a simple matter to disconnect the two ends of the spring (19) and replace it with a new one.

MECHANISM

The breaker mechanism is a spring actuated, over-center toggle type of mechanism. As the closing force is applied, either by movement of the operating handle or the closing solenoid armature, energy is stored in the operating springs. After the springs have gone over center, movement of the output crank of the mechanism is still blocked for a time by a cam arrangement. As the springs are further extended, the blocking cam moves away from the output crank, and the springs are allowed to discharge part of their stored energy, closing the breaker contacts.

This assures a fast-snapping closing action regardless of the speed at which the closing handle is operated.

The breaker mechanism is tripped by the displacement of the trip latch (7), Figure 6. Looking at the breaker from the right hand side as in Figure 5, the tripping movement of the latch is counter-clockwise. Operation of any of the automatic trip devices or the trip push button causes the latch to move in the tripping direction. When the latch moves off the trip latch roller (7), the remaining force in the operating spring causes the mechanism toggle to collapse, resulting in the opening of the breaker contacts.

ADJUSTMENT

Since all the mechanism adjustments are carefully set by experienced factory personnel after assembly at the factory, it should normally not be necessary to make any adjustments in the field. At the time of installation, and also in the course of a maintenance inspection, if the breaker functions properly through several repeated operations, it is best to assume that adjustments are satisfactory.

If the breaker mechanism does not function properly, it is best to first perform the available remedial measures listed in the "Trouble Shooting" chart of these instructions. One of the remedies listed is that of proper mechanism latch engagement, the amount of engagement between the latch (7) and latch roller (5), Figure 6. This is the only adjustment that is required on the breaker mechanism, and proper latch engagement is obtained in the following manner:

(NOTE - Before making latch adjustments, check to make sure that the buffer paddle which stops against the end of the latch adjustment screw is rigidly fastened to the trip shaft. Hold the trip shaft (8), Figure 5, steady and attempt to move the buffer paddle. If any relative movement between the two is noted, tighten the fasteners holding the buffer paddle to the trip shaft.)

Latch Adjustment - Manual Breaker

1. Locate the latch adjustment screw on the lower, outer side of the right-hand mechanism side frame. This screw is threaded through a nylon insert locknut which, in turn, is welded to a projecting bracket on the side frame.

2. Rotate the closing handle 90 degrees counter-clockwise, setting the closing mechanism in the reset position. Turn the adjusting screw into the locknut until the closing mechanism trips open, the closing handle returning to its normal vertical position. NOTE: KEEP HANDS CLEAR OF THE CLOSING HANDLE WHEN MAKING THIS ADJUSTMENT.

3. Withdraw the adjusting screw from the locknut 1/4 turn at a time, attempting to close the breaker after each 1/4 turn, and observing whether the contacts move toward closing before tripping occurs. If the contacts move before tripping occurs, you have established the position of the adjusting screw where the latch and latch roller begin to engage. In some cases, it may be necessary to turn the adjusting screw less than 1/4 turn in order to establish the position where the contacts begin to move before tripping occurs. When this position is established, note the position of the slot in the head of the adjusting screw.

4. Withdraw the adjusting screw three and one-half turns from the position noted in step 3. This sets the proper amount of latch engagement.

Latch Adjustment - Electrical Breaker

1. Locate the latch adjustment screw on the lower, outer side of the right mechanism side frame. This screw is threaded through a nylon insert locknut which, in turn, is welded to a projecting bracket on the side frame.

2. With the breaker in the open position turn the adjusting screw into the locknut one complete turn at a time, closing the breaker after each complete turn of the adjusting screw, until

the breaker will not close. Use the maintenance closing handle whenever closing or attempting to close the breaker during this entire operation.

3. Withdraw the adjusting screw from the locknut 1/4 turn at a time, attempting to close the breaker after each 1/4 turn, and observing whether the contacts move toward closing before tripping occurs. If the contacts move toward closing before tripping occurs, you have established the position of the adjusting screw where the latch and latch roller begin to engage. In some cases, it may be necessary to turn the adjusting screw less than 1/4 turn to establish the position where the contacts move before tripping occurs. When this position is established, note the position of the slot in the head of the adjusting screw.

4. Withdraw the adjusting screw three and one-half turns from the position noted in step 3. This sets the proper amount of latch engagement.

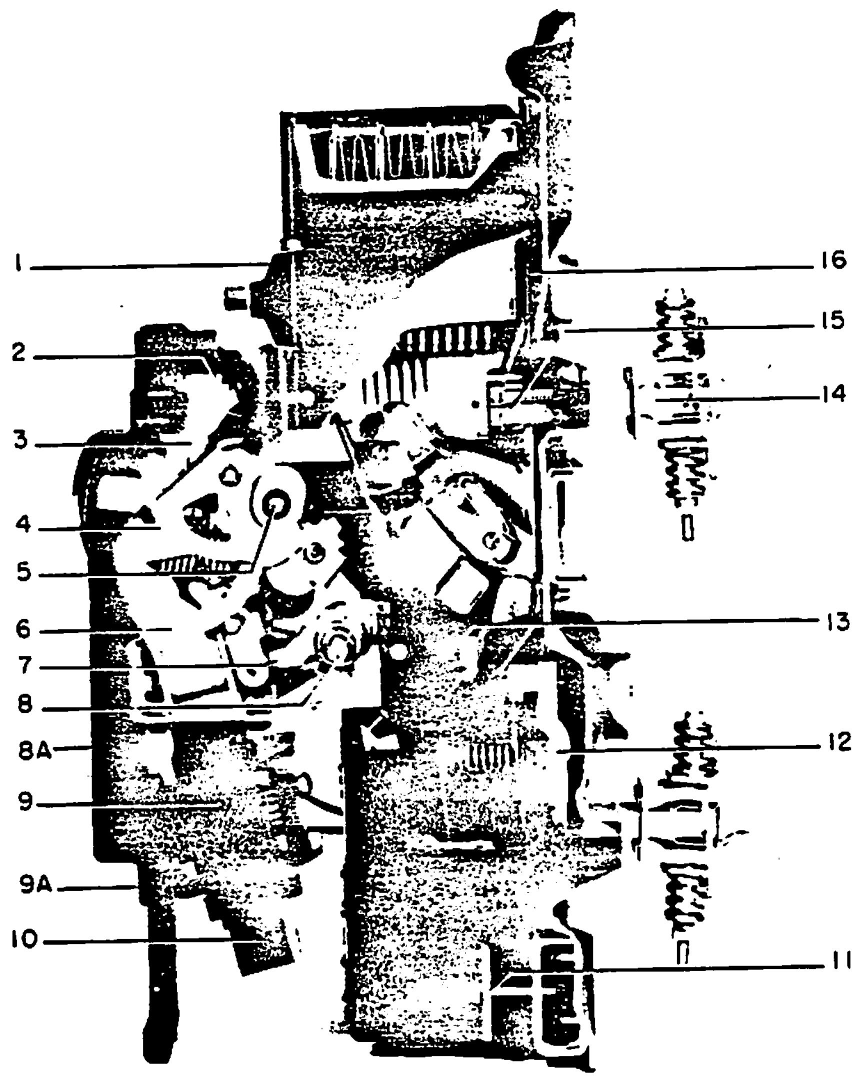


Figure 5. (8024457) Cut Away Model of Electrically Operated AK-2 Breaker

1. Arc Quencher Retainer
2. Cutoff Switch
3. Cutoff Switch Actuator
4. Spring Carrier
5. Shoulder Pin
6. Connecting Link
7. Trip Latch Roller
8. Trip Shaft
8A. Front Escutcheon
9. Closing Solenoid
9A. Location of Slots for Maintenance Handle
10. Closing Solenoid Armature
11. Cover Retainer of Overload Device
12. Lower Stud
13. Socket Head Screws
14. Upper Stud
15. Stationary Contacts and Springs
16. Arc Runner

Should the mechanism continue to function improperly after the proper latch engagement has been set and the corrective measures listed in the "Trouble Shooting" chart carried out, it is generally recommended that no attempt be made to repair the mechanism interior but that a replacement mechanism assembly be obtained from the factory.

REPLACEMENT

1. If the breaker is electrically operated, remove the front escutcheon by taking four screws from flange. If the breaker is a drawout type, two small round head screws must also be removed from the bottom edge of the escutcheon. (For removal of front escutcheon from manually operated breakers, see procedure described below.)

2. Remove arc quenchers (See "Arc Quencher").

3. Disconnect the two insulated connecting links between the mechanism and the contacts as in step 2 of the procedure for "Separation of Front and Back Frames".

4. Remove the two elastic stop nuts, which fasten the upper extensions of mechanism frame to studs connecting with rear frame.

5. Remove four screws which fasten the bottom of the mechanism frame to the horizontal cross member of the front frame.

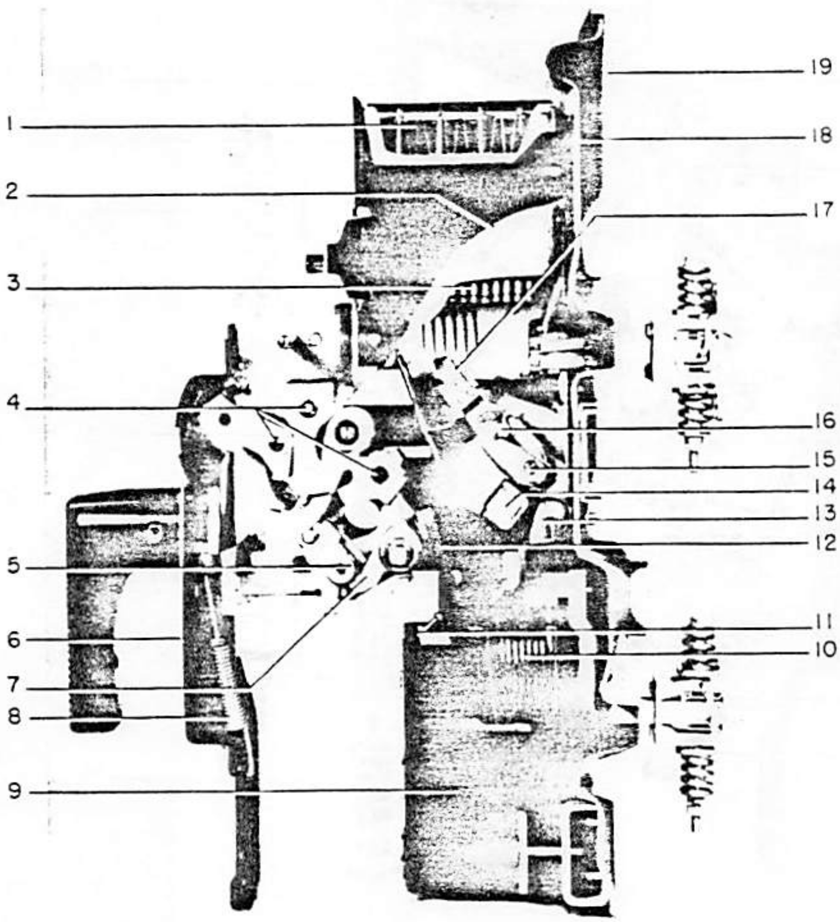


Figure 6. (8024516) Cut Away Model of Manually Operated AK-2 Breaker

1. Arc Quencher Muffler
2. Ceramic Side Plates
3. Steel Plates
4. Fixed Centers in Mechanism
5. Latch Roller
6. Escutcheon
7. Trip Latch
8. Handle Return Spring
9. Overload Device
10. Series Coil of Overload Device
11. Trip Arm of Overload Device
12. Trip Paddle
13. Movable Contact Pivot Support
14. Crossbar
15. Movable Contact Pivot
16. Contact Wipe Adjustment Pin
17. Movable Contact
18. Moulded Compound Bar
19. Steel Back Plate

6. If the breaker is manually operated, and has no auxiliary switch, it is now free to be lifted clear of the breaker. If it has an auxiliary switch, this may be disconnected from the mechanism as described under "Auxiliary Switch - Replacement, elsewhere in these instructions.

7. If the breaker is electrically operated, it will be necessary to disconnect the mechanism from the solenoid armature. In order to do this, raise the mechanism as far as the travel of the armature will permit and remove the screw which binds together the two extensions of the armature. After this is removed, the armature extensions must be spread apart to release them from the link connecting with the mechanism. This can be done by threading a #10-32 screw at least 1-3/4 inches long into the top hole of the armature extension. This hole is just above the one from which the binding screw has been removed. As the end of the screw butts against the far extension, the two extensions will be spread open, releasing the mechanism link.

8. The replacement mechanism may be installed by reversing the order of procedure for disassembly. After reassembly, check the operation of the breaker and, if necessary, adjust the latch engagement.

REMOVAL OF FRONT ESCUTCHEON OF MANUAL BREAKERS

1. Remove set screw fastening the plastic handle to steel operating shaft and remove the operating

2. Open and remove annealed (soft) retainer and two flat washers from shaft.

3. Remove four screws from flange of escutcheon If the breaker is a drawout type, two small round head screws must also be removed from the bottom edge of the escutcheon.

4. Push steel operating shaft through escutcheon bushing.

5. Remove handle reset spring (8) Figure 6, and escutcheon is free of breaker.

6. Handle and escutcheon assembly can be assembled most easily by exactly reversing the procedure for disassembly. In replacing the escutcheon it may be necessary to use pliers to pull the operating shaft fully into the escutcheon in order to have space enough to replace the flat washers and the soft retainer. The latter may be closed on its groove in the shaft by ordinary gas pliers. After replacement, check operation of breaker.

AUXILIARY SWITCH

The auxiliary switch is mounted on the left side of the operating mechanism frame. Its operating shaft is linked to the output crank of the breaker mechanism. Through a cam arrangement, the operating shaft of the switch controls the open and closed positions of the individual contact pairs. Each stage of the switch, which is usually two-stage or five-stage, contains one "a" and one "b" set of contacts. An "a" pair of contacts is always in the same position as the main breaker contacts. That is, open when the breaker contacts are open, and closed when the breaker contacts are closed. Just the oposite is true of the "b" contacts. The terminals of the switch are covered by a sheet of insulating material held in place by two screws fastened along its left edge. When this is removed, the terminals are exposed. The upper pairs of terminals are those which connect to "a" switches. The lower terminals connect to "b" switches.

REPLACEMENT

1. Remove auxiliary switch cover.

2. Disconnect leads to switch termin.

3. Remove two screws which fasten s side of mechanism frame.

4. Remove switch by moving towards lef.

5. Before mounting replacement switch, turn the crank end of the switch operating shaft in position to engage the hole in the link connecting with with the breaker mechanism. Be sure the bearing washer is in place between the mechanism link and the switch operating shaft.

6. Complete mounting by following disassembly steps in reverse order.

ELECTRICAL CONTROL COMPONENTS

These consist of the following:

1. Closing solenoid
2. "X" contactor (relay)
3. "Y" permissive relay
4. Cut-off switch
5. Closing switch
6. Shunt-trip device

The last two of these components may or may not be present in the control arrangement.

CLOSING SOLENOID

The closing solenoid consists of a magnet, armature and coil. This assembly is located directly beneath the breaker mechanism to which it is connected by a link which ties the upper end of the armature to the spring carrier of the mechanism. (See Figure 5.)

When voltage is applied to the coil, the magnetic force generated pulls the armature up into the coil and magnet assembly. This, in turn, rotates the spring carrier about its pivot, extending the mechanism spring and causing its line of action to move "over center", resulting in a closing operation.

REPLACEMENT

The only replacement operation that might conceivably be required on this assembly is that of the solenoid coil. To replace this, proceed as follows:

1. Remove escutcheon by unfastening four flat head screws in flange.
2. Remove closing switch. (See "Closing switch".)
3. Cut off or disconnect the coil leads.
4. Remove four screws which fasten lower section of magnet to upper section.
5. Allow lower section of magnet and coil to slide downward until clear of armature.
6. Reassemble with new coil by reversing order of procedure.

"X" CONTACTOR

The "X" contactor is a heavy-duty relay which performs the function of closing the circuit of the breaker solenoid during electrical operations. Three of the four sets of contact of the device are arranged in series to minimize the duty required of any one contact. As explained under "Operation", the fourth contact is used to "seal-in" the "X" coil.

The "X" contactor is located on the right beneath the horizontal front frame member. It is mounted on three studs which fasten it to a mounting bracket which is suspended from the frame. Rubber bushings on the mounting studs provide anti-vibration and anti-shock protection for the relay. The relay contacts and their terminals are covered by a molded piece of insulation which fits over spring clips that hold the cover in place.

REPLACEMENT

Removal of the complete device is accomplished by removing the cover, disconnecting the leads from the terminals, and removing the nuts from the three mounting studs. If the replacement unit includes the mounting bracket, the relay need not be removed from the old bracket. This can be taken off the breaker simply by removing the two screws which fasten it to the breaker frame. If the breaker is a drawout type, the supporting bracket of the "Y" relay may be temporarily displaced to provide access to the screws.

Since the expendable parts of the "X" contactor are the contacts and the coil, ease of replacement of these parts has been designed into the relay. Methods of procedure are as follows:

Contacts

1. Remove relay cover.
2. Remove terminal binding screw of stationary contact to be replaced.
3. Lightly pinch with pliers (pointed end) the split section of the contact which enters the hole in the compound body of the device and lift out the stationary contact.
4. With the fingers, pull forward on the spring guide of the movable contact, compressing the contact spring as far as possible.
5. With the spring thus held, grip the end of the contact strip with pointed pliers, turn it through 90 degrees on its long axis, and withdraw it.
6. Replace new contacts by reversing the procedure.

Coil

1. Remove relay cover.
2. Turn the two retaining spring clips on the ends of the device through 90 degrees about their pivots.
3. Pull out the two halves of the body of the device which carry the stationary contacts. When these are clear of the frame, the armature and movable contact assembly will move aside, exposing the coil.
4. Remove the terminal screws of the coil and pull it free of its retaining spring clips.
5. Place new coil on pole piece inside of the spring clips and fasten terminals to leads.
6. Just start the replacement of one of the compound blocks which hold the stationary contacts into its groove in the frame.
7. Position the armature and movable contact assembly to allow the entrance of the second stationary contact block.
8. When these parts are all properly aligned, with the stationary contacts under the movable contacts, push them into their guiding grooves in the frame until they bottom.

9. Rotate the retaining spring clips to the locked position, making sure that each clip is in its proper recess, and replace the device cover.

"Y" RELAY

As described under "Operation", the "Y" relay is a permissive relay which limits to one the number of breaker closures possible on one closing signal.

On drawout breakers, the "Y" relay mounting bracket is fastened to the right hand side member of the breaker frame by two mounting screws. On terminal board breakers, it is fastened to the rear side of the terminal board support. The relay itself is fastened to an intermediate bracket which is detachable from the main support. The junctures between the relay and the intermediate bracket and between the two brackets are rubber cushioned against vibration and shock.

REPLACEMENT

If replacement of the "Y" relay becomes necessary, it may be detached from its supporting brackets by removal of the fastening hardware. The leads to the relay should be cut off as closely as possible to the soldered connections so that enough wire will remain for connection to the new relay. Sufficient original wire is allowed for this purpose.

After the old relay has been removed, the wire leads to the relay should be stripped of insulation to about 1/4 of an inch from the ends. A good mechanical connection should be made before soldering.

After all connections are completed, the relay may should again be mounted to the breaker by means of its supporting brackets and hardware.

After replacement has been completed, the relay may be checked electrically in the following manner:

1. Apply closing voltage to terminal board or secondary disconnects.

2. Push button of closing switch and hold closed.

3. Continuing to hold push button in closed position, manually trip the breaker open.

4. If the breaker stays open, and makes no attempt to close, the "Y" relay is functioning properly.

5. While releasing the close button, observe the "Y" relay. It should open as the closing switch is released.

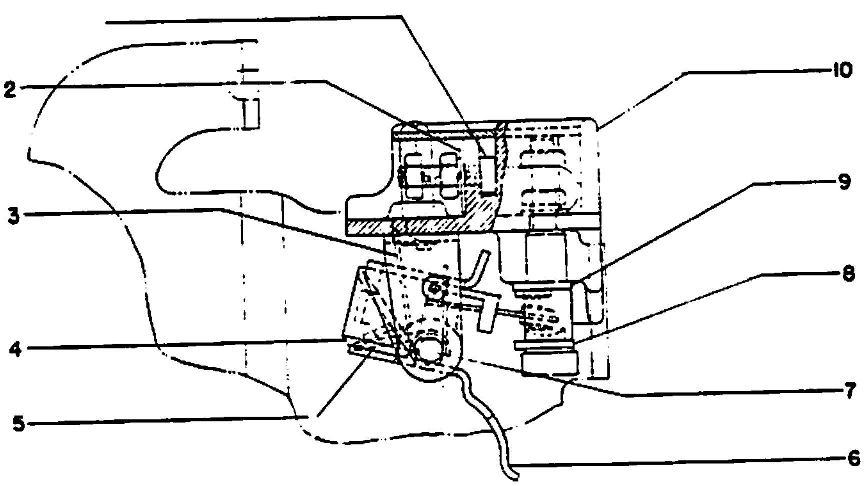


Figure 7. (695C162) Cut-Off Switch

1. Screw
2. Washer
3. Spring
4. Movable Contact Assembly
5. Spring
6. Actuator
7. Pivot Pin
8. Contact (BB)
9. Contact (AA)
10. Support

CUT-OFF SWITCH

Figure 7.

As explained under "Operation", the function of the cut-off switch is to de-energize the "X" contactor coil and energize the "Y" relay coil as the breaker mechanism moves from the opened to the closed position.

The switch is operated by the movement of a mechanism link against the switch actuator (6). This causes the actuator and movable contact assembly (4) to rotate counterclockwise about pin (7), opening the "bb" contacts (8) and closing the "aa" contacts at (9). Overtravel of the actuator (6) beyond the point of making contact at (9) is absorbed by spring (5) which couples the movable contact (4) to the actuator. Spring (3) resets the switch after the breaker contacts open and the breaker mechanism resets.

The point at which the cutoff switch operates during the breaker closing cycle is after the spring charged mechanism has been driven over-center. This assures that the cutoff switch cannot operate too early in the breaker closing cycle, thus the X and Y relays are de-energized and energized, respectively, at the proper time and the circuits anti-pump feature is maintained. When the closing mechanism is driven over-center, the force of the previously charged closing springs is released, closing the breaker.

REPLACEMENT

The cut-off switch is located above the breaker mechanism. It is fitted between the upper portions of the steel side plates that make up the mechanism frame. A raised horizontal ridge on each side of the molded body of the switch fits into a corresponding groove in each of the steel side plates. A round head screw on each side fastens the switch and side plate together. Replacement of the switch is accomplished by the following procedure:

1. Remove the cover on the top of the switch by taking out the two screws which hold it in place.
2. After taking careful note of the connection arrangements, disconnect the leads from the switch terminals.
3. Remove the two screws, one on each side, which fasten the switch to the mechanism side plates. Note that the one on the right hand side also holds a wiring cleat and spacer which serves to hold the wires clear of the link connecting the mechanism and the breaker position indicator.
4. Remove the front escutcheon from the breaker.
5. Slide the cut-off switch out from between the steel side plates by pulling straight forward.
6. Mount the replacement switch by reversing the order of procedure.

CLOSING SWITCH

Figure 8.

The closing switch is mounted on the upper flange of the closing solenoid coil. A hole in the escutcheon (3) permits access to the switch button (4). When the button is pressed, movable contact (5) deflects and impinges upon stationary contact (2). This energizes the "X" relay coil which seals itself in, and, in turn, energizes the closing solenoid.

REPLACEMENT

1. Remove escutcheon (3).
2. Disconnect leads from switch terminals.
3. Deflect the left end of hinge (7) to the left so that the movable contact (5) may be disengaged from the switch assembly.
4. Removal of the two screws (10) from speed-nuts (9) completes the disassembly of the switch.
5. Reassembly with new parts is a matter of reversing the described procedure. In reassembling, be sure the tab on the left end of hinge (7) is bent to the right far enough to avoid any possibility that movable contact (5) might become free of the assembly.

SHUNT TRIP DEVICE

Figure 9.

The shunt trip device is mounted underneath the horizontal cross frame member, just to the left of the front escutcheon. It is composed of a magnet, coil and armature. The armature has an extended arm or striker (11) which bears against the trip paddle (12) on the trip shaft when the coil (8) is energized. This displaces the trip latch in the breaker mechanism, opening the breaker contacts.

The trip device is generally activated by a remote switch or relay which closes the shunt trip coil circuit.

In order to avoid unnecessary heating of the coil of the device, an auxiliary switch "a" contact is wired in series with the coil. This prevents the energization of the coil if the breaker is open.

REPLACEMENT

The entire shunt trip device may be dismounted by disconnecting the coil leads and removing nuts (1). However, the only part of the device that might conceivably need replacement during the life of the breaker is the coil (8). This

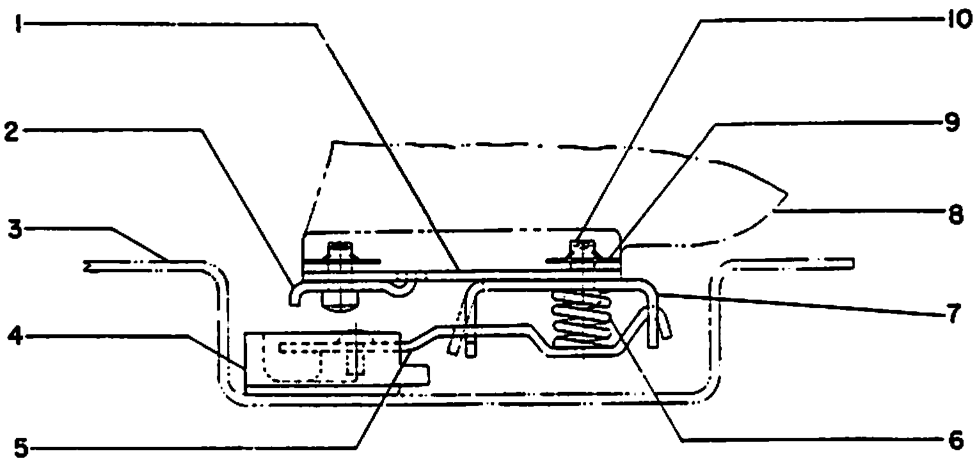


Figure 8. (805B905) Closing Switch (Top View)

1. Insulation
2. Stationary Contact
3. Front Escutcheon
4. Push Button
5. Movable Contact
6. Spring
7. Hinge
8. Closing Solenoid
9. Speed Nut
10. Screw

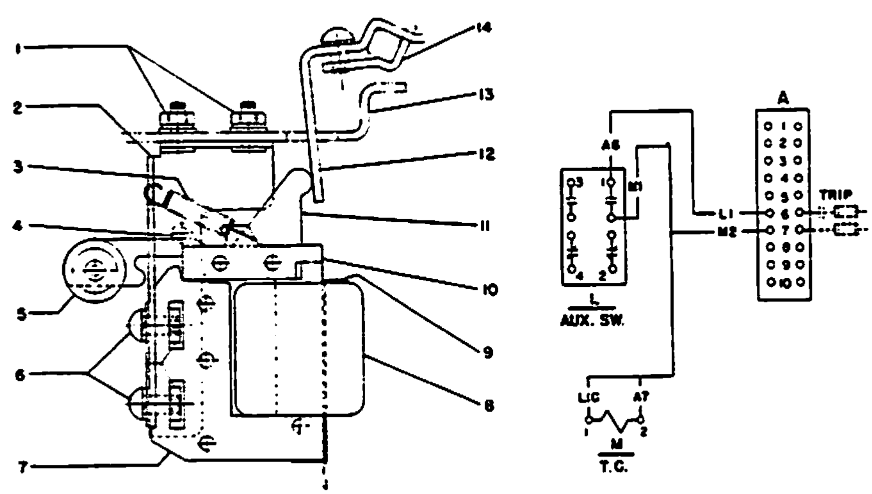


Figure 9. (695C161) Shunt Trip Device

1. Nut
2. Frame
3. Spring
4. Rivet
5. Weight
6. Screws
7. Magnet
8. Coil
9. Clamp
10. Armature
11. Armature Arm
12. Trip Paddle
13. Mechanism Frame
14. Trip Shaft Clamp

may be replaced without removing the device from the breaker by proceeding as follows:

1. Disconnect leads of coil (8).
2. Remove two screws (6) which fasten magnet (7) and coil to the frame (2).
3. Having removed the magnet from the device, straighten the end of clamp (9).
4. Remove the coil from the magnet.
5. Install new coil, again forming end of clamp (9) as shown.
6. Reassemble to frame.
7. Connect coil leads.

ADJUSTMENT

The only adjustment required on the shunt trip device is that which ensures positively that the breaker will trip when the device is activated. In order to be sure of this, armature arm (11) must travel from 1/32 to 1/16 of an inch beyond the point at which the breaker trips. A good method of checking this is to hold a 1/32nd shim between the magnet and armature at (10), and with the breaker closed, push upwards at (5), closing the armature against the magnet. If the breaker trips, there is sufficient overtravel. If adjustment is necessary, trip paddle (12) may be formed towards or away from armature arm (11).

PROTECTIVE DEVICES

An AK-2/3 breaker may be equipped with the following protective devices:

1. Overcurrent trip (Magnetic) AK-2
2. Power Sensor Trip (Static) AK-3
3. Reverse Current Trip AK-2
4. Under Voltage Trip & Lockout Device
5. Bell Alarm and/or Lockout device
6. Open Fuse lockout device.
7. AKD-5 Interlock AK-2A/AK-3A

OVERCURRENT TRIP DEVICE
(Magnetic)

The typical overcurrent trip device consists of a magnetic structure, a series current coil, and a pivoted armature.

When current flow through the series coil generates a magnetic field strong enough, the armature overcomes the restraining force of a calibration spring attached to it, and closes against the magnet. This trips the breaker by means of an extension on the armature which strikes against a trip paddle on the trip shaft.

Depending on the type of individual device, the movement of the armature may be delayed for a time by a timing device. If a relatively long time-delay (seconds or minutes) is desired, the velocity of armature movement is governed by a piston moving through an oil dashpot. If only a short-time delay (cycles or milli-seconds) is required, movement is controlled by an escapement gear and pallets arrangement.

An AK-2-15/25 breaker may be equipped with either the EC-2 or EC-1 overcurrent trip device. The majority of applications will require the use of the EC-2 device. The EC-1 device is normally used when the short-time delay feature is required, or when the trip device is used to operate a special over-current alarm switch.

Most circuit breakers are equipped with series overcurrent trip devices either of the dual magnetic type (instantaneous and time delay tripping) or instantaneous alone. Breakers are designed to carry up to 100% of the continuous current rating of their trip devices. Any attempt to carry higher currents for a prolonged period will cause overheating and possible damage.

EC-2 OVERCURRENT TRIP DEVICE

The Type EC-2 overcurrent tripping device is available in three forms:

1. Dual overcurrent trip, with long-time delay and high-set instantaneous tripping.
2. Low-set instantaneous tripping.
3. High-set instantaneous tripping.

The dual trip has adjustable long-time and instantaneous pick-up settings and adjustable time settings. Both forms of instantaneous trips have adjustable pick-up settings.

DUAL OVERCURRENT TRIP, WITH LONG-TIME DELAY AND HIGH-SET INSTANTANEOUS TRIPPING.

By means of the adjustment knob (5), Figure 10, which can be manipulated by hand, the current pick-up point can be varied from 80 to 160 percent of the series coil rating. The indicator and a calibration plate (4), Figure 10, on the front of the case provide a means of indicating the pick-up point setting in terms of percentage of coil rating. The calibration plate is indexed at percentage settings of 80, 100, 120, 140 and 160.

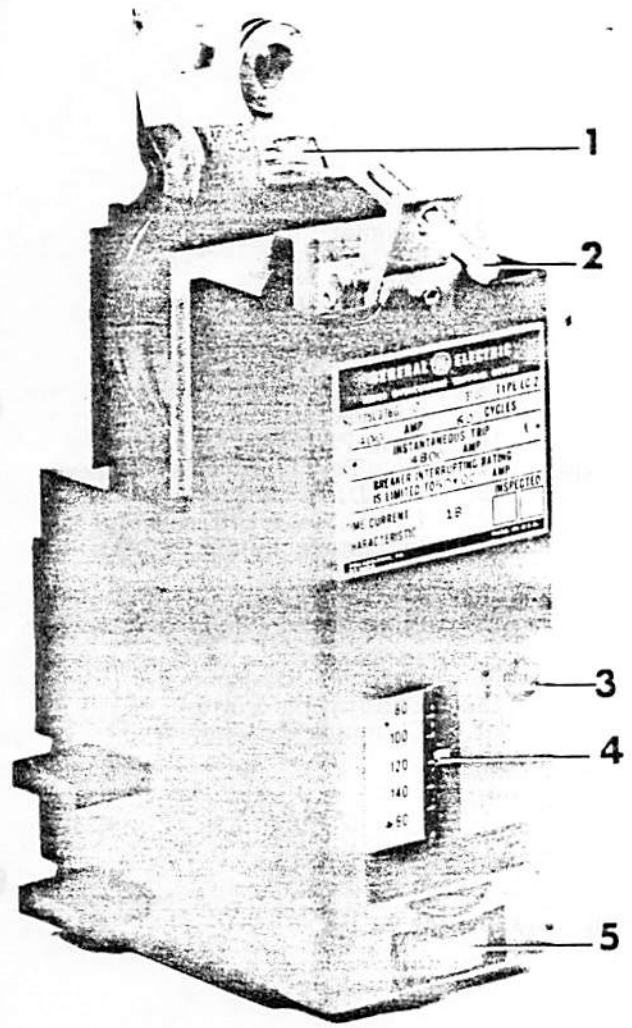


Figure 10. (8024842) EC-2 Overcurrent Trip

1. Series Coil.
2. Trip Adjustment Screw
3. Opening for Time Adjustment
4. Pickup Indicator & Calib. Plate
5. Pickup Adjustment Knob

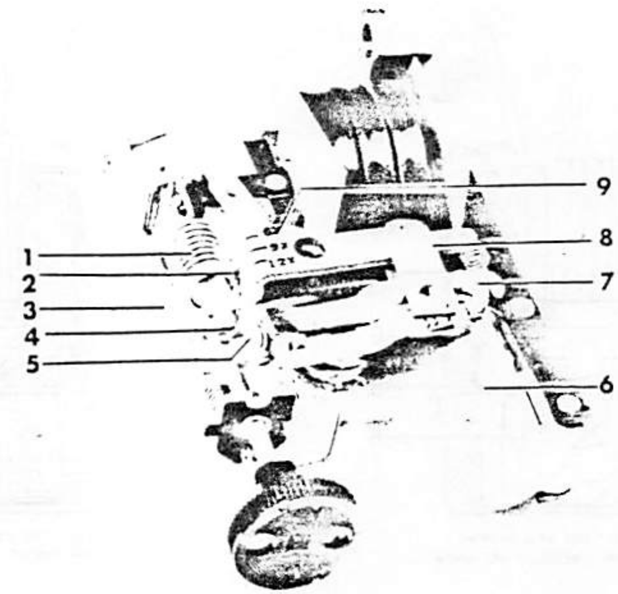


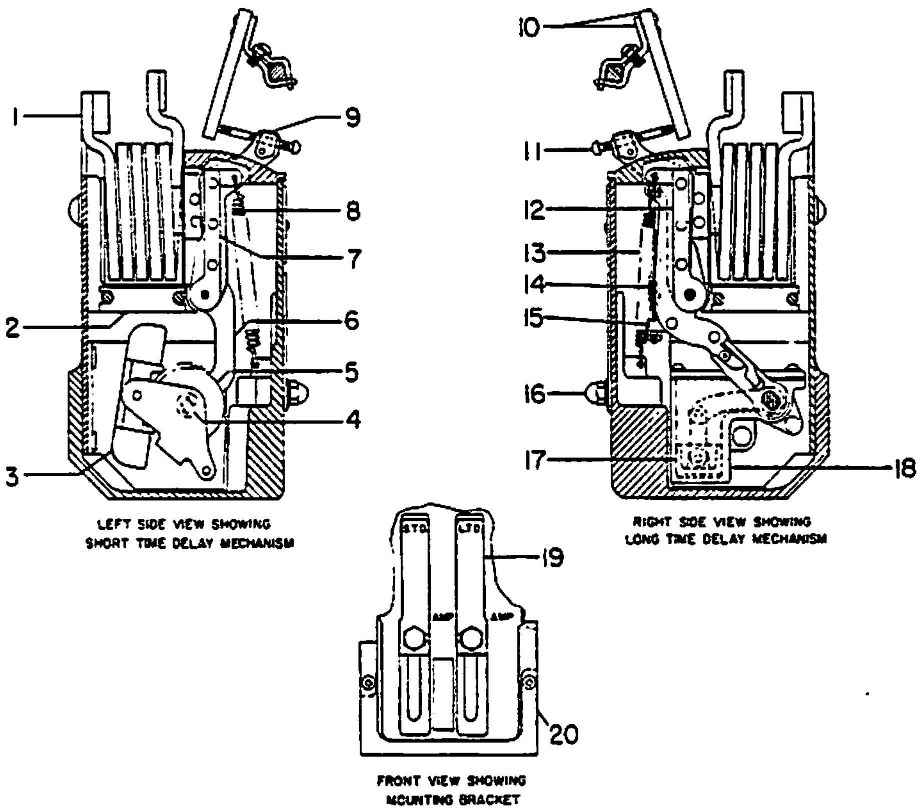
Figure 11. (8024843) EC-2 Overcurrent Trip With Cover Removed.

1. Instantaneous Calibration Spring
2. Movable Nut (Index Pointer)
3. Time-Delay Calibration Spring
4. Instantaneous Pickup Adjustment Screw
5. Time-Delay Adjustment Screw
6. Oil Dashpot
7. Dashpot Arm
8. Connecting Link
9. Instantaneous Pickup Calibration Marks

The long-time delay tripping feature can be supplied with any one of three time-current characteristics which correspond to the NEMA standards maximum, intermediate and minimum long-time delay operating bands. These are identified as 1A, 1B and 1C characteristics, respectively. Approximate tripping time for each of these, in the same order are 30, 15 and 5 seconds at 600% of the pick-up value of current. (See time-current characteristic curves 286B201A, B, and C).

The tripping time may be varied within the limits shown on the characteristic curves by turning the time adjustment screw (5), Figure 11. Turning in a clockwise direction increases the tripping time; counter-clockwise motion decreases it. The dashpot arm (7), Figure 11 is indexed at four points, maximum - 2/3 - 1/3 - minimum from the left, as viewed in Figure 11. When the index mark on the connecting link (8), Figure 11, lines up with a mark on the dashpot arm, the approximate tripping time as shown by the characteristic curve is indicated. The 1A and 1B characteristic devices are shipped with this setting at the 2/3 mark and the 1C characteristic at the 1/3 mark. The standard characteristic curves are plotted at the same settings.

Time values are inversely proportional to the effective length of the dashpot arm. Therefore, the linkage setting that gives the shortest time value is the one at which dimension "A" Figure 11, is greatest. The time adjustment screw (5), Figure 11, may be turned by inserting a Phillips head screwdriver through the hole in the front of the case, but if it is desired to relate the linkage setting to the index marks on the linkage it will be necessary to remove the case. This may be done by removing the two mounting screws, one on each side of the case, which may be taken off without disturbing the trip unit itself.



1. Series Coil
2. Magnet
3. Pallet
4. Pinion
5. Escape Wheel
6. Driving Segment
7. S.T.D. Armature
8. S.T.D. Calibration Spring
9. Trip Arm
10. Trip Paddle
11. Trip Paddle Adjusting Screw
12. L.T.D. Armature
13. L.T.D. Calibration Spring
14. Instantaneous Trip Spring (High Set)
15. Spring Holder
16. Calibration Clamp Nut
17. Plunger
18. Cylinder (Dashpot)
19. Calibration Plate
20. Clamping Bracket

Figure 12. (695C189) EC-1 Type Overcurrent Trip Device

NOTE: Forcing the adjusting screw to either extreme position may cause binding of the device and should be avoided.

INSTANTANEOUS LOW-SET TRIPPING

The low-set instantaneous pick-up point may be varied by the adjustment knob (5), Figure 10. The calibration in this case usually ranges from 80% to 250% of the series coil rating, the calibration plate being indexed at values of 80%, 100%, 200% and 250% of the rating.

INSTANTANEOUS HIGH-SET TRIPPING

The high set instantaneous pick-up value may have one of the following three ranges: 4 to 9 times coil rating; 6 to 12 times coil rating or 9 to 15 times coil rating. The pick-up setting may be varied by turning the instantaneous trip adjusting screw (4), Figure 11.

Three standard calibration marks will appear on the operating arm at (9), Figure 11, and the value of these calibration marks will be indicated by stampings on the arm as follows:

4X		6X		9X
6X	or	9X	or	12X
9X		12X		15X

At the factory, the pick-up point has been set at the nameplate value of the instantaneous trip current. (Usually expressed in times the ampere rating of the trip coil.) The variation in pick-up setting is accomplished by varying the tensile force on the instantaneous spring. Turning the adjustment screw changes the position of the movable nut (2), Figure 11, on the screw. The spring is anchored to this movable nut so that when the position of the nut is changed, there is a corresponding change in the spring load. As the spring is tightened, the pick-up point is increased. The top edge of the movable nut (2), Figure 11 serves as an index pointer and should be lined up with the center of the desired calibration mark, punched slots on operating arm, to obtain the proper instantaneous trip setting.

EC-1 OVERCURRENT TRIP DEVICE

The EC-1 device can be provided with the following tripping combination

1. Long time delay, short time delay and instantaneous -tripping.
2. Long time and short time delay tripping only.
3. Long time delay and instantaneous tripping.
4. Short time delay and instantaneous tripping.
5. Short time delay tripping only.
6. Instantaneous tripping only.
   a. Adjustable (Low set)
      or
      Non-adjustable (High set)

SHORT TIME DELAY TRIPPING, Figure 12.

The armature (7) is retained by calibrating spring (8). After the magnetic force, produced by an overcurrent condition, overcomes this restraining force, the armature movement is further retarded by an escapement mechanism which produces an inverse time delay characteristic. The mechanism is shown in the left side view of Figure -12.

The pickup for this device can be field set between limits having a ratio of 2-1/2 to 1 in the range of 200 to 1000% of the coil rating.

LONG TIME DELAY TRIPPING, Figure 12

The armature (12), is retained by the calibration spring (13). After the magnetic force, produced bs an overcurrent condition, overcomes this restraining force, the armature movement is further retarded by the flow of silicone oil in a dashpot, which produces an inverse time delay characteristic. The mechanism is shown in the right side view of Figure 12.

INSTANTANEOUS TRIPPING, Figure 12.

a. Adjustable instantaneous tripping takes place after the magnetic force produced by an overcurrent condition, overcomes the restraining force of the adjustable calibration spring (13).

b. Nonadjustable instantaneous tripping takes place after the magnetic force produced by an overcurrent condition overcomes the restraining force of a nonadjustable spring (14).

ADJUSTMENTS, EC-1 AND EC-2

In addition to the pick-up settings and time-delay adjustments already described, overcurrent trip devices must be adjusted for positive tripping. This adjustment is made at the factory on new breakers, but must be made in the field when the breaker mechanism or the overcurrent trip devices have been replaced.

Positive tripping is achieved when adjustment screw (2), Figure 10, is in such a position that it will always carry the trip paddle on the trip shaft beyond the point of tripping the mechanism, when the armature closes against the magnet.

In order to make the adjustment, first unscrew trip screw (2), Figure 10, until it will not trip the breaker even though the armature is pushed against the magnet. . Then, holding the armature in the closed position, advance the screw until it just trips the breaker. After this point has been reached, advance the screw two additional full turns. This will give an overtravel of 1/16 of an inch and will make sure that activation of the device will always trip the breaker.

Adjustment screw (2), Figure 10, can best be manipulated by an extended 1/4 inch hex socket wrench.

In order to gain access to the adjustment screw on the center pole overload device, it will be necessary to remove the nameplate from the front escutcheon of the breaker. This will reveal a hole, centrally located in the escutcheon, by means of which the extended socket wrench can engage the adjustment screw.

REPLACEMENT, EC-1 and EC-2

Replacement of either the EC-1 or EC-2 overcurrent trip device is accomplished by the following procedure:

1. Separate the breaker's front and back frames as described in the section under "Maintenance".
2. Remove the steel clamps which fasten the cover of the device to the back of the breaker. NOTE: Pickup settings on the cover of each device are calibrated for the specific device. When replacing covers, replace on associated device.
3. Remove the 3/8 inch hexagon headed bolts which fasten the coil of the overload device to the breaker copper.
4. Remove the round head screw which fastens the frame of the overload to the breaker base.
5. After reassembling breaker with new overload device, adjust for "positive trip" as described under "Adjustments" of this section.

REVERSE CURRENT TRIP DEVICE
Figure 13.

The reverse current trip device sometimes used with d-c breakers will trip the breaker open if the direction of current flow is reversed.

This device is similar in appearance and is mounted in the same way as the overcurrent trip.

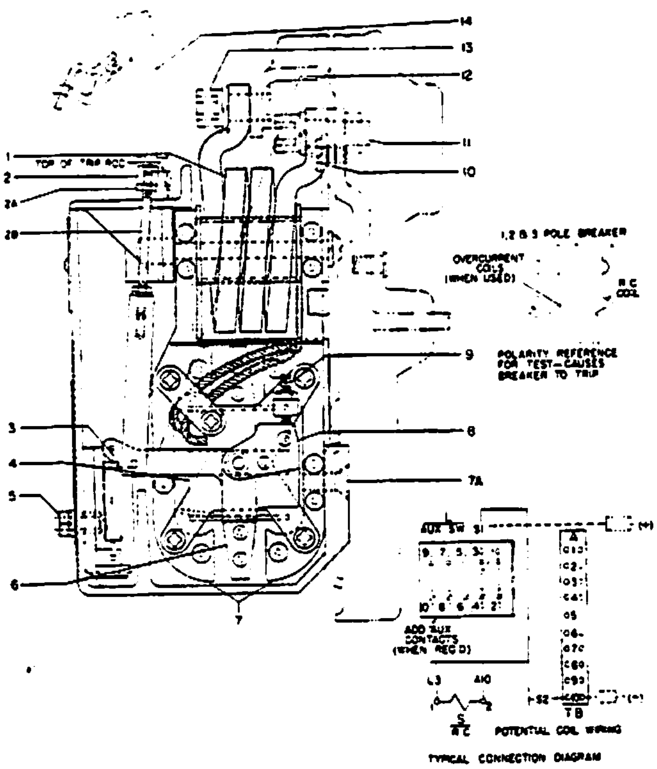


Figure 13. (286B209) Reverse Current Tripping Device

1.	Series Coil	7A.	Screws
2.	Adjusting Nut	8.	Counterweight
2A.	Locking Nut	9.	Stop Screw
2B.	Trip Rod	10.	Mounting Screw
3.	Spring	11.	Screw (Lower Stud)
4.	Potential Coil	12.	Trip Crank
5.	Calibration Nut	13.	Screw (Lower Stud)
6.	Armature	14.	Trip Paddle
7.	Pole Pieces		

The device consists of a series coil (1), with an iron core mounted between two pole pieces (7) and a potential coil connected across a constant source of voltage and mounted around a rotary type armature (6). Calibration spring (3) determines the armature pick-up value when a reversal of current occurs.

As long as the flow of current through the breaker is in the normal direction, the magnetic flux of the series coil and the magnetic flux of the potential coil produce a torque which tends to rotate the armature counterclockwise. The calibration spring (3) also tends to rotate the armature in the same direction. This torque causes the armature to rest against stop screw (9) attached to a bearing plate on the right side of the device.

If the current through the series coil (1) is reversed, armature (6) tends to move in a clockwise direction against the restraint of calibration spring (3). When the current reversal exceeds the calibration setting, the armature will move in a clockwise direction. This causes trip rod (2B) to move upwards against trip paddle (14), tripping the breaker open.

ADJUSTMENTS

The only adjustment to be made on the reverse current device is to make sure that the trip rod has a minimum overtravel of 1/32 of an inch beyond the point of tripping the breaker. The only occasion this adjustment should have to be made is when an old device is being replaced by a new one.

The new device will be factory adjusted so that the top end of the trip rod (2B) will extend 1/2 inch above the top of the device case, and no additional adjustments of the trip rod should be required. To obtain the proper 1/32 of an inch overtravel, close the breaker and proceed as follows:

1. Loosen the locking nut (2A).
2. Manually lift the trip rod and vary the position of the adjusting nut (2), thus establishing the position of the adjusting nut where the breaker is just tripped. (NOTE - Be sure that all parts of the person are kept clear of moving breaker parts when tripping the breaker.
3. With this position of the adjusting nut established, advance the adjusting nut upward one and one half turns.
4. Tighten the locking nut and the minimum 1/32 of an inch overtravel of the trip rod should be obtained.

REPLACEMENT

Replacement of the ED-1 Reverse Current Device is accomplished by means of the same procedure as that followed in the case of the EC Overcurrent Trip Devices. There is, however, one additional step to the taken. This consists of disconnecting the leads of the potential coil. These are connected to a small two point terminal board mounted between two of the phases on the breaker base. After the new device has been installed, adjust for overtravel of the trip rod as described above.

POWER SENSOR TRIP

GENERAL DESCRIPTION

All AK-3 Type Air Circuit Breakers contain Power Sensor Overcurrent Trip Devices. The Power Sensor Trip functions with solid state components with the exception of the Magnetic Trip Device which is used to trip the breaker on signal from the Power Sensor Unit. The Power Sensor Overcurrent Trip Device consists of four major components.

1. The magnetic coils around the breaker conductors (Figure 14).
2. The Power Supply which provides both the tripping energy and the comparison basis for overcurrent detection (Figure 15).
3. The Power Sensor Unit with the various pick-up settings and time delay selection taps (Figure 16).
4. The Magnetic Trip Device which physically trips the breaker (Figure 17).

In addition to the phase overcurrent protection, a ground fault sensing feature may be provided. The Ground Sensing Device works on the principle that the instantaneous value of current flowing in the three conductors (or; in four conductors on four wire systems) must add to zero unless ground current is flowing. Therefore, if the electrical system is a four wire wye system with the neutral grounded at the transformer, the fourth sensing coil (Figure 18) must be included on the neutral conductor with its secondary combined with the secondaries of the three phase sensors which are mounted on the breaker. On Draw-out breakers, the output of the external neutral sensor must enter the breaker by a control disconnect (Figure 19) which is mounted low and on the center-line on the back of the breaker. Refer to Figure 20 for Power Sensor Cabling diagram.

MAINTENANCE

When mal-functioning of the Power Sensor Trip is indicated the trouble should be traced to one or more of these four components involved, and that component should be replaced as a unit. The following steps should be taken to detect a mal-functioning unit.

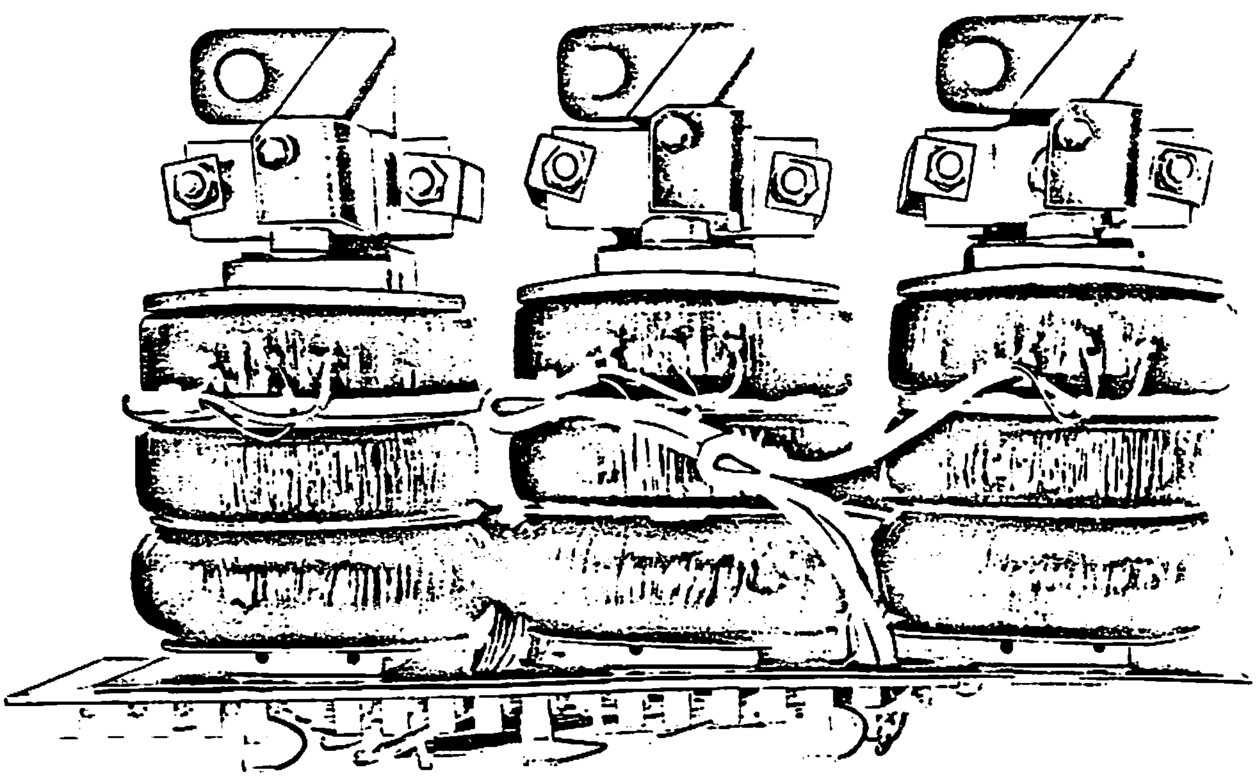


Figure 14. (8041866) Magnetic Coils

NOTE: No adjustment to the taps controlling pick-up or timing should be made with the breaker carrying current.

In the event the Power Sensor Device must be made non-operative to allow the breaker to continue carrying current without over-current protection, it is recommended that the leads to the tripping solenoid be removed to completely eliminate the possibility of the breaker tripping. Do not close breaker with power on the main contacts while the dis-connect plug to the magnetic coils is dis-connected

1. Check for the existence of overcurrent or ground fault conditions that may be causing the breaker to trip as a proper response to these abnormal circuit conditions.

2. The possibility of the breaker being trip free by mechanical interferences along the trip shaft or inadvertent shunt trip opera-tions should be positively eliminated before investigating the Power Sensor. Successful operations in the test position should be ob-tained before proceeding with the Power Sensor trouble shooting.

3. A PST-1 Power Sensor Test Kit must be available. (Figure 21). Check the Power Sensor Unit for correct function for each pick-up setting and one point on each time delay characteristic. Then check for the correct operation of each phase of the Power Supply Unit. This procedure is described in the instruction manual (GEK-7301) for the PST-1 Test Kit, and GEK-7309 Power Sensor Instructions. If the test results for this test do not deviate more than 10% from the published curves, proceed to step 4. If the deviation is more than 10% contact the factory for possible replacement of the Power Sensor Unit.

4. If the breaker is equipped with ground fault protection, determine whether the false trip-ping is the result of falsely answering an overcurrent trip or a ground trip signal. This may be determined by temporarily eliminating the ground trip signal by shorting out the ground signal points 1 and 5 at the ground signal terminal board on the back frame bottom of the breaker. Terminals 1 and 5 can be identified by the 0.15UF capacitor connected

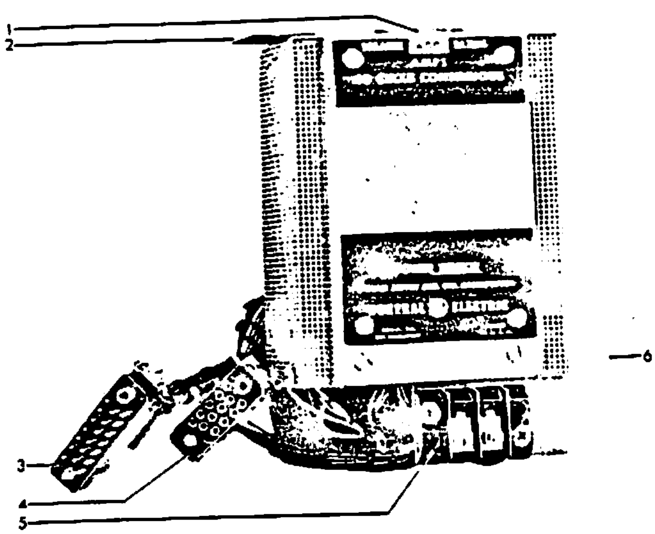


Fig. 15. (8039850) Power Supply

1. Rating Disc
2. Mounting Bracket
3. Male Disconnect Plug
4. Female Disconnect Plug
5. Terminal Block
6. Mounting Bracket

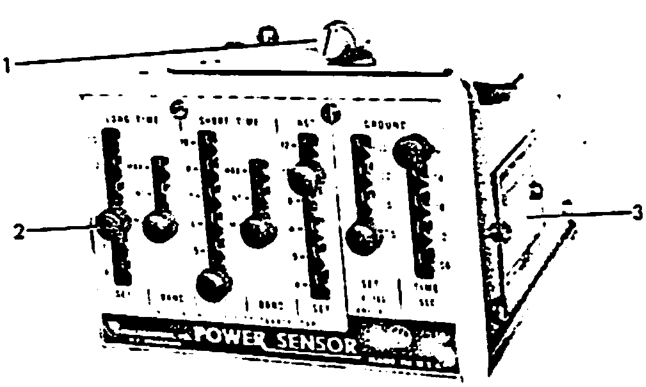


Figure 16. (8041864) Power Sensor Unit

1. Mounting Screw
2. Captive Thumb Screw
3. Name Plate

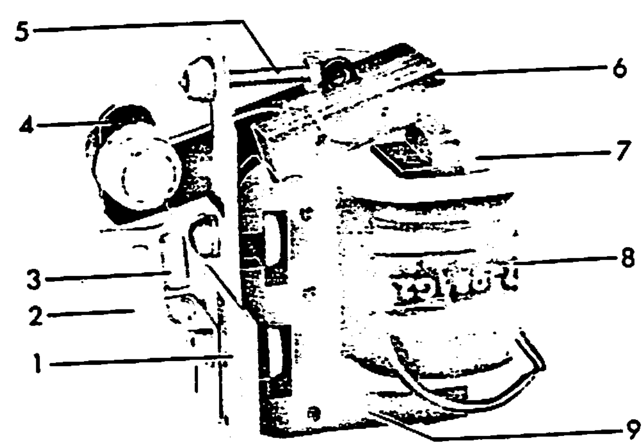


Figure 17. (8041863) Magnetic Trip Device

1. Name Plate
2. Mounting Bracket
3. Spring
4. Trip Arm
5. Adjusting Screw
6. Armature
7. Clamp
8. Coil
9. Magnet

between them. See drawing 138B2454 (Figure 22) with the breaker restored to service with the ground fault detector deactivated, establish whether there is false tripping due to over-current.

FALSE TRIPPING CAUSED BY FAULTY GROUND FAULT DETECTION

If the breaker is equipped for four wire service (fourth C.T. remotely mounted, Figure 18) it is important that the shielding be effective by having continuity from the disconnect plug at the Power Sensor Unit to the external C.T. and further, that this shield be isolated from the signal conductors. It is also important that continuity exists through the ground signal circuit. Check these conditions as follows; referring to Figure 22.

1. Remove connection plug at Power Sensor Unit and check continuity between A and C (Signal). Letters are located on end of plug.
2. Check to be sure no continuity exists between R and A, or between R and C.
3. Temporarily connect jumper from shield to either terminal at remote C.T. and check to assure the shield is continuous from Power Sensor Plug to remote C.T. by checking for continuity between R and A. If continuity does not now exist, shield is not continuous and point of discontinuity must be found. Check the control disconnect as the possible point of discontinuity. Remove jumper at remote C.T. after shield continuity is established.

Note the polarity marks on the ground sensors. Be sure the external ground C.T. senses the neutral current associated with the particular breaker load current and that polarity marks are in accordance with 138B2454 (Figure 22). If the breaker bottom studs connect to the source, the external C.T. must also have its polarity mark toward the source.

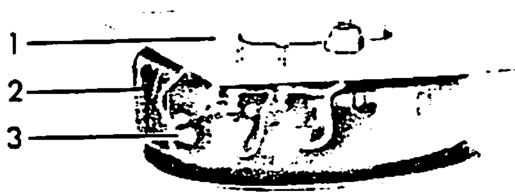


Figure 18. (8041867) Ground Sensor Coil (Remotely Located)

1. Terminal
2. External Ground Sensor Coil
3. White Polarity Dot

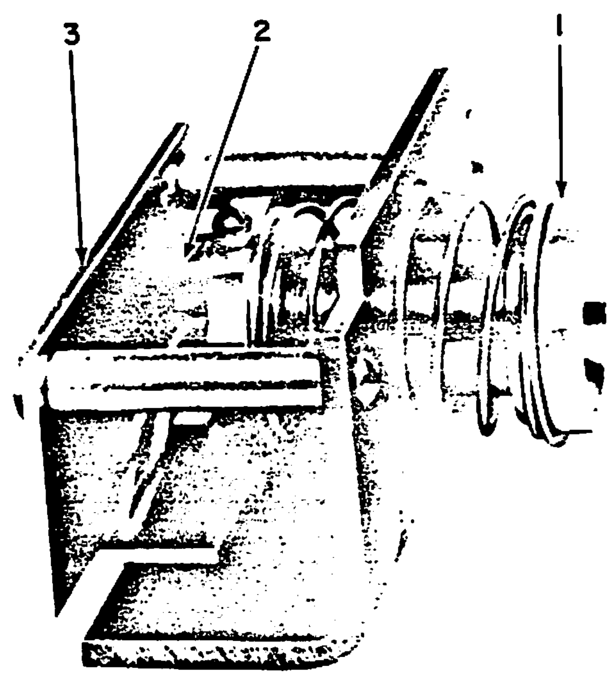


Figure 19. (8918380A) Control Disconnect Plug

1. Female Disconnect Plug
2. Terminal Board
3. Mounting Bracket

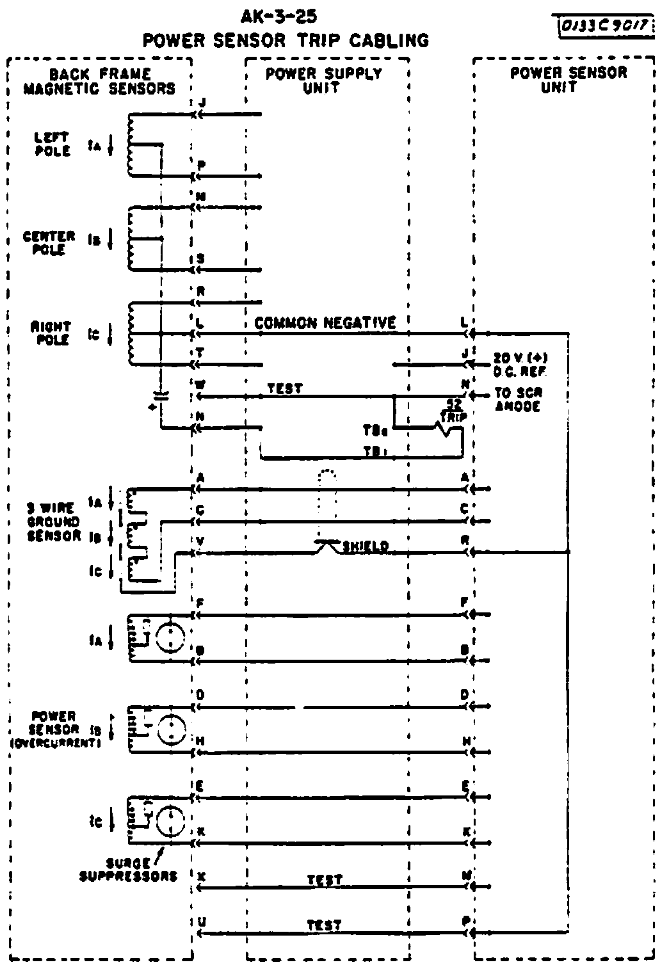


Figure 20. (0133C9017) Power Sensor Cabling Diagram

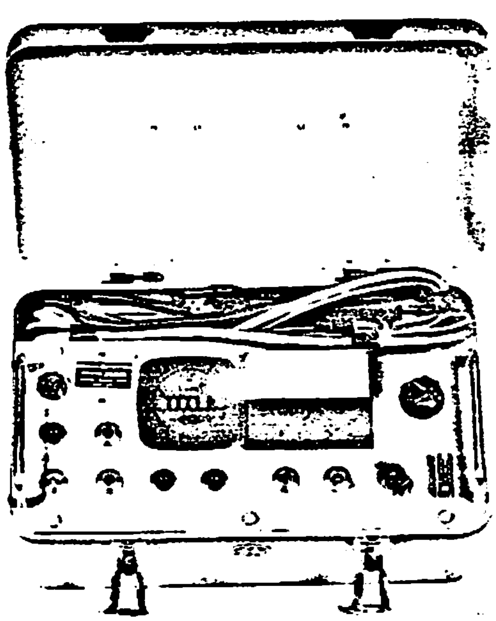


Figure 21. (8039962) Power Sensor Test Kit

TESTING MAGNETIC COILS

After the PST-1 Test Kit has been used to determine the adequacy of performance of the Power Sensor Unit, it may be advisable or required to test the magnetic coils by the use of a hi-current Low voltage type test set. In this event, only one test per phase need be made. This test should be made at some convenient multiple of pick-up setting such as 300% for comparison with published time-current curves.

In the event the breaker is equipped with ground sensor, the ground sensor will cause tripping on single phase testing unless the signal is shorted at the terminal board (Figure 22). Jumper points 1 and 5 during overcurrent test.

The above considerations should indicate which of the four major components is faulty and in need of replacement.

REPLACEMENT OF POWER SENSOR COMPONENTS

POWER SENSOR UNIT (Figure 16).

1. Loosen screw connecting the unit to the front frame.
2. Slide unit forward.
3. Remove control plug by alternately loosening the two retaining screws.
4. Replace in reverse order.

MAGNETIC TRIP DEVICE (Figure 17).

1. Remove trip solenoid wires from the terminal board on power supply.
2. Remove four screws holding power supply to breaker frame.
3. Pull power supply forward until restricted by wiring.
4. Remove two bolts holding trip device to breaker frame.
5. Lift out trip device.
6. Replace in reverse order.

POWER SUPPLY (Figure 15).

1. Remove magnetic trip wires from the terminal board on POWER SUPPLY
2. Remove four screws holding power supply to breaker frame.

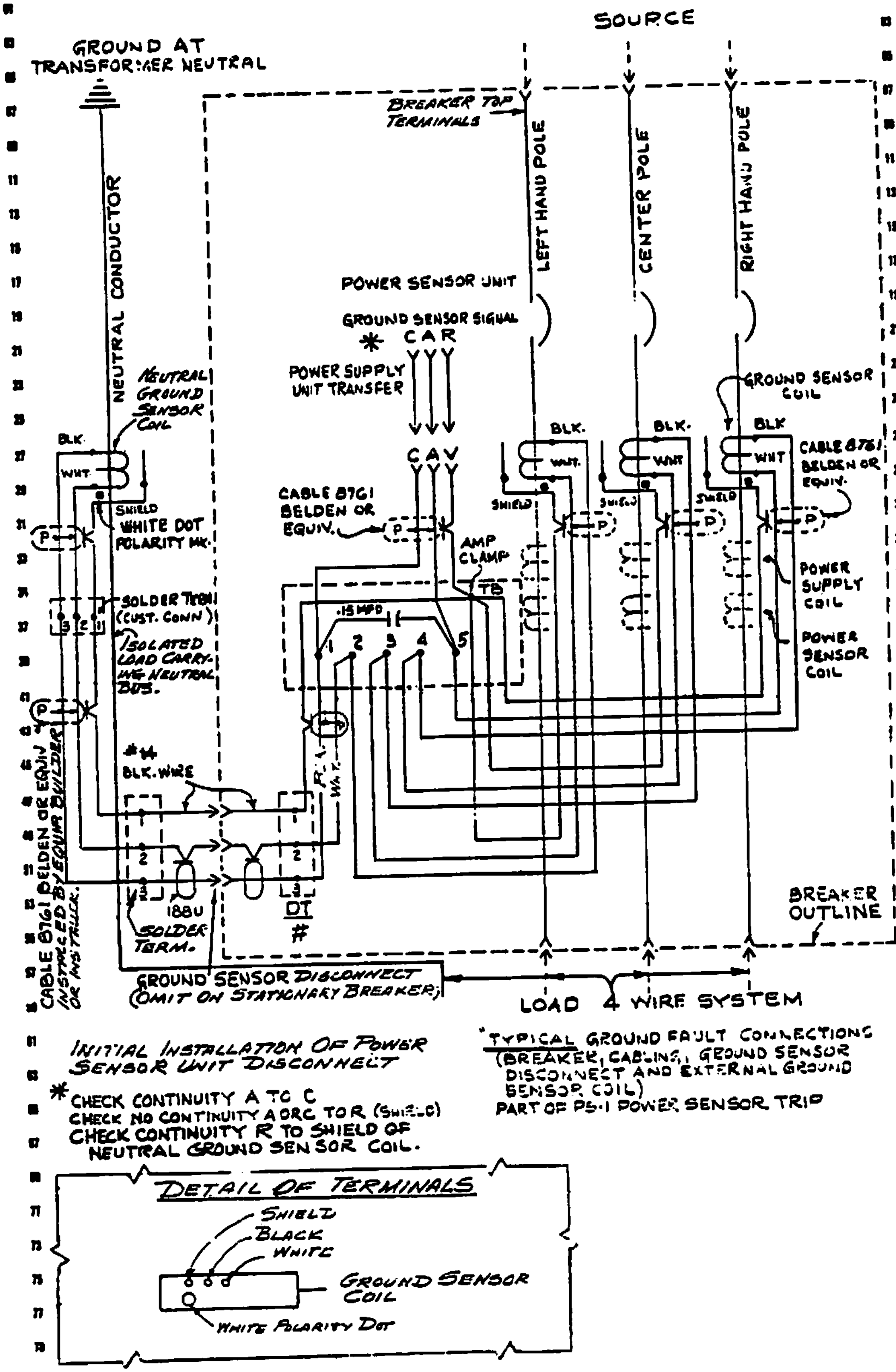


Figure 22. (138B2454) Ground Fault Wiring Diagram

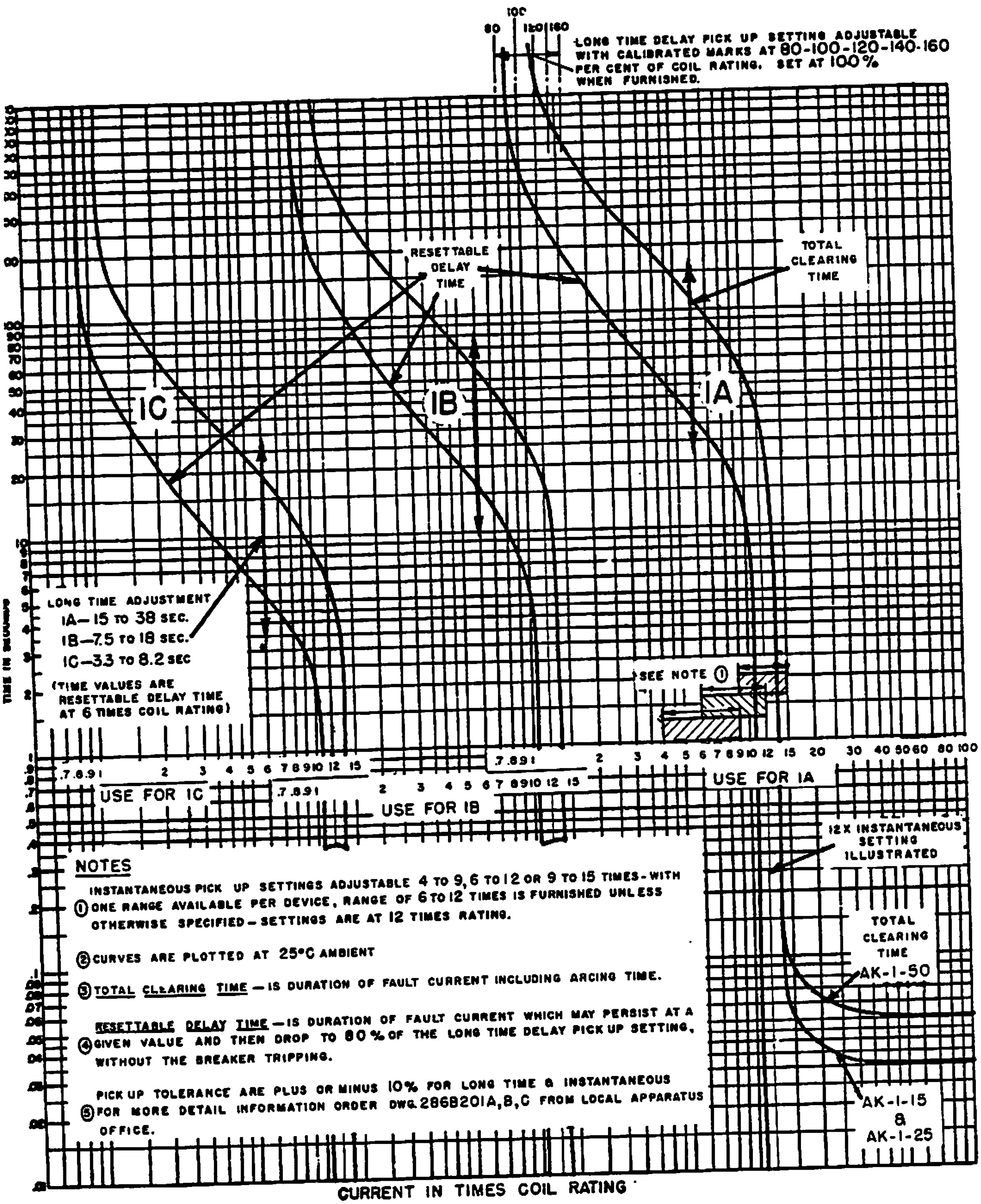


Figure 23. (286B209) Time-Current Characteristic - EC Devices

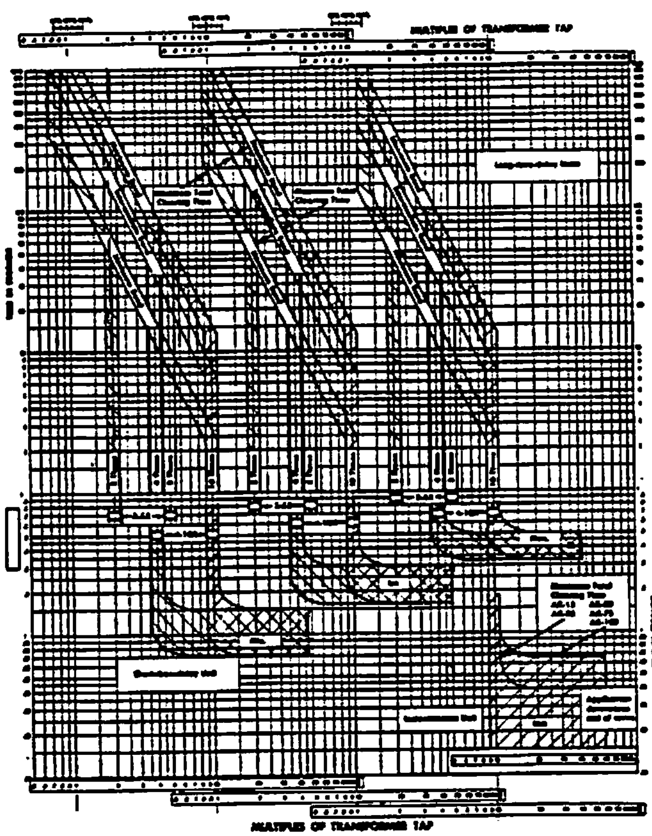


Figure 24. (109HL687) Time Curve

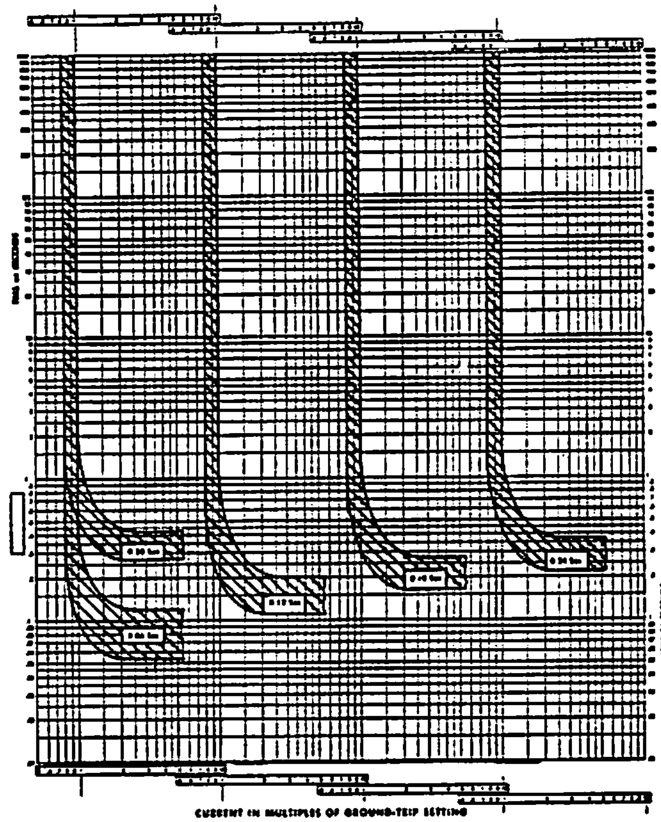


Figure 25. (109HL689) Time Curve

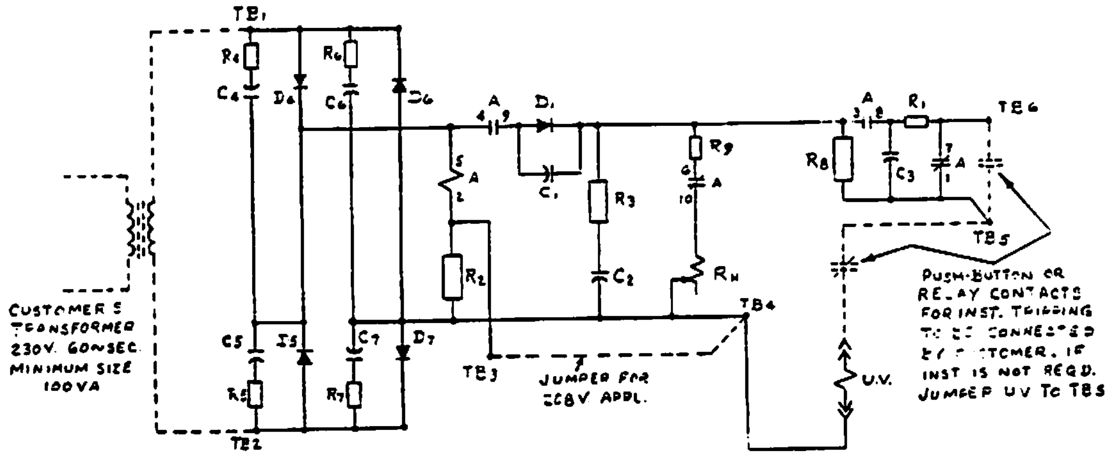
3. Remove four screws holding escutcheon to mechanism frame and remove escutcheon.
4. Disconnect control plug to power sensor coils and power sensor unit.
5. Remove cable clamps holding cabling in place.
6. Remove power supply unit with attached cabling.
7. Replace in reverse order.

SENSOR COILS (Figure 14).

1. Separate the breaker front and back frame as described in the section under "Maintenance".
2. Remove two screws holding sensor coil disconnect plug bracket to back frame.
3. Remove bolt holding resistor bracket to back frame.
4. Remove 2 screws holding capacitor bracket to back frame.
5. Unsolder three leads at ground disconnect and pull wire through hole in back frame. On stationary breakers with fourth wire ground disconnect, unsolder leads at external ground coil and pull wire through hole in back frame.
6. Remove primary disconnects per instructions under disconnects.
7. Remove three 3/8 hexagon headed bolt connecting coils to breaker copper.
8. With the back frame in the vertical position, and supported, grasp the outside coils and lift coil assembly from back frame. When carrying or moving sensor coil assembly, always support the outside coils.

SELECTIVE TRIPPING

Selective overcurrent tripping is the application of circuit breakers in series so that only the circuit breaker nearest the fault opens. Anyone or combination of two or more of the preceding over-current devices may be used in a selective system. The breaker having the shorter time setting and lower pickup will trip before the



A - 250V DC RELAY
C_1, C_4, C_5, C_6, C_7 - .10uf ±10% 600 WVDC
C_2 - 550 uF 350 WVDC
C_3 - 1000 uf 200 WVDC
D_1, D_4, D_5, D_6, D_7 - 1N560 - 600 ma @ 30°C
R_1 - 15 Ω 2W ±5%
R_2 - 1500 Ω 5W ±5%
R_3 - 75 Ω 5W ±5%
R_4 R_5, R_6, R_7 - 10 Ω 1/2 W
R_8 - 2750 Ω 20W ±5%
R_H - 0-25,000 Ω 25 W
R_9 - 500 Ω 3W ±5%

breaker having the longer setting and higher pick-up, provided the fault is on the part of the line protected by the breaker having the lower setting.

For the exact characteristics and setting of each breaker in a selective system, reference should be made to a coordination chart for the particular system. (Figures 23, 24, and 25)

STATIC TIME DELAY UNDERVOLTAGE TRIPPING DEVICE

The Static Time Delay Undervoltage Tripping Device consists of an undervoltage device mounted on the breaker, a static time delay box mounted separately from the breaker and a control power transformer which is also mounted separately from the breaker when the reference voltage is other than DC., 208V AC or 230V AC. Refer to wiring diagram 0102C3698 (Figure 26).

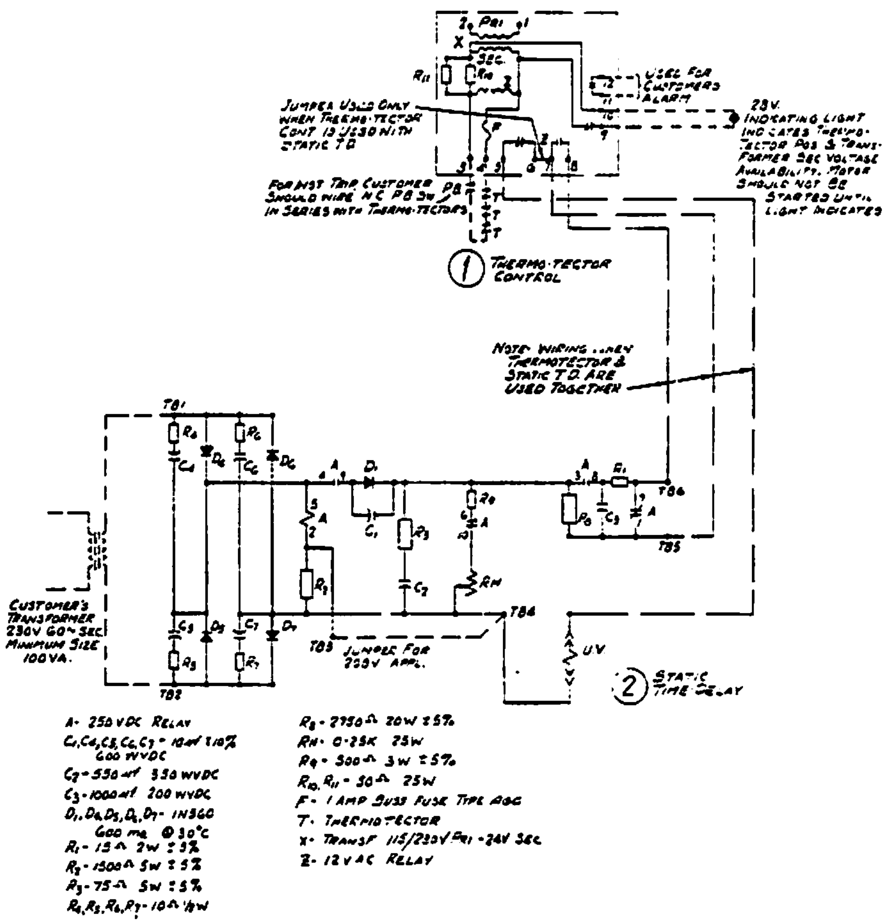
The voltage 208V AC or 230V AC, to be monitored is connected to terminals #1 and #2 of the time delay box. The undervoltage device on the breaker is always connected through either its secondary disconnects or terminal board, to terminals #4 and #5 of the time delay box.

The undervoltage device is set to pickup at approximately 80% of bus voltage and drop out between 30% and 60%.

The undervoltage device coil circuit is continuously rated and will remain picked up as long as the voltage remains above the predetermined drop out voltage. The time delay is field adjustable between 1 and 5 seconds, it is factory set at the minimum setting, and once the time delay is established, it is consistent.

No more than one undervoltage device should be connected to a static time delay box.

The Static Time Delay Undervoltage can also be furnished in conjunction with the termotector control package, as shown on wiring diagram 0102C3699 (Figure 27). Overheating of the motor windings causes the termotector, imbedded in the motor windings, to open and allow the "Z" relay of the control box to instantaneously trip the



breaker through a normally closed "Z" contact in series with the undervoltage device mounted on the breaker.

WARNING - Do not use bell set to check continuity of bridge circuit in static time delay box, only a volt-ohm meter or vacuum tube volt meter should be used.

In the event the device fails to pick-up, the following checks are recommended to determine whether the magnetic device on the breaker or the static time delay unit is the faulty component.

A. Check input voltages across terminals 1 & 2 on static box. These voltages should be as follows:

   1. Device 177L316G-12-208 or 230 volts A.C.

   2. Device 177L316 G-14-125 volts D.C.

   3. Device 177L316 G-15-250 volts D.C.

B. Check output voltages on terminals 4 & 5 with the under voltage device connected. The approximate voltages are as follows:

   1. 208 Volt A.C. 177L316 G-12-110 volts D.C.

      230 Volt A.C. 177L316 G-12-120 volts D.C.

   2. 125 Volt D.C. 177L316 G-14 50 volts D.C.

   3. 250 Volt D.C. 177L316 G-15-100 volts D.C.

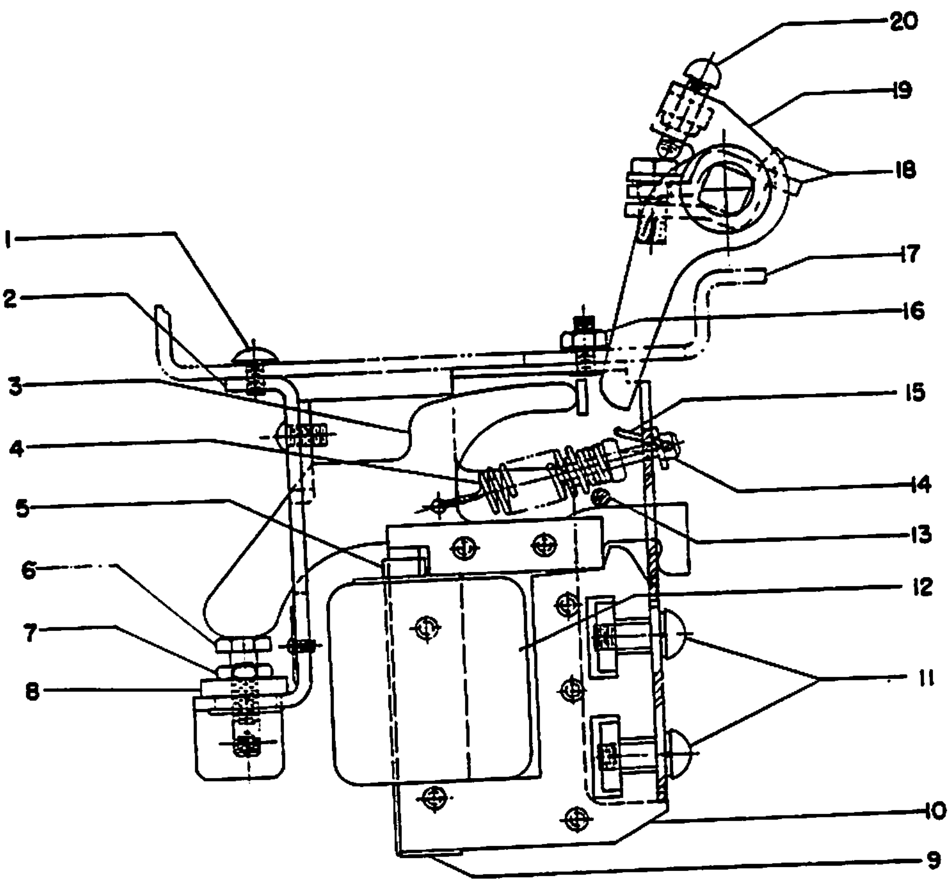
C. The resistance of the under-voltage coils are as follows:

   1. 6275080 G-59 - 1830 Ohms.

   2. 6275081 G-61 - 440 Ohms.

REPLACEMENT

The entire device may be dismounted by disconnecting the coil leads and removing screw (1) and nuts 16. Normally, only the coil (12) will ever need replacement. This may be removed from the device by taking out screws (11) which will free both the magnet (10) and the coil. Straight-



1. Mounting Screw
2. Frame
3. Armature
4. Spring
5. Shading Ring
6. Adjusting Screw
7. Locking Nut
8. Bushing
9. Clamp
10. Magnet
11. Screws
12. Coil
13. Rivet
14. Adjusting Screw
15. Locking Wire
16. Mounting Nut
17. Mechanism Frame
18. Trip Paddle Clamps
19. Trip Paddle
20. Adjusting Screw

Figure 28. (0152C9206) Undervoltage Tripping Device

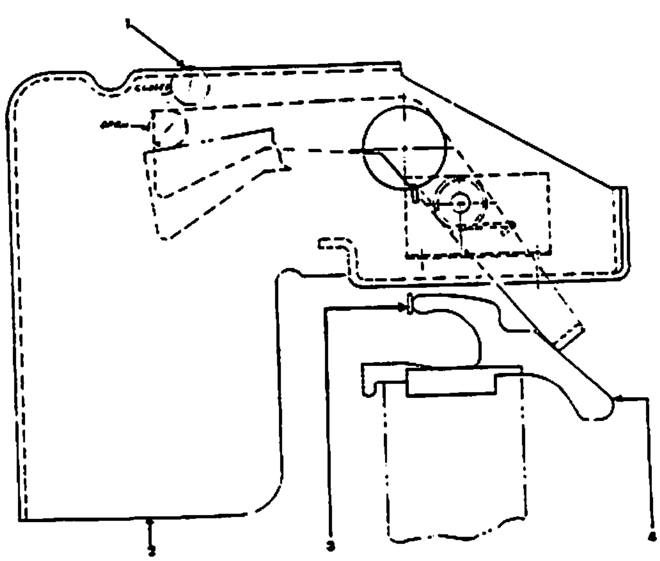


Figure 29. (0101C7842) Undervoltage Lockout Device

1. Cross Bar
2. Left Side Frame
3. Trip Paddle
4. Undervoltage Armature

ening of the bend in clamp (9) will separate the coil from the magnet. The coil leads, of course, must be disconnected.

INSTANTANEOUS UNDERVOLTAGE TRIPPING DEVICE

The instantaneous undervoltage device is mounted in the same location and manner as the static time-delay device and its construction is similar.

The adjustments and replacement of t is device are the same as those described above for the static time-delay undervoltage device.

UNDERVOLTAGE LOCKOUT DEVICE
(Figure 29)

The undervoltage lockout device holds an open breaker trip-free when the coil of the device is deenergized. When the breaker is in the closed position, linkage operated by the breaker mechanism cam positions itself to mechanically hold the undervoltage device armature in the closed air gap position to prevent tripping the breaker in the event the undervoltage device coil is de-energized. This feature when used in conjunction with normally-closed auxiliary contacts of an alternate breaker presents a convenient method of mechanically interlocking two or more breakers to assure that no two breakers may be closed at the same time.

BELL ALARM SWITCH AND/OR LOCKOUT ATTACHMENTS

(Figure 30)

The bell alarm device is mounted on top of the horizontal cross frame member just to the left of the mechanism frame when the breaker is viewed from the front. This device operates a switch with two sets of contacts, one normally open, the other normally closed. The switch may be used to open or close an external circuit, giving a bell or light indication of a protective trip device operation.

If the breaker is tripped open by any means other than the manual trip button or the shunt trip device, the bell alarm mechanism is activated. The alarm is shut off and the bell alarm and lockout mechanism is reset by operation of the manual trip button or shunt trip device. If the device is a bell alarm only, the bell alarm mechanism is also reset simply by closing the breaker.

OPERATION

Lever (2) is connected to the breaker mechanism so that when the breaker opens lever (2) rotates counterclockwise about pin (14). The motion is transmitted through links (1) and (13) to paddle (12) which operates bell alarm switch (11). If the device has the lockout feature, the movement of link (13) also causes lockout link (8) to slide in a direction that results in its striking trip paddle (5) which, by displacement of the breaker mechanism trip latch, makes it impossible to reset the breaker mechanism until the bell alarm mechanism is reset.

Link (6) serves as a latch in the bell alarm mechanism. If it is displaced, link (10) is free to rotate about its lower pin. This deprives the linkage of its normally fixed center of rotation about pin (15) and defeats both the bell alarm and the lockout operation. Operation of either the manual trip button or the shunt trip device will displace latch (6) and have this effect. Thus if the breaker is tripped by either of these means, the bell alarm and/or lockout will not operate. Also, operation of either of these devices will reset the switch and inactivate the lockout.

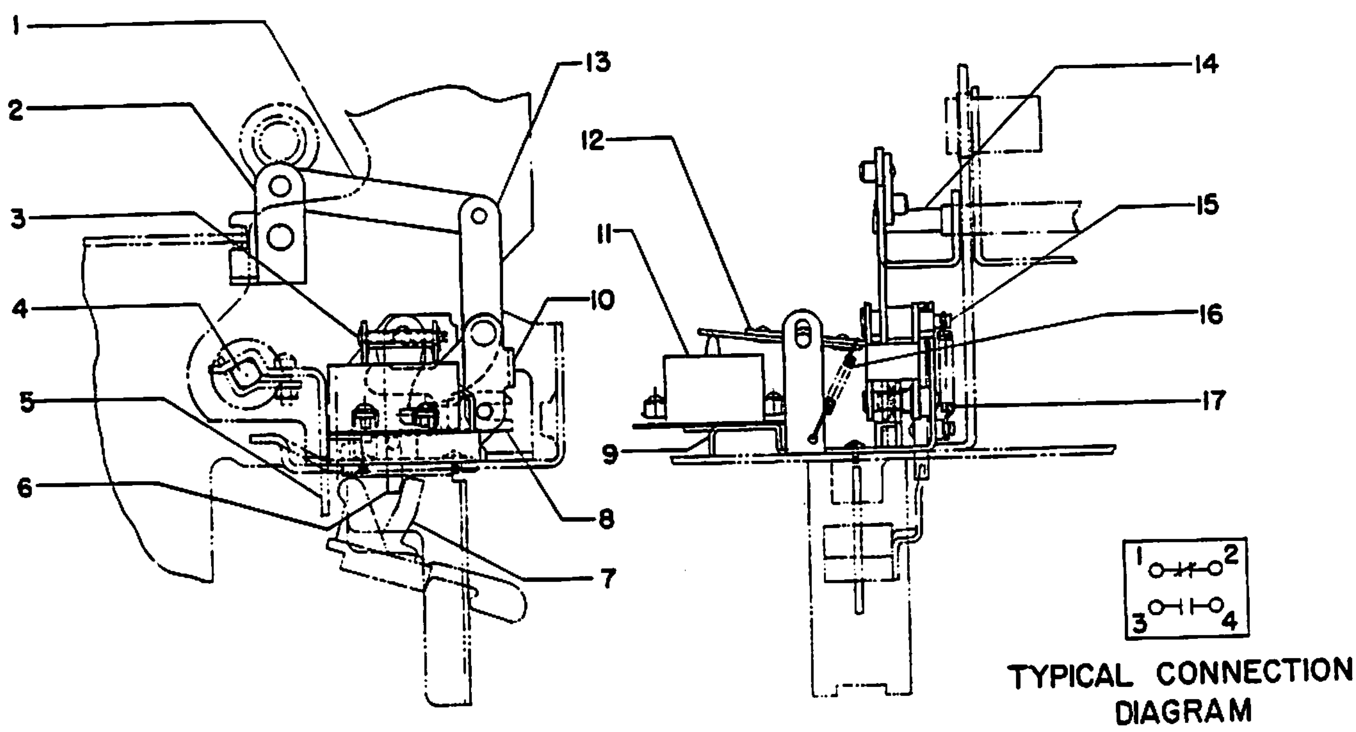


Figure 30. (695C158) Bell Alarm and Lockout Device

1. Link
2. Lever
3. Pin
4. Trip Shaft
5. Trip Paddle
6. Link
7. Trip Arm
8. Lockout Link
9. Frame
10. Link
11. Switch
12. Paddle
13. Link
14. Pin
15. Pin
16. Springs
17. Spring

OPEN FUSE LOCKOUT DEVICE
(Figure 31)

The Open Fuse Lockout Device consists of two or three separately operated devices (one per phase). Each wired in parallel to corresponding breaker fuses. This device is furnished on all AKU breakers. The purpose of this device is to trip the breaker upon the blowing of any one of the breaker fuses and render the breaker trip free until the blown fuse is replaced and the associated coil assembly reset.

OPERATION, Figure 31.

When any one of the breaker fuses blow, the coil (6) in that phase is energized and the armature (5) closes. With the armature closed, leaver (2) slips under the armature and latches it in the closed position. The latched closed armature holds the breaker in the trip free position until it is released by pushing the associated reset button (1). The coil is deenergized as soon as the breaker opens.

ADJUSTMENTS

1. Set top cylindrical collor (not shown) to engage the trip shaft paddle in the tripped position.

2. Check that each armature holds the breaker trip free when the armature position is limited in reset by the lower latch surface on the indicator.

3. With the breaker in the closed position, the top collor must clear the trip shaft paddle by more than 1/32 inch.

REPLACEMENT

1. Remove three mounting screws at top of device.

2. Remove coil leads from fuses and work wire harness back to the device. Remove device from breaker.

3. Replace new unit in reverse order and check procedure under ADJUSTMENTS.

AKD-5 INTERLOCK
(Figure 32)

The rackout mechanism is interlocked so that the circuit breaker must be open before the operating handle can be inserted. When the breaker is closed, the interlock link (1) operated by the breaker cross bar blocks the interlock linkage on the rackout mechanism.

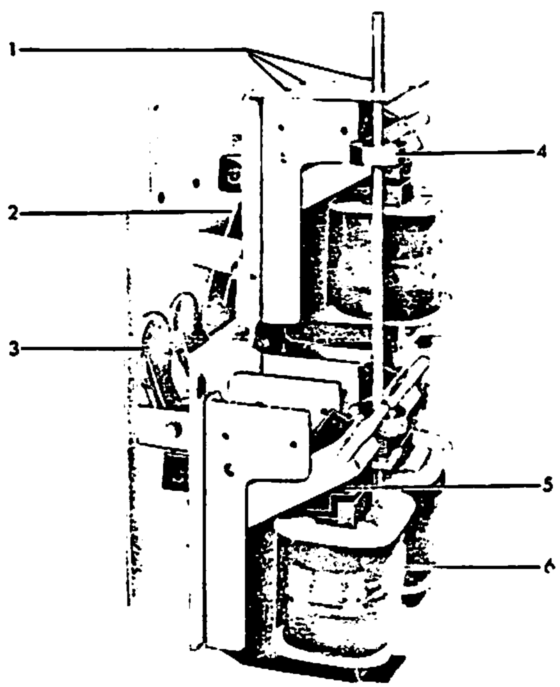


Figure 31. (8041865) Open Fuse Lockout Device

1. Mounting Holes
2. Lever
3. Reset Button
4. Collor
5. Armature
6. Coil

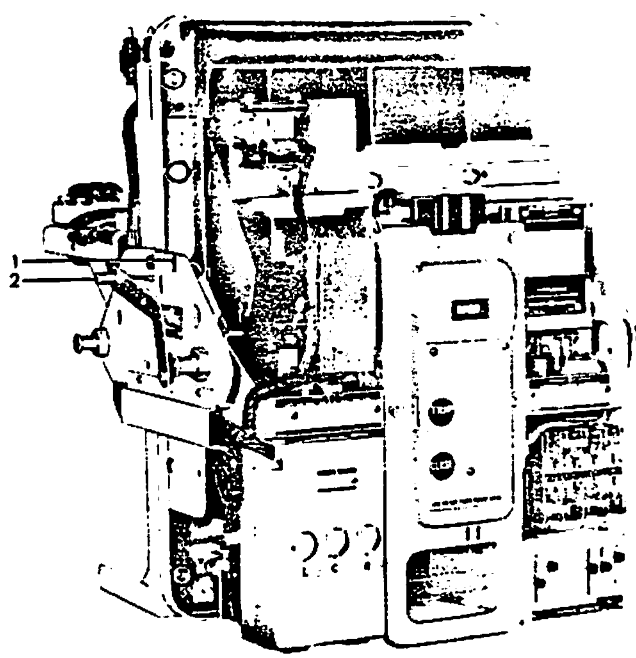


Figure 32. (8039852) AKD-5 Interlock

1. Rackout Mechanism Interlock
2. Trip Interlock

MISCELLANEOUS

Changes in breaker requirements may occasionally bring about the necessity of adding or changing breaker components or accessories in the field. The AK-2 breaker has been designed so that such additions or conversions are simple and easy to make, requiring only a minimum of time or skill on the part of the operator.

Special instructional drawings are available which will further simplfy the addition of such accessories to breakers which were originally shipped without them.

These drawings will accompany the necessary material when it is shipped from the factory. They will also be available upon request. The drawings and the accessory additions which they cover are listed below.

When an accessory is added to a breaker, it is recommended that the section of instructions contained herein covering that particular accessory be reviewed, in addition to referring to the following instructional drawing. Any adjustments described in these instructions should be carefully made after the device has been assembled on the breaker.

Conversion of breakers from manual to electrical operation is also covered on an instructional drawing. This operation consists simply of separation of the front and back frames of the breaker as described under "Maintenance" in these instructions and the reassembly of the existing back frame with the new front frame.

Addition of	Covered By
Shunt Trip Device	698C900
Auxiliary Switch	698C901
Undervoltage Device	698C902
Bell Alarm & Lockout Device	698C904
Drawout Mechanism	698C922
Conversion to Elec. Oper.	698C904

MAINTENANCE TOOLS

The following tools are recommended for proper maintenance of AK-2-15 and AK-2/3-25 breakers. (NOTE: Obtain from local hardware firm; do not order on General Electric Company.)

Screw Drivers

Long thin, slotted screw
Standard, slotted screw
Phillips, No. 2, (8" shaft)

Pliers

Waldes Truarc, No. 2 straight
Long Nose, side cutting, 6"

End Wrenches

Adjustable, 8"
1/4" open end

Allen Head Wrenches

5/16" for 3/8" screw
1/8" for 1/4" screw

Socket Wrenches (3/8" drive)

Ratchet Handle
12" extension bar
3/8" socket
9/16" socket
7/16" socket (long)

Miscellaneous Tools

1/4" Spintite (long shank)
7/16" Spintite
8-32 screw (at least 2" long)

RENEWAL PARTS

When ordering renewal parts, address the nearest Sales Office of the General Electric Company, specifying the quantity required. Complete nameplate data of the breaker involved should be given as well as an accurate description of the parts required. If the parts needed are illustrated in this book, refer to the figure number and part number involved.

Renewal Parts which are furnished may not be identical to the original parts since from time to time design changes may be made. The parts supplied, however, will be interchangeable with the original parts.

Renewal Parts Bulletin

Bulletin	Breaker Type
GEF-4149F	AK-2-15/25 AK-3-25

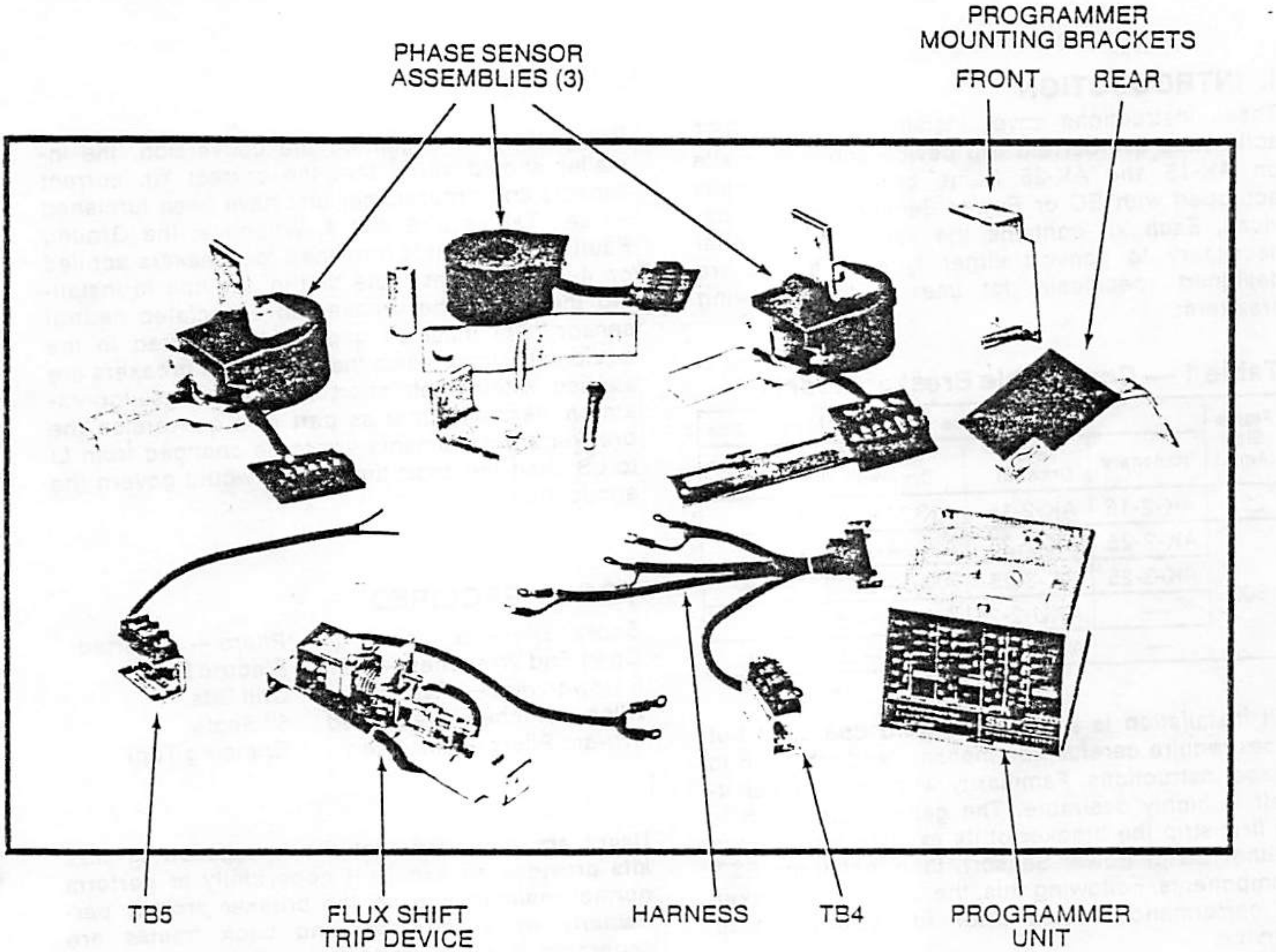
GENERAL ELECTRIC COMPANY
CIRCUIT PROTECTIVE DEVICES DEPARTMENT
PLAINVILLE, CONNECTICUT 06062

GENERAL ELECTRIC

8–79 (2M)

Conversion Kits

For Installing the SST Solid State Overcurrent Trip Device on Low Voltage Power Circuit Breaker Types AK-15 and AK/AKU-25



Components of SST Conversion Kit for AK-15/25

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.

CONVERTING AK-15/25 BREAKERS TO THE SST TRIP DEVICE

CONTENTS

I. INTRODUCTION

These instructions cover installation of the SST solid state overcurrent trip device conversion kits on AK-15 and AK-25 frame breakers originally equipped with EC or Power Sensor type trip devices. Each kit contains the variety of material necessary to convert either type. The kits are designed specifically for use on the following breakers:

Table 1 — Convertible Breaker Models

Frame Size (Amp.)	Breaker Type			Trip Device	
	Stationary	AKD Drawout	AKD-5 Drawout	EC	Power Sensor
225	AK-2-15	AK-2-15	AK-2A-15	x	
600	AK-2-25	AK-2-25	AK-2A-25	x	
	AK-3-25	AK-3-25	AK-3A-25		x
	—	AKU-2-25	AKU-2A-25	x	
	—	AKU-3-25	AKU-3A-25		x

Kit installation is a straightforward operation but does require careful workmanship and attention to these instructions. Familiarity with the breaker itself is highly desirable. The general approach is to first strip the breaker of its existing trip devices (either EC or Power Sensor), then install the SST components. Following this, the converted breaker is performance tested prior to restoring it to service.

For the majority of breaker models listed in Table 1, kit installation does not require any customized assembly work. However, some conversions may involve unusual mounting circumstances or accessory combinations which necessitate minor modification/relocation of a component(s). In most instances this supplementary work can be done on site.

Preparatory to beginning the conversion, the installer should verify that the correct kit, current sensors and programmer unit have been furnished — see Tables 2, 3 and 4. Whenever the Ground Fault trip element is furnished for breakers applied on 4-wire systems, note that in addition to installing the kit on the breaker an associated neutral sensor (CT) must be separately mounted in the equipment. Insure also that retrofitted breakers are applied within their short circuit ratings; for example, assuming that as part of a conversion the breaker's trip elements are to be changed from LI to LS, then the short time rating would govern the application.

TOOLS REQUIRED

Socket Set — 3/8″ drive	Pliers — Assorted
Open End Wrenches — Set	Electric Drill
Screwdrivers — Assorted	Drill Bits
Allen wrenches — Assorted	6″ Scale
Tru-arc Pliers — Assorted	Crimping Tool

Users are reminded that the installation of SST kits provides an excellent opportunity to perform normal maintenance on the breaker proper, particularly while the front and back frames are separated. Renewal parts are available as listed in Bulletin GEF-4149G, a copy of which is included with each SST Kit.

Table 2 — Basic Conversion Kits for AK-15/25, AKU-25

Breaker Mounting Type	Basic Kit Cat. 343L692-(Gp. No.)			
	With 4th-Wire Neutral Sensor		W/O 4th-Wire Neutral Sensor	
	Man.	Elec.	Man.	Elec.
Stationary	G3	G4	G1	G2
AKD & AKD-5 Drawout	G5	G6		

Table 4 — Tapped Current Sensors for Use with SST Conversion Kits

Breaker Type	Sensor Ampere Range	Cat. 343L692-(Gp. No.)	
		Phase Sensors	4th-Wire Neutral Sensor
AK-15	70-225	G37	G67
AK-25, AKU-25	70-225		
	200-600	G38	G68

Table 3 — Programmer Units for AK-15/25, AKU-25 SST Conversion Kits

Trip Elements ①	Cat. 343L692-(Gp. No.)		
	Short-Time Pickup		
	None	1.75L-4L	3L-10L
LS	—	G19	G13
LI	G14	—	—
LSI	—	G20	G15
LSG	—	G21	G16
LIG	G17	—	—
LSIG	—	G22	G18

① Trip Element Abbreviations
L = Long Time
S = Short Time
I = Instantaneous
G = Ground Fault

II. PREPARING THE BREAKER

WARNING: Before starting any work, disconnect the breaker from all power sources (primary and secondary) and place in a clean work area.

1. Remove the steel arc quencher retainer by loosening the two ¼ x 20 hex capnuts. On electrically operated AK-3/3A-25 breakers the "Y" relay is mounted on the left end of the retainer, but there is no need to remove it.

2. Remove the three arc quenchers by lifting upward and outward.

3. Separate the breaker's front and back frames. Refer to Maintenance Manual GEI-50299 page 5; if Power Sensor, see pp. 28-31 also.

CAUTION: Be careful to avoid damage to breaker components during this operation.

4. Remove the overcurrent trip devices. Refer to Maintenance Manual GEI-50299 pp. 23, 31.

5. On drawout breakers, remove the primary disconnect fingers from the bottom (loadside) copper studs. Refer to Maintenance Manual GEI-50299 page 7.

6. Remove the three bottom (loadside) copper stud assemblies. On Power Sensor equipped breakers this will have been done during Step 4 above.

7. On electrically operated breakers equipped with EC trip devices, the "Y" relay is mounted on the front frame at the right side of the operating mechanism. To provide mounting space for the SST flux shift trip device, remove the "Y" relay and remount it on the left end of the arc quencher retainer as shown in Figs. 1 and 2 (using hardware and parts included). Modify the breaker's wiring harness to suit.

8. On EC equipped breakers, remove and discard the four trip device support brackets mounted along the lower front of the back frame. See Fig. 3. At this point the breaker back frame is ready for installation of the kit.

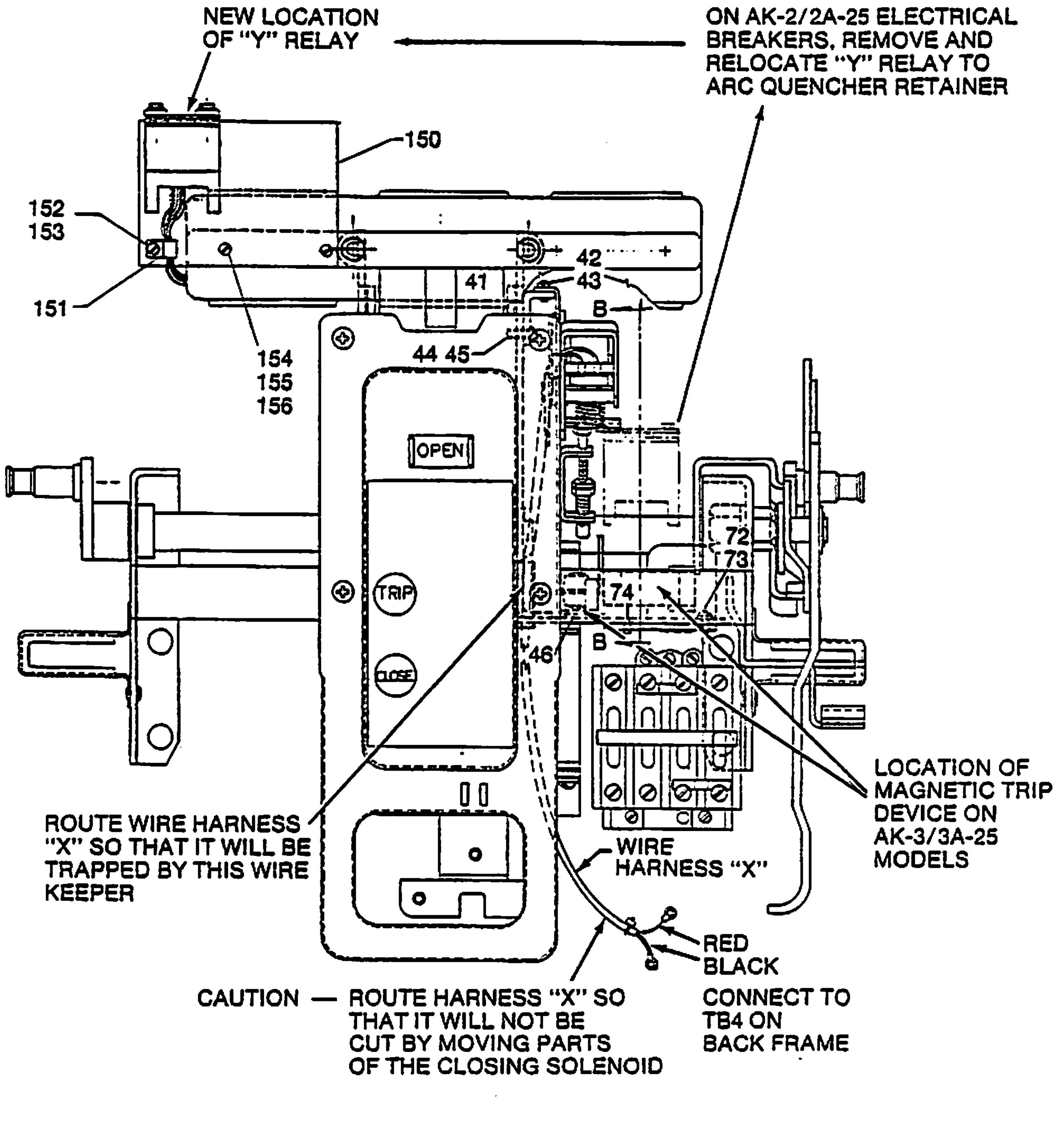


Fig. 1 — Front view of front frame (AKD type drawout shown)

* RE denotes reuse of existing hardware

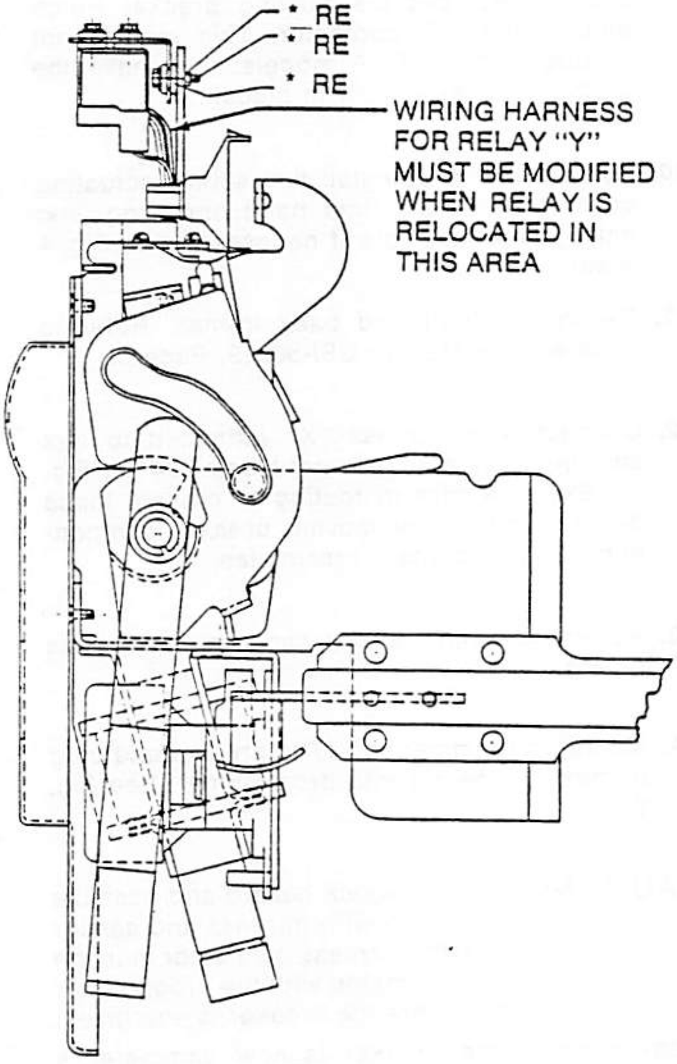


Fig. 2 — Right side view of front frame

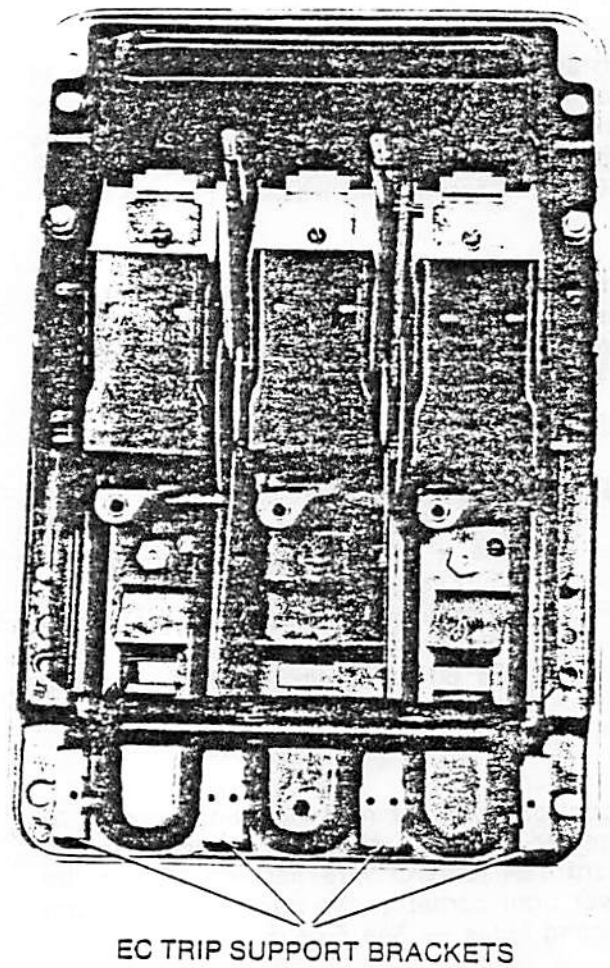


Fig. 3 — Front view of rear frame

III INSTALLING THE KIT

1. Modify the left and right pole lower stud insulator shields per Fig. 8; remount on back plate using original screws and special nut (Item 93 on Fig. 7) supplied with kit.

2. Assemble and mount the three current sensor (CT) assemblies to the back frame. See Figs. 5, 6 and 7. Proceed with each pole by first inserting lower copper stud 90 through the back plate and attaching it via the mounting screw; then position CT 18 with its terminals toward the rear and loosely mount it to stud 90 with copper parts 91 and 92; align the assembly and torque the two ⅜″ bolts in strap 91 to 25 ft.-lbs. each to assure proper contact integrity.

3. Install CT terminal board mounting bracket 80 below the CT's using the (2) 8-32 x ½″ screws provided. See Fig. 5. Mount terminal boards TB1, TB2 and TB3 to the bracket using the (6) 6-32 x ½″ screws and washers provided.

4. On drawout type breakers, remount the primary disconnect fingers on the new lower studs. Refer to Maintenance Manual GEI-50299 pp. 7 and 13.

CAUTION: Adequate primary contact force is mandatory. Tighten the nuts on the ¼ x 20 mounting bolts to obtain a spring dimension of 13/16 to 27/32. The proper dimensions between contact fingers is 7/16″. Proper contact force is 60 to 70 lbs. with the contacts spread to ½″.

5. Mount programmer rear mounting bracket 70 together with flux shift trip device terminal board TB4 (part of wire harness 100) to the lower right corner of the back frame utilizing existing holes — See Figs. 5 and 6.

6. Install wire harness 100 on back frame and connect per instructions on Figs. 9, 12 or 16 as applicable to the particular breaker type involved. For tie-down and forming details, see Fig. 5.

   This step completes conversion of the back frame — see example illustrated in Fig. 4.

7. Proceeding next to the front frame, mount the flux shift trip paddle on the breaker's trip shaft per Figs. 17 and 18.

8. Mount the flux shift trip device per Figs. 17 and 19. NOTE: Adjustment of trip rod length will be performed later in Step 13.

9. Install programmer front mounting bracket 71 to the underside of the front frame per Fig. 21. On AK-2/2A electrically operated models, this bracket replaces the existing bracket which mounts the "X" contactor. This step is not required on AK-3/3A models; they have the proper bracket already in place.

10. Reference Fig. 6, install flux shifter actuating bushing 49 in the right hand operating link; enlarge the link hole if necessary. See Fig. 4 also.

11. Rejoin the front and back frames. Refer to Maintenance Manual GEI-50299, Page 5.

12. Connect wire harness "X" (attached to flux shift trip device) to terminal block TB4 per Fig. 20. Exercise care in routing to prevent leads being damaged by moving breaker components such as contact assemblies.

13. Adjust flux shift trip rod gap per instructions on Fig. 17.

14. Mount programmer unit 17 to breaker and plug harness connector into programmer. See Fig. 21.

CAUTION: To avoid shock hazard and possible damage to wire harness and sensor coils, the harness connector must be securely mated with the programmer unit before the breaker is energized.

Conversion of the breaker is now complete. A typical example is shown in Fig. 22.

Proceed next to Section IV — EQUIPMENT MODIFICATIONS. If these are not required, proceed directly to Section V — FUNCTIONAL TESTING.

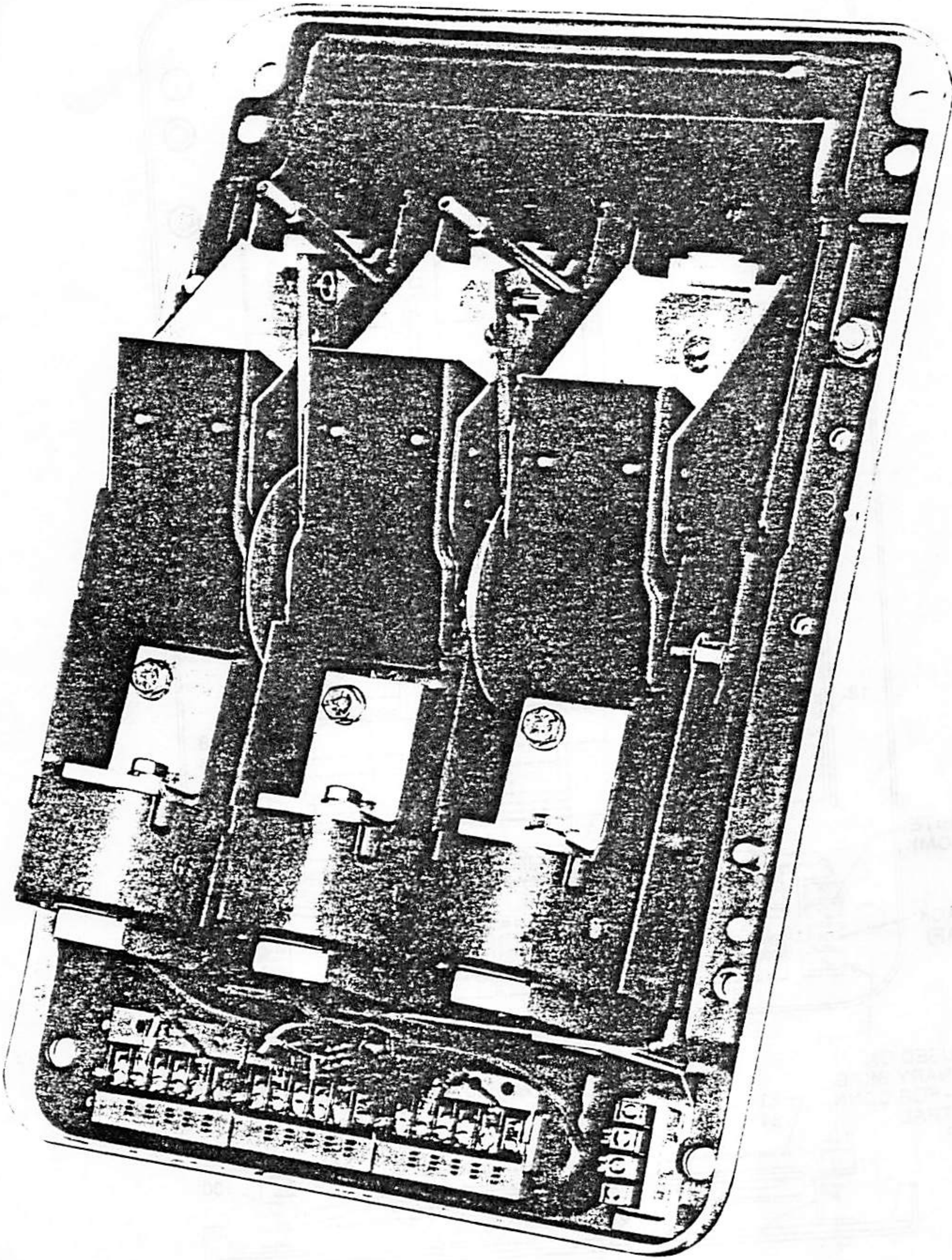


Fig. 4 — AK-25 back frame with SST conversion components installed and ready for reassembly to front frame.

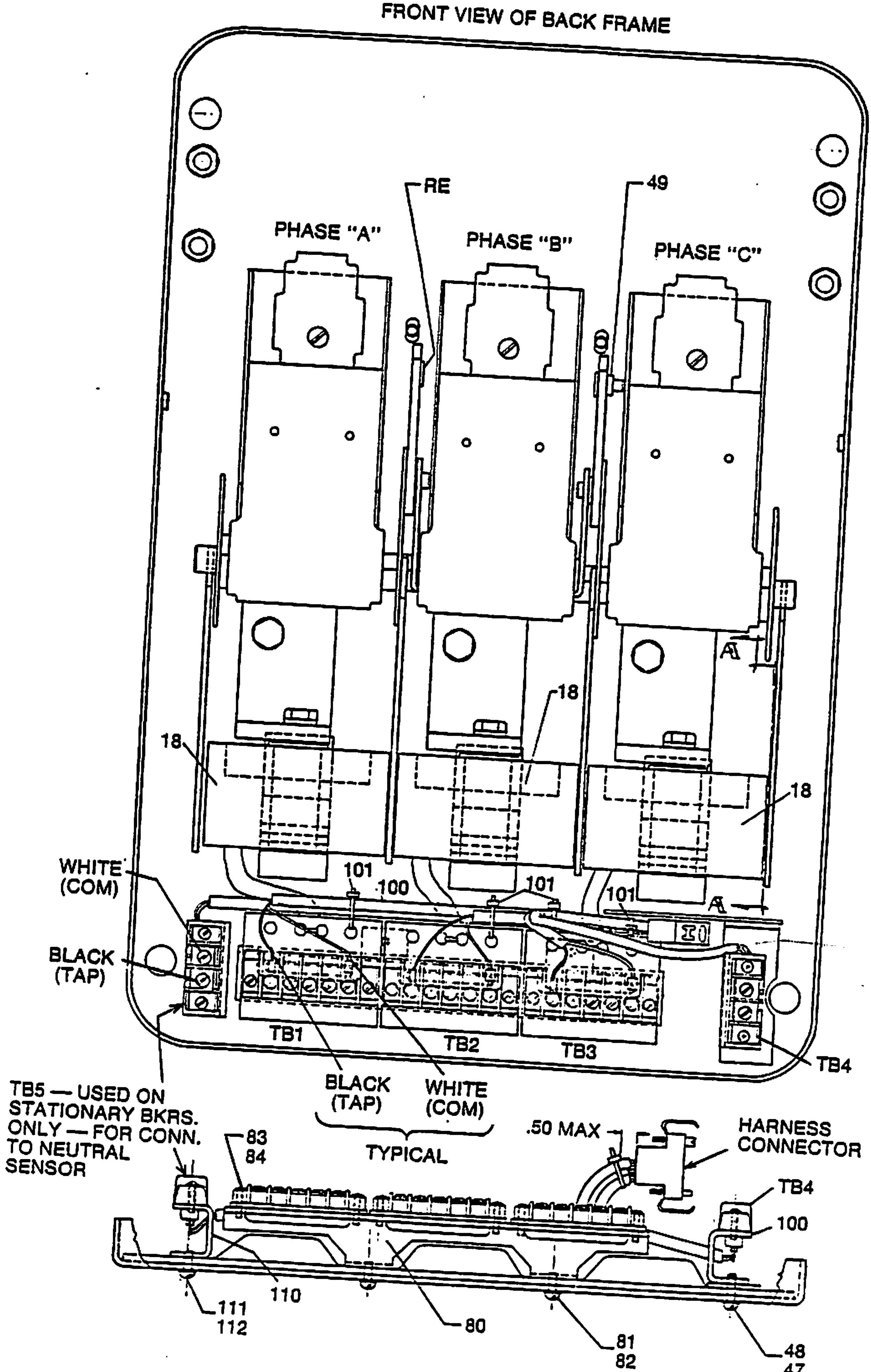


Fig. 5 — Back frame assembly

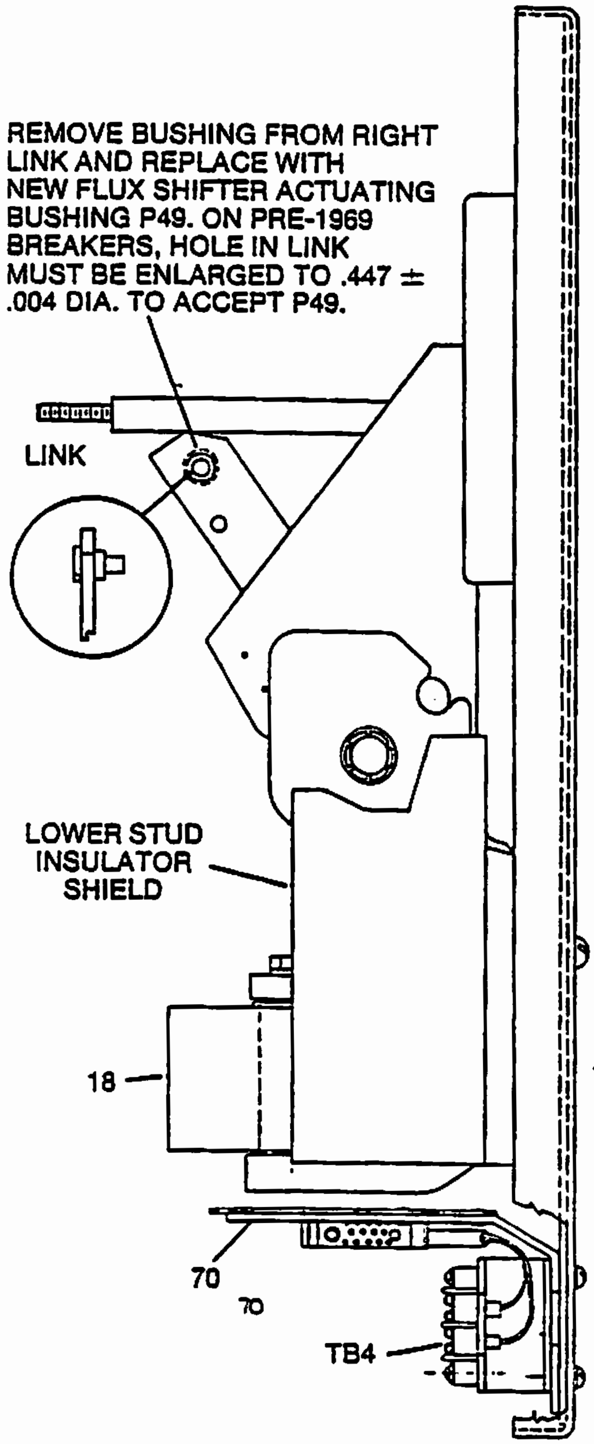


Fig. 6 — Right side view of back frame

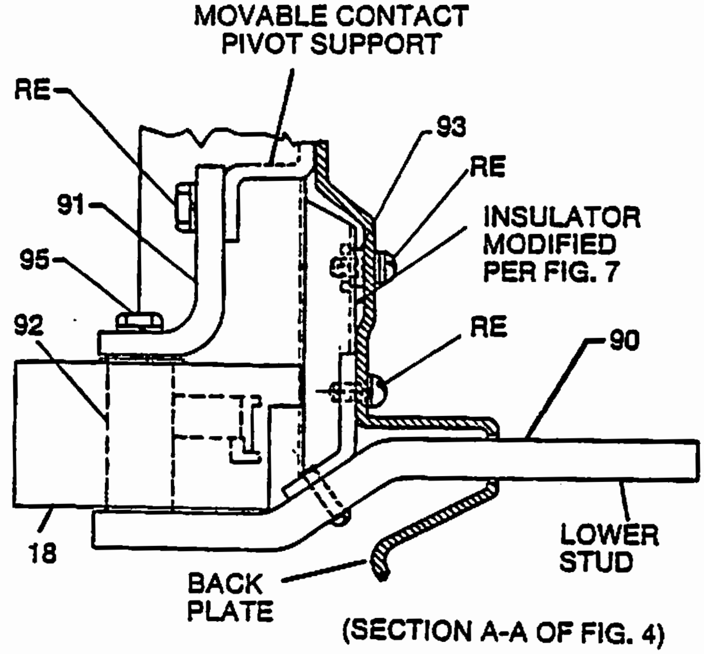


Fig. 7 — Phase sensor assembly, right side view

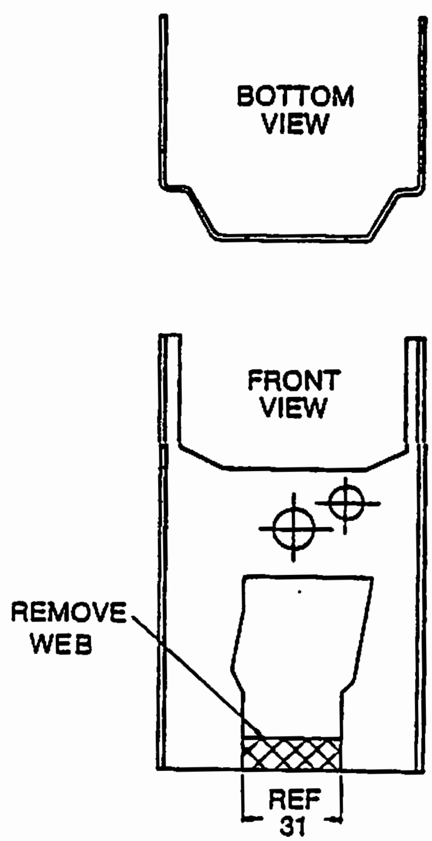


Fig. 8 — Stud insulator modification

FRONT VIEW OF BACK FRAME

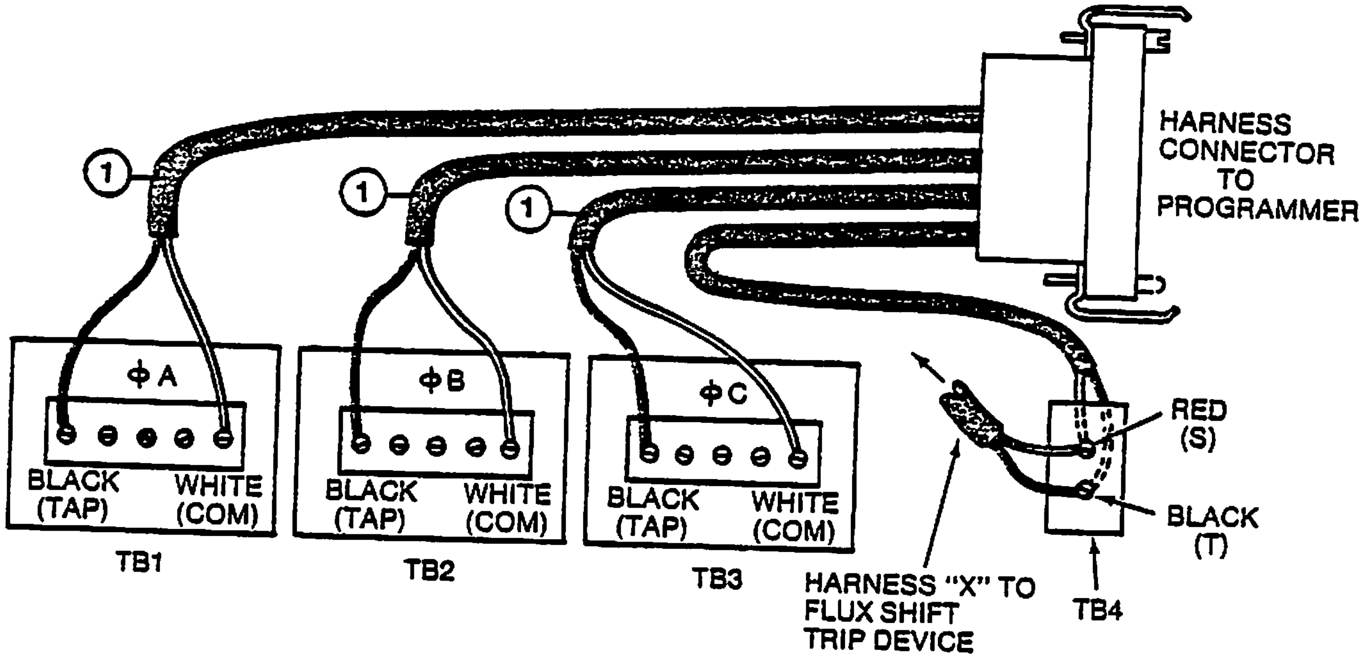


FIG. 9 **Harness connections for all drawout and stationary breakers used on 3-wire systems — with and without ground fault. For elementary diagram see Figs. 10 & 11.**

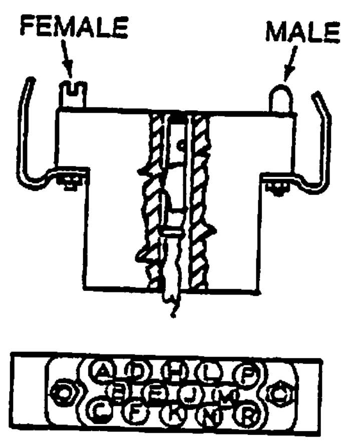
INSTALLATION STEPS

1. Connect the A, B and C Phase Sensor Leads respectively to TB1, TB2 and TB3. Identify per Table 5.

TABLE 5 — Harness Connections

Component	From Terminal Board	Wire Color	To Harness Connector Socket Number
Phase A Sensor	TB1	White Black	A C
Phase B Sensor	TB2	White Black	D F
Phase C Sensor	TB3	White Black	H K
Flux Shift Trip Device	TB4	Red Black	B E
4th-Wire Neutral* Sensor	TB5 or Secondary Disconnect	White Black	L N

*Used only with 4-wire Ground Fault.



HARNESS CONNECTOR

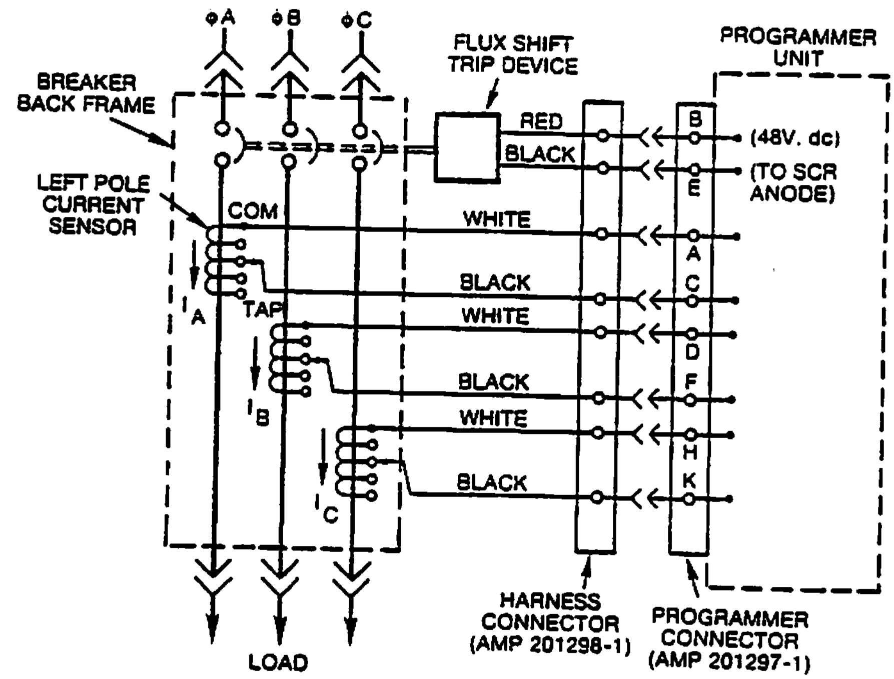


Fig. 10 — Cabling Diagram — SST without ground fault.

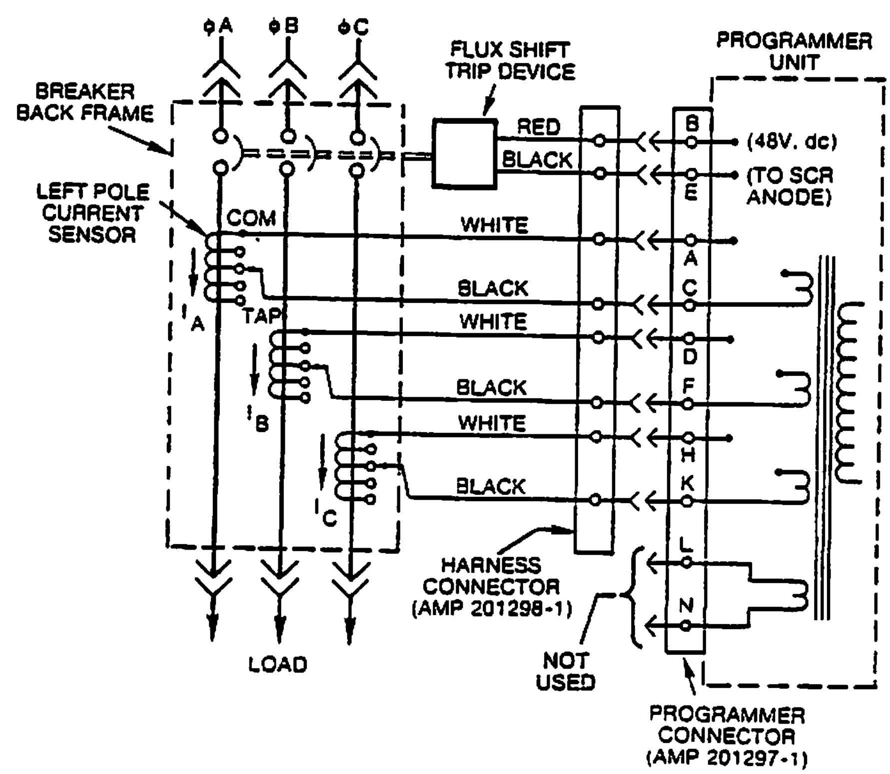


Fig. 11 — Cabling Diagram — SST with ground fault on 3-wire load.

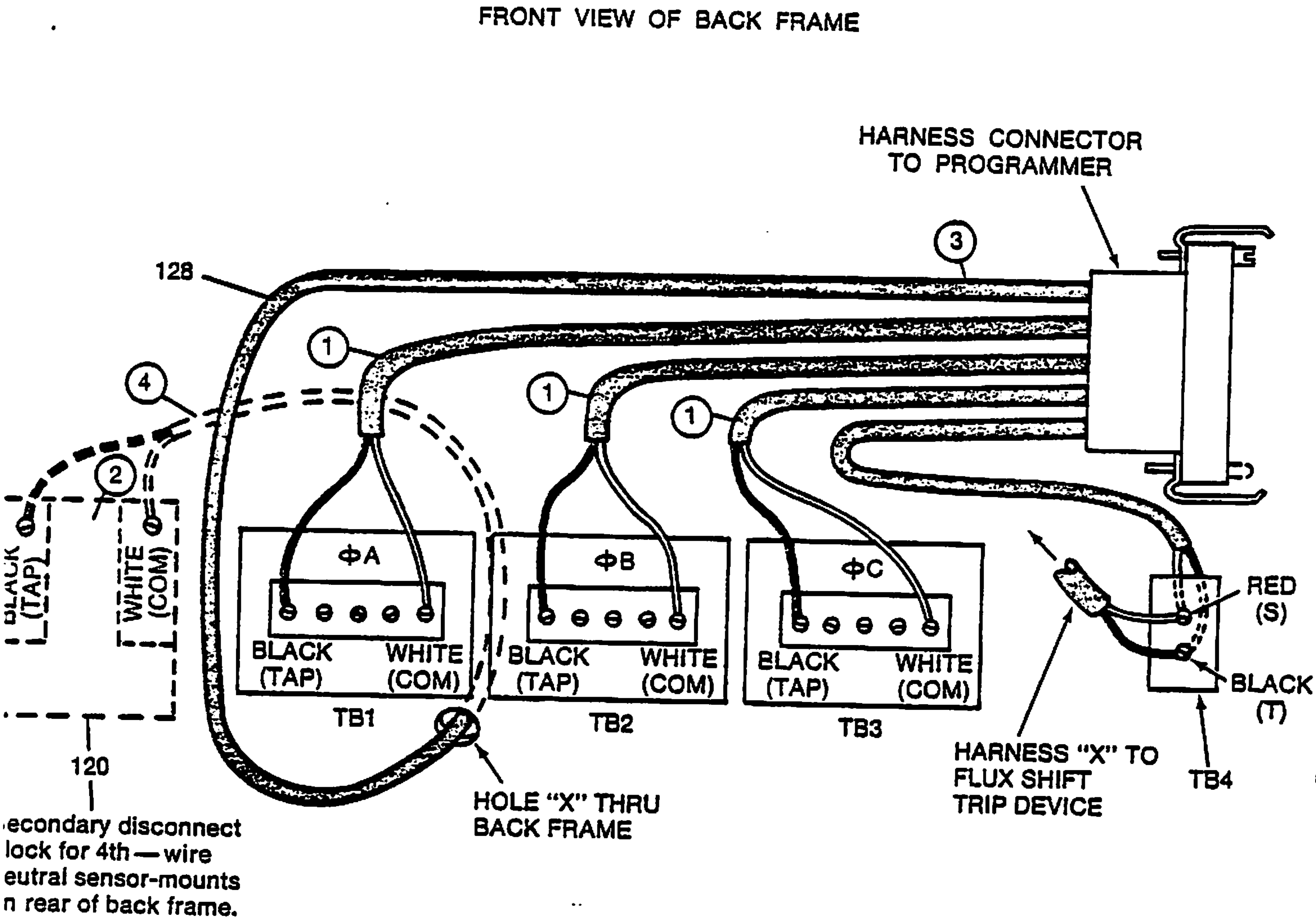


FIG. 12 **Harness connections for all drawout breakers equipped with 4-wire ground fault. For elementary diagram see Fig. 14.**

INSTALLATION STEPS

1. Connect the A, B, and C phase sensor leads respectively to TB1, TB2 & TB3. Identify per Table 5.
2. Mount the neutral sensor disconnect block 120 to the rear of the back frame per Fig. 13. Use existing mounting holes.
3. Insert the two prepared leads of harness 128 into the harness connector: Black to socket N, white to socket L.
4. Feed the opposite end of harness 128 thru hole "X" in the back frame and connect leads to block 120 as shown in Fig. 13.

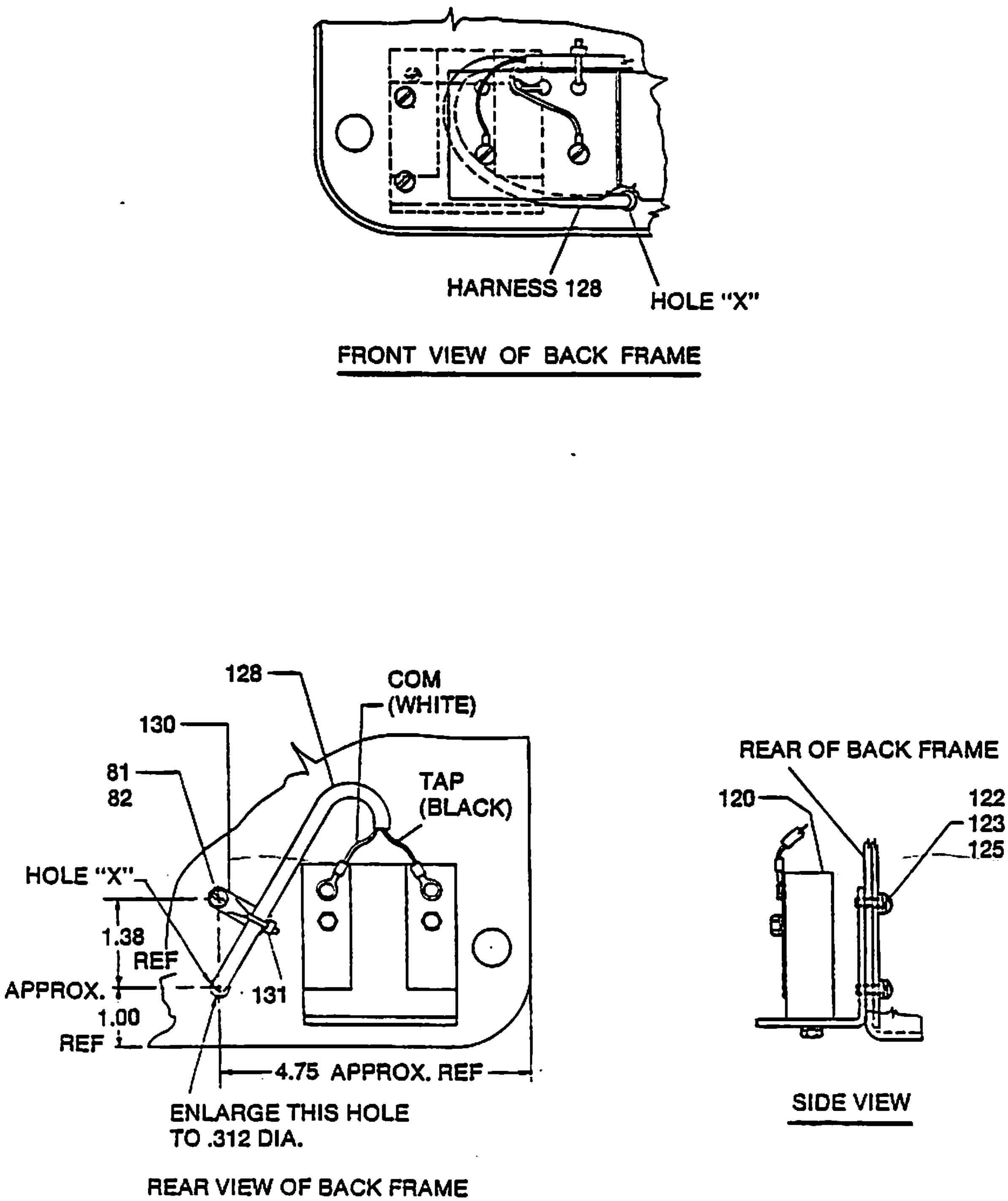


Fig. 13 — Mounting detail for secondary disconnect block 120 for 4th-wire neutral sensor (drawout breakers only).

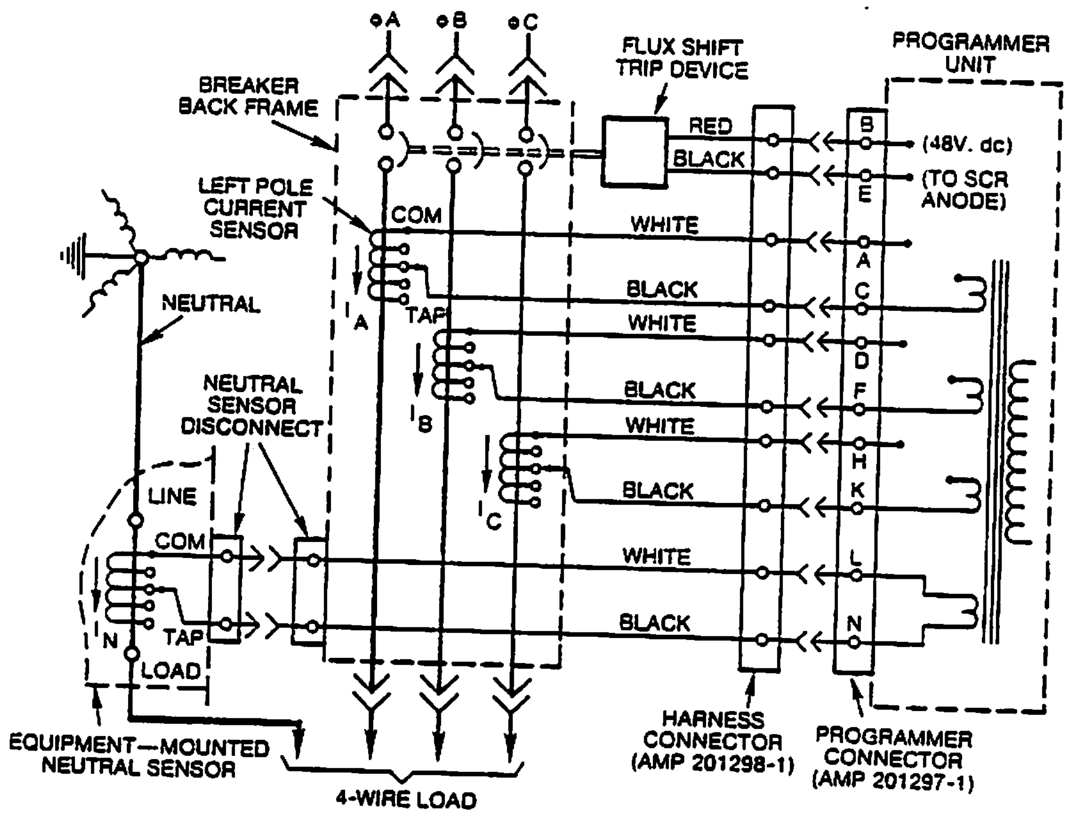


Fig. 14 — Cabling Diagram — SST with ground fault on 4-wire load — drawout breaker.

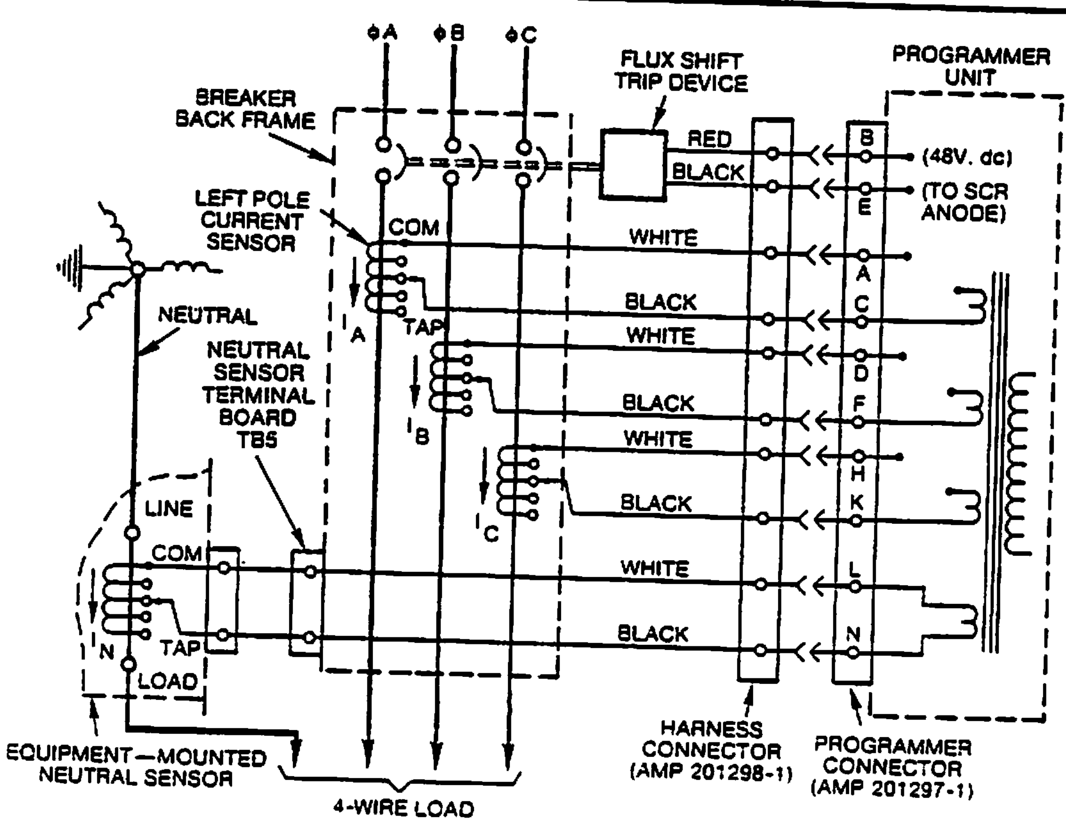


Fig. 15 — Cabling Diagram — SST with ground fault on 4-wire load — stationary breaker.

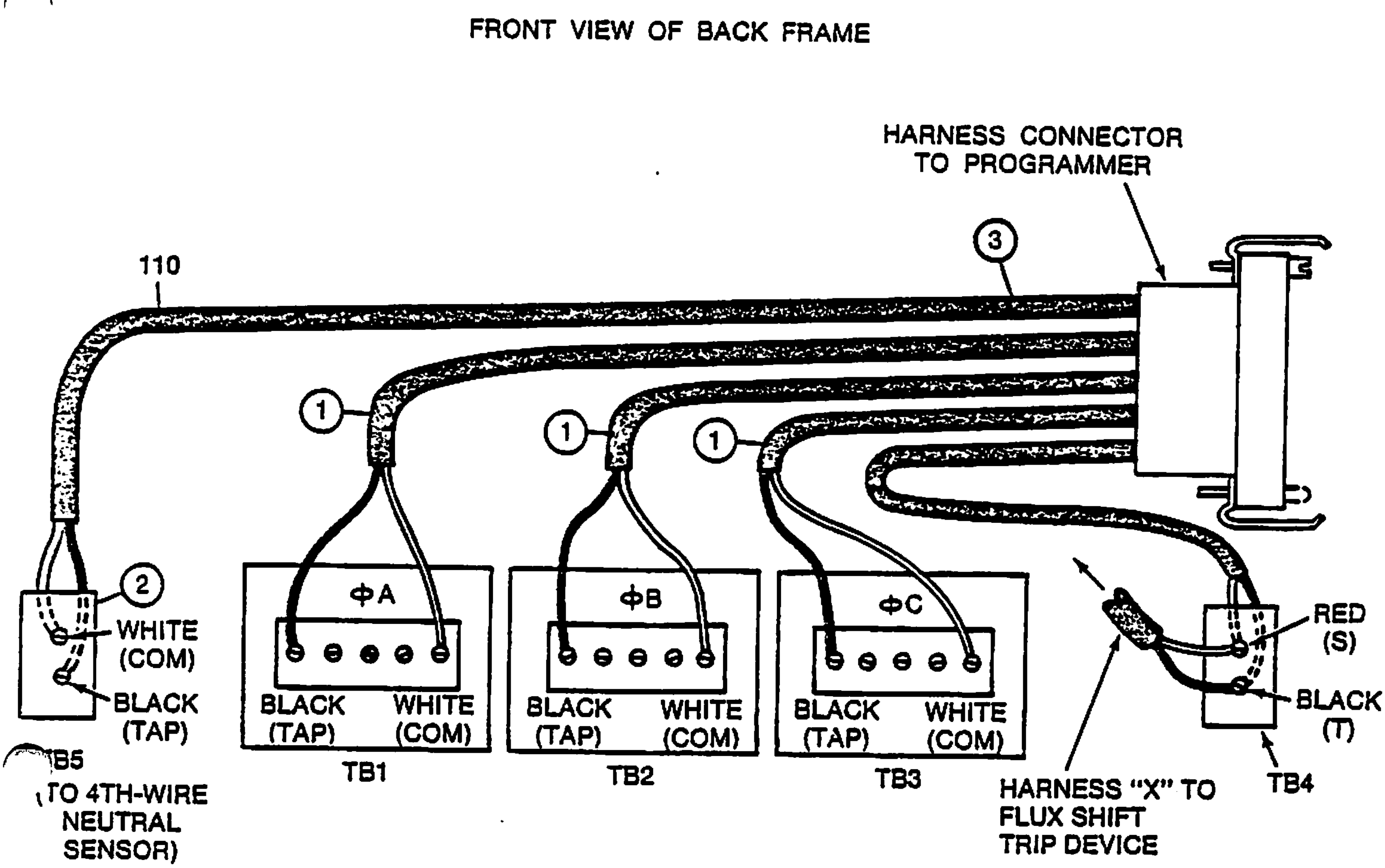


Fig. 16 **Harness connections for stationary breakers equipped with 4-wire ground fault. For elementary diagram see Fig. 15.**

INSTALLATION STEPS

1. Connect the A, B and C phase sensor leads respectively to TB1, TB2 & TB3. Identify per Table 5.
2. Mount neutral sensor terminal board TB5 (part of harness 110) to the back frame.
3. Insert the prepared leads on the opposite end of harness 110 into the harness connector: Black to socket N, white to socket L.

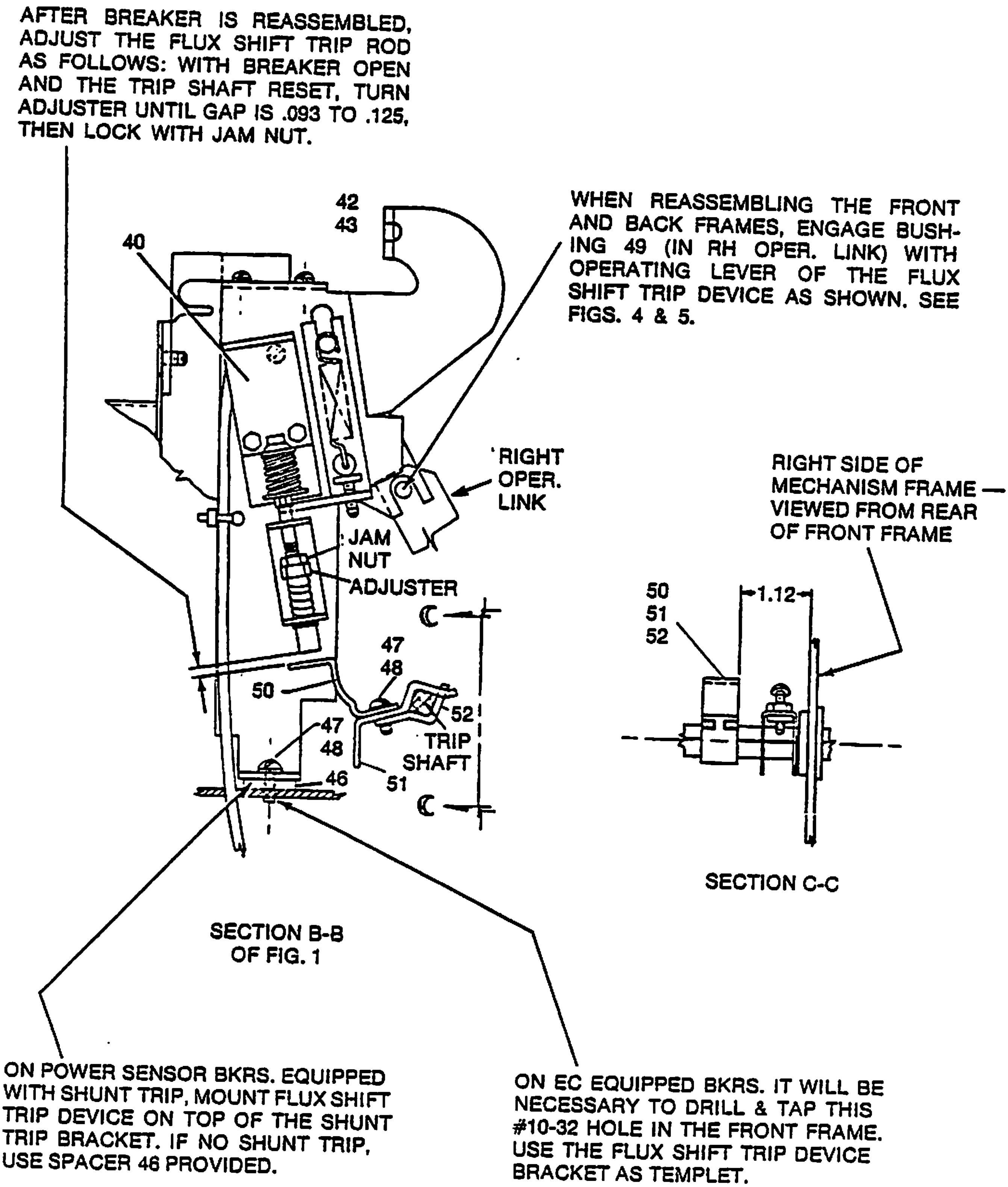


Fig. 17 — Right side view of mechanism frame showing mounting of flux shift trip device 40.

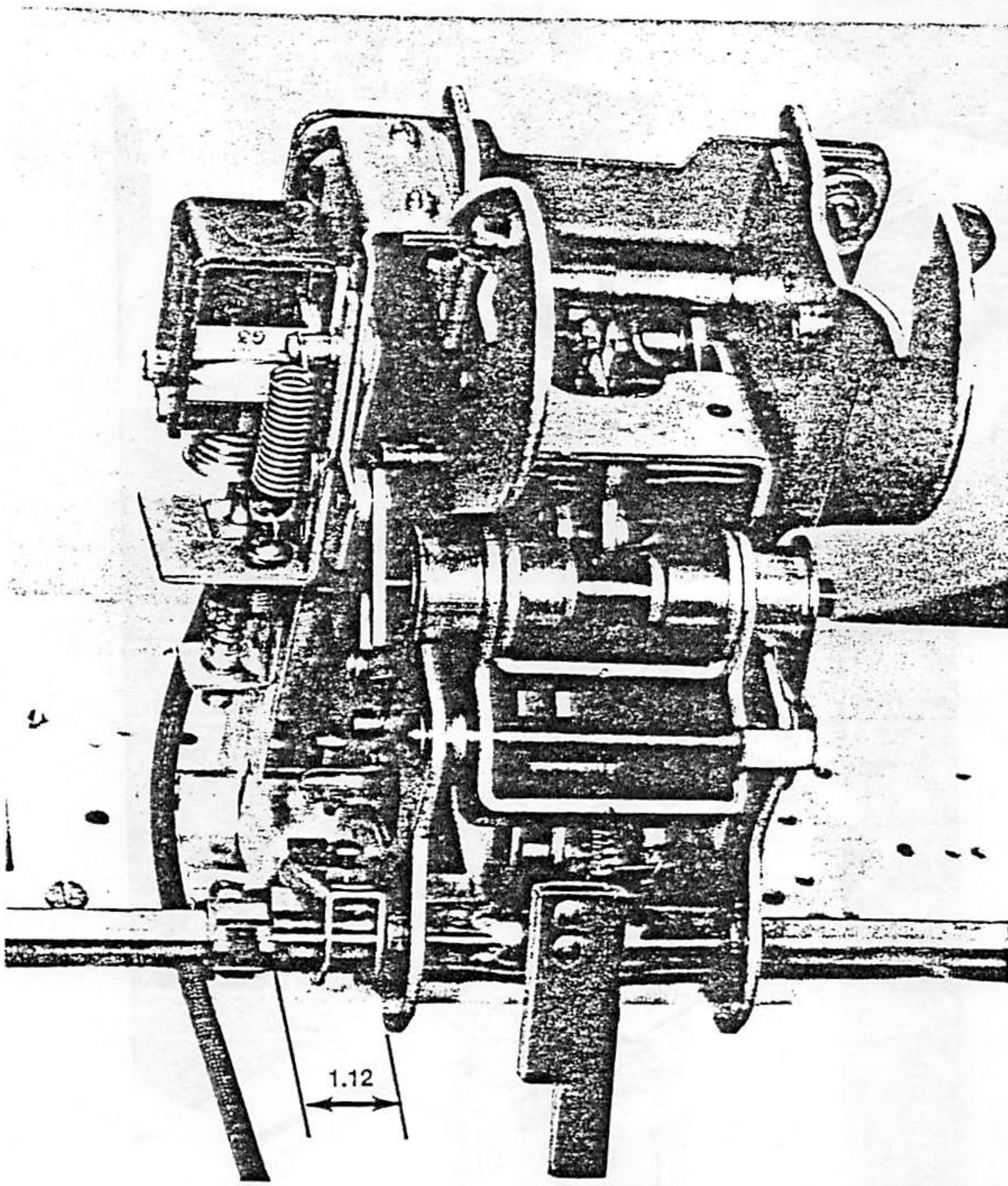


Fig. 18 — Rear view of front frame showing location of trip paddle for flux shift trip device.

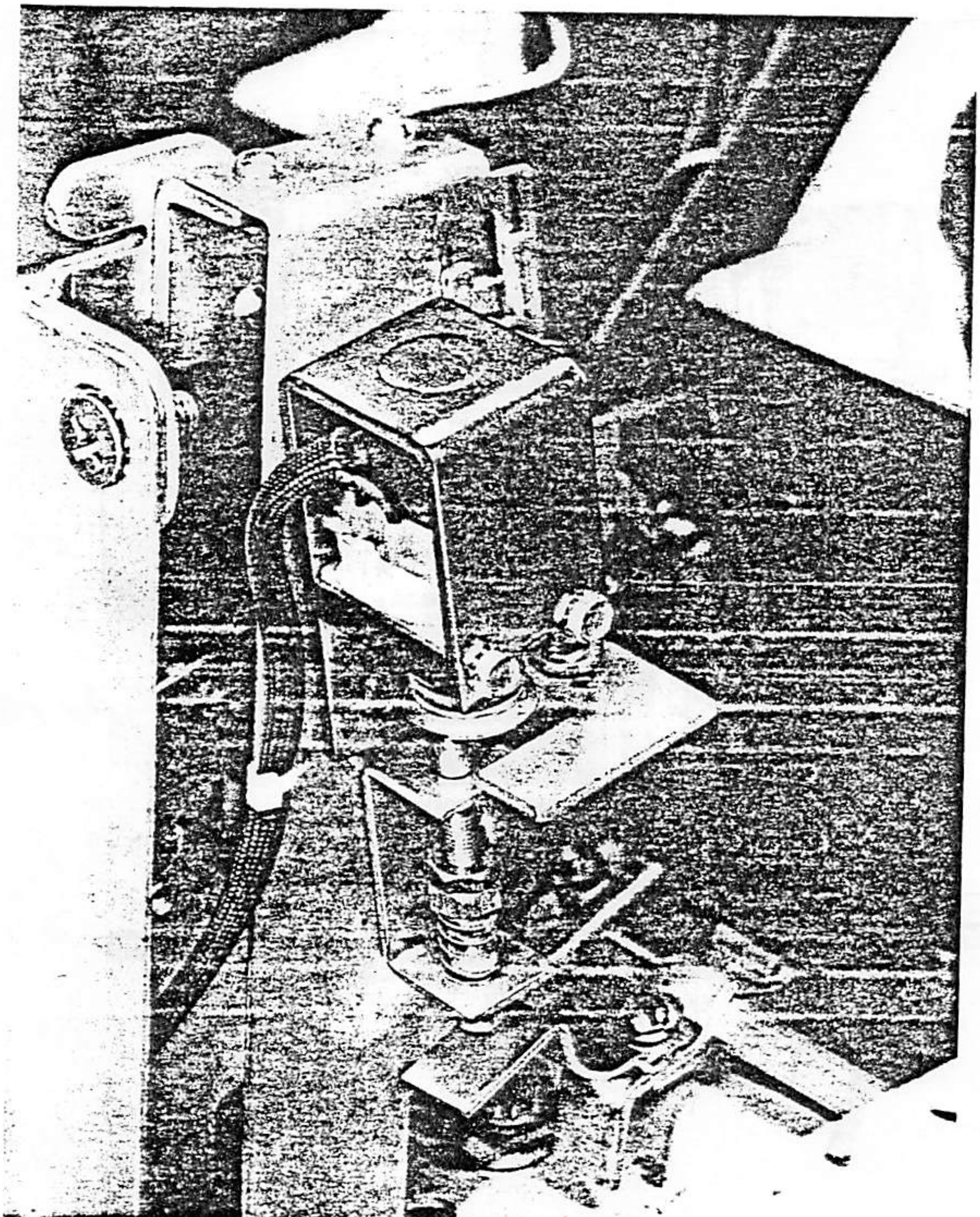


Fig. 19 — Right side view of operating mechanism showing mounting of flux shift trip device.

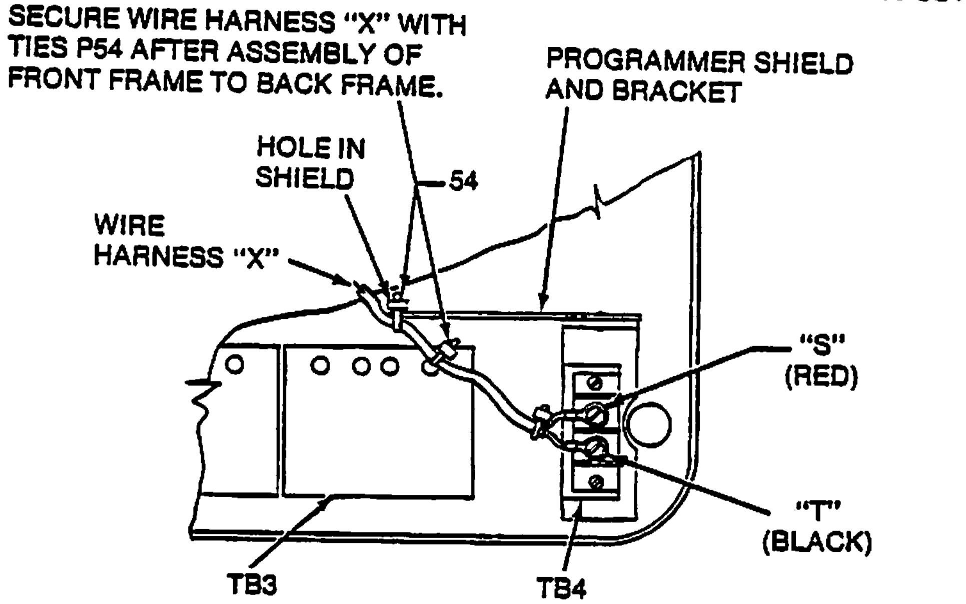


Fig. 20 — Connection of Harness "X" from flux shift trip device to terminal board TB4 on back frame.

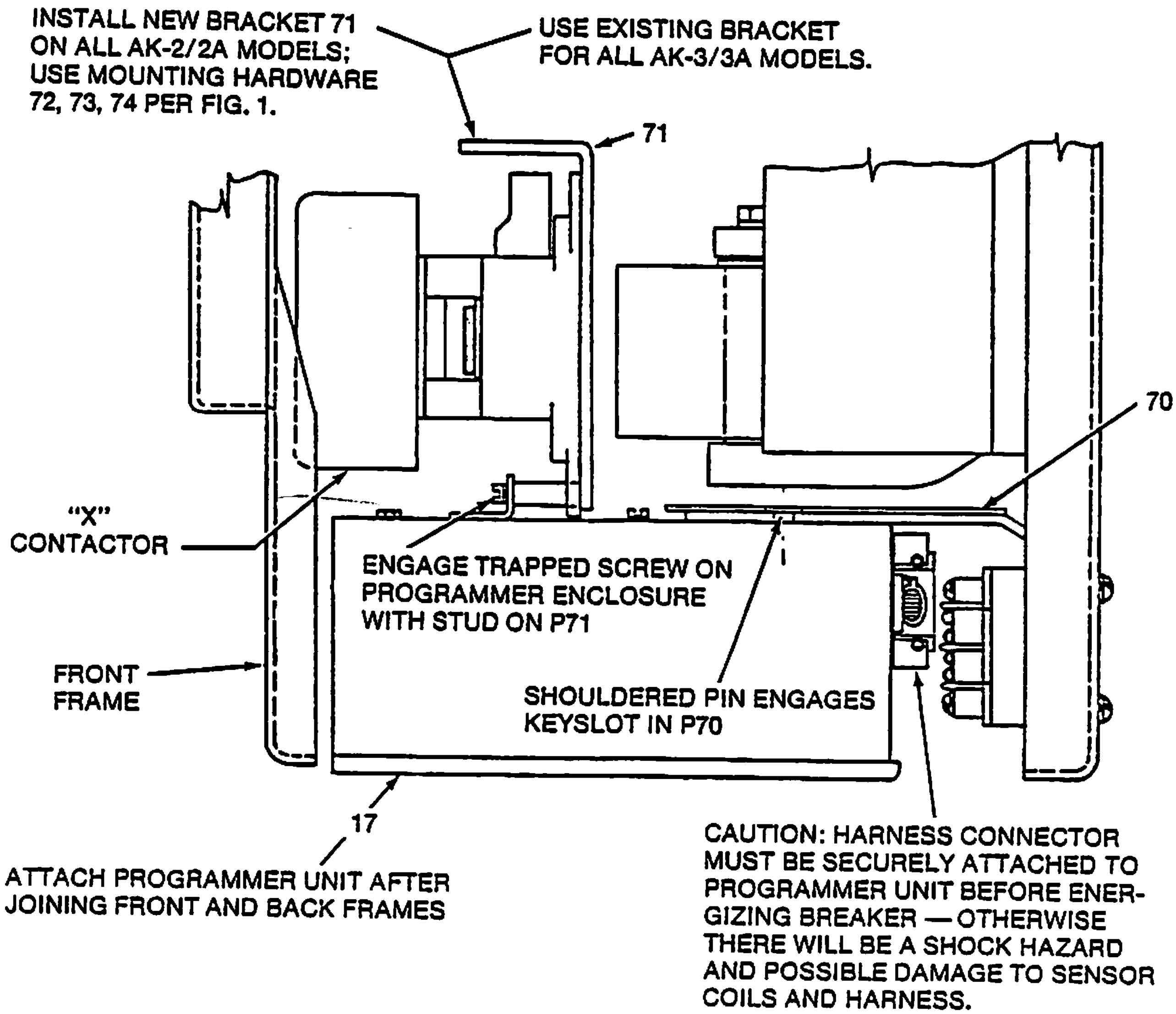


Fig. 21 — Right side view of breaker showing mounting of programmer unit.

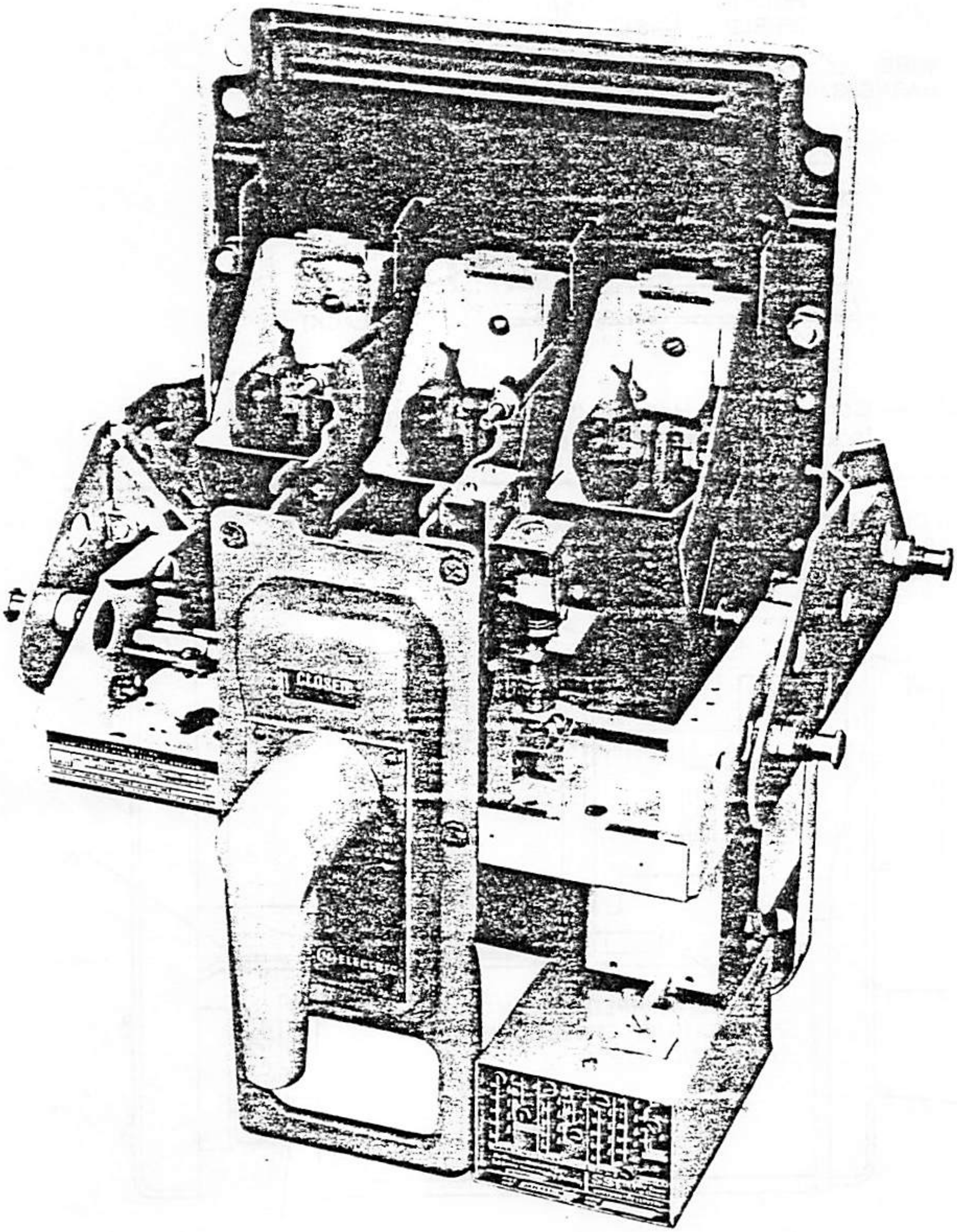


Fig. 22 — AK-25 breaker with SST conversion completed. (AKD-5 type drawout shown)

IV. EQUIPMENT MODIFICATIONS

NOTE:
The following modifications are required ONLY in conjunction with breakers being equipped with 4-wire Ground Fault trip elements.

1. Mount the neutral sensor (CT) in the outgoing neutral lead, normally in the equipment's bus or cable compartment. See Fig. 23 for the sensor's bar drilling plan. Check to insure that the neutral and phase sensors match, i.e., have the same ampere range.

2. On drawout type breakers, mount the 4th-wire neutral sensor stationary disconnect block 121 inside the breaker compartment at the lower rear as shown in Figs. 24 or 25, whichever applies. For the AKD-5 type equipments of Fig. 24, be careful to select the correct mounting bracket (Part 126 or 127).

3. Connect the neutral sensor to disconnect block 121 per wiring instructions of Fig. 26. For stationary breakers, the neutral sensor is connected to TB5.

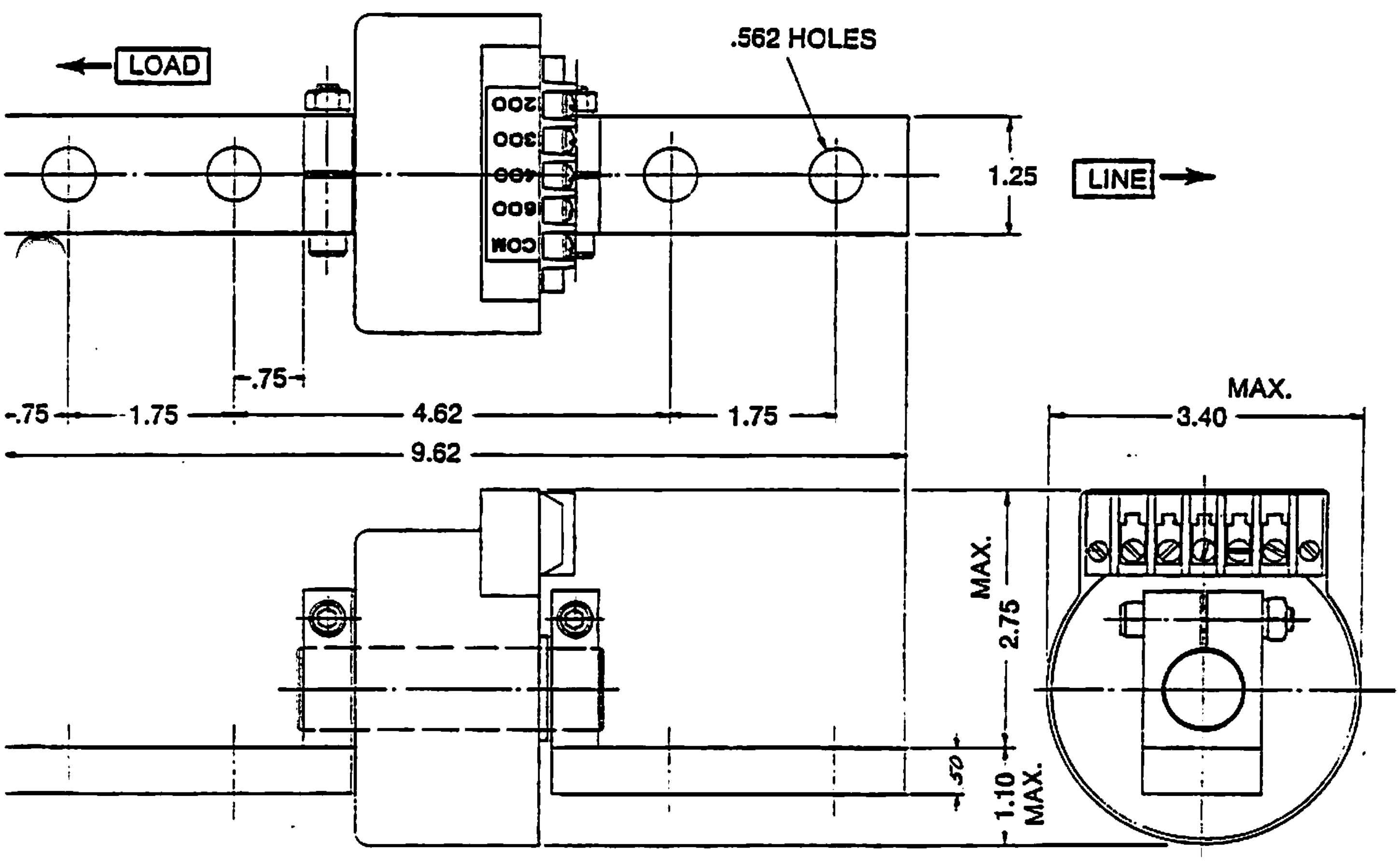


Fig. 23 — Outline of SST Neutral Sensors:
Cat. 139C4475G1 70-225 amp
Cat. 139C4475G2 200-600 amp
(from outline dwg. 139C4476)

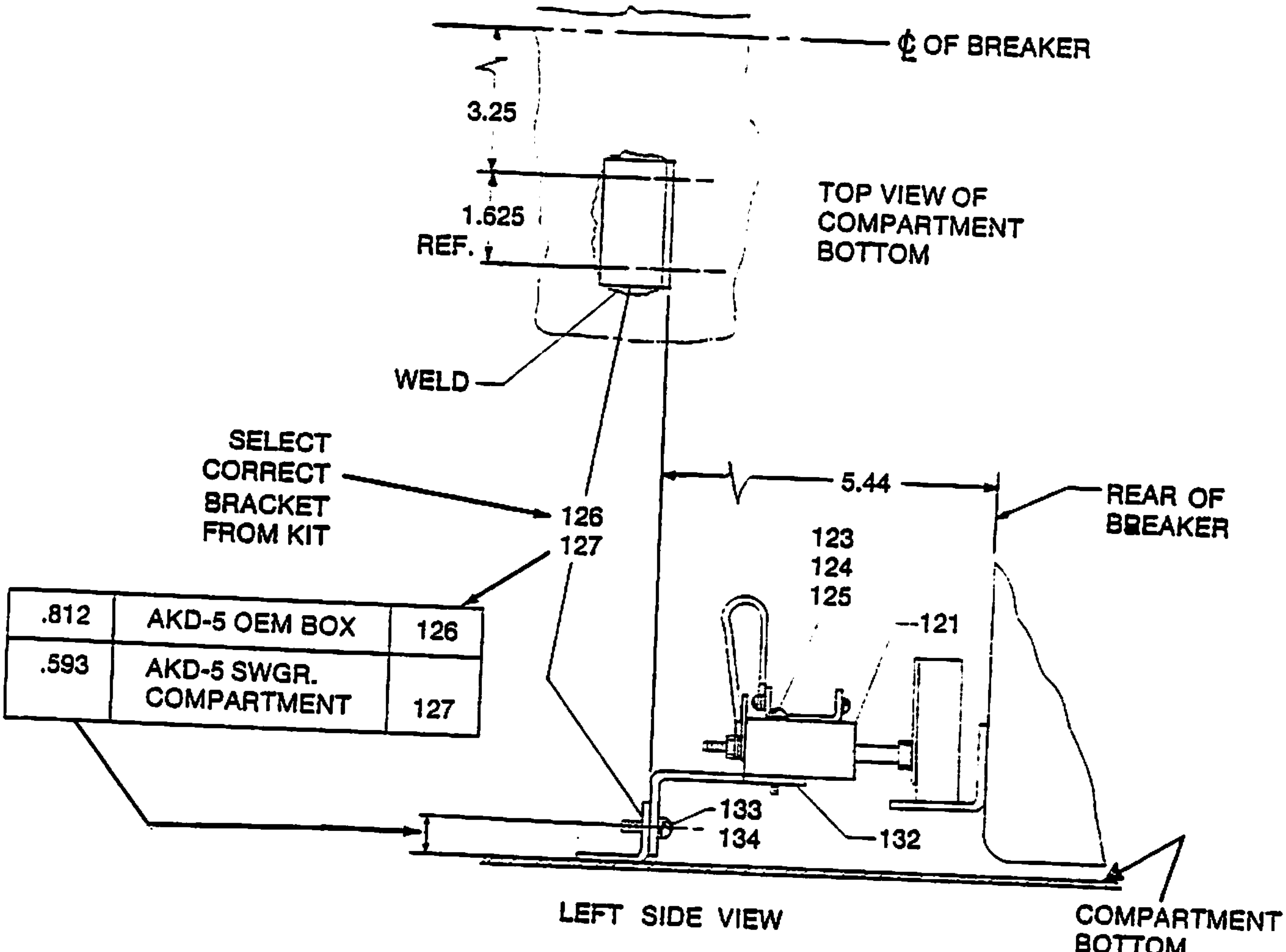


Fig. 24 — Mounting of 4th-wire neutral sensor disconnect block in AKD-5 switchgear compartments and AKD-5 type OEM boxes.

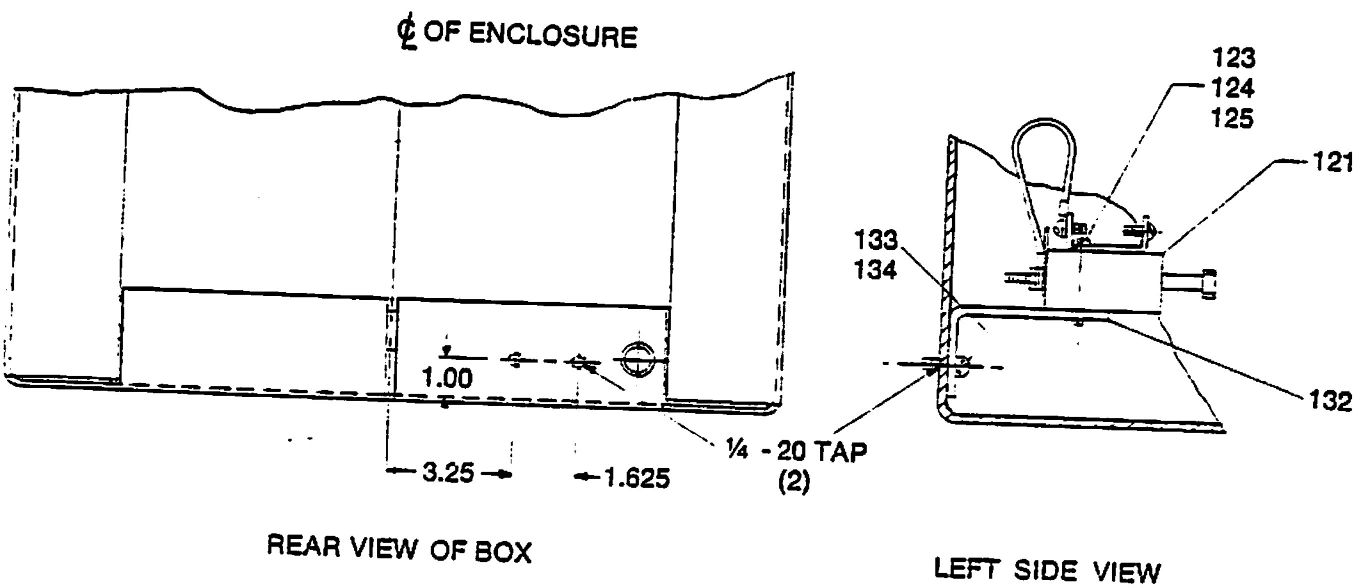
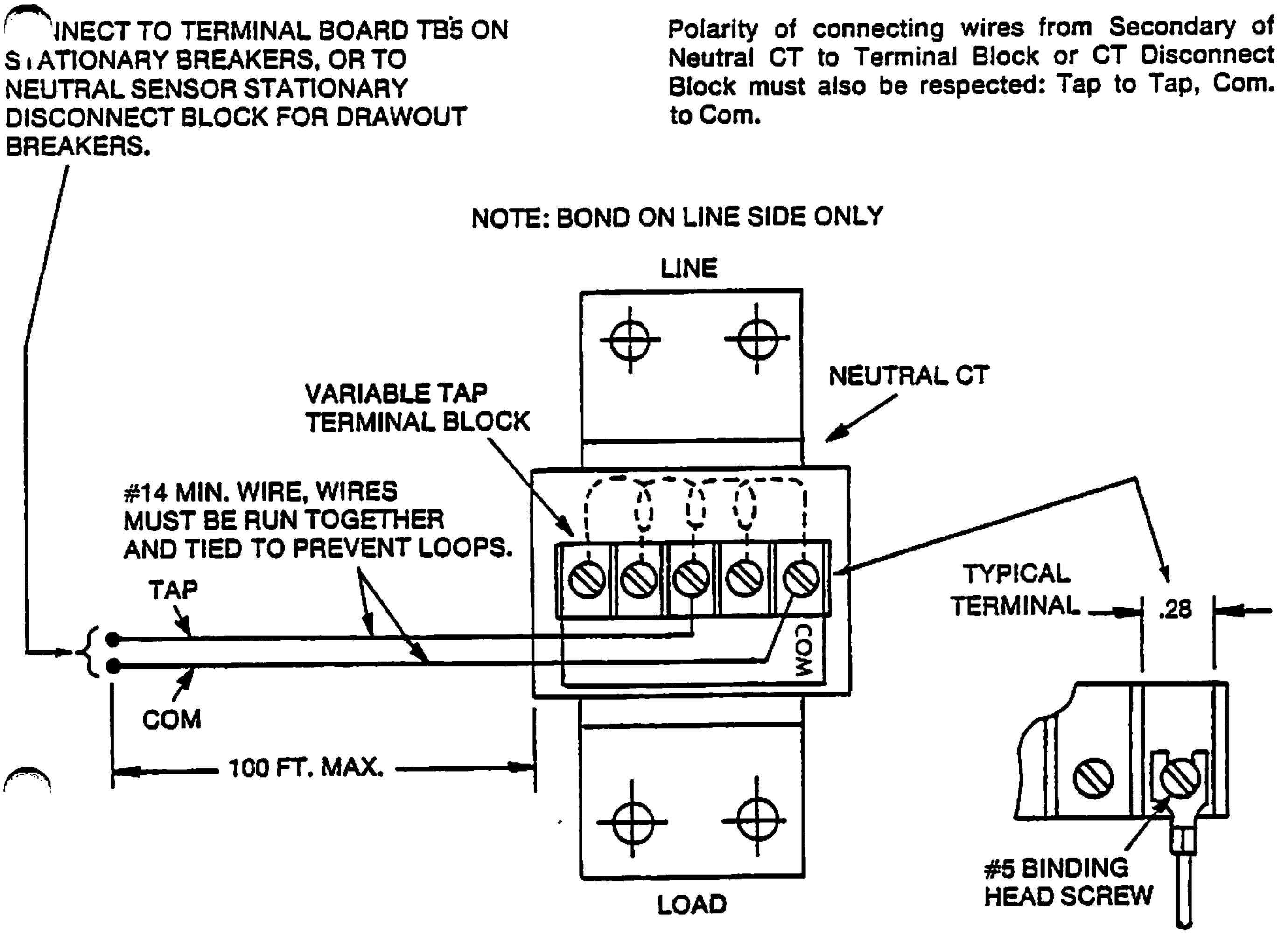
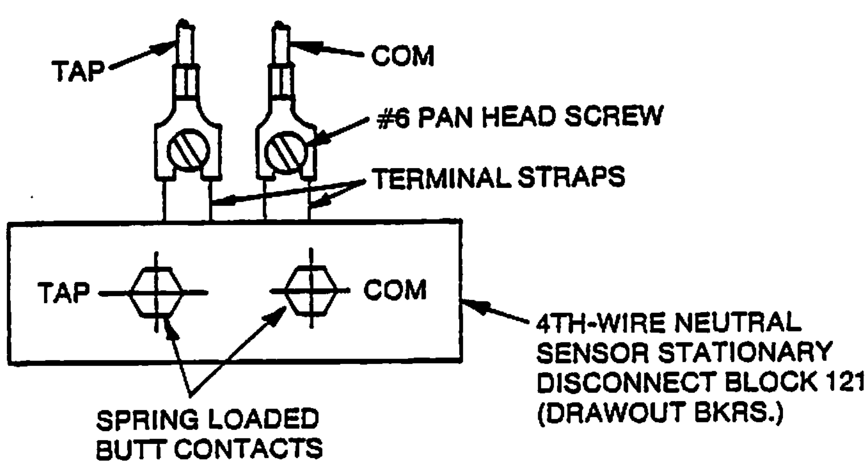


Fig. 25 — Mounting of 4th-wire neutral sensor disconnect block in AKD type OEM box.

NOTE:
Neutral CT markings of LINE and LOAD must be respected when making bus or cable connections.

Polarity of connecting wires from Secondary of Neutral CT to Terminal Block or CT Disconnect Block must also be respected: Tap to Tap, Com. to Com.





FRONT VIEW LOOKING INTO BREAKER COMPARTMENT

Fig. 26 — Connecting the 4th-wire neutral sensor.

V. FUNCTIONAL TESTING

Before the breaker is reinstalled to service:

1. Megger breaker primary circuit using a 1000V megger.

   Perform either of the following tests:

A — Using ECS/SST test set Catalog #TAK-TS1, test per Instructions GEK-64454 to assure proper operation of the breaker and its trip device Or,

B — Using a single-phase, high current-low voltage test set, test each trip element (L, S, I, G) to assure proper protective device operation. Compare results with applicable time-current characteristic curves reproduced on pages 26 & 27.

NOTE:

When testing units equipped with a ground fault trip element, the latter must be deactivated by using Ground Fault Defeat Cable Catalog #TGFD as shown in Fig. 27 below. If this defeat cable is not available, the breaker can be tested by connecting two poles in series.

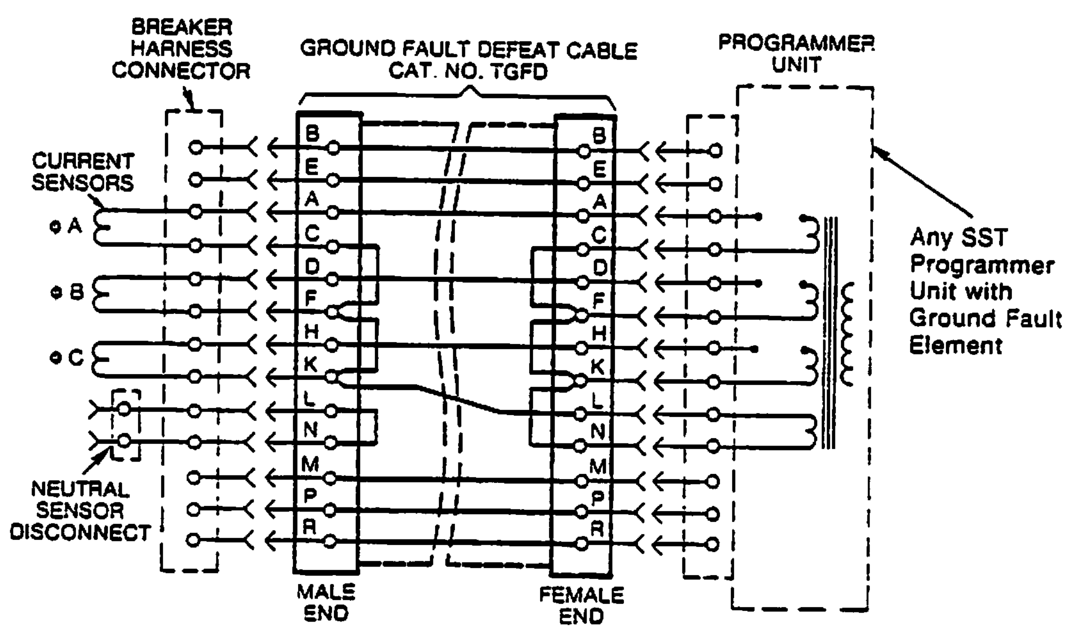


Fig. 27 — Cabling diagram with Ground Fault Defeat Cable inserted between breaker harness and SST Programmer Unit — for use during single-phase, high current — low voltage testing.

TABLE 6 — TRIP CHARACTERISTICS — SST CONVERSION KITS

Applicable time-current Curves: GES-6033B, 6034A, 6035B

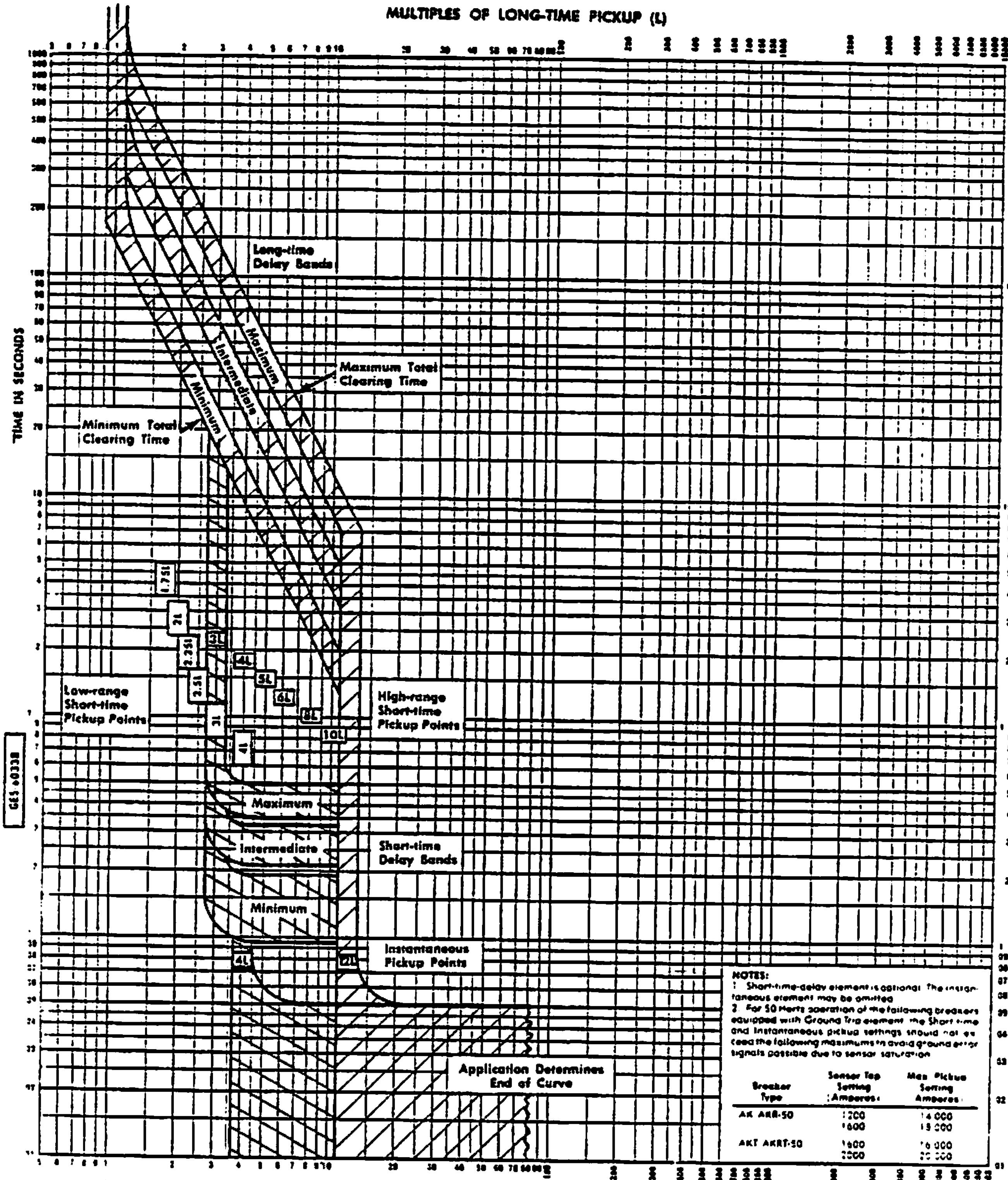
Breaker Frame Type	Frame Size (Amperes)	Sensor Taps (X) (Amperes)	SST Programmer Adjustment Range (Set Points)						
			Ground Fault		Long Time		Short Time		Instantaneous Pickup (Multiple of L)
			Pickup (Multiple of X)	Delay Band (Seconds)	Pickup (L) (Multiple of X)	Delay Band (Seconds)	Pickup (Multiple of L)	Delay Band (Seconds)	
AK-15	225	70, 100, 150, 225							
AK-25	600	70, 100, 150, 225 or 200, 300, 400, 600	.5, .6, .8, 1, 1.5, 2 (X)	Maximum 0.30		Maximum 22	1.75, 2, 2.25, 2.5, 3, 4 (L)	Maximum 0.35	
AK-50	1600	300, 400, 600, 800 or 600, 800, 1200, 1600	.25, .3, .4, .5, .6, .7 (X)	Intermed. 0.165	.6, .7, .8, .9, 1, 1.1 (X)	Intermed. 10	or	Intermed. 0.21	4, 5, 6, 8, 10, 12 (L)
AKT-50	2000	800, 1200, 1600, 2000	.2, .25, .3, .4, .5, .6 (X)	Minimum 0.065		Minimum 4	3, 4, 5, 6, 8, 10 (L)	Minimum 0.095	
AK-75	3000	1200, 1600, 2000, 3000	.2, .22, .25, .3, .35, .37 (X)						
AK-100	4000	1600, 2000, 3000, 4000	.18, .2, .22, .25, .27, .3 (X)						
NOTES		①	②	④	②	③	②	④	②

① X = Sensor ampere tap = trip rating

② Pickup tolerance = ± 10%

③ Time delay at lower limit of band @ 6L

④ Time delay at lower limit of band



NOTES:

1. Short-time-delay element is optional. The instantaneous element may be omitted.
2. For 50 Hertz operation of the following breakers equipped with Ground Trip element, the Short-time and Instantaneous pickup settings should not exceed the following maximums to avoid ground error signals possible due to sensor saturation.

Breaker Type	Sensor Tap Setting (Amperes)	Max Pickup Setting Amperes
AK AKR-50	1200	14 000
	1600	15 000
AKT AKRT-50	1600	16 000
	2000	20 000

MULTIPLES OF LONG-TIME PICKUP (L)

GENERAL ELECTRIC

AK/AKR LOW-VOLTAGE POWER CIRCUIT BREAKERS

SST™ SOLID-STATE OVERCURRENT TRIP DEVICE

Long-time-delay, Short-time-delay and Instantaneous Time-current Curves

Curves apply at 50/60 Hertz
From − 20C to − 70C Programmer Ambient

GES-6033B

X = Current Sensor Taps (Amperes)

AK-15	70 100 150 225
AK-25	70 100 150 225 or 200 300 400 600
AKR-30	100 150 225 300 or 300 400 600 800
AK AKR-50	300 400 600 800 or 600 800 1200 1600
AKT AKRT-50	800 1200 1600 2000
AK-75	1200 1600 2000 3000
AKR-75	1200 1600 2000 3200
AK AKR-100	1600 2000 3000 4000

Programmer Set Points

PICKUP
Long-time: [illegible]
Short-time: 1.75 2 2.25 2.5 3 [illegible]
Instantaneous: [illegible]
TIME DELAY BANDS
Long-time and Short-time: [illegible]

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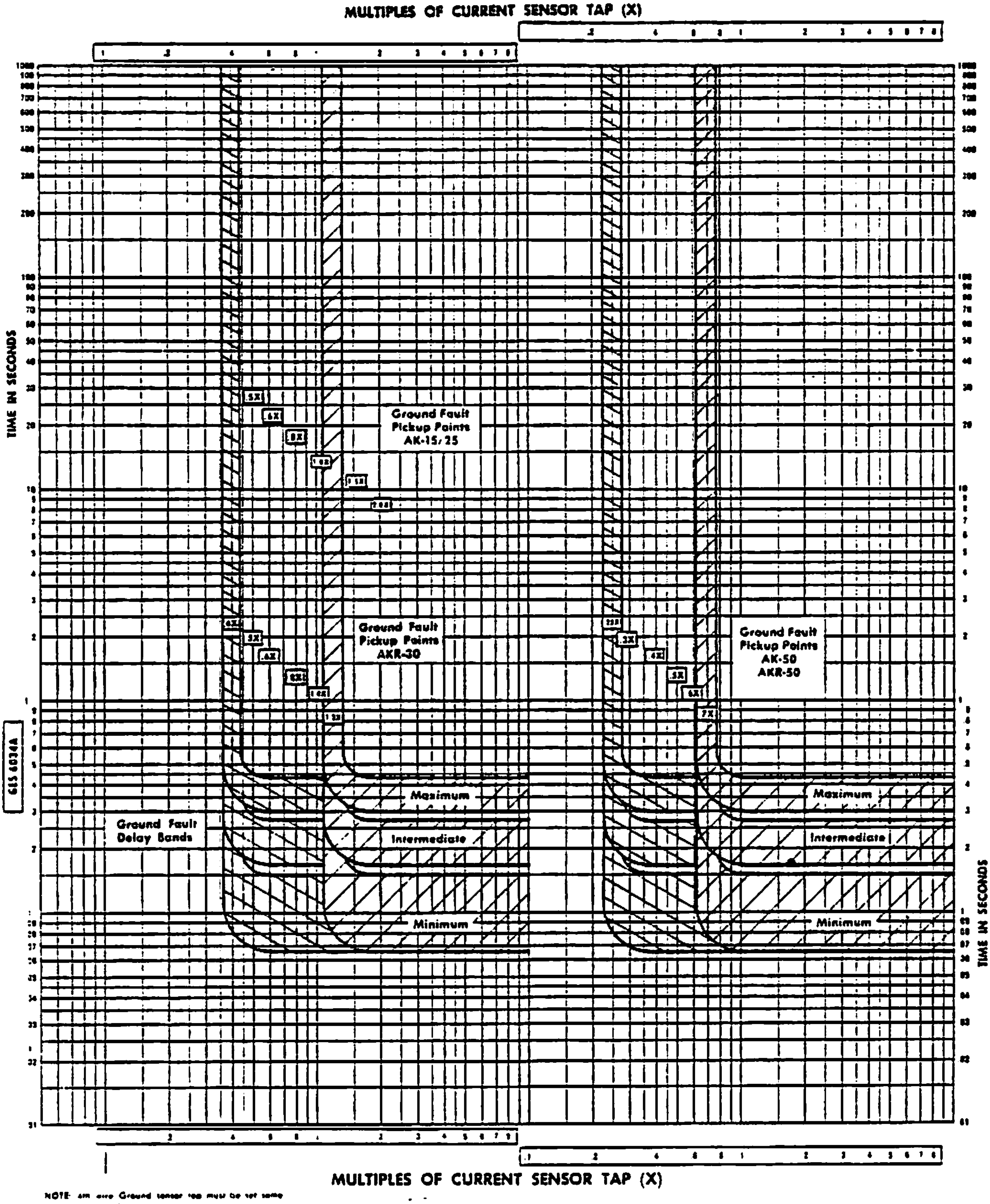

NOTE: AM, also Ground sensor tap must be set same as phase sensor tap.

GENERAL ELECTRIC

TYPE AKR LOW-VOLTAGE POWER CIRCUIT BREAKERS

SST™ SOLID-STATE OVERCURRENT TRIP DEVICE

Ground Trip Time-current Curves

GES-6034A

Current Sensor Taps (Amperes)

AK-15	70 100 150 225
AK-25	70 100 150 225 or 200 300 400 600
AKR-30	100 150 225 300 or 200 400 600 800
AK AKR-50	300 400 600 800 or 600 800 1200 1600

Curves apply at 50/60 Hertz
From − 20C to + 70C Programmer Ambient

Programmer Set Points

Ground Fault Pickup:

AK-15/25	.5x .6x .8x 1.0x 1.5x & 2.0x
AKR-30	.4x .5x .6x .8x 1.0x & 1.2x
AK AKR-50	.25x .3x .4x .5x .6x & .7x

Where X = sensor tap setting

Ground Fault Delay Bands:
Maximum Intermediate & Minimum

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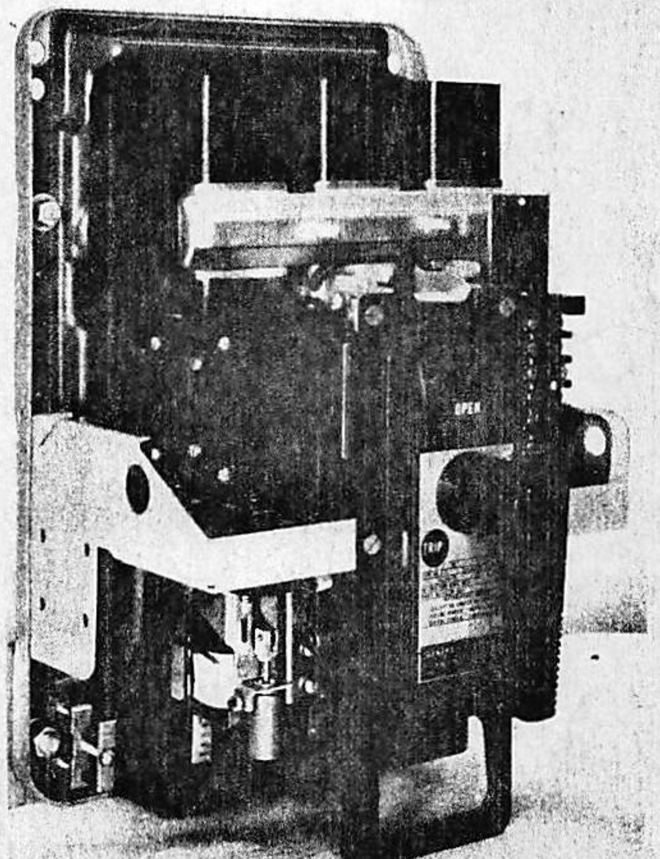
GENERAL ELECTRIC COMPANY
CIRCUIT PROTECTIVE DEVICES DEPARTMENT
PLAINVILLE, CONNECTICUT 06062

GENERAL ELECTRIC

MAINTENANCE
INSTRUCTIONS

GEI-50299A
SUPERSEDES GEI-50299

POWER CIRCUIT BREAKERS



Types
AK-2-15
AK-2-25

LOW VOLTAGE SWITCHGEAR DEPARTMENT

GENERAL ELECTRIC

PHILADELPHIA, PA.

CONTENTS

Cover (8024020)

POWER CIRCUIT BREAKERS
TYPES AK-2-15 AND AK-2-25

INTRODUCTION

The instructions contained herein provide information for performing maintenance procedures and for replacing AK-2-15/25 breaker components and accessories. For information regarding the receiving, handling, storage and installation of these breakers, refer to GEH-2021A, furnished with all AK breakers.

OPERATION

ELECTRICAL OPERATION FIG. 1

The electrically operated breaker closes whenever the closing solenoid coil is energized. This causes an upward movement of the solenoid armature, which initiates the mechanical closing action. The closing signal may be given either by a remote switch or relay, or by a closing button in the front escutcheon if the breaker is so equipped. Either action (refer to the elementary of the wiring diagram) energizes the coil of the X relay through the bb contacts of cutoff switch G and the normally closed contacts of the Y relay. When the X relay or contactor is energized, it closes its contacts. One of these (X1-2) seals in the X coil. The other three sets of contacts, which are arranged in series, activate the closing solenoid.

The breaker control scheme has an anti-pump feature which allows only one closure of the breaker for a single operation of the closing switch no matter how long the switch may be held closed. This prevents the repeated operations that would ensue if one of the automatic trip devices was activated at the time of closing. The Y relay, together with the cut off switch, provides the anti-pump feature. The mechanical action of closing operates the cutoff switch, reversing the position of the contacts from that shown on the diagram. This energizes the Y relay, if contact is still maintained at the closing switch, with the result that the X relay circuit is opened by Y contacts 5-6. This prevents the X relay from again becoming energized. Y contact 1-2 seals in the Y coil as long as contact is maintained at the closing switch.

Electrically operated breakers may also be closed by means of the maintenance handle which is furnished with the breaker. This is a separate tool and is simply a lever which permits an operator to push upwards on the closing solenoid armature. Two small hooks on one end of maintenance handle are engaged in slots (9A) Fig. 5, located in the lower portion of the front escutcheon (8A) Fig. 5. Rotation of the long end of the handle downwards forces the shorter end of the handle upwards against the bottom of the solenoid armature, and closes the breaker.

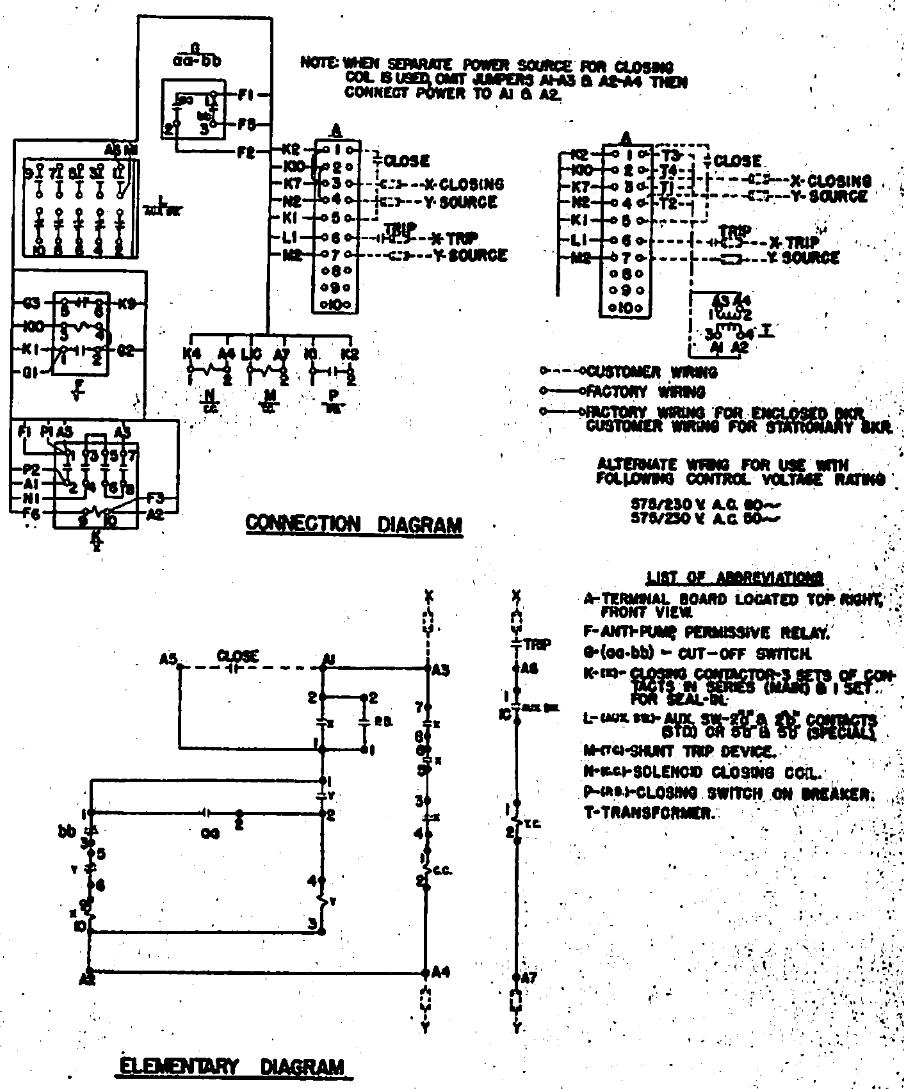


Fig. 1 Typical Wiring Diagram

Fig. 1 (695C160-1)(695C159-1)

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.

The breaker may be tripped open by any one of a number of electrical tripping devices which will be described in detail later in these instructions. An individual breaker may have none or any combination of these devices. They are the overcurrent tripping device, shunt tripping device, undervoltage tripping device and reverse current tripping device. All of them effect tripping by displacing the trip latch of the mechanism. The trip latch is rigidly attached to a trip shaft which runs through the breaker from left to right. Whenever the trip shaft is rotated in a counterclockwise direction looking from the right, the latch is displaced. The tripping devices are all equipped with strikers or trip arms which act against trip paddles rigidly fastened to the trip shaft, causing it to rotate on its bearings in a direction to trip the breaker.

The reverse current device and the shunt tripping device each have a set of auxiliary switch "a" contacts in their circuits. (An "a" contact is open when the breaker contacts are open). This prevents their operation unless the breaker is closed.

The undervoltage device coil is normally continually energized. When the control voltage is low or non-existant, as when the breaker has been pulled out for inspection or maintenance, the breaker is rendered trip-free by the undervoltage device. If it is desired to close the breaker, the device armature must be tied down or blocked closed against the magnet.

MANUAL OPERATION

The manually operated breaker is closed by first rotating the handle in a counterclockwise direction through 90 degrees, then rotating it clockwise back to its normal vertical position. The counterclockwise stroke resets the mechanism, readying it for the clockwise closing stroke.

The breaker may be tripped manually by pushing the manual trip button. This action pushes a rod against a trip paddle of the trip shaft, rotating it, and causing the mechanism trip latch to be displaced. This allows the mechanism linkage to collapse through the action of the mechanism operating springs.

CAUTION: If the breaker is tripped manually while the operating handle is in the reset position, the handle should be lowered by the right hand while operating the trip button with the left hand.

ELECTRICAL AND MANUAL OPERATION

This operating mechanism provides both manual and electrical closing. The operating mechanism is similar to the mechanism of the standard electrical breaker with the addition of the manual handle, cam and mechanism connecting link. The solenoid connecting link and manual cam connecting link are both connected to the closing spring pin at the top of the mechanism, thus compressing the springs when force is provided by either means of breaker closing.

The breaker is manually closed by rotating the closing handle 90 degrees counterclockwise. No reset stroke is necessary as is the case with the standard manual breaker. Electrical closing may be performed either locally or remotely in the same manner as the standard electrical breaker.

Tripping is accomplished by the manual trip button on the escutcheon or by any of the electrical tripping devices available for use on the standard breakers.

MAINTENANCE

INSPECTION

BEFORE INSPECTION OR ANY MAINTENANCE WORK IS DONE, BE SURE THAT THE BREAKER IS IN THE OPEN POSITION. ALL ELECTRICAL POWER, BOTH PRIMARY AND CONTROL SOURCES, SHOULD ALSO BE DISCONNECTED.

Periodic inspection of the circuit breaker is recommended at least once a year. More frequent inspections are recommended, if severe load conditions, dust, moisture, or other unfavorable conditions exist.

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.

At all times it is important not to permit pencil lines, paint, oil or other foreign materials to remain on the insulating surfaces of the breaker as they may cause low resistance between points of different potential and result in eventual electrical breakdown.

Always inspect the breaker after a short circuit current has been interrupted.

At the time of periodic inspection, the following checks should be made after the breaker has been de-energized.

1. Manually operate the breaker several times, checking for obstructions or excessive friction.

2. Electrically operate the breaker several times (if breaker has electrical control) to ascertain whether the electrical attachments are functioning properly.

3. Remove and inspect the arc quencher. Breakage of parts or extensive burning will indicate need for replacement.

4. Check contact condition and wipe.

5. Check latch engagement.

6. Check operation of tripping devices, including overcurrent trip devices, making sure all have positive tripping action. (Discernible movement in tripping direction beyond point of tripping.)

(For detailed information on breaker features listed, refer to appropriate sections of these instructions.)

SEPARATION OF FRONT AND BACK FRAMES FIG. 3

Many maintenance operations will either require or be greatly facilitated by separating the front frame and mechanism of the breaker from the back frame or base, which consists of the current carrying parts of the breaker and their supporting structure. The procedure for this operation is as follows:

1. Remove the arc quenchers (see section on "Arc Quenchers").

2. Disconnect the two insulated connecting links (6), between the mechanism and the crossbar (10), by removing the tie bolt (7), and slipping the ends of the links off the ends of the shouldered pin, (5) Fig. 5, in the mechanism.

3. If the breaker is a drawout type, with secondary disconnects, Fig. 2, remove the secondary disconnect supporting bracket from the breaker back frame. Also remove any wiring bundle retainers that may be attached to the back frame.

4. Remove one elastic stop nut from each of two studs (3), which tie the upper ends of the mechanism frame to the back frame of the breaker.

5. Remove the two elastic stop nuts (9/16" Hex.) which fasten the wrap around portion of the front frame to the back frame. One of these is located on each side of the breaker, about 2/3 of the distance down from the top edge of the back frame.

On drawout breakers, the bottom plate must be removed by first removing two #8-36 screws located at the front of the bottom plate and then freeing the plate from the slots located in the bottom of the back frame.

6. The two frames are now disconnected. However, care should be exercised in separating them to avoid damage to the trip shaft arms and paddles. While the back frame is held steady, lift the front frame and mechanism up and out so that the trip paddles on the trip shaft clear the trip arms of the overload trip devices.

Reassembly of the two breaker halves is accomplished by following the procedure outlined in reverse order.

LUBRICATION

In general, the circuit breaker requires very little lubrication. Bearing points and sliding surfaces should be lubricated very lightly at the regular inspection periods with a thin film of extreme temperature, high pressure, light grease, similar to G. E. Spec. No. D50H15 or RPM No. 5. Hardened grease and dirt should be removed from latch and bearing surfaces by the use of a safe cleaning solvent such as kerosene. Latch surfaces should be left clean and dry and not be lubricated. ALL EXCESS LUBRICANT SHOULD BE REMOVED WITH A CLEAN CLOTH IN ORDER TO AVOID ANY ACCUMULATION OF DIRT OR DUST.

At each maintenance period, all silver to silver friction points, such as primary disconnects, should be cleaned and given a fresh coat of G. E. Spec. No. D50H47 lubricant.

TROUBLE SHOOTING

The following table lists several typical symptoms of breaker malfunction, together with their causes and remedies. If, at any time, these symptoms are observed, their cause should be determined and the necessary corrective action should be taken.

TROUBLE SHOOTING

TROUBLE	CAUSE	REMEDY
Overheating	Contacts not aligned.	Adjust contacts.
	Contacts dirty, greasy or coated with dark film.	Clean contacts.
	Contacts badly burned or pitted.	Replace contacts.
	Current carrying surfaces dirty.	Clean surfaces of current carrying parts.
	Corrosive atmosphere.	Relocate or provide adequate enclosure.
	Insufficient bus or cable capacity.	Increase capacity of bus or cable.
	Bolts and nuts at terminal connections not tight.	Tighten, but do not exceed elastic limit of bolts or fittings.
	Current in excess of breaker rating.	Check breaker application or modify circuit by decreasing load.
	Excessive ambient temperature.	Provide adequate ventilation.
Failure to Trip	Travel of tripping device does not provide positive release of tripping latch.	Re-adjust or replace tripping device and check mechanism latch adjustment.
	Worn or damaged trip unit parts.	Replace trip unit.
	Bind in overcurrent trip device.	Replace overcurrent trip device.
False Tripping	Overcurrent trip device pick up too low.	Check application of overcurrent trip device.
	Overcurrent trip device time setting too short.	Check application of overcurrent trip device.
	Bind in overcurrrent trip device.	Replace overcurrent trip device.
Failure to Close and Latch	Binding in attachments preventing resetting of latch.	Re-align and adjust attachments.
	Latch out of adjustment.	Adjust latch.
	Latch return spring too weak or broken.	Replace spring.
	Hardened or gummy lubricant.	Clean bearing and latch surfaces.
	Closing solenoid burned out.	Replace solenoid coil.
	Solenoid control device not functioning properly.	Re-adjust or replace device.

BASIC BREAKER COMPONENTS

DISCONNECTS

PRIMARY DISCONNECTS

The primary disconnects are attached to the ends of the breaker studs on the rear side of the breaker base. Each disconnect assembly consists of two pair of opposed contact fingers. These are secured to the breaker stud by a bolt which passes through the assembly and the stud. When engaged with the stationary stud of the enclosure, the disconnect fingers exert a set amount of force against the stationary stud through the action of the compression springs. Retainers and spacers hold the contact fingers in correct alignment for engagement with the stud. The amount of force which the fingers exert against the stud is determined by degree to which the springs are compressed by the bolt and nut which hold the assembly together. If, for any reason, the disconnects must be taken apart, the position of the nut on the bolt should be carefully noted, so that in reassemblying, the original amount of compression can be restored by replacing the nut at its former position on the bolt.

SECONDARY DISCONNECT, FIG. 2

The secondary disconnects serve as connections between breaker control circuit elements and external control circuits. They are used only on drawout type breakers. A terminal board serves the same purpose on stationary mounted and general purpose enclosure mounted breakers. The secondary disconnects allow removal of the breaker without the necessity of having to detach external connections.

The movable part of the secondary disconnect consists of an insulating body which holds a conducting spring loaded plunger to which a flexible lead is attached. As the breaker moves into its enclosure, the plunger is depressed by sliding onto the stationary disconnects of the enclosure.

REPLACEMENT OF MOVABLE SECONDARY DISCONNECTS

1. Unfasten disconnect body from breaker back frame.

2. Open tabs which hold wires on inner side.

3. Pull contact tip loose from hollow tube.

4. Remove contact tip by cutting wire at its base.

5. Push wire through hollow tube of new disconnect assembly.

6. Strip insulation off end of wire to about 1/4 of an inch from end.

7. Place new contact tip on end of wire and crimp.

8. Pull wire through hollow tube until contact tip fits snugly against end of hollow tube.

9. Crimp tab on other side of assembly to hold wire in place.

10. Any hollow tubes which are not used should be pushed into the disconnect body and held in that position by placing fibre spacers over inner ends of tubes and spreading tabs.

11. When all wires have been connected, refasten the body of the assembly to the breaker back frame.

ARC QUENCHER

The arc quencher is an integral riveted assembly composed of two ceramic side plates, a series of steel plates, and a muffler. The assembly is covered by a wrap around of insulating material which inhibits any sidewise emission of gases. The steel plates are held in position and supported by the ceramic sides which are grooved vertically to provide recesses for the vertical edges of the steel plates. The bottom edges of the latter form an inverted "V" along the path of the arc that may be drawn between the breaker contacts during interruption. The steel plates have the effect of breaking up the arc, and cooling it and the gases that result from interruption. The entire assembly provides a "chimney" effect which directs the hot, ionized gases upwards through the steel plates and mufflers and allows their safe and controlled escape at a cooler temperature.

The muffler at the top of the assembly is a serpentine shaped strip of perforated, copper plated steel. It is important that the perforations of the muffler be kept open, since their closure could tend to prevent the escape of the gases along the desired path. At the regular maintenance inspection, it would be well to check their condition and open any of the perforations that appear to be clogged.

If any very extensive burning or corrosion is noted in the arc quencher, it should be replaced. Replacement is also indicated if any breaks or cracks are noted in the ceramic material.

REPLACEMENT

Removal of the arc quencher is simply a matter of lifting the assembly up and out, after the steel retainer across the front of the arc quenchers has been removed. The upper edge of the steel arc runner fastened to the back plate of the breaker fits into a recess in the back portion of the arc quencher and locates it in its proper position upon replacement. Make sure the steel retainer is replaced and fastened firmly to its mounting studs after the arc quencher has been replaced.

BREAKER CONTACT STRUCTURE

The copper current carrying parts of the breaker are all mounted on a common base of insulating material made of polyester glass mat. The copper of each pole consist of an upper stud and pivot, stationary contacts, two movable contact arms, a movable contact pivot, and the lower stud.

The upper stud branches into two pivot surfaces on its inner end on the forward or front side of the breaker base. Each of these convex pivot surfaces mates with the concave pivot surface on the rear side of the stationary contacts. Each of the stationary contacts pivot in a horizontal plane approximately at their mid-points. The end of the contact opposite to the contact tip end is formed into the shape of a small hook. A tension spring engages this hook and provides the necessary contact pressure at the pivot and also at the point of contact with the movable contact arm. When the breaker contacts open, a projection on the contact tip end of the stationary contact bears against a stop pin restricting the movement of the stationary contact. This arrangement results in a continual high force existing between the mating pivot surfaces and eliminates the necessity of fast-wearing flexible shunts around the pivot point.

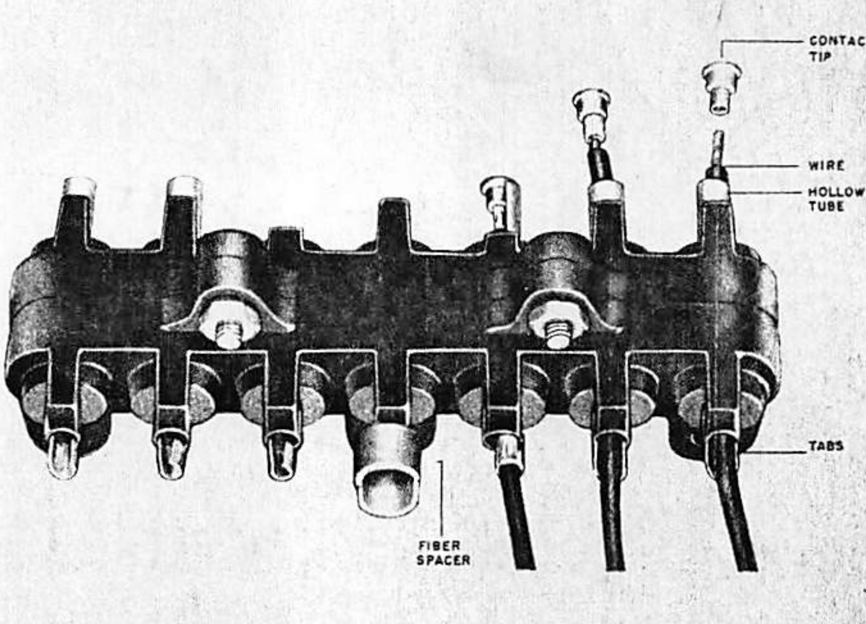


Fig. 2 Movable Secondary Disconnects

The movable contact arms pivot in a vertical plane, each making contact with a pair of stationary contacts, and thus providing four low resistant parallel paths of current for each breaker pole. The movable contacts rotate about a burnished, silver plated, copper pin which, in turn, is held by a pivot support. Each side of the pivot support bears against the lower, outer surface of the contact arm and supplies a second low resistance path through the pivot. A "U" shaped spring clip made of silver plated conducting material provides an additional current path and protects the other contact surfaces of the pivot against pitting when in motion. It also contributes to the force tending to increase the contact pressure between the lower ends of the movable contacts and the pivot support.

The movable contact pivot support is mounted securely to the breaker base. If, as is normally the case, the pole is equipped with an overcurrent trip device, one of the terminals of the series coil of the trip unit is fastened to the lower end of the pivot support. The other terminal of the coil fastens to the lower stud.

CONTACT ADJUSTMENTS

The only adjustment to be made on the breaker contacts is that of contact wipe. This may be described as the distance the movable and stationary contacts move while they are touching one another in the process of breaker closing. The amount of contact wipe can be measured by comparing the position of the front surface of the stationary contact when the breaker is open to its position when the breaker is closed, in reference to some absolutely stationary part of the breaker. The most convenient stationary part of the breaker to use as a reference point is the steel arc runner above and behind the stationary contacts.

The amount of wipe the contacts should have is nominally 1/8 of an inch. A plus or minus tolerance of 1/32 of an inch is allowable.

The means of adjusting contact wipe is provided by an eccentric pin which passes through the center of the movable contact assembly. Each end of this pin has a free, projecting, hexagon shaped section which is easily accessible to a small, open end, 1/4 inch wrench. Two cantilever springs, which bear on each end against a portion of the hexagon section of the pin, lock the adjusting pin in place and provide index stops for the process of adjustment. The right hand hexagon shaped end of the pin is numbered from 1 to 6, which provides a reference for making wipe adjustments.

When contacts are to be adjusted, the recommended procedure is as follows:

1. With the breaker in the open position and using the numbers on the right

end of each adjusting pin as a reference, set each pin in the same position. In many cases, the number 3 is a good beginning point. The proper view of the number on the adjusting pin is obtained by viewing the breaker from the front and the adjusting pin from approximately a 15 degree angle with respect to the movable contacts. Note that the numbers on the pin are not in numerical sequence as the pin is rotated.

2. By measurement, establish the position of the front surfaces of the stationary contacts with reference to the steel arc runners above and behind the contacts.

3. Close the breaker, and establish the amount of wipe by again measuring as in step two, and comparing the measurements with those taken with the breaker open.

4. If any set of contacts lead or lag the others, open the breaker and advance or retard the adjusting pin to the next higher or lower number. Moving the adjusting pin to a higher number will increase the contact wipe and moving to a lower number will decrease the contact wipe.

NOTE: No attempt should be made to move the adjusting pin when the breaker is closed. Besides being more difficult, the additional force required to move the pin will tend to round off the flats of the hex section of the pin.

5. When all the contacts have the recommended wipe of 3/32 to 5/32 of an inch, the contact adjustments are complete.

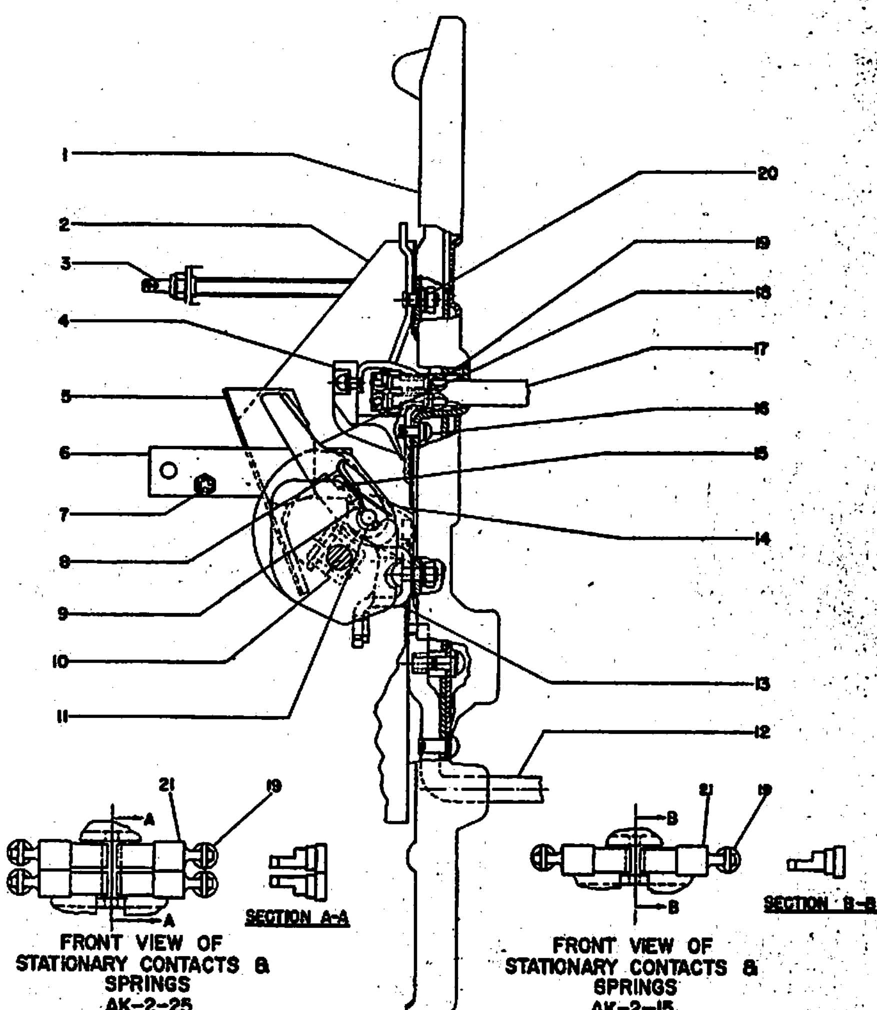
CONTACT REPLACEMENT FIG. 3

The normal situation that will exist in the matter of contact replacement will call for replacement of all the movable and stationary contacts at the same time. This will be the case where long use of the breaker in service has resulted in extensive wear or erosion of the silver alloy contact tips. A commonly used "rule of thumb" is that contact replacement is indicated if less than one-half of the original thickness (1/8 of an inch) of the contact tip material remains.

When the movable breaker contacts are to be replaced, remove the front frame from the back frame as described under "Separation of Front and Back Frames" of these instructions. The stationary contacts can be replaced with the breaker intact. The procedures for replacing both stationary and movable contacts is described as follows:

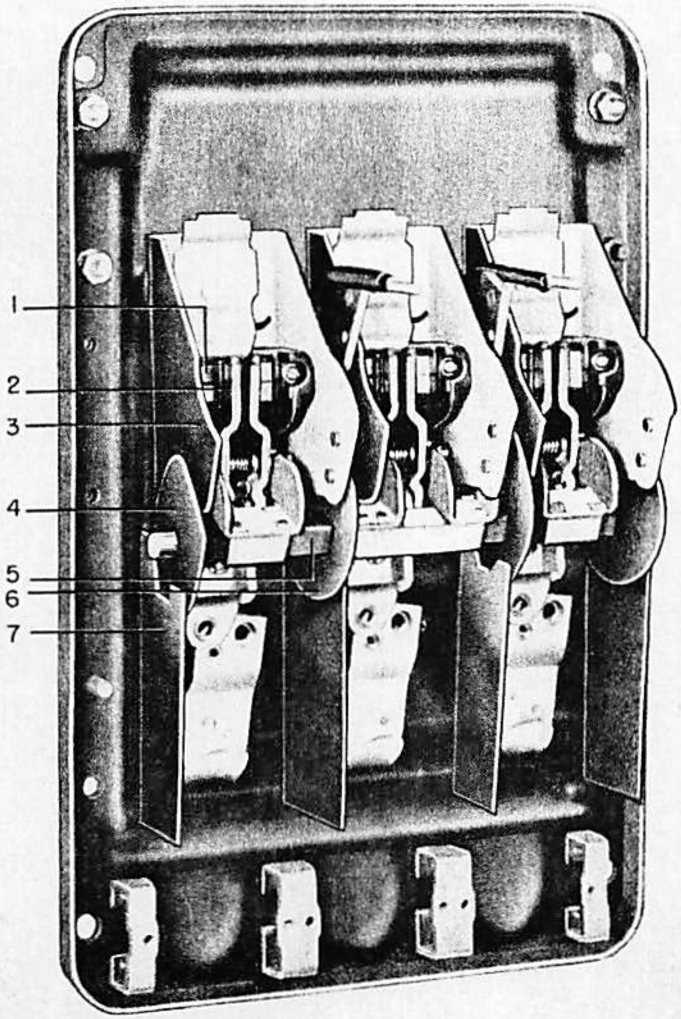
STATIONARY CONTACTS (21)

Without separating the breaker front and back frames, force the contacts away from the contact assembly center stop pin and toward their own pivot point with a screwdriver until the contacts stop surface is free of the center stop pin. The contact can then be removed with the fingers by disengaging the contact from its



1. Breaker Base
2. Insulation
3. Insulated Stud
4. Upper Stud Barrier
5. Insulation
6. Links (Insulated)
7. Tie Bolt
8. Spring
9. Spring Clip (Retainer)
10. Cross Bar
11. Pivot Pin
12. Lower Stud
13. Contact Pivot Support
14. Spring
15. Contact Wipe Adjustment Pin
16. Screw
17. Upper Stud & Arc Runner
18. Movable Contact
19. Spring
20. Nut
21. Stationary Contacts

Fig. 3 Contact Assembly



1. Stationary Contacts
2. Movable Contacts
3. Upper Stud Asbestos Shield
4. Crossbar Plastic End Shield
5. Crossbar Assembly
6. Crossbar Asbestos Inner Shield
7. Lower Stud Asbestos Shield

Fig. 4 AK-2-25 Back Frame - Location of Crossbar and Pole Shields

Fig. 4 (8026294)

spring. Remove each stationary contact in this manner.

MOVABLE CONTACTS (18)

1. Separate the front frame from the back frame of the breaker. (See section dealing with subject).

2. Remove insulation (5) by lifting and pinching sides together so that the enlarged portion of the slotted hole in each side of the insulation clears the head of the rivet which holds it in place.

3. Release the pivot pin spring clip retainer (9). On the outer poles this retainer is similar to a safety pin and is released by opening its ends as with a safety pin. The center pole is equipped with a clothes pin type retainer which can simply be pulled off the pivot pin (11).

4. The pivot pin (11) of the outer poles is tapped on its outer end. The thread size is #8-32. A #8-32 screw may be used to engage the threads and drift out the pin. If no screw is available, the pin may be pushed out from its inner end.

5. After the pivot pins have been removed from the outer poles, the outer movable contact assemblies may be pulled free of the crossbar assembly (10). A small amount of force will be required to do this as springs (8) and (14) will offer some resisting force.

6. The crossbar assembly (10) may now be removed from the center pole contact assembly. Again, the retaining forces of springs (8) and (14) must be overcome. The pivot pin (11) of the center pole is shorter than its counterpart in the outer poles and does not engage the bracket on the crossbar assembly.

7. If spring clip retainer (9) has not already been removed, it may now be pulled off and the center pole pivot pin (11) drifted out, freeing the contact assembly.

REASSEMBLY

Reassembly is accomplished by reversing the procedure of disassembly. Important factors to remember in performing the reassembly are as follows:

1. The stationary contacts must be arranged in the pole units as shown in sections A-A and B-B of Fig. 3. Note the position of the back projection of each contact. If the contacts are not arranged as shown, the back of the contacts will bear against the stud supports, causing possible damage to the contacts or failure of the breaker to latch in, when the breaker is closed.

2. In replacing the stationary contacts, first place the hook on the end of the contact in the hole of the contact spring (19), then push sidewise until the back projection on the opposite end of the contact can be slipped behind the stop pin in the center of the contact assembly.

3. The adjustment of contact wipe will be facilitated by following the procedure outlined under "Contact Adjustments" of these instructions.

4. When reassembling the crossbar assembly, the crossbar shields should be located with respect to the asbestos pole shields as shown in Fig. 4. If the crossbar shields are not located as shown, breakage may occur when the breaker is operated.

CONTACT SPRINGS (19)

A minimum force of 5 lbs and a maximum force of 9 lbs. should be required to begin movement of a single stationary contact from the open position towards the closed position. This may be checked by using a push scale applied at the point at which the movable contact touches the stationary contact. If these pressures are not obtained or if the spring is damaged, replacement is required.

In order to replace the contact spring the upper stud (17) must be removed. The hardware which fastens the stud to the breaker base consists of two screws (16), and nut (20). When these are removed, the stud may be withdrawn from the base in a forward direction. After the stud has been removed, it is a simple matter to disconnect the two ends of the spring (19) and replace it with a new one.

MECHANISM

The AK-2 breaker mechanism is a spring actuated, over-center toggle type of mechanism. As the closing force is applied, either by movement of the operating handle or the closing solenoid armature, energy is stored in the operating springs. After the springs have gone over center, movement of the output crank of the mechanism is still blocked for a time by a cam arrangement. As the springs are further extended, the blocking cam moves away from the output crank, and the springs are allowed to discharge part of their stored energy, closing the breaker contacts.

This assures a fast-snapping closing action regardless of the speed at which the closing handle is operated.

The breaker mechanism is tripped by the displacement of the trip latch (7), Fig. 6. Looking at the breaker from the right hand side as in Fig. 5, the tripping movement of the latch is counterclockwise. Operation of any of the automatic trip devices or the trip push button causes the latch to move in the tripping direction. When the latch moves off the trip latch roller (7), the remaining force in the operating spring causes the mechanism toggle to collapse, resulting in the opening of the breaker contacts.

ADJUSTMENT

Since all the mechanism adjustments are carefully set by experienced factory personnel after assembly at the factory, it should normally not be necessary to make any adjustments in the field. At the time of installation, and also in the course of a maintenance inspection, if the breaker functions properly through several repeated operations, it is best to assume that adjustments are satisfactory.

If the breaker mechanism does not function properly, it is best to first perform the available remedial measures listed in the "Trouble Shooting" chart of these instructions. One of the remedies listed is that of proper mechanism latch engagement, the amount of engagement between the latch (7) and latch roller (5), Fig. 6. This is the only adjustment that is required on the breaker mechanism, and proper latch engagement is obtained in the following manner:

(NOTE - Before making latch adjustments, check to make sure that the buffer paddle which stops against the end of the latch adjustment screw is rigidly fastened to the trip shaft. Hold the trip shaft (8), Fig. 5, steady and attempt to move the buffer paddle. If any relative movement between the two is noted, tighten the fasteners holding the buffer paddle to the trip shaft.)

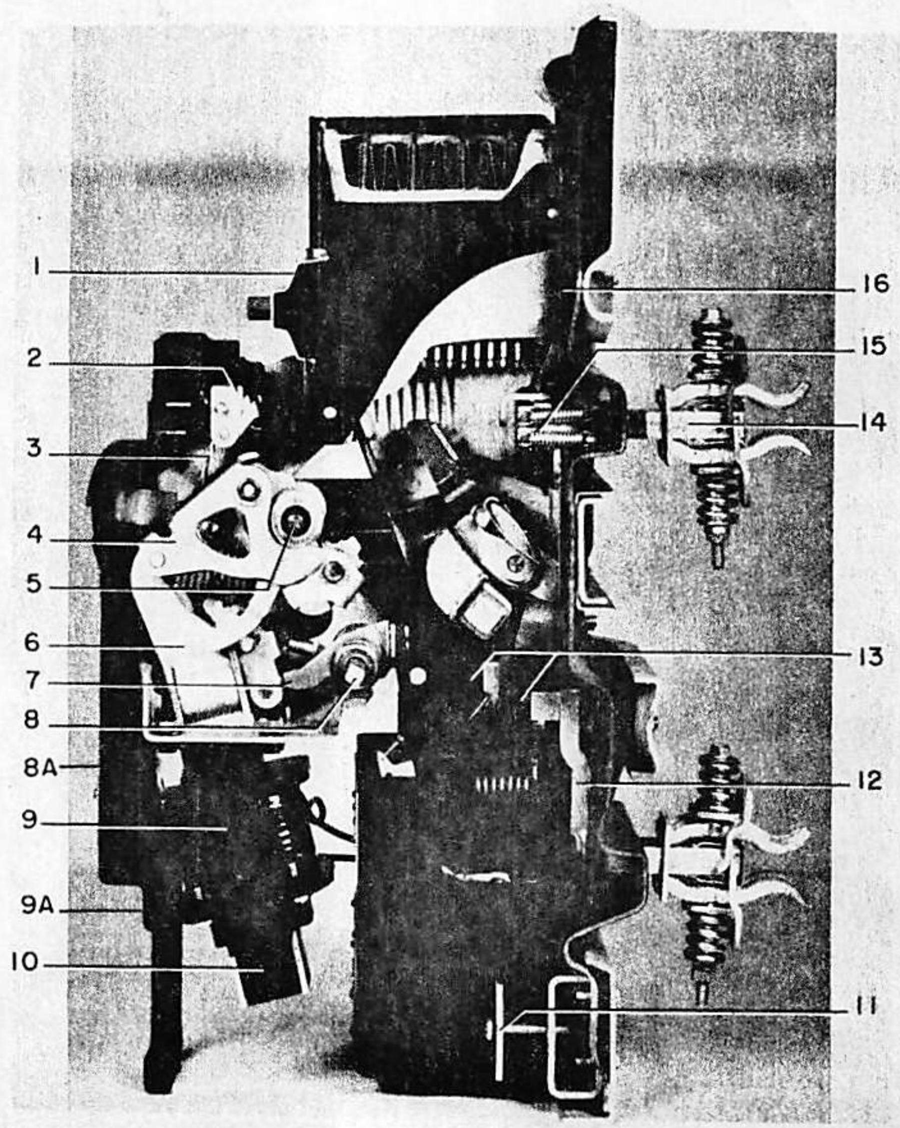
Latch Adjustment - Manual Breakers

1. Locate the latch adjustment screw on the lower, outer side of the right-hand mechanism side frame. This screw is threaded through a nylon insert locknut which, in turn, is welded to a projecting bracket on the side frame.

2. Rotate the closing handle 90 degrees counterclockwise, setting the closing mechanism in the reset position. Turn the adjusting screw into the locknut until the closing mechanism trips open, the closing handle returning to its normal vertical position. NOTE: KEEP HANDS CLEAR OF THE CLOSING HANDLE WHEN MAKING THIS ADJUSTMENT.

3. Withdraw the adjusting screw from the locknut 1/4 turn at a time, attempting to close the breaker after each 1/4

Fig. 5 (8024457)



1. Arc Quencher Retainer
2. Cut off Switch
3. Cut off Switch Actuator
4. Spring Carrier
5. Shoulder Pin
6. Connecting Link
7. Trip Latch Roller
8. Trip Shaft
8A. Front Escutcheon
9. Closing Solenoid
9A. Location of Slots For Maintenace Handle
10. Closing Solenoid Armature
11. Cover Retainer of Overload Device
12. Lower Stud
13. Socket Head Screws
14. Upper Stud
15. Stationary Contacts and Springs
16. Arc Runner

Fig. 5 Cut Away Model of Electrically Operated AK-2 Breaker turn, and observing whether the contacts move toward closing before tripping occurs. If the contacts move before tripping occurs, you have established the position of the adjusting screw where the latch and latch roller begin to engage. In some cases, it may be necessary to turn the adjusting screw less than 1/4 turn in order to establish the position where the contacts begin to move before tripping occurs. When this position is established, note the position of the slot in the head of the adjusting screw.

4. Withdraw the adjusting screw three and one-half turns from the position noted in step 3. This sets the proper amount of latch engagement.

Latch Adjustment - Electrical Breakers

1. Locate the latch adjustment screw on the lower, outer side of the right mechanism side frame. This screw is threaded through a nylon insert locknut which, in turn, is welded to a projecting bracket on the side frame.

2. With the breaker in the open position turn the adjusting screw into the locknut one complete turn at a time, closing the breaker after each complete turn of the adjusting screw, until the breaker will not close. Use the maintenance closing handle whenever closing or attempting to close the breaker during this entire operation.

3. Withdraw the adjusting screw from the locknut 1/4 turn at a time, attempting to close the breaker after each 1/4 turn, and observing whether the contacts move toward closing before tripping occurs. If the contacts move toward closing before tripping occurs, you have established the position of the adjusting screw where the latch and latch roller begin to engage. In some cases, it may be necessary to turn the adjusting screw less than 1/4 turn to establish the position where the contacts move before tripping occurs. When this position is established, note the position of the slot in the head of the adjusting screw.

4. Withdraw the adjusting screw three and one-half turns from the position noted in step 3. This sets the proper amount of latch engagement.

Should the mechanism continue to function improperly after the proper latch engagement has been set and the corrective measures listed in the "Trouble Shooting" chart carried out, it is generally recommended that no attempt be made to repair the mechanism interior but that a replacement mechanism assembly be obtained from the factory.

REPLACEMENT

1. If the breaker is electrically operated, remove the front escutcheon by taking four screws from flange. If the breaker is a drawout type, two small round head screws must also be removed from the bottom edge of the escutcheon. (For removal of front escutcheon from manually operated breakers, see procedure described below.)

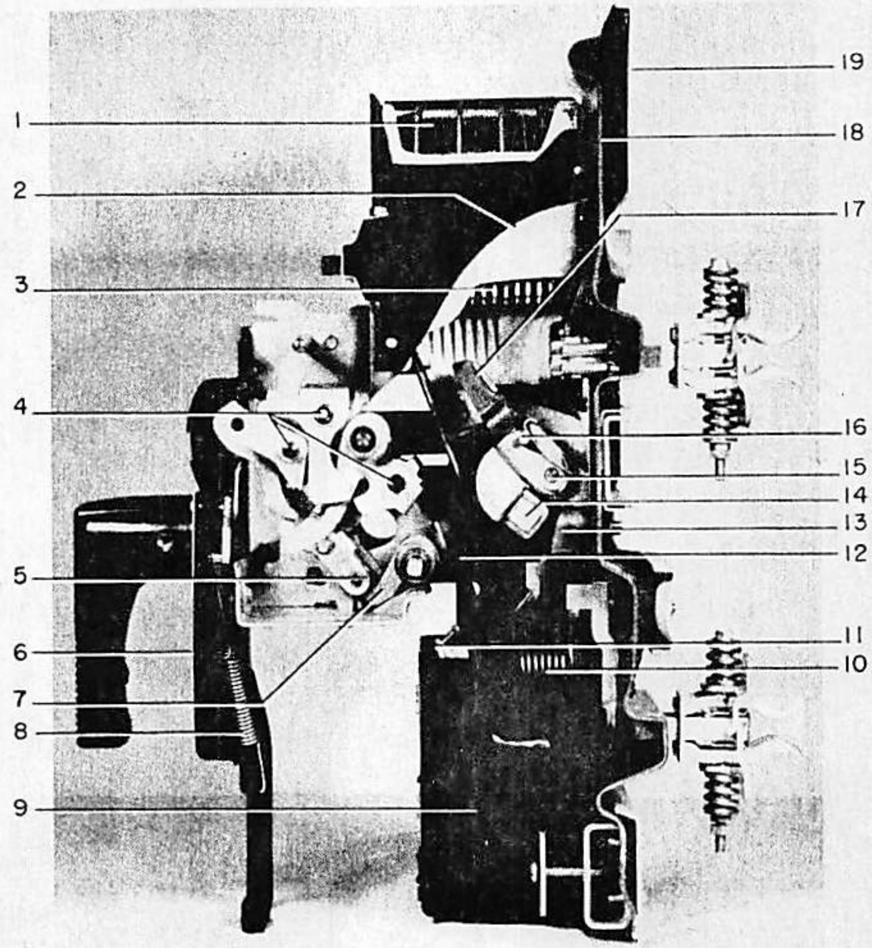


Fig. 6 (8024516)

1. Arc Quencher Muffler
2. Ceramic Side Plates
3. Steel Plates
4. Fixed Centers in Mechanism
5. Latch Roller
6. Escutcheon
7. Trip Latch
8. Handle Return Spring
9. Overload Device
10. Series Coil of Overload Device
11. Trip Arm of Overload Device
12. Trip Paddle
13. Movable Contact Pivot Support
14. Crossbar
15. Movable Contact Pivot
16. Contact Wipe Adjustment Pin
17. Movable Contact
18. Moulded Compound Base
19. Steel Back Plate

Fig. 6 Cut Away Model of Manually Operated AK-2 Breaker

2. Remove arc quenchers (see "Arc Quencher").

3. Disconnect the two insulated connecting links between the mechanism and the contacts as in step 2 of the procedure for "Separation of Front and Back Frames".

4. Remove the two elastic stop nuts, which fasten the upper extensions of mechanism frame to studs connecting with rear frame.

5. Remove four screws which fasten the bottom of the mechanism frame to the horizontal cross member of the front frame.

6. If the breaker is manually operated, and has no auxiliary switch, it is now free to be lifted clear of the breaker. If it has an auxiliary switch, this may be disconnected from the mechanism as described under "Auxiliary Switch - Replacement, elsewhere in these instructions.

7. If the breaker is electrically operated, it will be necessary to disconnect the mechanism from the solenoid armature. In order to do this, raise the mechanism as far as the travel of the armature will permit and remove the screw which binds together the two extensions of the armature. After this is removed, the armature extensions must be spread apart to release them from the link connecting with the mechanism. This can be done by threading a #10-32 screw at least 1 3/4 inches long into the top hole of the armature extension. This hole is just above the one from which the binding screw has been removed. As the end of the screw butts against the far extension, the two extensions will be spread open, releasing the mechanism link.

8. The replacement mechanism may be installed by reversing the order of procedure for disassembly. After reassembly, check the operation of the breaker and, if necessary, adjust the latch engagement.

REMOVAL OF FRONT ESCUTCHEON OF MANUAL BREAKERS

1. Remove set screw fastening the plastic handle to steel operating shaft and remove the operating handle.

2. Open and remove annealed (soft) retainer and two flat washers from shaft.

3. Remove four screws from flange of escutcheon. If the breaker is a drawout type, two small round head screws must also be removed from the bottom edge of the escutcheon.

4. Push steel operating shaft through escutcheon bushing.

5. Remove handle reset spring (8) Fig. 6, and escutcheon is free of breaker.

6. Handle and escutcheon assembly can be assembled most easily by exactly reversing the procedure for disassembly. In replacing the excutcheon it may be necessary to use pliers to pull the operating shaft fully into the escutcheon in order to have space enough to replace the flat washers and the soft retainer. The latter may be closed on its groove in the shaft by ordinary gas pliers. After replacement, check operation of breaker.

AUXILIARY SWITCH

The auxiliary switch is mounted on the left side of the operating mechanism frame. Its operating shaft is linked to the output crank of the breaker mechanism. Through a cam arrangement, the operating shaft of the switch controls the open and closed positions of the individual contact pairs. Each stage of the switch, which is usually two-stage or five-stage, contains one "a" and one "b" set of contacts. An "a" pair of contacts is always in the same position as the main breaker contacts. That is, open when the breaker contacts are open, and closed when the breaker contacts are closed. Just the opposite is true of the "b" contacts. The terminals of the switch are covered by a sheet of insulating material held in place by two screws fastened along its left edge. When this is removed, the terminals are exposed. The upper pairs of terminals are those which connect to "a" switches. The lower terminals connect to "b" switches.

REPLACEMENT

1. Remove auxiliary switch cover.

2. Disconnect leads to switch terminals.

3. Remove two screws which fasten switch to side of mechanism frame.

4. Remove switch by moving towards left.

5. Before mounting replacement switch, turn the crank end of the switch operating shaft in position to engage the hole in the link connecting with the breaker mechanism. Be sure the bearing washer is in place between the mechanism link and the switch operating shaft.

6. Complete mounting by following disassembly steps in reverse order.

ELECTRICAL CONTROL COMPONENTS

These consist of the following:

1. Closing solenoid
2. "X" contactor (relay)
3. "Y" permissive relay
4. Cut-off switch
5. Closing switch
6. Shunt-trip device

The last two of these components may or may not be present in the control arrangement.

CLOSING SOLENOID

The closing solenoid consists of a magnet, armature and coil. This assembly is located directly beneath the breaker mechanism to which it is connected by a link which ties the upper end of the armature to the spring carrier of the mechanism. (See Fig. 5.)

When voltage is applied to the coil, the magnetic force generated pulls the armature up into the coil and magnet assembly. This, in turn, rotates the spring carrier about its pivot, extending the mechanism spring and causing its line of action to move "over center", resulting in a closing operation.

REPLACEMENT

The only replacement operation that might conceivably be required on this assembly is that of the solenoid coil. To replace this, proceed as follows:

1. Remove escutcheon by unfastening four flat head screws in flange.

2. Remove closing switch. (See "Closing switch".)

3. Cut off or disconnect the coil leads.

4. Remove four screws which fasten lower section of magnet to upper section.

5. Allow lower section of magnet and coil to slide downward until clear of armature.

6. Reassemble with new coil by reversing order of procedure.

"X" CONTACTOR

The "X" contactor is a heavy-duty relay which performs the function of closing the circuit of the breaker solenoid during electrical operations. Three of the four sets of contact of the device are arranged in series to minimize the duty required of any one contact. As explained under "Operation", the fourth contact is used to "seal-in" the "X" coil.

The "X" contactor is located on the right beneath the horizontal front frame member. It is mounted on three studs which fasten it to a mounting bracket which is suspended from the frame. Rubber bushings on the mounting studs provide anti-vibration and anti-shock protection for the relay. The relay contacts and their terminals are covered by a moulded piece of insulation which fits over spring clips that hold the cover in place.

REPLACEMENT

Removal of the complete device is accomplished by removing the cover, disconnecting the leads from the terminals, and removing the nuts from the three mounting studs. If the replacement unit includes the mounting bracket, the relay need not be removed from the old bracket. This can be taken off the breaker simply by removing the two screws which fasten it to the breaker frame. If the breaker is a drawout type, the supporting bracket of the "Y" relay may be temporarily displaced to provide access to the screws.

Since the expendable parts of the "X" contactor are the contacts and the coil, ease of replacement of these parts has been designed into the relay. Methods of procedure are as follows:

Contacts

1. Remove relay cover.

2. Remove terminal binding screw of stationary contact to be replaced.

3. Lightly pinch with pliers (pointed end) the split section of the contact which enters the hole in the compound body of the device and lift out the stationary contact.

4. With the fingers, pull forward on the spring guide of the movable contact, compressing the contact spring as far as possible.

5. With the spring thus held, grip the end of the contact strip with pointed pliers, turn it through 90 degrees on its long axis, and withdraw it.

6. Replace new contacts by reversing the procedure.

Coil

1. Remove relay cover.

2. Turn the two retaining spring clips on the ends of the device through 90 degrees about their pivots.

3. Pull out the two halves of the body of the device which carry the stationary contacts. When these are clear of the frame, the armature and movable contact assembly will move aside, exposing the coil.

4. Remove the terminal screws of the coil and pull it free of its retaining spring clips.

5. Place new coil on pole piece inside of the spring clips and fasten terminals to leads.

6. Just start the replacement of one of the compound blocks which hold the stationary contacts into its groove in the frame.

7. Position the armature and movable contact assembly to allow the entrance of the second stationary contact block.

8. When these parts are all properly aligned, with the stationary contacts under the movable contacts, push them into their guiding grooves in the frame until they bottom.

9. Rotate the retaining spring clips to the locked position, making sure that each clip is in its proper recess, and replace the device cover.

"Y" RELAY

As described under "Operation", the "Y" relay is a permissive relay which limits to one the number of breaker closures possible on one closing signal.

On drawout breakers, the "Y" relay mounting bracket is fastened to the right hand side member of the breaker frame by two mounting screws. On terminal board breakers, it is fastened to the rear side of the terminal board support. The relay itself is fastened to an intermediate bracket which is detachable from the main support. The junctures between the relay and the intermediate bracket and between the two brackets are rubber cushioned against vibration and shock.

REPLACEMENT

If replacement of the "Y" relay becomes necessary, it may be detached from its supporting brackets by removal of the fastening hardware. The leads to the relay should be cut off as closely as possible to the soldered connections so that enough wire will remain for connection to the new relay. Sufficient original wire will be allowed for this purpose.

After the old relay has been removed, the wire leads to the relay should be stripped of insulation to about 1/4 of an inch from the ends. A good mechanical connection should be made before soldering.

After all connections are completed, the relay should again be mounted to the breaker by means of its supporting brackets and hardware.

After replacement has been completed, the relay may be checked electrically in the following manner.

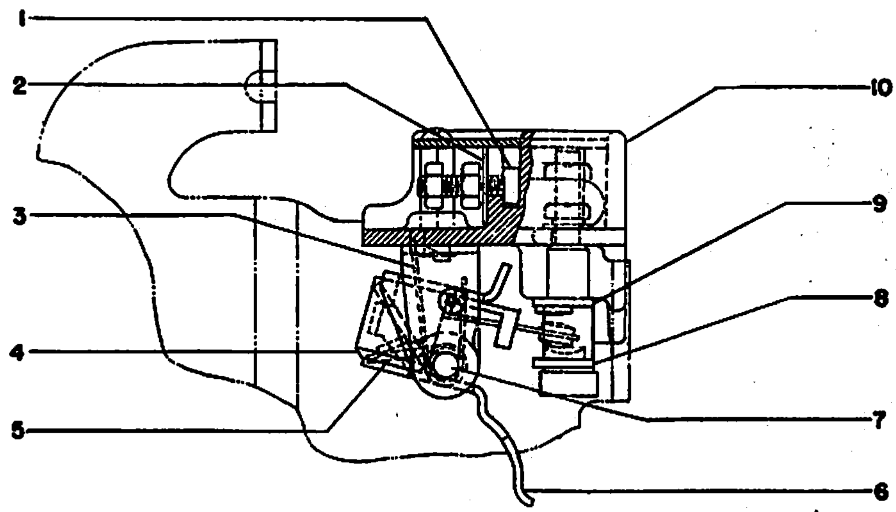
1. Apply closing voltage to terminal board or secondary disconnects.

2. Push button of closing switch and hold closed.

3. Continuing to hold push button in closed position, manually trip the breaker open.

4. If the breaker stays open, and makes no attempt to close, the "Y" relay is functioning properly.

5. While releasing the close button, observe the "Y" relay. It should open as the closing switch is released.



1. Screw 2. Washer 3. Spring 4. Movable Contact Assembly 5. Spring 6. Actuator 7. Pivot Pin 8. Contact (BB) 9. Contact (AA) 10. Support

Fig. 7 Cut-Off Switch

CUT-OFF SWITCH, FIG. 7

As explained under "Operation", the function of the cut-off switch is to de-energize the "X" contactor coil and energize the "Y" relay coil as the breaker mechanism moves from the opened to the closed position.

The switch is operated by the movement of a mechanism link against the switch actuator (6). This causes the actuator and movable contact assembly (4) to rotate counterclockwise about pin (7), opening the "bb" contacts (8) and closing the "aa" contacts at (9). Overtravel of the actuator (6) beyond the point of making contact at (9) is absorbed by spring (5) which couples the movable contact (4) to the actuator. Spring (3) resets the switch after the breaker contacts open and the breaker mechanism resets.

The point at which the cutoff switch operates during the breaker closing cycle is after the spring charged mechanism has been driven over-center. This assures that the cutoff switch cannot operate too early in the breaker closing cycle, thus the X and Y relays are de-energized and energized, respectively, at the proper time and the circuits anti-pump feature is maintained. When the closing mechanism is driven over-center, the force of the previously charged closing springs is released, closing the breaker.

REPLACEMENT

The cut-off switch is located above the breaker mechanism. It is fitted between the upper portions of the steel side plates that make up the mechanism frame. A raised horizontal ridge on each side of the moulded body of the switch fits into a corresponding groove in each of the steel side plates. A round head screw on each side fastens the switch and side plate together. Replacement of the switch is accomplished by the following procedure:

1. Remove the cover on the top of the switch by taking out the two screws which hold it in place.

2. After taking careful note of the connection arrangement, disconnect the leads from the switch terminals.

3. Remove the two screws, one on each side, which fasten the switch to the mechanism side plates. Note that the one on the right hand side also holds a wiring cleat and spacer which serves to hold the wires clear of the link connecting the mechanism and the breaker position indicator.

4. Remove the front escutcheon from the breaker.

5. Slide the cut-off switch out from between the steel side plates by pulling straight forward.

6. Mount the replacement switch by reversing the order of procedure.

CLOSING SWITCH, FIG. 8

The closing switch is mounted on the upper flange of the closing solenoid coil. A hole in the escutcheon (3) permits access to the switch button (4). When the button is pressed, movable contact (5) deflects and impinges upon stationary contact (2). This energizes the "X" relay coil which seals itself in, and, in turn, energizes the closing solenoid.

Fig. 8 (8058905)

REPLACEMENT

1. Remove escutcheon (3).

2. Disconnect leads from switch terminals.

3. Deflect the left end of hinge (7) to the left so that the movable contact (5) may be disengaged from the switch assembly.

4. Removal of the two screws (10) from speednuts (9) completes the disassembly of the switch.

5. Reassembly with new parts is a matter of reversing the described procedure. In reassembling, be sure the tab on the left end of hinge (7) is bent to the right far enough to avoid any possibility that movable contact (5) might become free of the assembly.

Fig. 9 (695C161)

SHUNT TRIP DEVICE, FIG. 9

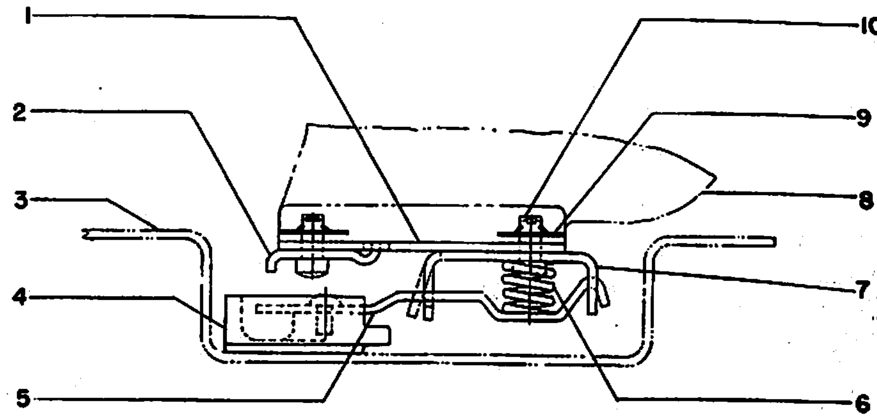
The shunt tripping device is mounted underneath the horizontal cross frame member, just to the left of the front escutcheon. It is composed of a magnet, coil and armature. The armature has an extended arm or striker (11) which bears against the trip paddle (12) on the trip shaft when the coil (8) is energized. This displaces the trip latch in the breaker mechanism, opening the breaker contacts.

The trip device is generally activated by a remote switch or relay which closes the shunt trip coil circuit.

In order to avoid unnecessary heating of the coil of the device, an auxiliary switch "a" contact is wired in series with the coil. This prevents the energization of the coil if the breaker is open.

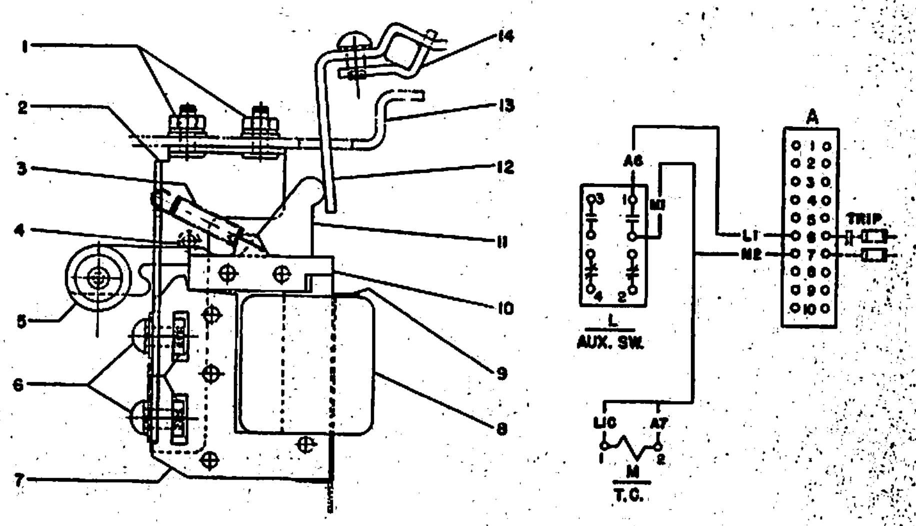
REPLACEMENT

The entire shunt trip device may be dismounted by disconnecting the coil leads and removing nuts (1). However, the only part of the device that might conceivably



1. Insulation
2. Stationary Contact
3. Front Escutcheon
4. Push Button
5. Movable Contact
6. Spring
7. Hinge
8. Closing Solenoid
9. Speed Nut
10. Screw

Fig. 8 Closing Switch (Top View)



1. Nut
2. Frame
3. Spring
4. Rivet
5. Weight
6. Screws
7. Magnet
8. Coil
9. Clamp
10. Armature
11. Armature Arm
12. Trip Paddle
13. Mechanism Frame
14. Trip Shaft Clamp

Fig. 9 Shunt Trip Device

need replacement during the life of the breaker is the coil (8). This may be replaced without removing the device from the breaker by proceeding as follows:

1. Disconnect leads of coil (8).

2. Remove two screws (6) which fasten magnet (7) and coil to the frame (2).

3. Having removed the magnet from the device, straighten the end of clamp (9).

4. Remove the coil from the magnet.

5. Install new coil, again forming end of clamp (9) as shown.

6. Reassemble to frame.

7. Connect coil leads.

ADJUSTMENT

The only adjustment required on the shunt trip device is that which ensures positively that the breaker will trip when the device is activated. In order to be sure of this, armature arm (11) must travel from 1/32 to 1/16 of an inch beyond the point at which the breaker trips. A good method of checking this is to hold a 1/32nd shim between the magnet and armature at (10), and with the breaker closed, push upwards at (5), closing the armature against the magnet. If the breaker trips, there is sufficient overtravel. If adjustment is necessary, trip paddle (12) may be formed towards or away from armature arm (11).

PROTECTIVE DEVICES

An AK-2-15 or AK-2-25 breaker may be equipped with any combination of the following protective devices:

1. Overcurrent trip
2. Reverse current trip
3. Undervoltage trip
4. Bell alarm and/or lockout attachment.

OVERCURRENT TRIP DEVICE

The typical overcurrent trip device consists of a magnetic structure, a series current coil, and a pivoted armature.

When current flow through the series coil generates a magnetic field strong enough, the armature overcomes the restraining force of a calibration spring attached to it, and closes against the magnet. This trips the breaker by means of an extension on the armature which strikes against a trip paddle on the trip shaft.

Depending on the type of individual device, the movement of the armature may be delayed for a time by a timing device. If a relatively long time-delay (seconds or minutes) is desired, the velocity of armature movement is governed by a piston moving through an oil dashpot. If only a short-time delay (cycles or milli-seconds) is required, movement is controlled by an escapement gear and palletts arrangement.

An AK-2-15/25 breaker may be equipped with either the EC-2 or EC-1 overcurrent trip device. The majority of applications will require the use of the EC-2 device. The EC-1 device is normally used when the short-time delay feature is required, or when the trip device is used to operate a special overcurrent alarm switch.

Most circuit breakers are equipped with series overcurrent trip devices either of the dual magnetic type (instantaneous and time delay tripping) or instantaneous alone. Breakers are designed to carry up to 100% of the continuous current rating of their trip devices. Any attempt to carry higher currents for a prolonged period will cause overheating and possible damage.

EC-2 OVERCURRENT TRIP DEVICE

The Type EC-2 overcurrent tripping device is available in three forms:

1. Dual overcurrent trip, with long-time delay and high-set instantaneous tripping.

2. Low-set instantaneous tripping.

3. High-set instantaneous tripping.

The dual trip has adjustable long-time and instantaneous pick-up settings and adjustable time settings. Both forms of instantaneous trips have adjustable pick-up settings.

DUAL OVERCURRENT TRIP, WITH LONG-TIME DELAY AND HIGH-SET INSTANTANEOUS TRIPPING.

By means of the adjustment knob (5), Fig. 10, which can be manipulated by hand, the current pick-up point can be varied from 80 to 160 percent of the series coil rating. The indicator and a calibration plate (4), Fig. 10, on the front of the case provide a means of indicating the pick-up point setting in terms of percentage of coil rating. The calibration plate is indexed at percentage settings of 80, 100, 120, 140 and 160.

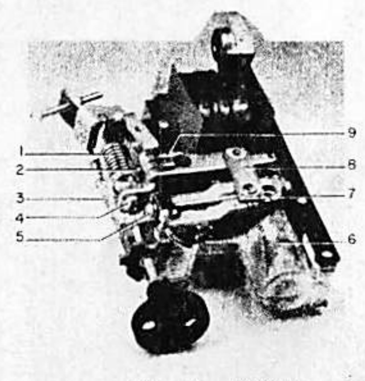
The long-time delay tripping feature can be supplied with any one of three time-current characteristics which correspond to the NEMA standards maximum, intermediate and minimum long-time delay operating bands. These are identified as 1A, 1B and 1C characteristics, respectively. Approximate tripping time for each of these, in the same order are 30, 15 and 5 seconds at 600% of the pick-up value of current. (See time-current characteristic curves 286B201A, B and C).

The tripping time may be varied within the limits shown on the characteristic curves by turning the time adjustment screw (5), Fig. 11. Turning in a clockwise direction increases the tripping time; counter-clockwise motion decreases it. The dashpot arm (7), Fig. 11, is indexed at four points, max. - 2/3 - 1/3 - min. from the left, as viewed in Fig. 11. When the index mark on the connecting link (8), Fig. 11, lines up with a mark on the dashpot arm, the approximate tripping time as shown by the characteristic curve is indicated. The 1A and 1B characteristic devices are shipped with this setting at the 2/3 mark and the 1C characteristic at the 1/3 mark. The standard characteristic curves are plotted at the same settings.

1. Series Coil
2. Trip Adjustment Screw
3. Opening for Time Adjustment
4. Pickup Indicator & Calib. Plate
5. Pickup Adjustment Knob

Fig. 10 (8024842)

Fig. 10 EC-2 Overcurrent Trip



1. Instantaneous Calibration Spring
2. Movable Nut (Index Pointer)
3. Time-Delay Calibration Spring
4. Instantaneous Pickup Adjustment Screw
5. Time-Delay Adjustment Screw
6. Oil Dashpot
7. Dashpot Arm
8. Connecting Link
9. Instantaneous Pickup Calibration Marks

Fig. 11 (8024843)

Fig. 11 EC-2 Overcurrent Trip With Cover Removed

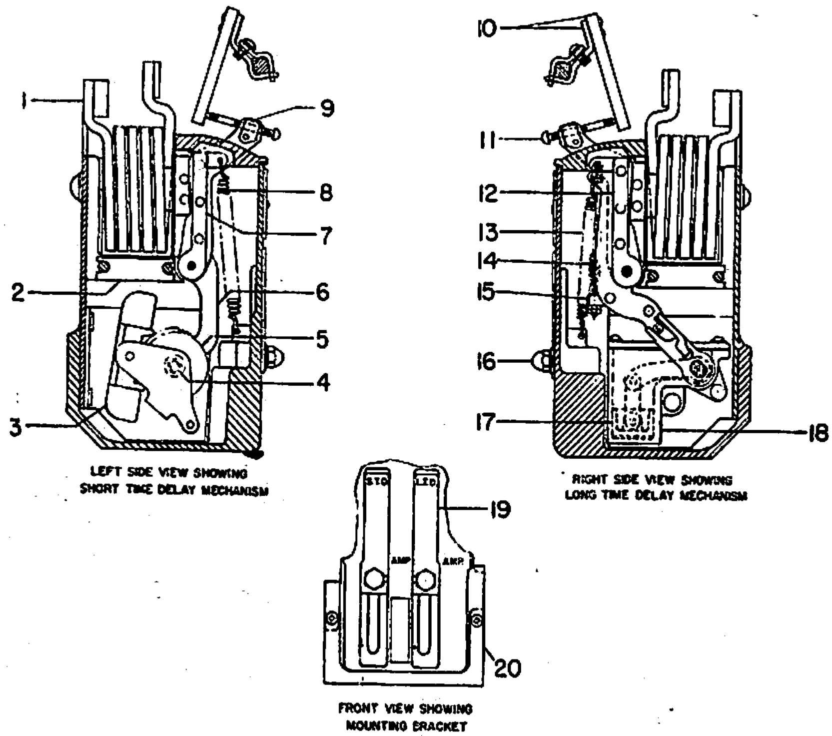


Fig. 12 (695C189)

1. Series Coil
2. Magnet
3. Pallet
4. Pinion
5. Escape Wheel
6. Driving Segment
7. S.T.D. Armature
8. S.T.D. Calibration Spring
9. Trip Arm
10. Trip Paddle
11. Trip Paddle Adjusting Screw
12. L.T.D. Armature
13. L.T.D. Calibration Spring
14. Instantaneous Trip Spring (High Set)
15. Spring Holder
16. Calibration Clamp Nut
17. Plunger
18. Cylinder (Dashpot)
19. Calibration Plate
20. Clamping Bracket

Fig. 12 EC-1 Type Overcurrent Trip Device

Time values are inversely proportional to the effective length of the dashpot arm. Therefore, the linkage setting that gives the shortest time value is the one at which dimension "A", Fig. 11, is greatest. The time adjustment screw (5), Fig. 11, may be turned by inserting a Phillips head screwdriver through the hole in the front of the case, but if it is desired to relate the linkage setting to the index marks on the linkage it will be necessary to remove the case. This may be done by removing the two mounting screws, one on each side of the case, which may be taken off without disturbing the trip unit itself.

NOTE: Forcing the adjusting screw to either extreme position may cause binding of the device and should be avoided.

INSTANTANEOUS LOW-SET TRIPPING

The low-set instantaneous pick-up point may be varied by the adjustment knob (5), Fig. 10. The calibration in this case usually ranges from 80% to 250% of the series coil rating, the calibration plate being indexed at values of 80%, 100%, 150%, 200% and 250% of the rating.

INSTANTANEOUS HIGH-SET TRIPPING

The high set instantaneous pick-up value may have one of the following three ranges: 4 to 9 times coil rating; 6 to 12 times coil rating or 9 to 15 times coil rating. The pick-up setting may be varied by turning the instantaneous trip adjusting screw (4), Fig. 11.

Three standard calibration marks will appear on the operating arm at (9), Fig. 11, and the value of these calibration marks will be indicated by stampings on the arm as follows:

4X		6X		9X
6.5X	or	9X	or	12X
9X		12X		15X

At the factory, the pick-up point has been set at the nameplate value of the instantaneous trip current. (Usually expressed in times the ampere rating of the trip coil.) The variation in pick-up setting is accomplished by varying the tensile force on the instantaneous spring. Turning the adjustment screw changes the position of the movable nut (2), Fig. 11, on the screw. The spring is anchored to this movable nut so that when the position of the nut is changed, there is a corresponding change in the spring load. As the spring is tightened, the pick-up point is increased. The top edge of the movable nut (2), Fig. 11, serves as an index pointer and should be lined up with the center of the desired calibration mark, punched slots on operating arm, to obtain the proper instantaneous trip setting.

EC-1 OVERCURRENT TRIP DEVICE

The EC-1 device can be provided with the following tripping combinations:

1. Long time delay, short time delay and instantaneous tripping.

2. Long time and short time delay tripping only.

3. Long time delay and instantaneous tripping.

4. Short time delay and instantaneous tripping.

5. Short time delay tripping only.

6. Instantaneous tripping only.

(a) Adjustable (Low set)
or
Nonadjustable (High set)

SHORT TIME DELAY TRIPPING, FIG. 12

The armature (7) is retained by calibrating spring (8). After the magnetic force, produced by an overcurrent condition, overcomes this restraining force, the armature movement is further retarded by an escapement mechanism which produces an inverse time delay characteristic. The mechanism is shown in the left side view of Fig. 12.

The pickup for this device can be field set between limits having a ratio of 2-1/2 to 1 in the range of 200 to 1000% of the coil rating.

LONG TIME DELAY TRIPPING, FIG. 12

The armature (12), is retained by the calibration spring (13). After the magnetic force, produced by an overcurrent condition, overcomes this restraining force, the armature movement is further retarded by the flow of silicone oil in a dashpot, which produces an inverse time delay characteristic. The mechanism is shown in the right side view of Fig. 12.

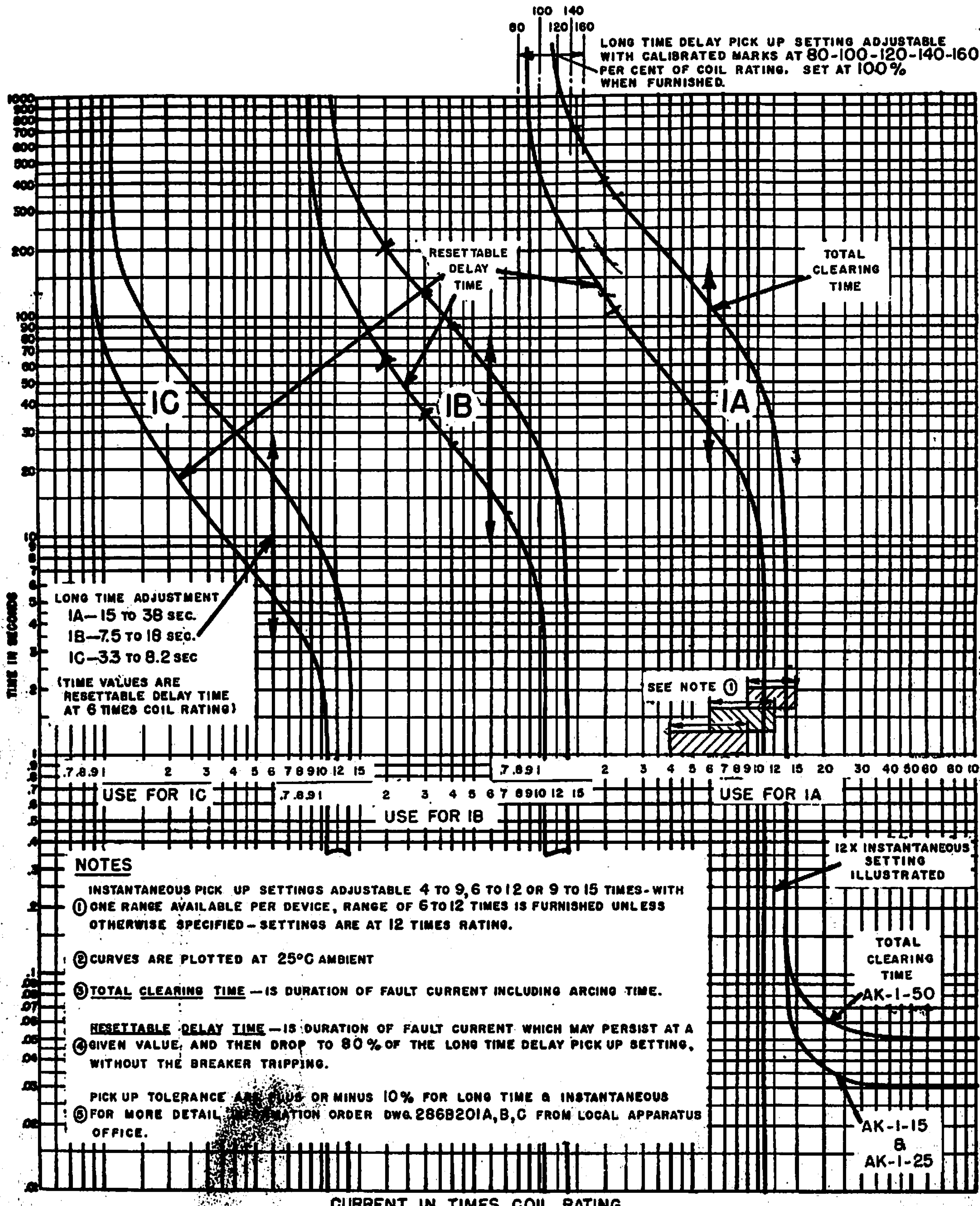


Fig. 13 Time-Current Characteristic of the Type EC-2 Overcurrent Trip Device

INSTANTANEOUS TRIPPING, FIG. 12

(a) Adjustable instantaneous tripping takes place after the magnetic force produced by an overcurrent condition, overcomes the restraining force of the adjustable calibration spring (13).

(b) Nonadjustable instantaneous tripping takes place after the magnetic force produced by an overcurrent condition overcomes the restraining force of a nonadjustable spring (14).

SELECTIVE TRIPPING

Selective overcurrent tripping is the application of circuit breakers in series so that only the circuit breaker nearest the fault opens. Any one or combination of two or more of the preceding over-current devices may be used in a selective system. The breaker having the shorter time setting and lower pickup will trip before the breaker having the longer setting and higher pickup, provided the fault is on the part of the line protected by the breaker having the lower setting.

For the exact characteristics and setting of each breaker in a selective system, reference should be made to a coordination chart for the particular system.

ADJUSTMENTS, EC-1 AND EC-2

In addition to the pick-up settings and time-delay adjustments already described, overcurrent trip devices must be adjusted for positive tripping. This adjustment is made at the factory on new breakers, but must be made in the field when the breaker mechanism or the overcurrent trip devices have been replaced.

Positive tripping is achieved when adjustment screw (2), Fig. 10, is in such a position that it will always carry the trip paddle on the trip shaft beyond the point of tripping the mechanism, when the armature closes against the magnet.

In order to make the adjustment, first unscrew trip screw (2), Fig. 10, until it will not trip the breaker even though the armature is pushed against the magnet. Then, holding the armature in the closed position, advance the screw until it just trips the breaker. After this point has been reached, advance the screw two additional full turns. This will give an overtravel of 1/16 of an inch and will make sure that activation of the device will always trip the breaker.

Adjustment screw (2), Fig. 10, can best be manipulated by an extended 1/4 inch hex socket wrench.

In order to gain access to the adjustment screw on the center pole overload device, it will be necessary to remove the nameplate from the front escutcheon of the breaker. This will reveal a hole, centrally located in the escutcheon, by means of which the extended socket wrench can engage the adjustment screw.

REPLACEMENT, EC-1 AND EC-2

Replacement of either the EC-1 or EC-2 overcurrent trip device is accomplished by the following procedure:

1. Separate the breaker's front and back frames as described in the section under "Maintenance".

2. Remove the steel clamps which fasten the cover of the device to the back of the breaker. NOTE: Pickup settings on the cover of each device are calibrated for the specific device. When replacing covers, replace on associated device.

3. Using a 5/16 inch Allen Head Wrench, remove the 3/8 inch bolts which fasten the coil of the overload device to the breaker copper.

4. Remove the round head screw which fastens the frame of the overload to the breaker base.

5. After reassembling breaker with new overload device, adjust for "positive trip" as described under "Adjustments" of this section.

REVERSE CURRENT TRIP DEVICE

FIGURE 14

The reverse current trip device sometimes used with d-c breakers will trip the breaker open if the direction of current flow is reversed.

This device is similar in appearance and is mounted in the same way as the overcurrent trip. The device consists of a series coil (1), with an iron core mounted between two pole pieces (7) and a potential coil connected across a constant source of voltage and mounted around a rotary type armature (6). Calibration spring (3) determines the armature pick-up value when a reversal of current occurs.

As long as the flow of current through the breaker is in the normal direction, the magnetic flux of the series coil and the magnetic flux of the potential coil produce a torque which tends to rotate the armature counterclockwise. The calibration spring (3) also tends to rotate the armature in the same direction. This torque causes the armature to rest against stop screw (9) attached to a bearing plate on the right side of the device.

If the current through the series coil (1) is reversed, armature (6) tends to move in a clockwise direction against the restraint of calibration spring (3). When the current reversal exceeds the calibration setting, the armature will move in a clockwise direction. This causes trip rod (2B) to move upwards against trip paddle (14), tripping the breaker open.

ADJUSTMENTS

The only adjustment to be made on the reverse current device is to make sure that the trip rod has a minimum overtravel of 1/32 of an inch beyond the point of tripping the breaker. The only occasion this adjustment should have to be made is when an old device is being replaced by a new one.

The new device will be factory adjusted so that the top end of the trip rod (2B) will extend 1/2 inch above the top of the device case, and no additional adjustments of the trip rod should be required. To obtain the proper 1/32 of an inch overtravel, close the breaker and proceed as follows:

1. Loosen the locking nut (2A).

2. Manually lift the trip rod and vary the position of the adjusting nut (2), thus establishing the position of the adjusting nut where the breaker is just tripped. (NOTE - Be sure that all parts of the person are kept clear of moving breaker parts when tripping the breaker.

3. With this position of the adjusting nut established, advance the adjusting nut upward one and one half turns.

4. Tighten the locking nut and the minimum 1/32 of an inch overtravel of the trip rod should be obtained.

REPLACEMENT

Replacement of the ED-1 Reverse Current Device is accomplished by means of the same procedure as that followed in the case of the EC Overcurrent Trip Devices. There is, however, one additional step to be taken. This consists of disconnecting the leads of the potential coil. These are connected to a small two-point terminal board mounted between two of the phases on the breaker base. After the new device has been installed, adjust for overtravel of the trip rod as described above.

UNDERVOLTAGE TRIP DEVICE

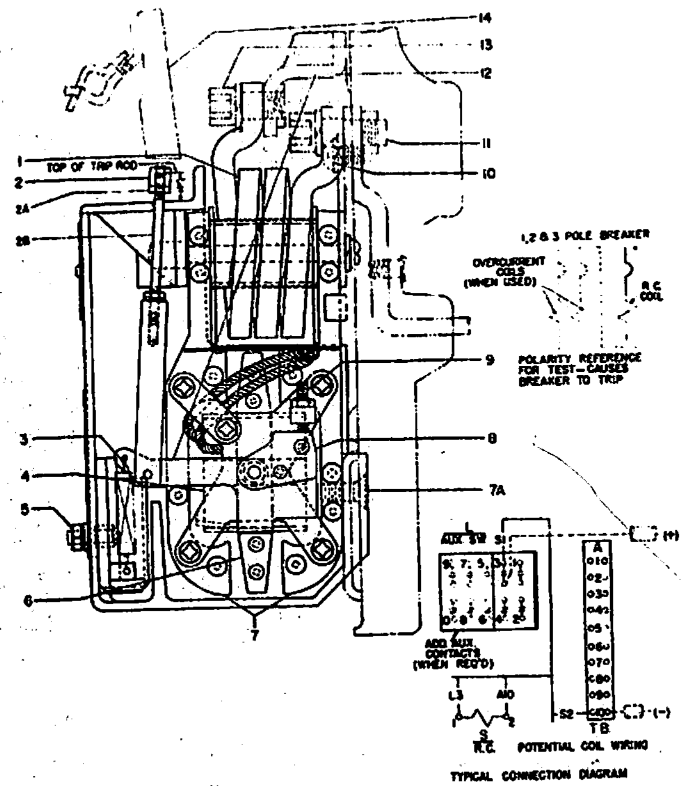
FIGURE 15

The undervoltage device is mounted on the left side of the breaker observed from the front. It hangs from the left end of the horizontal cross member of the front frame. This device has the function of tripping the breaker open if the circuit voltage drops below a predetermined value. Since the coil (16) of the device is normally energized, the flux of the magnetic circuit normally holds armature (3) down against magnet (14). If the voltage drops below a certain percentage value of nominal voltage, the magnetic flux is no longer strong enough to overcome the force of calibration spring (4) which tends to pull the armature away from the magnet. When this occurs, the striker on the armature hits against trip paddle (23), tripping the breaker open.

The undervoltage device may or may not be equipped with a time-delay feature, depending upon requirements. This is provided by an oil dashpot (12) and piston (11). If it does have this feature, when the voltage drops below tripping value, the movement of the armature is delayed by the time it takes to displace the piston a short distance through the oil. The minimum time delay thus afforded is 3 seconds. The depth of the oil in the dashpot should be 1/4 to 3/8 of an inch. The oil level may be checked by unscrewing cylinder (12) from its cap. If additional oil is needed, G. E. silicone oil SF96-40, or its equivalent should be used.

ADJUSTMENTS

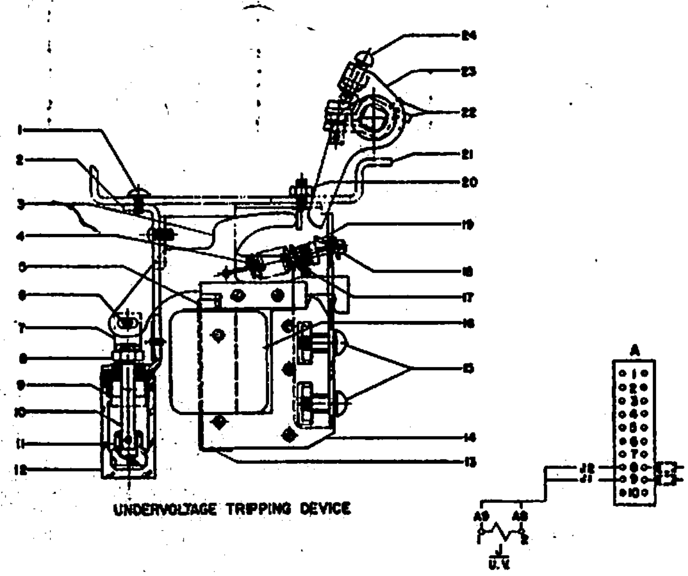
Adjustment screw (24) is used to provide an overtravel of from 1/32 to 1/16 of an inch beyond the point of tripping. If the armature is manually held down with the de-energized breaker in the closed position, and then allowed to gradually move to



1. Series Coil
2. Adjusting Nut
2A. Locking Nut
2B. Trip Rod
3. Spring
4. Potential Coil
5. Calibration Nut
6. Armature
7. Pole Pieces
7A Screws
8. Counterweight
9. Stop Screw
10. Mounting Screw
11. Screw (Lower Stud)
12. Trip Crank
13. Screw (Lower Stud)
14. Trip Paddle

Fig. 14 Reverse Current Tripping Device

Fig. 14 (549013-1)



1. Mounting Screw
2. Device Frame
3. Armature
4. Spring
5. Shading Ring
6. Pin
7. Clevis
8. Locking Nut
9. Cap
10. Connecting Rod
11. Plunger (Piston)
12. Cylinder (Dashpot)
13. Clamp
14. Magnet
15. Screws
16. Coil
17. Rivet
18. Adjusting Screw
19. Locking Wire
20. Mounting Nut
21. Mechanism Frame
22. Trip Paddle Clamps
23. Trip Paddle
24. Adjusting Screw

Fig. 15 Undervoltage Tripping Device

Fig. 15 (695C163)

the point of tripping the breaker, the amount of further armature movement may be noted visually. If this is approximately within the range stated, the positive trip adjustment is satisfactory.

The time delay of the device may be varied somewhat by changing the relative positions of the connecting rod (10) and clevis (7). This is accomplished by first loosening the locking nut (8), then raising or lowering the plunger (11), by turning the connecting rod which is threaded into the clevis. When any time delay of 3 to 10 seconds exists from loss of voltage, the device is considered satisfactorily adjusted.

The value of increasing voltage at which the open armature will pick-up and close, allowing closure of the breaker, is determined by a sliding stop which sets the open gap of the armature. This is a factory adjustment, and should not be set in the field. The pick-up point of voltage is 80% of normal voltage.

Calibration spring (4) establishes the drop out value of voltage, which results in breaker tripping. This setting is made at the factory. Drop-out voltage is set at between 30% and 60% of normal voltage.

REPLACEMENT

The entire device may be dismounted by disconnecting the coil leads and removing screw (1) and nuts (20). Normally, only the coil (16) will ever need replacement. This may be removed from the device by taking out screws (15) which will free both the magnet (14) and the coil. Straightening of the bend in clamp (13) will separate the coil from the magnet. The coil leads, of course, must be disconnected.

BELL ALARM SWITCH AND/ OR LOCKOUT ATTACHMENT

FIGURE 16

The bell alarm device is mounted on top of the horizontal cross frame member just to the left of the mechanism frame when the breaker is viewed from the front. This device operates a switch with two sets of contacts, one normally open, the other normally closed. The switch may be used to open or close an external circuit, giving a bell or light indication of a protective trip device operation.

If the breaker is tripped open by any means other than the manual trip button or the shunt trip device, the bell alarm mechnism is activated. The alarm is shut off and the bell alarm and lockout mechanism is reset by operation of the manual trip button or shunt trip device. If the device is a bell alarm only, the bell alarm mechanism is also reset simply by closing the breaker.

OPERATION

Lever (2) is connected to the breaker mechanism so that when the breaker opens lever (2) rotates counterclockwise about pin (14). The motion is transmitted through links (1) and (13) to paddle (12) which operates bell alarm switch (11). If the device has the lockout feature, the movement of link (13) also causes lockout link (8) to slide in a direction that results in its striking trip paddle (5) which, by displacement of the breaker mechanism trip latch, makes it impossible to reset the breaker mechanism until the bell alarm mechanism is reset.

Link (6) serves as a latch in the bell alarm mechanism. If it is displaced, link (10) is free to rotate about its lower pin. This deprives the linkage of its normally fixed center of rotation about pin (15) and defeats both the bell alarm and the lockout operation. Operation of either the manual trip button or the shunt trip device will displace latch (6) and have this effect. Thus if the breaker is tripped by either of these means, the bell alarm and/or lockout will not operate. Also, operation of either of these devices will reset the switch and inactivate the lockout.

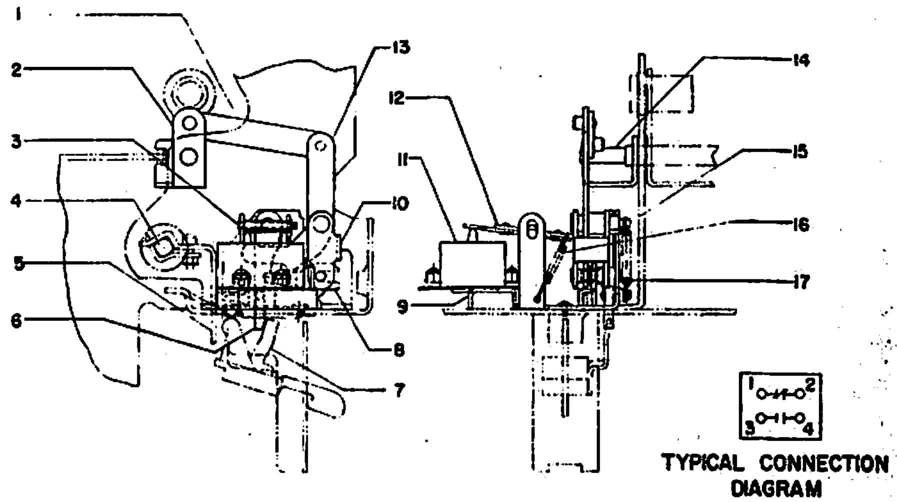


Fig. 16 (695C158)

1. Link	6. Link	11. Switch	16. Springs
2. Lever	7. Trip Arm	12. Paddle	17. Spring
3. Pin	8. Lockout Link	13. Link	
4. Trip Shaft	9. Frame	14. Pin	
5. Trip Paddle	10. Link	15. Pin	

Fig. 16 Bell Alarm and Lockout Device

MISCELLANEOUS

Changes in breaker requirements may occasionally bring about the necessity of adding or changing breaker components or accessories in the field. The AK-2 breaker has been designed so that such additions or conversions are simple and easy to make, requiring only a minimum of time or skill on the part of the operator.

Special instructional drawings are available which will further simplify the addition of such accessories to breakers which were originally shipped without them.

These drawings will accompany the necessary material when it is shipped from the factory. They will also be available upon request. The drawings and the accessory additions which they cover are listed below.

When an accessory is added to a breaker, it is recommended that the section of instructions contained herein covering that particular accessory be reviewed, in addition to referring to the following instructional drawing. Any adjustments described in these instructions should be carefully made after the device has been assembled on the breaker.

Conversion of breakers from manual to electrical operation is also covered on an instructional drawing. This operation consists simply of separation of the front and back frames of the breaker as described under "Maintenance" in these instructions and the reassembly of the existing back frame with the new front frame.

ADDITION OF	COVERED BY
Shunt Trip Device	698C900
Auxiliary Switch	698C901
Undervoltage Device	698C902
Bell Alarm & Lockout Device	698C903
Drawout Mechanism	698C922
Conversion to Elec. Oper.	698C904

MAINTENANCE TOOLS

The following tools are recommended for proper maintenance of AK-2-15 and 25 breakers. (NOTE - Obtain from local hardware firm; do not order on General Electric Company.)

SCREW DRIVERS

Long thin, slotted screw
Standard, slotted screw
Phillips, No. 2, (8" shaft)

PLIERS

Waldes Truarc, No. 2, straight
Long Nose, side cutting, 6"

END WRENCHES

Adjustable, 8"
1/4" open end

ALLEN HEAD WRENCHES

5/16" for 3/8" screw
1/8" for 1/4" screw

SOCKET WRENCHES (3/8" DRIVE)

Ratchet handle
12" extension bar
3/8" socket
9/16" socket
7/16" socket (long)

MISCELLANEOUS TOOLS

1/4" Spintite (long shank)
7/16" Spintite
8/32 screw (at least 2" long)

RENEWAL PARTS

When ordering renewal parts, address the nearest Sales Office of the General Electric Company, specifying the quantity required. Complete nameplate data of the breaker involved should be given as well as an accurate description of the parts required. If the parts needed are illustrated in this book, refer to the figure number and part number involved.

Renewal Parts which are furnished may not be identical to the original parts since from time to time design changes may be made. The parts supplied, however, will be interchangeable with the original parts.

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GENERAL ELECTRIC COMPANY, PHILADELPHIA, PA.

6-59

INSTRUCTIONS

GEI-93863A
SUPPLEMENT TO
GEI-50299

AK POWER CIRCUIT BREAKERS

ELECTRICALLY AND MANUALLY OPERATED

TYPES

AKF-2-25

AKF-2A-25

GENERAL ELECTRIC

TYPE AKF-2 POWER CIRCUIT BREAKER

The instructions contained herein supplement Instruction Book GEI-50299 and are to be used in conjunction with it.

The AKF-2-25 breaker is a special type of AK-2 breaker. The design is intended to switch shunt field circuits of synchronous generators and synchronous motors. These breakers are usually furnished without series overcurrent tripping devices and have a continuous rating of 600 amperes. The AKF is a two pole air circuit breaker with field discharge contacts located in the center pole position.

The closing of the field discharge contacts connects a field discharge resistor across the field winding of a generator or a motor. This arrangement of main and discharge contacts allows the excitation circuit to open without inducing excessively high voltage in the field winding.

AKF-2
FIELD DISCHARGE MECHANISM
FIGURE 2

When an AKF-2-25 field breaker is opened, the field discharge contacts close before the main contacts of the breaker open; on closing the field discharge contacts open after the main breaker contacts close. This contact overlap prevents opening the field circuit.

The outside pole contacts (1) close when the pin through eccentric bushing (12) is driven toward the pole base by the closing mechanism. The motion is transferred through eccentric bushing (12), link (10), link (14), crossbar (6) and the contact carrier pivoting about pivot pin (3).

Before the center pole contacts (7) open there is a moment of overlap when the center pole and outside poles are simultaneously closed. The motion to the center pole is transferred through eccentric

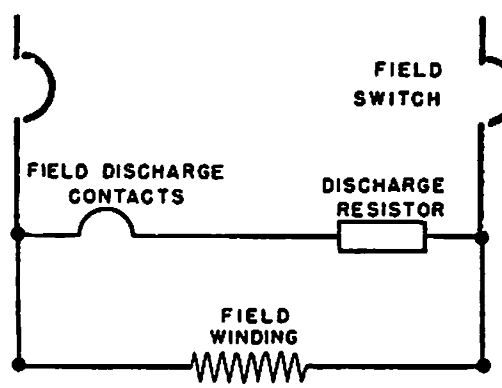


Figure 1. (415A845) Typical Connection Diagram

bushing (12) link (10), link (14), cam follower (13), link (15), link (8), pin (20) and contact (7) pivoting about pivot pin (22).

The opposite operation of opening the outside pole contacts and closing the center pole contacts is effected by the same linkage with a reversal of motion.

The mechanism of the AKF-2-25 is a spring actuated over center toggle type of mechanism. Refer to GEI-50299 for description of the mechanism.

ADJUSTMENTS

The contact wipe on the outside poles is measured and adjusted by following the procedures of GEI-50299 Page 6 and 7. Proper contact wipe must be maintained between 3/32 to 5/32 of an inch.

The center pole is measured in the same manner as the outside poles, and must be maintained between 3/32 to 5/32 of an inch.

The center pole contact wipe is adjusted by shims (18). This is a factory adjustment that is not likely to require field service. Should shims (18) be changed, it is necessary to reposition lower pivot block (17). A check of Lower Pivot Block (17) position is made by moving cam follower (13) in circular arc section of the link cam (15). The center pole contact is closed, and does not move because circular arc of (15) and center pole movable contact (7) have a common center in pin (22).

The AKF-2-25 field breaker has overlap of contacting on all poles for both opening and closing operations. The overlap condition is achieved by adjustments to eccentric bushing (12) and eccentric pins-adjustable (2).

NOTE: The pair of eccentric bushings (12) must be set to the same position before links (10) and tie bolt (11) are replaced.

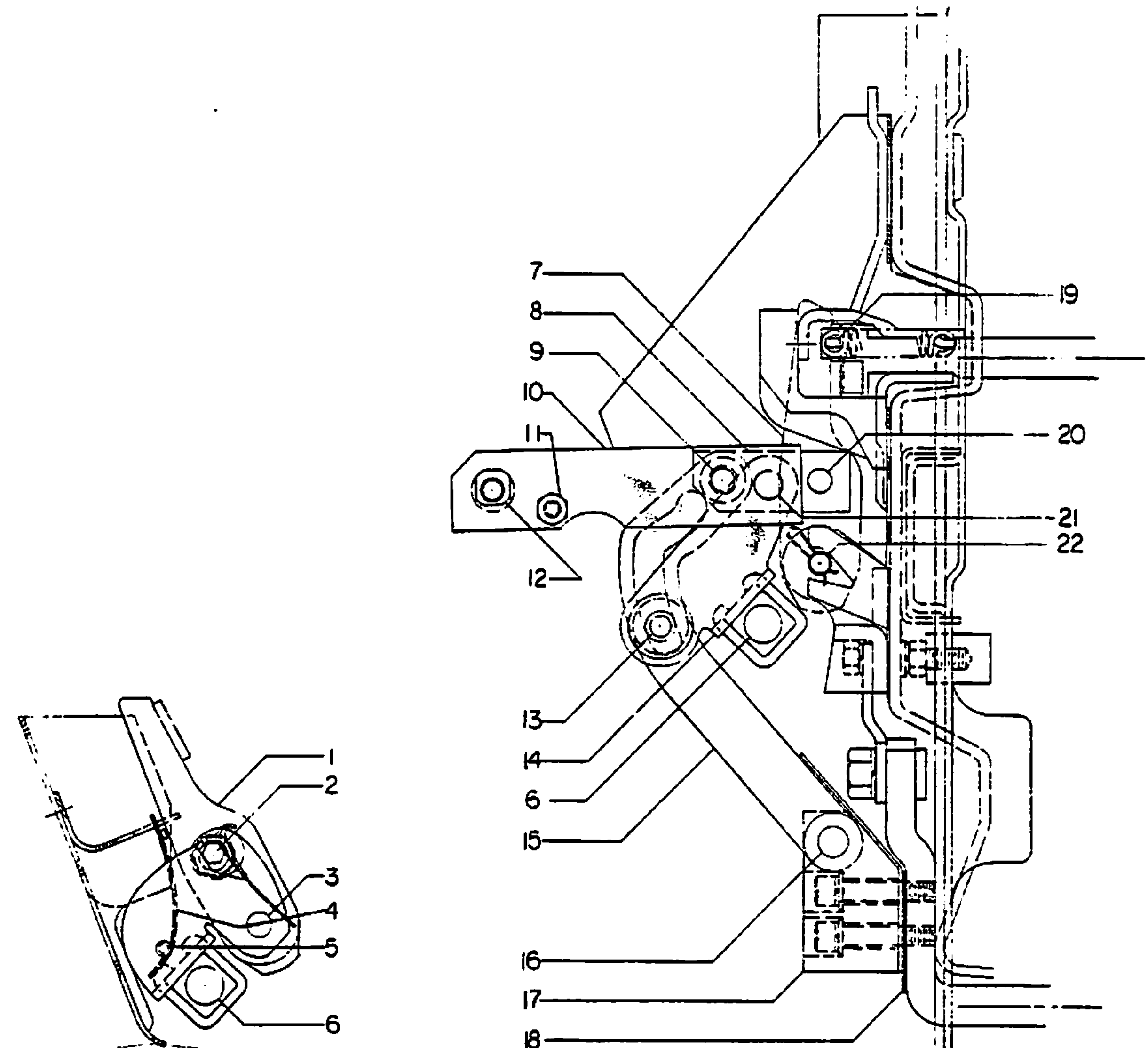
Replace the links and tie bolt, and measure contact wipes on all poles. The outside poles may have contact wipe adjusted individually by eccentric bushings (12).

Open the center pole, and press toward back frame with fingers to check slight detenting action between cam follower (13) and link-cam (15). This force is acceptable if over five pounds. Adjustment of eccentric bushing-adjustable (12) will achieve the position of the detent action for open center pole contact.

Check all contact wipes.

Test the overlap by connecting all poles in series. Check continuity of circuit for overlap during both closing and opening operations. A gas discharge lamp or an oscilloscope can be used to detect overlap action.

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.



OUTSIDE POLE CONTACTS AND BARRIER

CENTER POLE AND FIELD SWITCH MECH.

1 MOVABLE CONTACT - OUTSIDE POLES
2 ECCENTRIC PIN - ADJUSTABLE
3 PIVOT PIN
4 SPRINGS
5 PIN
6 CROSS BAR
7 MOVABLE CONTACT - CENTER POLE
8 LINK
9 PIN
10 LINK
11 TIE BOLT
12 ECCENTRIC BUSHING - ADJUSTABLE
13 CAM FOLLOWER
14 LINK AND CROSS BAR CLAMP
15 LINK AND CAM
16 PIVOT PIN
17 LOWER PIVOT BLOCK
18 SHIMS
19 STATIONARY CONTACT
20 PIN
21 PIN
22 PIVOT PIN

Figure 2. (121C2873) Field Switch Mechanism and Contact Assemblies.

ONTACT OVERLAP (See Fig. 2)

Contact overlap is a factory setting that is otained by adding or removing shims under the ower pivot block (17) during assembly. When ie proper overlap is obtained the lower pivot ock (17) is pinned at the factory and should not e changed in the field.

REPLACEMENTS

OVABLE CONTACT SPRINGS (4) (See Fig. 2)

. With contact (1) in the open position, take a screwdriver and push upward on the bottom of the "U" shaped springs (4) freeing them from pin (5) and contacts (1).

. Remove the one end of pin (5) from its mounting in the contact carrier and slide new springs (4) into proper position.

OTE: If springs (4) are not going to be changed at this time. They should be reformed to original shape before installing. To check springs place closed end of springs on a level table and measure the open end of springs to the table top. This dimension should be approximately 5/16 of an inch. Form springs until this dimension is obtained.

. With spring (4) in proper position push down on pin (5) and slide pin (5) into its mounting hole in the contact carrier.

MOVABLE CONTACTS (1,7) (See Fig. 2).

1. Remove arc quencher (See "Replacement" under "Arc Quencher", page 6 of GEI-50299).
2. Remove operating mechanism (See "Replacement" under "Mechanism", page 10 of GEI-50299).
3. Remove movable contact springs (4) (see above).
4. Remove movable contacts (See "Movable Contacts" under "Contact Replacement", page 8 of GEI-50299).
5. Replace new contacts in reverse order.
6. Replace operating mechanism.
7. Adjust contact wipes. (See Adjustments).
8. Replace arc quenchers.

STATIONARY CONTACTS (19) (See Fig. 2).

1. Remove stationary contacts (See "Stationary Contacts" under "Contact Replacement", page 7 of GEI-50299).
2. Replace contacts in reverse order (See "Reassembly" under "Contact Replacement", page 8 of GEI-50299).

GENERAL ELECTRIC COMPANY
CIRCUIT PROTECTIVE DEVICES DEPARTMENT
PLAINVILLE, CONNECTICUT 06062

GENERAL ELECTRIC

9-77 (2500)

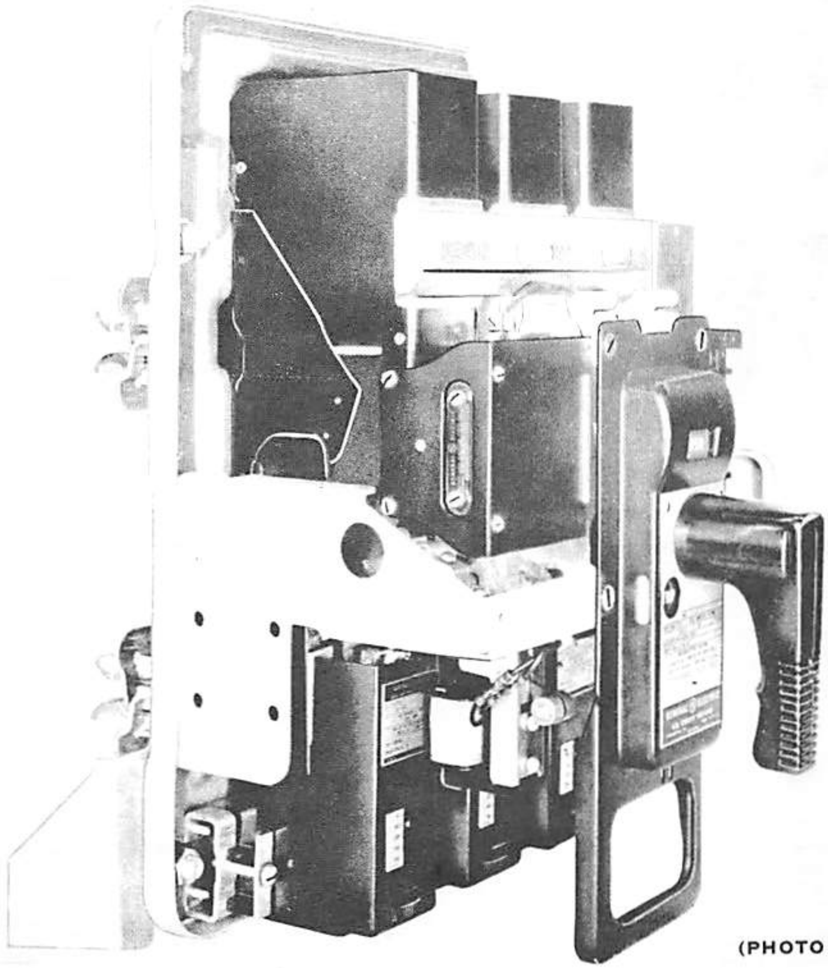
RENEWAL PARTS

GEF-4149G
Supersedes GEF-4149F

POWER CIRCUIT BREAKERS

TYPES

225 AMP FRAME SIZE	600 AMP FRAME SIZE		
AK-2-15	AK-2-25	AK-3-25	AKF-2-25
AK-2A-15	AK-2A-25	AK-3A-25	AKF-2A-25
	AKU-2-25	AKU-3-25	
	AKU-2A-25	AKU-3A-25	



(PHOTO 8024021)

Fig. 1. Type AK-2-25 manually operated power circuit breaker

ORDERING INSTRUCTIONS

1. Always specify the complete nameplate data of the breaker.
2. Specify the quantity, catalog number (if listed), reference number (if listed), description, and this bulletin number.
3. CAUTION: When local facilities for breaker recalibration are not available, the breaker should be forwarded to the nearest G-E Service Shop, or to the General Electric Company, 6901 Elmwood Avenue, Philadelphia 42, Pa.
4. Standard hardware, such as screws, bolts, nuts, washers, etc., is not listed in this bulletin. Such items should be purchased locally.
5. For prices, refer to the nearest office of the General Electric Company.

GENERAL ELECTRIC

subject to change without notice.

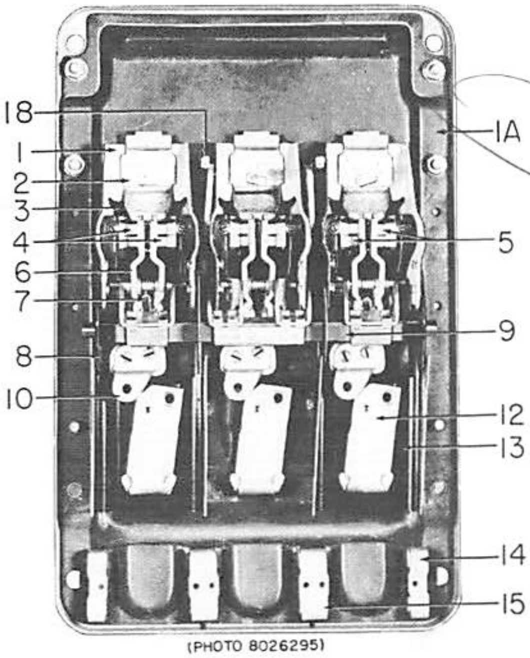


Fig. 2. Type AK-2-25 power circuit breaker back frame (operating mechanism removed)

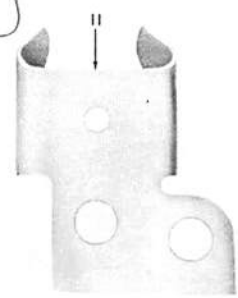


Fig. 2A. Spring (back of pivot)

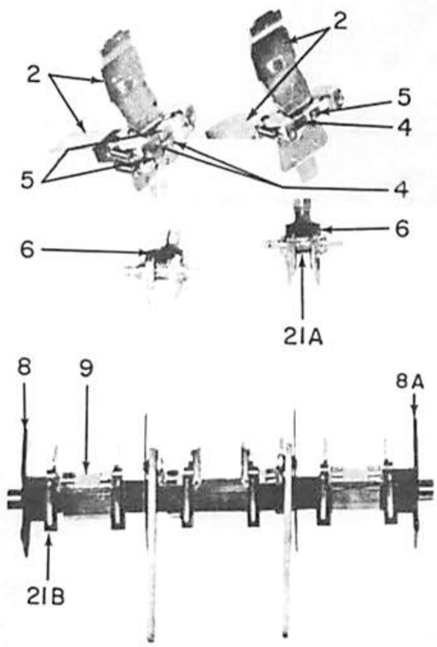


Fig. 3. Moving and stationary contacts and cross bar assembly

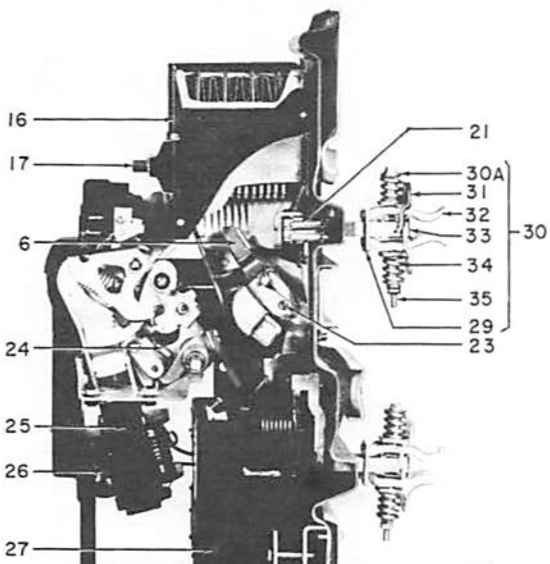


Fig. 4. Cutaway view of type AK-2-25 electrically operated power circuit breaker

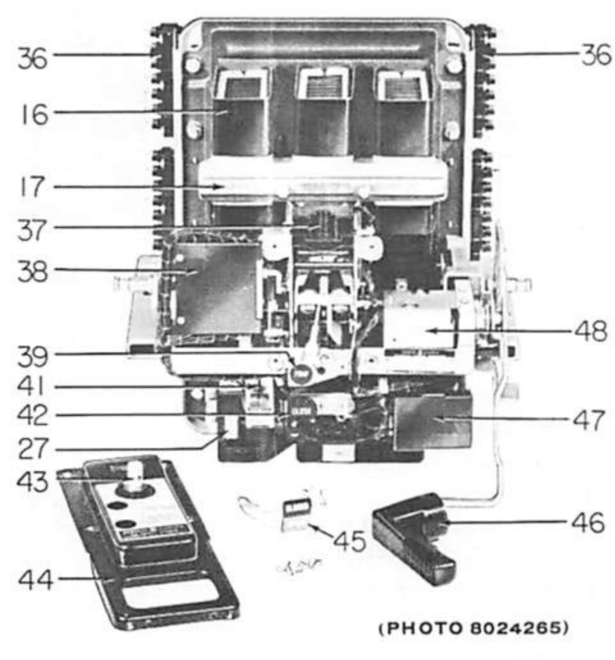


Fig. 5. Type AK-2-25 electrically operated power circuit breaker (escutcheon removed and dismantled)

Ref. No.	Quantity Required for 3-pole Breaker Frame Size 225 Amp**	600 Amp**	Catalog Number	Description
1A	1	1	227D190P1	Back plate
1	3	3	269C260G1	Insulation for upper stud, rear
†1B	3	3	269C260G2	Insulation for upper stud, front
2	3	-	269C283G1	Upper stud assembly
2	-	3	269C283G2	Upper stud assembly
3	3	3	295B460P1	Barrier
*4	3	6	269C257G1	Stationary contact assembly
*5	3	6	269C257G2	Stationary contact assembly
*6	3	-	269C257G14	Moving contact
*6	-	3	269C257G15	Moving contact
*7	2	2	412A250	Spring (outside poles)
*7A	1	1	269C280P5	Spring clip (center pole)
8	2	2	269C277P9	Barrier
8A	1	1	269C277P10	Barrier, complete (includes Ref. Nos. 8 and 8A)
9	1	1	269C277G1	Cross bar assembly
10	3	3	269C258G3	Pivot
*11	3	3	269C280P8	Spring (back of pivot)
12	-	3	269C258G1	Lower stud assembly (not used on AK-3 or AK-3A)
12	3	-	269C258G2	Lower stud assembly
13	2	2	263C526P1	Insulation (under lower stud)
14	2	2	269C280P7	Support (outside)
15	2	2	269C280P6	Support (intermediate)
16	3	3	269B288G1	Arc quencher
17	-	1	121C7514G2	Arc quencher clamp AK-3 or 3A only
17	1	1	269C273G2	Arc quencher clamp (sand gray) AK-2 or 2A
18	2	2	269C280P4	Stud, arc quencher clamp
†19	2	2	177L215P219	Insulation for Ref. No. 18
†20	2	2	393A993P9	Stop nut for Ref. No. 18
*21	6	12	412A286	Stationary contact spring
21A	3	3	412A208	Movable contact spring
21B	6	6	269C277P11	Spring clip
†22	1	1	269C280P1	Moving contact pivot pin (center pole)
23	2	2	269C280P2	Moving contact pivot pin (outside poles)
*24	1	1	0412A0290	Spring
25	1	1	622C521G1	δMagnet and armature assembly
26	1	1	See table B	δClosing coil
27	3	3	See note below	Overcurrent trip device
28	6	6	386A163P1	Clamp for EC-2 trip device
28	3	3	6555445P1	Clamp for EC-1 trip device
29	-	6	269C281P5	Retaining ring
29	6	-	269C281P6	Retaining ring
30	3	-	845C276G2	Primary disconnect assembly
30	-	3	845C276G4	Primary disconnect assembly
30A	6	6	412A222	Spring
31	12	12	269C281P3	Retainer
*32	24	24	453A100P2	Contact finger
33	6	-	453A129P1	Retainer
33	-	6	453A129P2	Retainer
34	6	6	457A681P4	Spacer
35	6	6	---------	Screw, hex. hd, 1/4 in.-20 by 3 1/2 in.

* Recommended for stock for normal maintenance.

† Not shown.

** See breaker nameplate for frame size.

δ Electrically operated breakers

Note for overcurrent trip devices:
(1) No parts furnished for field installation on EC-1 trip devices.
(2) Only part furnished for field installation on EC-2 or EC-2A trip devices is plastic cover, Cat. No. 242C645P1.
(3) When replacement trip devices are ordered, it is imperative that order includes complete nameplate reading of the breaker or breakers involved and, if a contemplated ampere rating change is involved, the order should also include information as to ampere rating, time-current characteristic, and instantaneous trip setting desired.

Note for operating mechanisms:
(1) Individual parts cannot be furnished for operating mechanisms.
(2) When replacement is necessary give complete nameplate reading when ordering.

Ref. No.	Quantity Required for 3-pole Breaker Frame Size 225 Amp**	600 Amp**	Catalog Number	Description	
36	4 maximum	4 maximum	386A110G2	Movable secondary disconnects (drawout breaker)	
37	1	1	622C505G1	Cutoff switch (electrically operated breaker)	
38	1	1	432A671G2	Auxiliary switch, 2 stages	
38	1	1	432A671G5	Auxiliary switch, 5 stages	
39	1	1	269C268P1	Manual trip button	
†39A	1	1	269C268P12	Trip label	
†40	1	1	412A133	Spring for manual trip button	
41	1	1	622C502G1	Shunt trip device with coil	
42	1	1	622C529G1	Closing switch	
43	1	1	101C7891G1	Shaft assembly (Manual Breaker only) order Ref. 43 and 43A together	
†43A	1	1	101C7891G2	Link assembly	
44	1	1	259C607G1	Escutcheon, manual breaker (black)	
44	1	1	259C607P10	Escutcheon, electrically operated breaker (black)	
44	1	1	259C607G2	Escutcheon, electrically operated breaker (with handle) (black)	
†44	1	1	259C607G3	Escutcheon, manual breaker (blue)	
†44	1	1	259C607P11	Escutcheon, electrically operated breaker (blue)	
†44	1	1	259C607G4	Escutcheon, electrically operated breaker (blue) with pistol grip handle	
45	1	1	259C608G1	Indicator	
46	1	1	276B191P1	Handle (black)	
46	1	1	669D807P1	Handle (gray)	
47	1	1	---------	"X" relay (see Table A, page 6)	
*48	1	1	---------	"Y" relay (see Table A, page 6)	
†49	1	1	148A2238	Return spring, rear of escutcheon	
Δ*50	1	1	295B445P221	Stationary contacts, "X" relay	On early AK-2-15, AK-2-25 and AKF-2-25 with no suffix number
Δ*51	1	1	295B445P222	Moving contacts, "X" relay	
†Δ52	1	1	295B445P223	Springs, moving contacts, "X" relay	
†Δ*52A	1	1	116B7197P221	Stationary contacts, "X" relay	all others
†Δ*52B	1	1	116B7197P223	Molded moving arm, "X" relay (with moving contacts)	
†Δ52C	1	1	116B7197P222	Armature return spring, "X" relay	
Δ*53	1	1	---------	Operating coil, "X" relay (see Table A, page 6)	
Δ54	1	1	622C501P1	Cover, "X" relay	On early AK-2-15, AK-2-25 and AKF-2-25 with no suffix number
Δ55	1	1	622C501P2	Jumper, "X" relay	
*56	1	1	---------	Coil for shunt trip device (see Table B, page 7)	
	1	1	269C282G2	‡Instantaneous undervoltage device, a-c (with coil)	
	1	1	269C282G5	‡Instantaneous undervoltage device, d-c (with coil)	
57	1	1	‡	Time-delay undervoltage device, a-c	
57	1	1	‡	Time-delay undervoltage device, d-c	
*58	1	1	--------	Coil for undervoltage device (see Table B, page 7)	
59	1	1	▲	Static time delay, a-c or d-c (replaces complete time delay and volt device coil only)	
*†60	1	1	6172594	Spring, for undervoltage device	
61	1	1	269C299G2	‡Bell alarm device	
62	1	1	6293908G275	Terminal board, 6 terminals	
62	1	1	6293908G274	Terminal board, 10 terminals	
63	1	1	846C865G1	Link and bushing for auxiliary switch	
64	1	1	6314936P1	Cover for auxiliary switch, 1 stage	
64	1	1	6314936P2	Cover for auxiliary switch, 2 stages	
64	1	1	6314936P3	Cover for auxiliary switch, 5 stages	
65	3	3	295B475P2	Base for wall mounted, general purpose breaker	
66	3	-	394A144P1	Angle for wall mounted, general purpose breaker	
67	6	-	275B995P1	Terminal for wall mounted, general purpose breaker	
67	-	6	695C131P1	Terminal for wall mounted, general purpose breaker	
68	6	-	394A106P1	Cable clamp for wall mounted, general purpose breaker	
68	-	6	457A673G1	Cable clamp for wall mounted, general purpose breaker	
69	1	1	269C276G2	Maintenance handle	

* Recommended for stock for normal maintenance.

** See breaker nameplate for frame size.

† Not shown.

‡ If at any time a breaker is to have added to it either shunt trip, undervoltage device, or bell alarm device, the order for the device must include the following information:

(1) Complete nameplate reading of breaker involved.
(2) Desired voltage rating of device, whether a-c or d-c, and if a-c, the frequency.
(3) In the case of undervoltage devices, specify whether instantaneous or time delay.

Δ On -1, specify Cat. No. of "X" relay when ordering these parts.

▲ Order by circuit breaker Serial No.

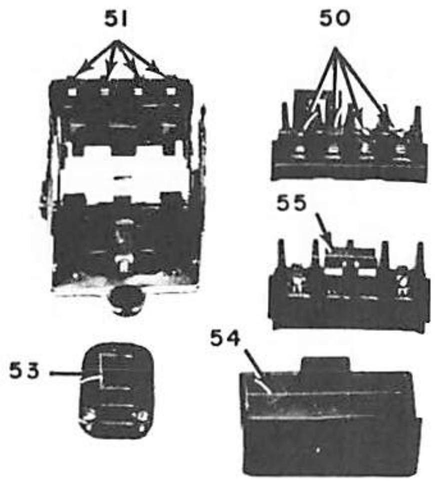


Fig. 6. "X" contactor
(ref. 47)

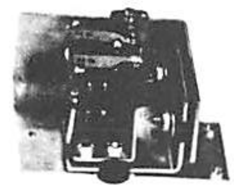


Fig. 7. "Y" relay
(ref. 48)

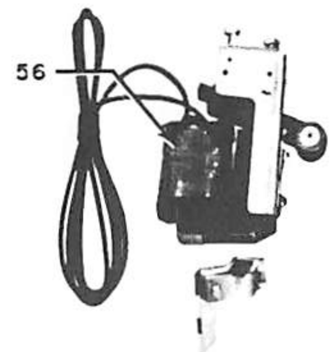


Fig. 8. Shunt trip
device (ref. 41)

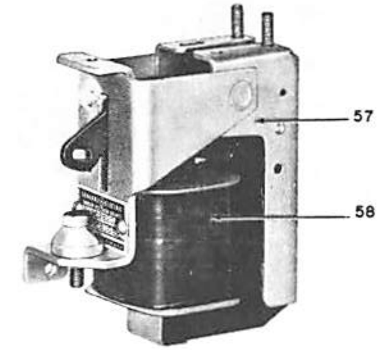


Fig. 9. Time delay undervoltage
device (ref. 57)

Fig. 10. Cutoff switch
(ref. 37)

Fig. 11. Bell alarm
device (ref. 61)

Fig. 12. Terminal
board (ref. 62)

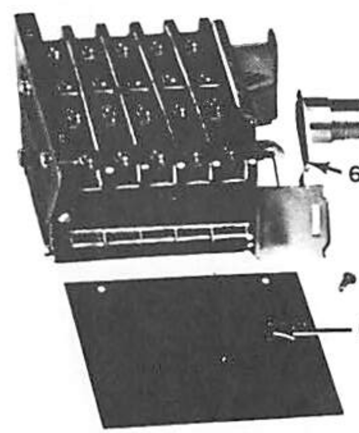
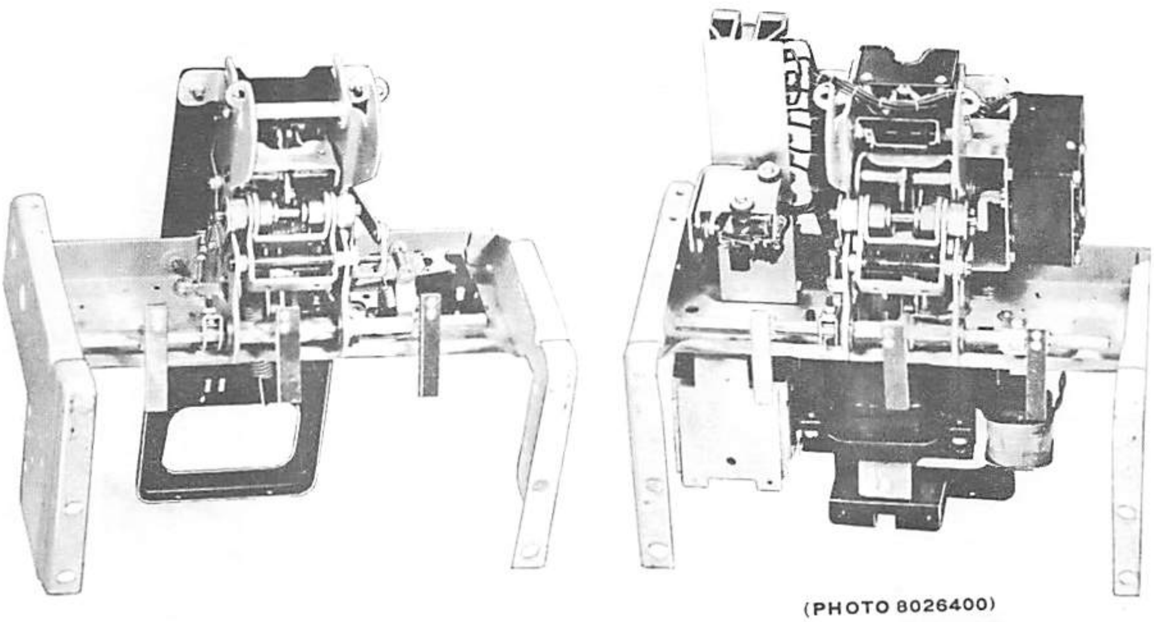


Fig. 13. Auxiliary
switch (ref. 38)

Fig. 13A. Static time delay



(PHOTO 8026400)

Fig. 14. Manual (left) and electrical (right) front frame assemblies for Type AK-2-15 and -25 power circuit breakers

NOTES FOR FIG. 14:

(1) Should it become necessary to replace the complete front frame of the breaker, it is necessary that the order include complete nameplate reading of existing breaker.

(2) If an existing manual breaker is to be converted to electrical operation, the order must include, in addition to complete nameplate reading, a description of desired change and complete voltage and frequency rating of both closing and tripping circuits.

TABLE A

Rating		Catalog Number				
		"X" Relay				"Y" Relay Complete (Ref. 48) §
Volts	Cycles	Relay Complete, Ref. 47	Coil, only (Ref. 53)	Relay Complete, Ref. 47	Coil, only (Ref. 53)	
		for Δ and Early -1 Breakers		for Late -1, and all -2 Breakers		
24	D-C	295B445P1	295B445P201	116B7197P1	116B7197P201	295B444P1
48	D-C	295B445P2	295B445P202	116B7197P2	116B7197P202	295B444P2
125	D-C	295B445P3	295B445P203	116B7197P3	116B7197P203	295B444P3
250	D-C	295B445P4	295B445P204	116B7197P4	116B7197P204	295B444P4
115	25	295B445P7	295B445P207	116B7197P7	116B7197P207	295B444P7
208	25	295B445P10	295B445P210	116B7197P10	116B7197P210	295B444P10
230	25	295B445P13	295B445P213	116B7197P13	116B7197P213	295B444P13
460	25	-----------	-----------	116B7197P16	116B7197P216	-----------
230	40	295B445P12	295B445P212	------------	-------------	295B444P11
115	50	295B445P6	295B445P206	116B7197P6	116B7197P206	295B444P5
208	50	295B445P9	295B445P209	116B7197P9	116B7197P209	295B444P8
230	50	295B445P12	295B445P212	116B7197P12	116B7197P212	295B444P11
380	50	295B445P17	295B445P214	116B7197P17	116B7197P217	295B444P17
460	50	295B445P15	295B445P216	116B7197P15	116B7197P215	295B444P14
115	60	295B445P5	295B445P205	116B7197P5	116B7197P205	295B444P5
208	60	295B445P8	295B445P208	116B7197P8	116B7197P208	295B444P8
230	60	295B445P11	295B445P211	116B7197P11	116B7197P211	295B444P11
460	60	295B445P14	295B445P215	116B7197P14	116B7197P214	295B444P14

Δ Original breaker had no suffix numeral or letter.
§ Only complete relay furnished.

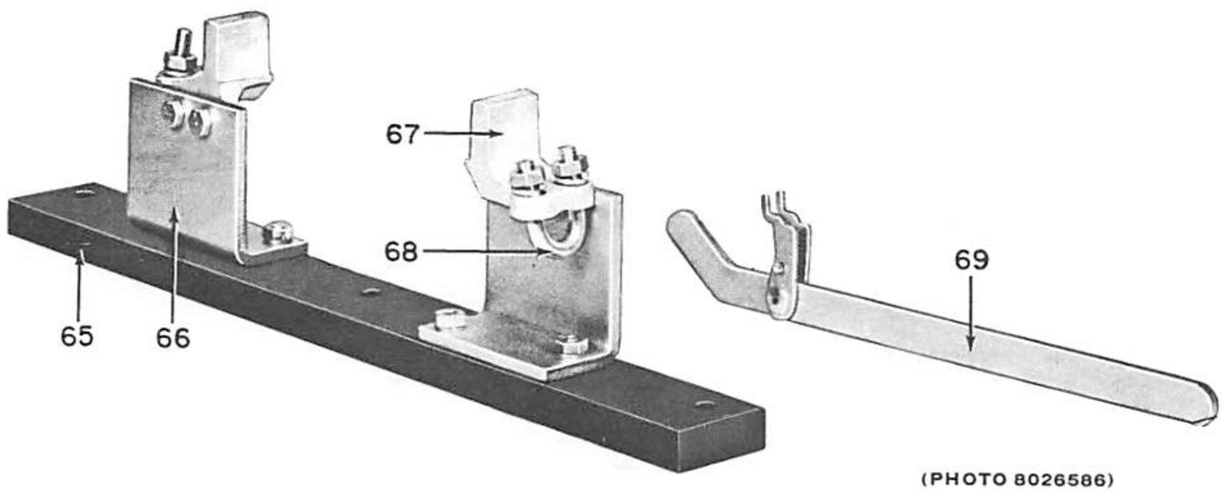


Fig 15. Accessories for wall mounting (ref. 65, 66, 67, 68)

Fig. 16. Maintenance handle for electrically operated breakers not equipped with manual handles (ref. 69)

TABLE B

Rating		Catalog Number			
		Closing Solenoid Coil (Ref. 26)	Shunt Trip Device Coil (Ref. 56)	Undervoltage Device Coil (Ref. 58)	
Volts	Cycles			Instantaneous or Old Design Oil Dashpot Type Time Delay	Static Time Delay Type
24	D-C	---	6275081G55	6275081G15	
48		366A773G17	6275081G28	6275081G9	
125		366A773G13	6275081G29	6275081G18	6275081G61π
250		366A773G15	6275081G30	6275081G19	6275081G59π
115	25	366A773G3	6275081G26	6275081G12	
208		366A773G6	6275081G29	6275081G10	
230		366A773G14	6275081G29	6275081G10	
460		366A773G11	6275081G7	6275081G17	
575		366A773G12	6275081G5	6275081G21	
115	50	366A773G2	6275081G56	6275081G4	
208		366A773G3	6275081G26	6275081G12	
230		366A773G5	6275081G26	6275081G12	
380		366A773G6	6275081G27	6275081G31	
460		366A773G8	6275081G4	6275081G3	
575		366A773G10	6275081G29	6275081G8	
115	60	366A773G1	6275081G25	6275081G26	
208		366A773G3	6275081G26	6275081G27	
230		366A773G4	6275081G26	6275081G7	6275081G59π
460		366A773G7	6275081G27	6275081G31	
575		366A773G9	6275081G7	6275081G20	

πInput voltage to static timing unit (Fig. 13A) indicated.

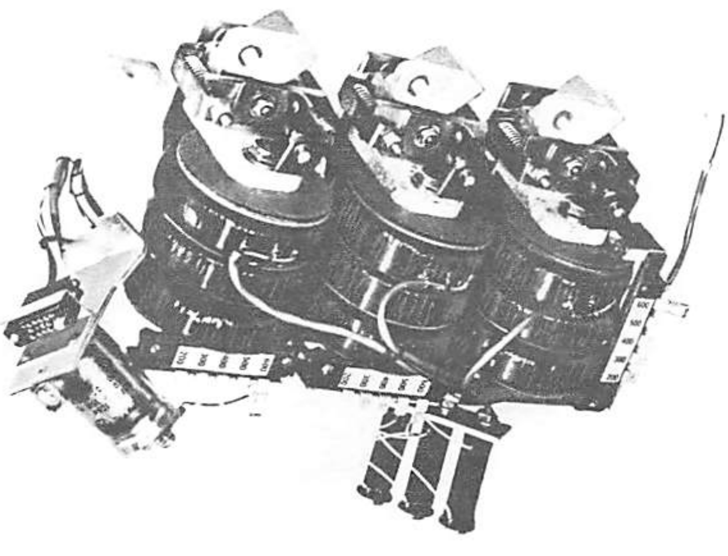


Fig. 17. Magnetic coil assembly

Magnetic Sensor Coils - Assembly (Fig. 17)

Without ground trip			With ground trip			
Poles	Rating	Cat. No.	Poles	Rating	Grd. Trip Range	Cat. No.
2	45/225	107D7554G2	2	45/225	100/400	107D7554G6
3	45/225	107D7554G3	3	45/225	100/400	107D7554G7
2	200/600	107D7554G4	2	200/600	100/400	107D7554G8
3	200/600	107D7554G5	3	200/600	100/400	107D7554G9
			2	200/600	300/1200	107D7554G10
			3	200/600	300/1200	107D7554G11

Fig. 18. Power supply unit

Power Supply Units - Cat. No. 156C4508G10

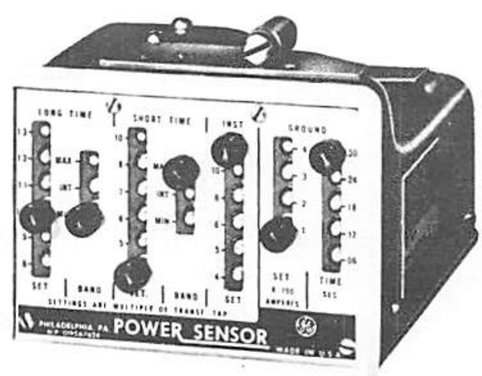


Fig. 19. Power sensor unit

Power Sensor Unit AK-25 (Fig. 19)

	With Long Time Delay 80 to 130% Range With Instantaneous Trip 4 to 12X Range	Without Long Time Delay With Instantaneous Trip 4 to 12X Range	With Long Time Delay 80 to 130% Range Without Instantaneous Trip	Without Long Time Delay Without Instantaneous Trip
With Ground Fault Protection 100 to 400 Amp Range				
Without Short Time Delay	184L373G57	184L373G78	----	----
With Short Time Delay				
2 to 5X Range	184L373G51	184L373G66	184L373G60	184L373G72
4 to 10X Range	184L373G54	184L373G69	184L373G63	184L373G75
Without Ground Fault Protection				
Without Short Time Delay	184L373G43	184L373G50	----	----
With Short Time Delay				
2 to 5X Range	184L373G41	184L373G46	184L373G44	184L373G48
4 to 10X Range	184L373G42	184L373G47	184L373G45	184L373G49

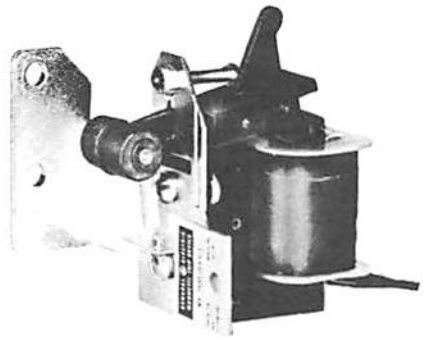


Fig. 20. Magnet trip device with mounting bracket

Magnet Trip Device with Mounting Bracket - Cat. No. 0846C0882 G4

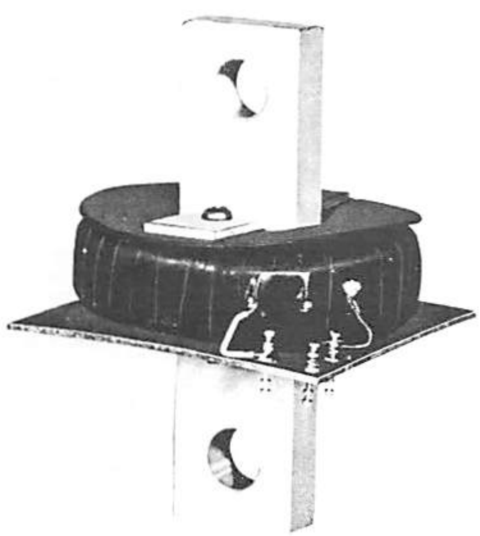


Fig. 21. Ground sensor coil with neutral mounting

Fourth Wire Grid Sensor Coils

100/400 Cat. No. 152C9218G1
300/1200 Cat. No. 152C9218G2

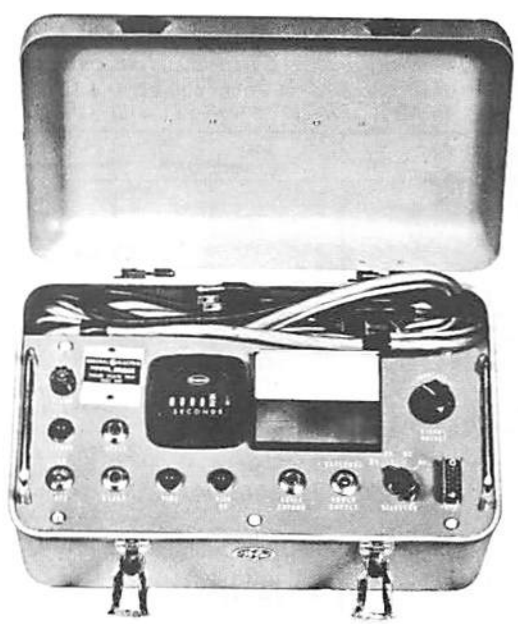


Fig. 22. Power sensor kit

Power Sensor Test Kit - Cat. No. 0102D2526 G10

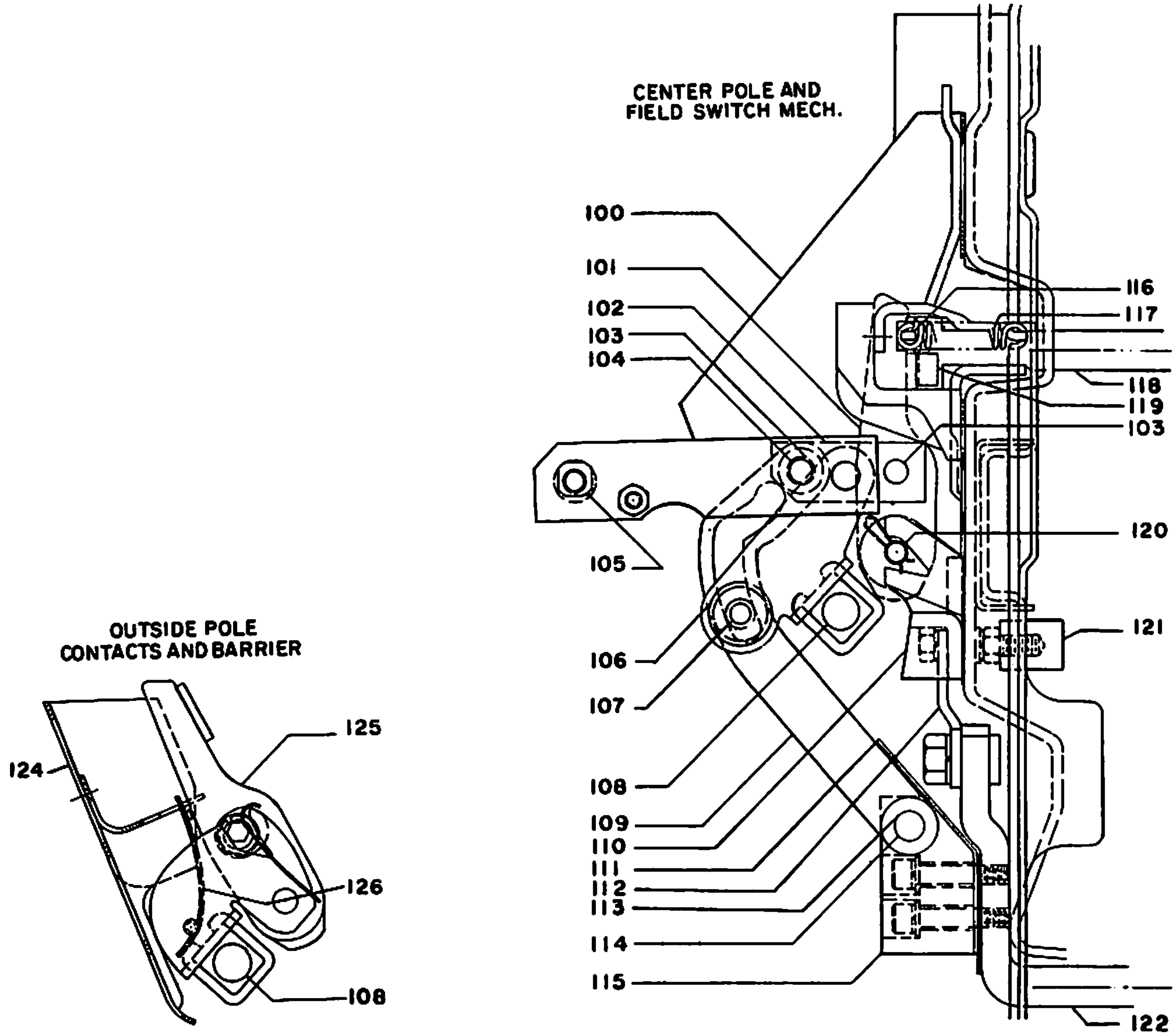


Fig. 23. Field switch mechanism and contact assemblies

NOTE: Parts listed below apply only to Types AKF-2-25 and AKF-2A-25. All other parts are identical to those used on Type AK-2-25.

Ref. No.	Qty. Per Center Pole	Catalog No.	Description
100	1	073-108C9697P9	Insulation
*101	1	108C9698G1	Moving contact
102	2	108C9695P2	Link
103	4	394A133P8	Retaining ring
104	1	108C9695P9	Pin
105	2	148A2279P1	Adjustable bushing
106	2	377A871P12	Bearing
107	1	108C9695P10	Cam follower
108	1	108C9696G1	Crossbar
109	1	108C9695G3	Cam assembly, left
109	1	108C9695G4	Cam assembly, right
110	1	108C9695P6	Pivot
111	1	108C9694P8	Lower stud insulation
112	1	108C9695P3	Connector
113	2	394A133P9	Retaining ring

Ref. No.	Qty. Per Center Pole	Catalog No.	Description
114	1	073-412A404P136	Pin
115	1	108C9694P7	Lower pivot
*116	1	269C257G1	Stationary contact
*116	1	269C257G2	Stationary contact
117	2	412A286	Stationary contact spring
118	1	269C283G4	Upper stud
119	1	108C9697P11	Contact spacer right side
119	1	108C9697P12	Contact spacer left side
120	1	269C280P1	Moving contact pivot pin
121	1	108C9698P14	Spacer
122	1	269C258G13	Lower stud
†123	1	293B288G1	Arc quencher
124	1	108C9697G3	Insulation
*125	1	108C9698G2	Moving contact
126	2	108C9694P5	Spring

* Recommended for stock for normal maintenance.

† Not shown.

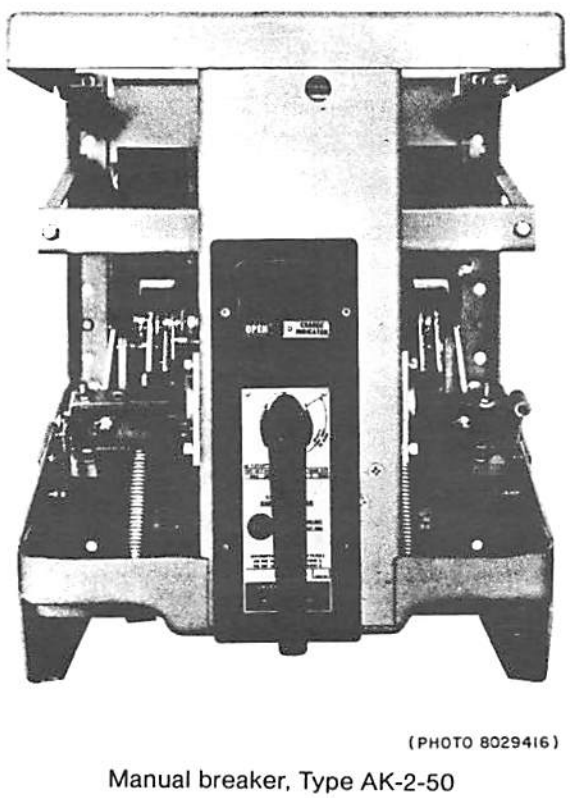
GEF-4150H
Supersedes GEF-4150G

POWER CIRCUIT BREAKERS

TYPES AK-2/3/2A/3A-50, AKU-2/3/2A/3A-50, AKT-2/3/2A/3A-50

ORDERING INSTRUCTIONS

1. Always specify complete nameplate data of the breaker.
2. Specify the quantity, catalog number (if listed), reference number (if listed), description, and this bulletin number.
3. Standard hardware such as screws, bolts, nuts, washers, etc., is not listed in this bulletin. Such items should be purchased locally.
4. For prices, refer to the nearest office of the General Electric Company.



(PHOTO 8029416)

Manual breaker, Type AK-2-50

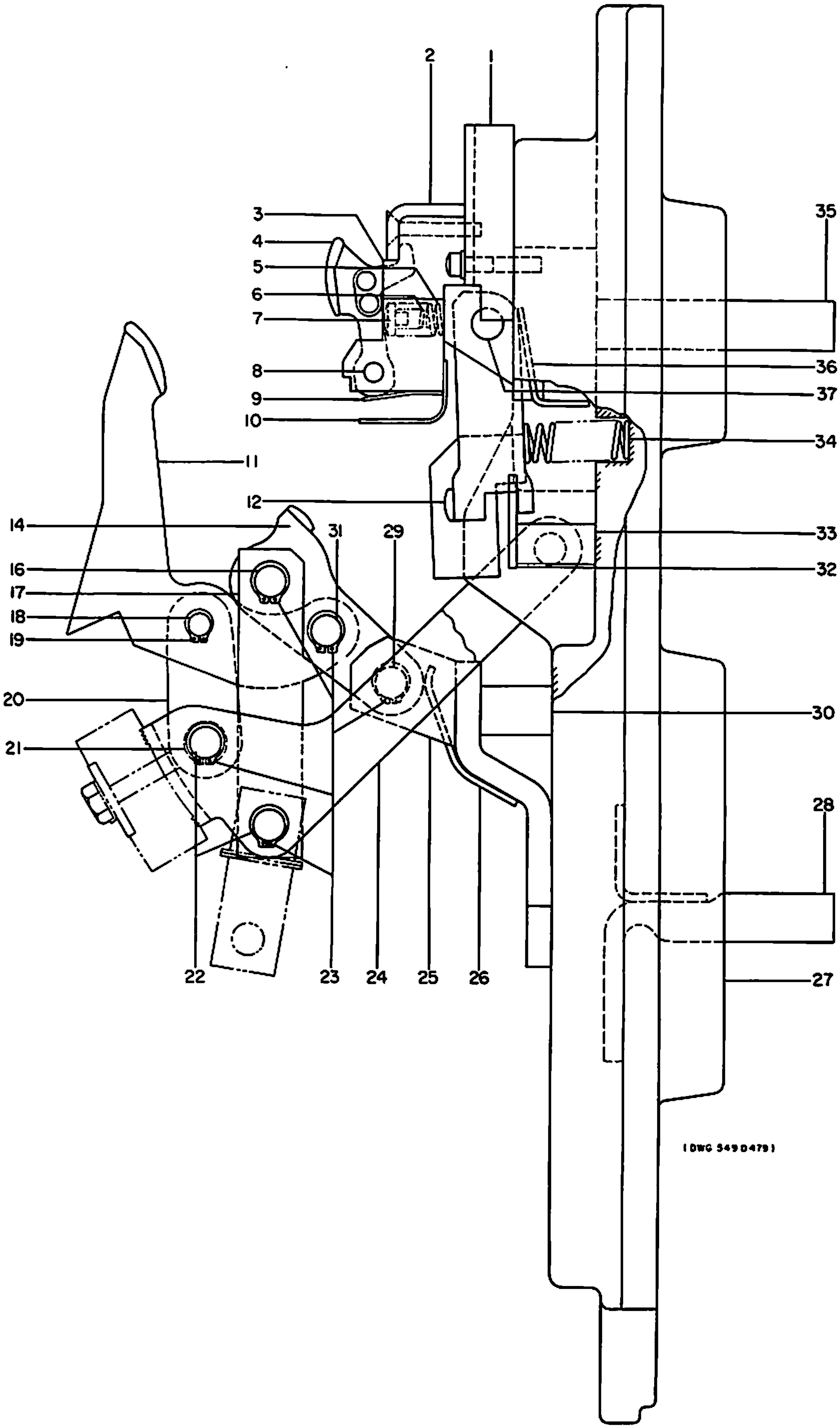


Fig. 1. Pole unit

Fig. No.	Ref. No.	No. Required per Pole †												Cat. No.	Description
		AK-2-50						AK-2A-50		AK-3-50		AK-3A-50			
		Man.			Elec.			Man.	Elec.	Man.	Elec.	Man.	Elec.		
		†	-1	-2	‡	-1	-2	†	†	†	†	†	†		
1	1	1	1	1	1	1	1	1	1	1	1	1	1	371A208P1	Spacer
1	2	1	1	1	1	1	1	1	1	1	1	1	1	9921587P1	Stop, AK-50 AC
1	2	1	1	1	1	1	1	1	1	1	1	1	1	449A994P3	Stop, AK50 DC, AKU-50, AKT-50
1	3	1	1	1	1	1	1	1	1	1	1	1	1	117A512P1	Block, AK-50 AC
1	3	1	1	1	1	1	1	1	1	1	1	1	1	452A542P1	Block, AK50 DC, AKU-50, AKT-50
1	•4	-	-	-	2	-	-	-	-	-	-	-	-	295B408G1	Stationary arcing contact, AK-50 AC
1	•4	-	-	-	3	-	-	-	-	-	-	-	-	295B408G1	Stationary arcing contact, AK-50 DC, AKU-50, AKT-50
1	•4	2	2	2	-	2	2	2	2	2	2	2	2	295B408G3	Stationary arcing contact, AK-50 AC
1	•4	3	3	3	-	3	3	3	3	3	3	3	3	295B408G3	Stationary arcing contact, AK-50 DC, AKU-50, AKT-50
1	•5	2	2	2	2	2	2	2	2	2	2	2	2	6509858P1	Spring for stationary arcing contacts, (outer) AK-50 AC
1	•5	3	3	3	3	3	3	3	3	3	3	3	3	6509858P1	Spring for stationary arcing contacts, (outer) AK50 DC, AKU-50, AKT-50
1	•6	2	2	2	2	2	2	2	2	2	2	2	2	6509859P1	Spring for stationary arcing contacts, (inner) AK-50 AC
1	•6	3	3	3	3	3	3	3	3	3	3	3	3	6509859P1	Spring for stationary arcing contacts, (inner) AK-50 DC, AKU-50, AKT-50
1	7	2	2	2	2	2	2	2	2	2	2	2	2	6447046P1	Spring guide for stationary arcing contact springs, AK-50 AC
1	7	3	3	3	3	3	3	3	3	3	3	3	3	6447046P1	Spring guide for stationary arcing contact springs, AK-50 DC, AKU-50, AKT-50
1	8	1	1	1	1	1	1	1	1	1	1	1	1	6404793P3	Pivot pin for stationary arcing contacts, AK-50 AC
1	8	1	1	1	1	1	1	1	1	1	1	1	1	6404793P2	Pivot pin for stationary arcing contacts, AK-50 DC, AKU-50, AKT-50
1	9	1	1	1	1	1	1	1	1	1	1	1	1	433A319P2	Leaf spring for stationary arcing contacts, AK-50 AC
1	9	1	1	1	1	1	1	1	1	1	1	1	1	433A319P1	Leaf spring for stationary arcing contacts, AK-50 DC, AKU-50, AKT-50
1	10	1	1	1	1	1	1	1	1	1	1	1	1	459A373P3	Insulation for stationary arcing contacts, AK-50 AC
1	10	1	1	1	1	1	1	1	1	1	1	1	1	459A373P1	Insulation for stationary arcing contacts, AK-50 DC, AKU-50, AKT-50
1	•11	2	2	2	2	2	2	2	2	2	2	2	2	9921572G2	Moving arcing contact, AK-50 AC
1	•11	3	3	3	3	3	3	3	3	3	3	-	-	9921572G2	Moving arcing contact, AK-50 DC, AKU-50, AKT-50
1	•12	3	3	3	3	3	3	3	3	3	3	3	3	293B221G1	Stationary main contact
2	•13	1	1	1	1	1	1	1	1	1	1	1	1	459A385G1	Stationary intermediate contact (includes barrier)
1	•14	3	3	3	3	3	3	3	3	3	3	3	3	293B220G7	Moving main contacts
2	•15	1	1	1	1	1	1	1	1	1	1	1	1	293B220G4	Moving intermediate contact
1	16	1	1	1	1	1	1	1	1	1	1	1	1	452A528P1	Pin for movable main contact
1	17	2	2	2	2	2	2	2	2	2	2	2	2	6404784P4	Link for movable main contact
1	18	1	1	1	1	1	1	1	1	1	1	1	1	6447153P3	Pin for movable arcing contact link, AK-50 AC
1	18	1	1	1	1	1	1	1	1	1	1	1	1	6447153P1	Pin for movable arcing contact link, AK-50 DC, AKU-50, AKT-50
1	19	2	2	2	2	2	2	2	2	2	2	2	2	394A133P9	Retainer
1	20	1	1	1	1	1	1	1	1	1	1	1	1	275B975P1	Link for movable arcing contact, AK-50 AC
1	20	2	2	2	2	2	2	2	2	2	2	2	2	275B975P1	Link for movable arcing contact, AK-50 DC, AKU-50, AKT-50
1	21	1	1	1	1	1	1	1	1	1	1	1	1	6447741P1	Insulating tube
1	22	2	2	2	2	2	2	2	2	2	2	2	2	6203981P1	Pin for side link
1	23	10	10	10	10	10	10	10	10	10	10	10	10	394A133P10	Retainer
1	24	1	1	1	1	1	1	1	1	1	1	1	1	457A624G1	Side link, right
1	24	1	1	1	1	1	1	1	1	1	1	1	1	457A624G2	Side link, left
1	25	1	1	1	1	1	1	1	1	1	1	1	1	452A569G2	Terminal
1	26	1	1	1	1	1	1	1	1	1	1	1	1	452A529P1	Leaf spring for movable main contacts
1	27	1	1	1	1	1	1	1	1	1	1	1	1	6414314P2	Pole unit base
1	28	1	1	1	1	1	1	1	1	1	1	1	1	452A564G1	Lower stud
1	29	1	1	1	1	1	1	1	1	1	1	1	1	6203981P9	Pivot pin for movable main contacts
1	30	1	1	1	1	1	1	1	1	1	1	1	1	293B287P3	Spacer for terminal
1	31	1	1	1	1	1	1	1	1	1	1	1	1	6203981P13	Pivot pin for movable arcing contact
1	32	1	1	1	1	1	1	1	1	1	1	1	1	453A116P1	Stop for stationary main contacts
1	33	-	-	-	1	-	-	-	-	-	1	-	-	453A116P2	Spacer for stationary main contact stop
1	33	1	1	1	-	1	1	1	1	1	-	1	1	453A116P3	Spacer for stationary main contact stop
1	34	-	-	-	4	-	-	-	-	-	4	-	-	6509893P1	Spring for stationary main contacts
1	34	4	4	4	-	4	4	4	4	4	-	4	4	412A0287P1	Spring for stationary main contacts
1	35	1	1	1	1	1	1	1	1	1	1	1	1	293B240G1	Upper stud, AK-50 AC
1	35	1	1	1	1	1	1	1	1	1	1	1	1	293B240G2	Upper stud, AK-50 DC, AKU-50, AKT-50
1	36	1	1	1	1	1	1	1	1	1	1	1	1	449A995P1	Leaf spring for stationary main contacts
1	37	1	1	1	1	1	1	1	1	1	1	1	1	6447734P2	Pivot pin for stationary main contacts
3	38	1	1	1	1	1	1	1	1	1	1	1	1	238D674G1	Arc quencher, AK-50 AC
3	38	1	1	1	1	1	1	1	1	1	1	1	1	238D674G2	Arc quencher, AK-50 DC, AKU-50, AKT-50

† To determine quantity required per breaker multiply by number of poles (2, 3 or 4).
‡ Original breaker had no suffix letter or numeral.
• Recommended for stock for normal maintenance.

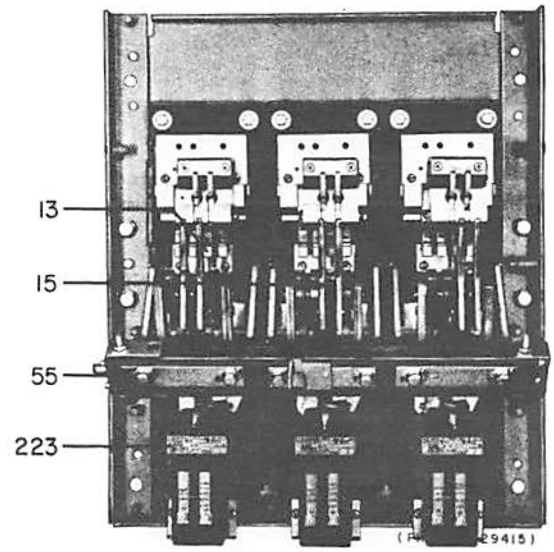


Fig. 2. Back frame assembly

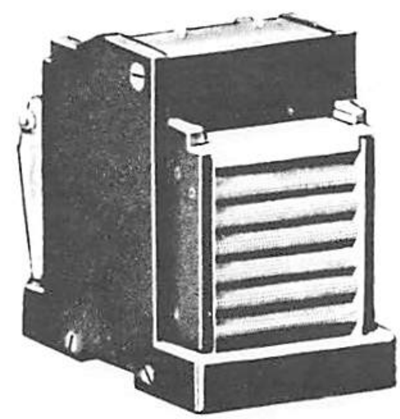


Fig. 3. Arc quencher (Ref. No. 38)

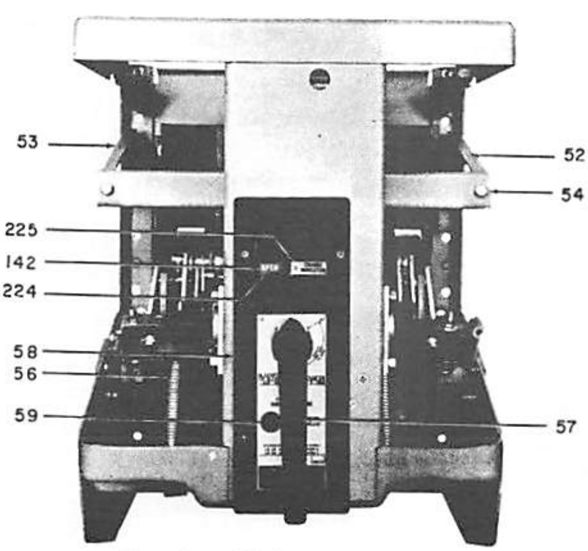


Fig. 4. AK-2-50 manual

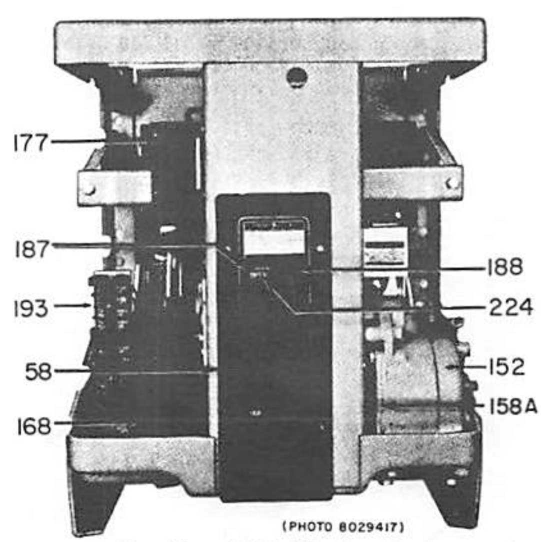


Fig. 5. AK-2-50 electrical

Fig. No.	Ref. No.	No. Required per Pole † AK-2-50 Man. ‡	AK-2-50 Man. -1	AK-2-50 Man. -2	AK-2-50 Elec. ‡	AK-2-50 Elec. -1	AK-2-50 Elec. -2	AK-2A-50 Man. ‡	AK-2A-50 Elec. ‡	AK-3-50 Man. ‡	AK-3-50 Elec. ‡	AK-3A-50 Man. ‡	AK-3A-50 Elec. ‡	Cat. No.	Description
*	51	2	2	2	2	2	2	2	2	2	2	2	2	6414763P1	Phase barrier
4	52	1	1	1	1	1	1	-	-	-	-	-	-	372A275G1	Lifting bracket, right (pearl gray)
4	52	1	1	1	1	1	1	-	-	1	1	-	-	372A275G3	Lifting bracket, right (sand gray)
4	53	1	1	1	1	1	1	-	-	-	-	-	-	372A275G2	Lifting bracket, left (pearl gray)
4	53	1	1	1	1	1	1	-	-	1	1	-	-	372A275G4	Lifting bracket, left (sand gray)
4	54	1	1	1	1	1	1	-	-	-	-	-	-	9921630P1	Arc quencher tie bar (pearl gray)
4	54	1	1	1	1	1	1	-	-	1	1	-	-	9921630P3	Arc quencher tie bar (sand gray)
4	54	-	-	-	-	-	-	1	1	-	-	1	1	9921630P2	Arc quencher tie bar
2	55	1	1	1	1	1	1	1	1	1	1	1	1	267B101P2	Cross bar
4	56	2	2	2	2	2	2	2	2	2	2	2	2	6509914P1	Opening spring, AC (not used on AKU or AKT)
4	56	2	2	2	2	2	2	2	2	2	2	2	2	6509813P1	Opening spring, AC (AKU or AKT)
4	56	2	2	2	2	2	2	2	2	-	-	-	-	6509813P1	Opening spring, DC
4	57	1	1	1	-	-	-	-	-	-	-	-	-	6548046P3	Handle (black)
17	57	-	-	1	-	-	-	1	-	-	-	1	-	669D0807P2	Handle (gray)
4	58	1	1	1	-	-	-	-	-	-	-	-	-	698C997P1	Front escutcheon (black)
5	58	-	-	-	1	1	1	-	-	-	-	-	-	275B997P2	Front escutcheon (w/o closing switch, black)
*	58	-	-	-	1	1	1	-	-	-	1	-	-	805B975P1	Front escutcheon (with closing switch black)
*	58	-	-	1	-	-	-	1	-	-	-	1	-	698C997P5	Front escutcheon (blue)
*	58	-	-	-	-	-	1	-	1	-	-	-	1	805B975P2	Front escutcheon (blue)
4	59	1	1	1	1	1	1	1	1	1	1	1	1	411A904G5	Trip button and rod assembly
*	60	1	1	1	1	1	1	1	1	1	1	1	1	412A139	Trip button spring
7	61	1	1	1	1	1	1	1	1	1	1	1	1	6203939P3	Hand, trip paddle
*	62	1	1	1	1	1	1	1	1	1	1	1	1	192A9567P1	Clamp
7	63	2	2	2	2	2	2	2	2	2	2	2	2	276B250P1	Trip shaft (outside)
7	64	2	2	2	2	2	2	2	2	2	2	2	2	174V536P1	Coupling
7	65	2	2	2	2	2	2	2	2	2	2	2	2	127A6493P2	Dowel pin
8	66	1	1	1	1	1	1	1	1	1	1	1	1	276B250P2	Trip shaft (center)
*	67	2	2	2	2	2	2	2	2	2	2	2	2	394A133P1	Retainer
*	68	4	4	4	4	4	4	4	4	4	4	4	4	192A9653P4	Trip shaft bearing (side sheets and mechanism frame)
*	69	2	2	2	2	2	2	2	2	2	2	2	2	394A133P16	Retainer
6	74	1	1	1	1	1	1	1	1	1	1	1	1	174V531P1	Pin
6	75	6	6	6	6	6	6	6	6	6	6	6	6	394A133P10	Retainer

† To determine quantity required per breaker multiply by number of poles (2 or 3).
* Not shown.
‡ Original breaker had no suffix letter or numeral.

FIG. NO. 5, REF. NO. 152 – GEAR BOXES

177L316 and 177L362 gear boxes are no longer manufactured for AK-50, 75, 100 breakers. A modification of the AKR design electrical closing assembly is available to replace these units. The replacement unit will include a new closing motor. Select replacement for 175L316G1 or G2 gear box from Column 1. Replacements for 177L362G2 should be selected from Columns 1 to 4, for G3 select from Columns 5 to 8.

REPLACEMENT KIT CAT. NO. 343L761 (Select Group Number Below)

Column		Conventional Close Type 1	2	3	4	Quick Close Type 5	6	7	8
Volts	Hertz	AK-1-50, 75, 100 AK-2-50, 75, 100 AK-3-50, 75, 100 Includes AKU	AK-2A-50 AK-3A-50 Includes AKU	AKT-2A-50 AKT-3A-50	AK-2A-75, 100 AK-3A-75, 100	AK-2-50, 75, 100 AK-3-50, 75, 100 Includes AKU	AK-2A-50 AK-3A-50 Includes AKU	AKT-2A-50 AKT-3A-50	AK-2A-75, 100 AK-3A-75, 100
48	DC	G37	G49	G61	G37	G28	G49	G61	G37
125	DC	G38	G50	G62	G38	G29	G50	G62	G38
250	DC	G39	G51	G63	G39	G30	G51	G63	G39
120	60	G40	G52	G64	G40	G31	G52	G64	G40
208	60	G44	G56	G68	G44	G34	G56	G68	G44
240	60	G43	G55	G67	G43	G34	G55	G67	G43
120	50	G41	G53	G65	G41	G32	G53	G65	G41
208	50	G46	G58	G70	G46	G35	G58	G70	G46
240	50	G45	G57	G69	G45	G35	G57	G69	G45

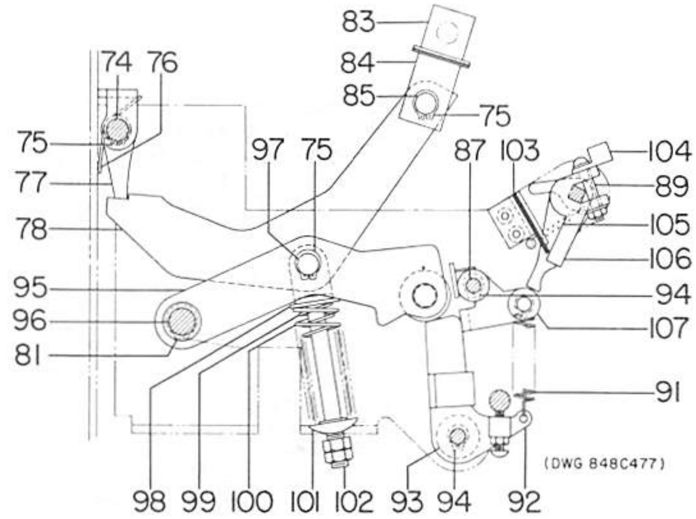


Fig. 6. AK-2-50 mechanism assembly

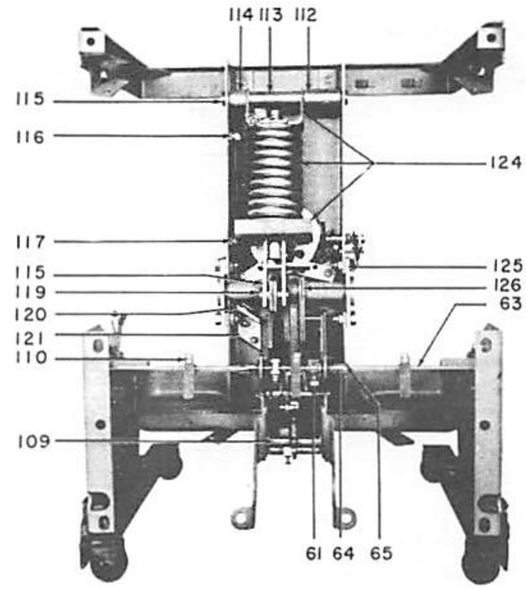


Fig. 7. AK-2-50 manual front frame assembly

Fig. No.	Ref. No.	No. Required per Breaker												Cat. No.	Description
		AK-2-50						AK-2A-50		AK-3-50		AK-3A-50			
		Man.			Elec.			Man.	Elec.	Man.	Elec.	Man.	Elec.		
		‡	-1	-2	‡	-1	-2	‡	‡	‡	‡	‡	‡		
6	76	1	1	1	1	1	1	1	1	1	1	1	1	412A140P1	Spring
6	77	1	1	1	1	1	1	1	1	1	1	1	1	419A366P1	Prop
6	78	1	1	1	1	1	1	1	1	1	1	1	1	6414743P1	Cam
6	83	1	1	1	1	1	1	1	1	1	1	1	1	6555414P2	Coupling
6	84	1	1	1	1	1	1	1	1	1	1	1	1	412A413P3	Clevis
6	85	1	1	1	1	1	1	1	1	1	1	1	1	412A405P414	Pin
6	87	1	1	1	1	1	1	1	1	1	1	1	1	6447744P1	Pin
*	88	-	-	-	1	1	-	-	-	-	1	-	-	457A610G1	Reset latch
6	89	1	1	1	1	1	1	1	1	1	1	1	1	6444916P1	Latch bolt
*	90	-	-	-	1	1	-	-	-	-	1	-	-	6414764P1	Latch
6	91	1	1	1	1	1	1	1	1	1	1	1	1	6403348P1	Spring
6	92	1	1	1	1	1	1	1	1	1	1	1	1	698C993G1	Prop
6	93	2	2	2	2	2	2	2	2	2	2	2	2	377A871P2	Prop shaft bearing
6	94	4	4	4	4	4	4	4	4	4	4	4	4	394A133P9	Retainer
6	95	1	1	1	1	1	1	1	1	1	1	1	1	457A622G1	Link assembly
6	96	1	1	1	1	1	1	1	1	1	1	1	1	6447099P1	Pin
6	97	1	1	1	1	1	1	1	1	1	1	1	1	6447091P1	Pin
6	98	1	1	1	1	1	1	1	1	1	1	1	1	6447331P1	Spring guide (upper)
6	99	1	1	1	1	1	1	1	1	1	1	1	1	148A2213P1	Spring reset (inner)
6	100	1	1	1	1	1	1	1	1	1	1	1	1	148A2214P1	Spring reset (outer)
6	101	1	1	1	1	1	1	1	1	1	1	1	1	6447353P1	Spring guide (lower)
6	102	1	1	1	1	1	1	1	1	1	1	1	1	6203914G1	Spring support assembly
6	103	1	1	1	-	-	1	1	1	1	-	1	1	457A627G1	Buffer assembly
6	104	1	1	1	1	1	1	1	1	1	1	1	1	383A671G2	Counter weight
6	105	1	1	1	1	1	1	1	1	1	1	1	1	6403366P1	Trip shaft return spring
6	106	1	1	1	-	-	1	1	1	1	-	1	1	848C0487P1	Latch
6	107	1	1	1	-	-	1	1	1	1	-	1	1	889B0410G1	Reset latch
7	109	1	1	1	1	1	1	1	1	1	1	1	1	412A412P2	Prop stop
7	110	3	3	3	3	3	3	3	3	3	3	3	3	269C267G5	Trip paddle

* Not shown.

‡ Original breaker had no suffix letter or numeral.

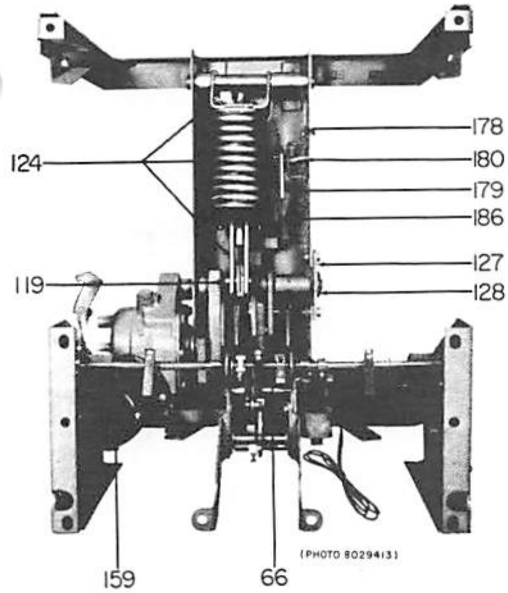


Fig. 8. AK-2-50 electrical front frame assembly

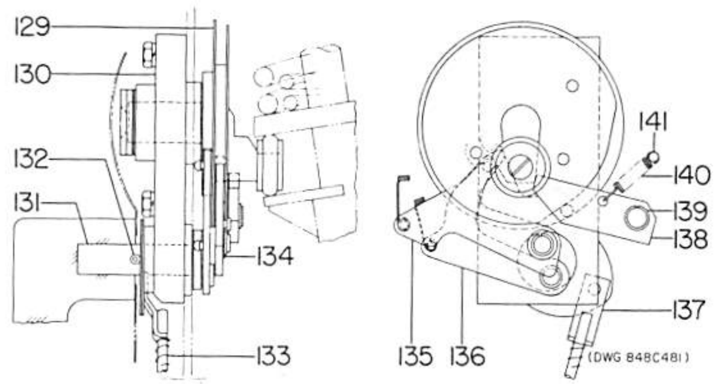


Fig. 9. AK-2-50 manual closing mechanism

Fig. No.	Ref. No.	AK-2-50 Man. ‡	AK-2-50 Man. -1	AK-2-50 Man. -2	AK-2-50 Elec. ‡	AK-2-50 Elec. -1	AK-2-50 Elec. -2	AK-2A-50 Man. ‡	AK-2A-50 Elec. ‡	AK-3-50 Man. ‡	AK-3-50 Elec. ‡	AK-3A-50 Man. ‡	AK-3A-50 Elec. ‡	Cat. No.	Description
*	111	1	1	1	1	1	1	1	1	1	1	1	1	6447767P1	Trip shaft stop
7	112	1	1	1	1	1	1	1	1	1	1	1	1	148A1946P10	Spacer
7	113	1	1	1	1	1	1	1	1	1	1	1	1	6447010P1	Upper spring guide assembly pin
7	114	1	1	1	1	1	1	1	1	1	1	1	1	148A1946P1	Spacer
7	115	4	4	4	4	4	4	4	4	4	4	4	4	394A133P4	Retaining ring
7	116	1	1	1	-	-	-	1	-	1	-	1	-	698C996G5	Pawl spring support (upper)
7	117	1	1	1	-	-	-	1	-	1	-	1	-	698C996G4	Pawl spring support (lower)
*	118	2	2	2	-	-	-	2	-	2	-	2	-	698C996P13	Pawl spring rollers
7	119	1	1	1	-	-	-	1	-	1	-	1	-	6447032P2	Lower spring guide assembly pin
8	119	-	-	-	1	1	1	-	1	-	1	-	1	6447032P1	Lower spring guide assembly pin
7	120	1	1	1	-	-	-	1	-	1	-	1	-	698C993P4	Buffer pin
7	121	1	1	1	-	-	-	1	-	1	-	1	-	698C993P3	Buffer support
*	122	1	1	1	-	-	-	1	-	1	-	1	-	698C993P5	Buffer washer
*	123	1	1	1	-	-	-	1	-	1	-	1	-	393A993P24	Buffer stop nut
7	124	1	1	1	-	-	-	1	-	1	-	1	-	889B0408G1	Spring guide assembly (closing)
8	124	-	-	-	1	1	1	-	1	-	1	-	1	273B569G9	Spring guide assembly (closing)
7	125	2	2	2	-	-	-	2	-	2	-	2	-	698C992G5	Support (includes bearing less outer race)
7	126	1	1	1	-	-	-	1	-	1	-	1	-	698C992G4	Crank (includes outer race of bearing)
8	127	-	-	-	1	1	1	-	1	-	1	-	1	393A554P1	Support
8	128	-	-	-	1	1	1	-	1	-	1	-	1	393A796P3	Bearing
9	129	1	1	1	-	-	-	1	-	1	-	1	-	698C987G2	Ratchet assembly
9	130	1	1	1	-	-	-	1	-	1	-	1	-	698C988G3	Support assembly
9	131	1	1	1	-	-	-	1	-	1	-	1	-	698C990G2	Shaft assembly
9	132	1	1	1	-	-	-	1	-	1	-	1	-	394A137P12	Roll pin
9	133	1	1	1	-	-	-	1	-	1	-	1	-	127A8306P1	Spring
9	134	1	1	1	-	-	-	1	-	1	-	1	-	394A133P28	Retainer
9	135	1	1	1	-	-	-	1	-	1	-	1	-	698C985G1	Pawl with spring (rear)
9	136	1	1	1	-	-	-	1	-	1	-	1	-	698C985G2	Pawl with spring (front)
9	137	1	1	1	-	-	-	1	-	1	-	1	-	846C817G1	Spring arm
9	138	1	1	1	-	-	-	1	-	1	-	1	-	698C991G5	Prop
9	139	1	1	1	-	-	-	1	-	1	-	1	-	394A133P3	Retainer
9	140	1	1	1	-	-	-	1	-	1	-	1	-	412A280P1	Prop spring
9	141	1	1	1	-	-	-	1	-	1	-	1	-	698C991P10	Pin
4,10	142	1	1	1	-	-	-	1	-	1	-	1	-	698C996G1	Indicator (when ordering indicator include label ref. No. 151)

* Not shown.
‡ Original breaker had no suffix letter or numeral.

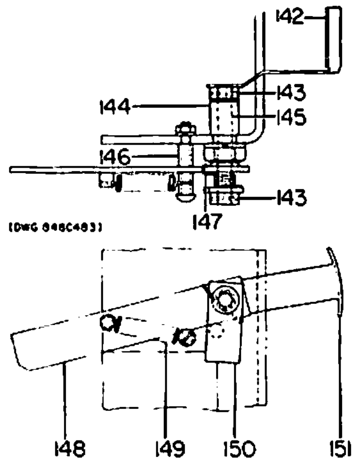


Fig. 10. AK-2-50 manual indicator assembly

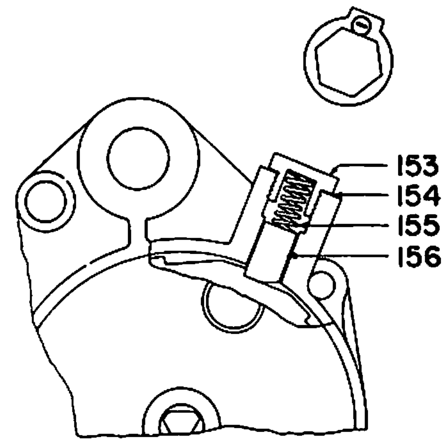


Fig. 11. Section of gear box

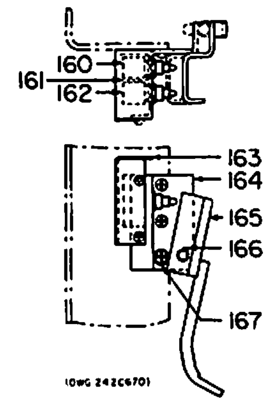


Fig. 12. Motor cut-off switch

Fig. No.	Ref. No.	No. Required per Breaker												Cat. No.	Description
		AK-2-50						AK-2A-50		AK-3-50		AK-3A-50			
		Man.			Elec.			Man.	Elec.	Man.	Elec.	Man.	Elec.		
		‡	-1	-2	‡	-1	-2	‡	‡	‡	‡	‡	‡		
10	143	2	2	2	-	-	-	2	-	2	-	2	-	394A137P11	Roll Pin
10	144	1	1	1	-	-	-	1	-	1	-	1	-	698C995P2	Bearing
10	145	1	1	1	-	-	-	1	-	1	-	1	-	127A6493P3	Rod
10	146	1	1	1	-	-	-	1	-	1	-	1	-	698C995P14	Tube
10	147	1	1	1	-	-	-	1	-	1	-	1	-	412A267P1	Spring
10	148	1	1	1	-	-	-	1	-	1	-	1	-	698C995G1	Indicator lever assembly
10	149	1	1	1	-	-	-	1	-	1	-	1	-	412A0292P1	Spring
10	150	1	1	1	-	-	-	1	-	1	-	1	-	698C995G2	Indicator crank assembly
10	151	1	1	1	-	-	-	1	-	1	-	1	-	259C608P3	Open-close label
11	153	-	-	-	1	1	1	-	1	-	1	-	1	6447398P1	Plug
11	154	-	-	-	1	1	1	-	1	-	1	-	1	393A992P2	"O" ring for plug
11	155	-	-	-	1	1	1	-	1	-	1	-	1	6509871P1	Spring for ratchet pin
11	156	-	-	-	1	1	1	-	1	-	1	-	1	372A383P1	Ratchet pin
*	157	-	-	-	1	1	1	-	1	-	1	-	1	393A991P1	Lubricant for gear box (4 oz.)
*	158	-	-	-	1	1	1	-	1	-	1	-	1	6447101P1	Gasket motor
5	158A	-	-	-	1	1	1	-	1	-	1	-	1	6447102P1	Gasket, gear box end plate
8	159	-	-	-	1	1	1	-	1	-	1	-	1	5P66MA6A	Motor, 115 volts, 25, 50, 60 cycles and 125 volt DC
8	159	-	-	-	1	1	1	-	1	-	1	-	1	5P66MA7A	Motor, 208-230 volts, 25, 50, 60 cycles and 250 volt DC
12	160	-	-	-	1	1	1	-	1	-	1	-	1	192A7153P8	Cut-off switch "G"
12	161	-	-	-	1	1	1	-	1	-	1	-	1	192A9792P1	Cut-off switch insulation
12	162	-	-	-	1	1	1	-	1	-	1	-	1	192A7153P7	Cut-off switch "F"
12	163	-	-	-	1	1	1	-	1	-	1	-	1	371A235P1	Cut-off switch cover
12	164	-	-	-	1	1	1	-	1	-	1	-	1	371A233G1	Cut-off switch mounting bracket
12	165	-	-	-	1	1	1	-	1	-	1	-	1	371A234G1	Cut-off switch lever bracket
12	166	-	-	-	1	1	1	-	1	-	1	-	1	394A133P9	Cut-off switch retainer

* Not shown.
‡ Original breaker had no suffix letter or numeral.

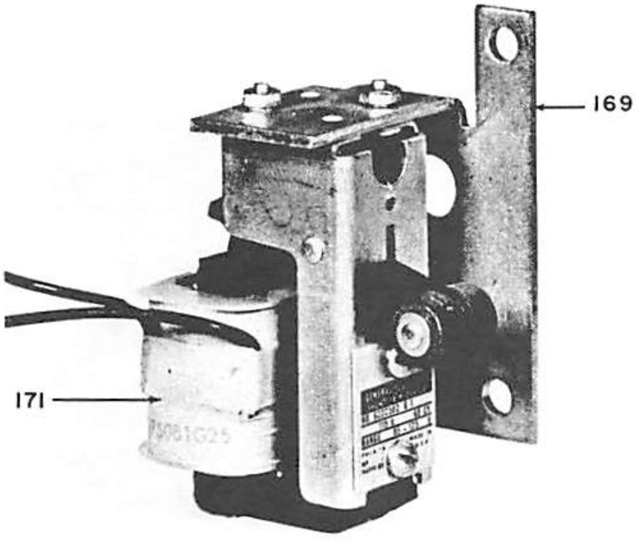


Fig. 13. Shunt trip
(Ref. No. 170)

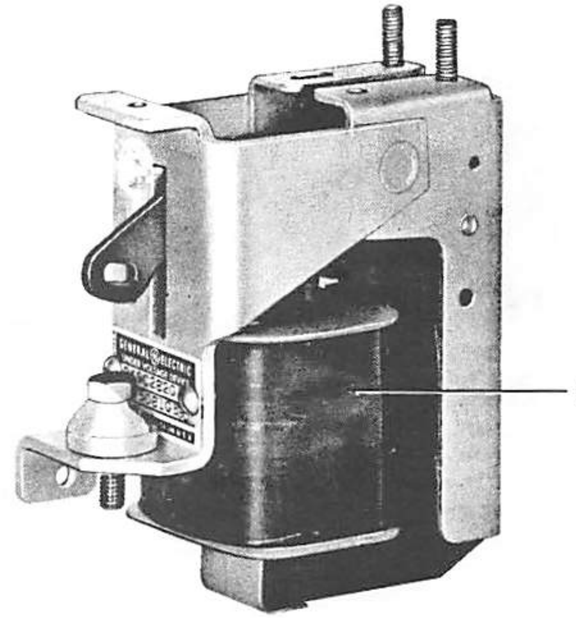


Fig. 14. Time delay undervoltage device
(Ref. No. 173)

Fig. No.	Ref. No.	No. Required per Pole †												Cat. No.	Description
		AK-2-50						AK-2A-50		AK-3-50		AK-3A-50			
		Man.			Elec.			Man.	Elec.	Man.	Elec.	Man.	Elec.		
		‡	-1	-2	‡	-1	-2	‡	‡	‡	‡	‡	‡		
12	167	-	-	-	1	1	1	-	1	-	1	-	1	192A8404P41	Cut-off switch spacer
5	168	-	-	-	1	1	1	-	1	-	1	-	1	See Table "B"	Closing relay (X) - standard
5	168A	-	-	-	1	1	1	-	1	-	1	-	1	See Table "B"	Closing relay (X) - quick close
*	168B	-	-	-	1	1	1	-	1	-	1	-	1	See Table "B"	Anti-pump relay (W) - quick close
*	168C	-	-	-	1	1	1	-	1	-	1	-	1	See Table "B"	Closing solenoid - quick close
13	169	1	1	1	1	1	1	1	1	1	1	1	1	449A537P1	Shunt trip device support
13	170	1	1	1	1	1	1	1	1	1	1	1	1	See Table "A"	Shunt trip device (with coil)
13	171	1	1	1	1	1	1	1	1	1	1	1	1	See Table "A"	Shunt trip coil
*	172	1	1	1	1	1	1	1	1	1	1	1	1	423A380P1	Undervoltage device support
14	173	1	1	1	1	1	1	1	1	1	1	1	1	δ	Time delay undervoltage device, AC
14	173	1	1	1	1	1	1	1	1	1	1	1	1	δ	Time delay undervoltage device, DC
15	174	1	1	1	1	1	1	1	1	1	1	1	1	#	Static time delay, AC or DC (replaces complete oil displacement time delay undervoltage device)
14	175	1	1	1	1	1	1	1	1	1	1	1	1	See Table "A"	Undervoltage device coil
*	176	1	1	1	1	1	1	1	1	1	1	1	1	See Table "A"	Instantaneous undervoltage device, AC (with coil)
*	176	1	1	1	1	1	1	1	1	1	1	1	1	See Table "A"	Instantaneous undervoltage device, DC (with coil)
5	177	-	-	-	1	1	1	-	1	-	1	-	1	192A9791P3	Auxiliary switch 3 stage
5	177	-	-	-	1	1	1	-	1	-	1	-	1	192A9791P6	Auxiliary switch 6 stage
*	177	1	1	1	-	-	-	1	-	1	-	1	-	192A9791P2	Auxiliary switch 2 stage
*	177	1	1	1	-	-	-	1	-	1	-	1	-	192A9791P5	Auxiliary switch 5 stage
8	178	1	1	1	1	1	1	1	1	1	1	1	1	411A952G1	Auxiliary switch crank bracket
8	179	-	-	-	1	1	1	-	1	-	1	-	1	887B386G2	Auxiliary switch link assembly
8	179	1	1	1	-	-	-	1	-	1	-	1	-	887B386G1	Auxiliary switch link assembly
8	180	1	1	1	1	1	1	1	1	1	1	1	1	6447157P1	Tube
*	181	1	1	1	1	1	1	1	1	1	1	1	1	457A643P8	Groove pin
*	182	1	1	1	1	1	1	1	1	1	1	1	1	127A6463G2	Auxiliary switch operating rod
*	183	1	1	1	1	1	1	1	1	1	1	1	1	127A6439P1	Auxiliary switch coupling
*	184	2	2	2	2	2	2	2	2	2	2	2	2	6076402P203	Pin
*	185	1	1	1	-	-	-	1	-	1	-	1	-	887B387G1	Adjusting plate
8	186	-	-	-	1	1	1	-	1	-	1	-	1	6203934P1	Open and close indicator link
5	187	-	-	-	1	1	1	-	1	-	1	-	1	265B268G1	Open and close indicator
5	188	-	-	-	1	1	1	-	1	-	1	-	1	265B268G2	Charged and discharged indicator

* Not shown.
‡ Original breaker had no suffix letter or numeral.
δ When ordering time delay undervoltage devices, the following information must be included:
(1) Complete nameplate reading of breaker involved.
(2) Desired voltage rating of device, whether a-c or d-c, and if a-c, the frequency.
Order by circuit breaker Serial No.

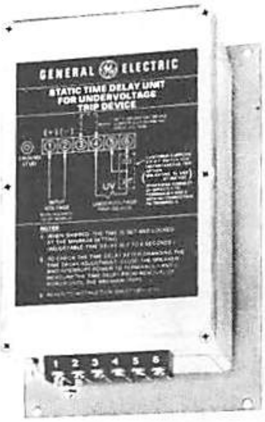


Fig. 15. Static time delay, (Ref. No. 174)

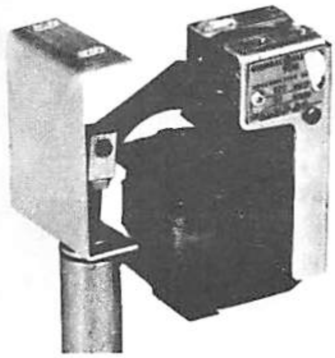


Fig. 15A. Oil-displacement type time-delay undervoltage tripping device.

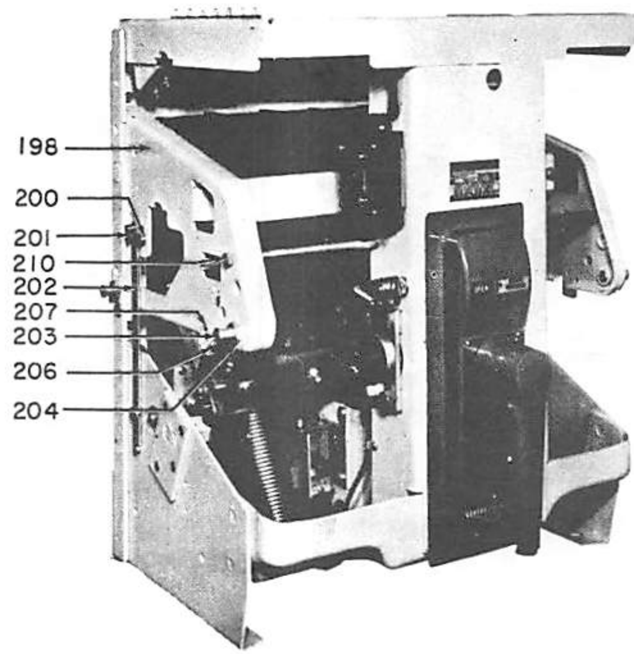


Fig. 16. AK-2A-50 manual

TABLE A

Volts	Hertz	Shunt Trip Device: Complete with Coil (less mounting) Reference 170 (Fig. 13)	Shunt Trip Device: Coil Only Reference 171	Instantaneous Undervoltage Device: Complete with Coil (less mounting)	Instantaneous Undervoltage Device: Coil Only for Instantaneous or Old Design Dashpot Type Time Delay	Time Delay Undervoltage Device†: Complete with Coil (less mounting) Reference 173 (Fig. 14)	Time Delay Undervoltage Device†: Coil Only Reference 175
24	DC	139C4378G1	6275081G55	568B309G1	6275081G15	-----	-----
48	DC	139C4378G3	6275081G28	568B309G2	6275081G9	-----	-----
125	DC	139C4378G4	6275081G29	568B309G3	6275081G18	568B309G5	6275081G61
250	DC	139C4378G5	6275081G30	568B309G4	6275081G19	568B309G6	6275081G59
70	60	139C4378G6	6275081G62	-----	-----	-----	-----
120	60	139C4378G7	6275081G25	568B309G7	6275081G26	-----	-----
120	50	139C4378G8	6275081G56	568B309G8	6275081G4	-----	-----
208	60	139C4378G10	6275081G26	568B309G10	6275081G27	568B309G24	6275081G59
208	50	139C4378G11	6275081G26	568B309G11	6275081G12	568B309G24	6275081G59
240	60	139C4378G13	6275081G26	568B309G13	6275081G7	568B309G24	6275081G59
240	50	139C4378G14	6275081G26	568B309G14	6275081G12	568B309G24	6275081G59
380	50	139C4378G17	6275081G27	568B309G17	6275081G31	-----	-----
480	60	139C4378G18	6275081G27	568B309G18	6275081G31	-----	-----
480	50	139C4378G19	6275081G4	568B309G19	6275081G3	-----	-----
575	60	139C4378G21	6275081G7	568B309G21	6275081G20	-----	-----
575	50	139C4378G22	6275081G29	568B309G22	6275081G8	-----	-----

NOTE: The static time undervoltage device (Fig. 14, Ref. 173) when used in combination with the static timing device (Fig. 15, Ref. 174) and a slight modification of breaker wiring will replace the older design oil-displacement type time delay undervoltage device shown in Fig. 15A.

TABLE B

CLOSING RELAYS AND COILS FOR CONVENTIONAL CLOSE AND QUICK CLOSE BREAKERS

Quick close breakers are identified by the letter "S" following the breaker type (i.e., AK-2A-50S-3).

Rating: Volts	Rating: Hertz	For Conventional Close Breaker Closing Relay "X"	For Quick Close Breaker: "X" Relay: Relay, Complete	For Quick Close Breaker: "X" Relay: *Coil, Only	For Quick Close Breaker: *"W" Relay, Complete δ	For Quick Close Breaker: *Closing Solenoid, Complete δ
125	D-C	12HGA11H52	192A9770P2	116B7197P203	192A9771P2	CR9500B202H3A
250		12HGA11H51	192A9770P3	116B7197P204	192A9771P3	CR9500B202H4A
115		12HGA11H74	192A9770P5	116B7197P206	192A9771P4	CR9500B102A6A
208	50	12HGA11H75	192A9770P7	116B7197P209	192A9771P5	CR9500B102A7A
230		12HGA11H75	192A9770P9	116B7197P212	192A9771P6	CR9500B102A7A
115		12HGA11H70	192A9770P4	116B7197P205	192A9771P4	CR9500B102A2A
208	60	12HGA11H71	192A9770P6	116B7197P208	192A9771P5	CR9500B102A3A
230		12HGA11H71	192A9770P8	116B7197P211	192A9771P6	CR9500B102A3A

* Recommended for stock for normal maintenance.
δ Only complete relay furnished.

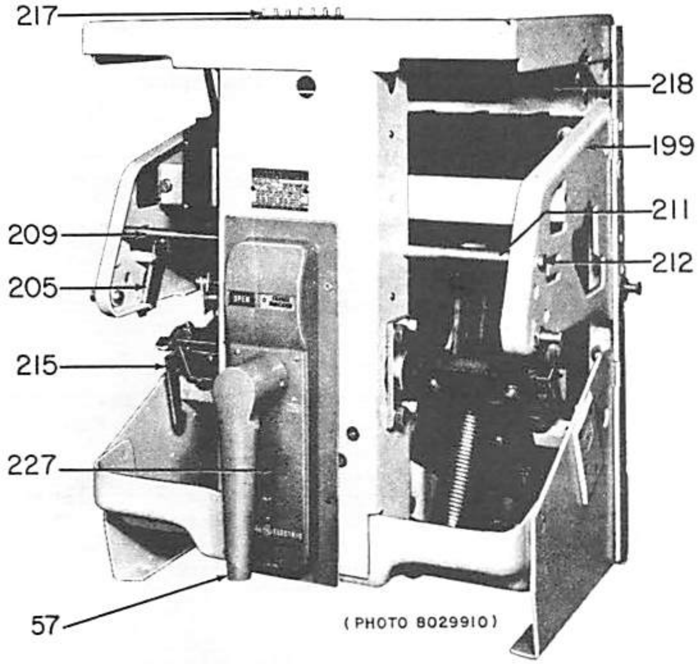


Fig. 17. AK-2A-50 manual

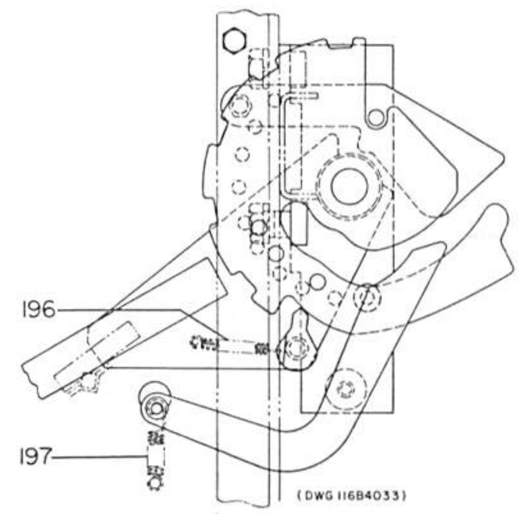


Fig. 18. Drawout racking mechanism, (Ref. No. 195)

Fig. No.	Ref. No.	No. Required per Breaker AK-2-50 Man. ‡	AK-2-50 Man. -1	AK-2-50 Man. -2	AK-2-50 Elec. ‡	AK-2-50 Elec. -1	AK-2-50 Elec. -2	AK-2A-50 Man. ‡	AK-2A-50 Elec. ‡	AK-3-50 Man. ‡	AK-3-50 Elec. ‡	AK-3A-50 Man. ‡	AK-3A-50 Elec. ‡	Cat. No.	Description
*	189	-	-	-	1	1	1	-	1	-	1	-	1	174V532P1	Pin for indicator
*	190	-	-	-	3	3	3	-	3	-	3	-	3	394A133P1	Retainer for indicator
*	191	-	-	-	2	2	2	-	2	-	2	-	2	6176109P7	Spacer for indicator
*	192	-	-	-	1	1	1	-	1	-	1	-	1	365A305P1	Spring for indicator
5	193	-	-	-	1	1	1	-	-	-	1	-	-	6293908G185	Terminal board (4 point)
5	193	1	1	1	1	1	1	-	-	1	1	-	-	6293908G168	Terminal board (6 point)
*	194	1	1	1	1	1	1	-	-	1	1	-	-	6423721P4	Terminal board support
*	194	-	-	-	-	-	-	-	-	-	-	-	-	9921543P1	Terminal board support
18	195	1	1	1	1	1	1	-	-	1	1	-	-	238D689G1	Drawout racking mechanism assembly
18	196	1	1	1	1	1	1	-	-	1	1	-	-	365A313P1	Pawl spring
18	197	1	1	1	1	1	1	-	-	1	1	-	-	412A135P1	Link spring
16	198	-	-	-	-	-	-	1	1	-	-	1	1	669D0819G1	Upper side sheet (left hand side)
17	199	-	-	-	-	-	-	1	1	-	-	1	1	669D0819G2	Upper side sheet (right hand side)
16	200	-	-	-	-	-	-	2	2	-	-	2	2	888B0420P1	Wheel
16	201	-	-	-	-	-	-	2	2	-	-	2	2	888B0420P2	Shaft
16	202	-	-	-	-	-	-	1	1	-	-	1	1	846C0839G1	Interlock link assembly
16	203	-	-	-	-	-	-	4	4	-	-	4	4	192A6976P53	Mounting stud
16	204	-	-	-	-	-	-	4	4	-	-	4	4	148A1988P1	Jam nut
17	205	-	-	-	-	-	-	1	1	-	-	1	1	846C0839P1	Latch
16	206	-	-	-	-	-	-	1	1	-	-	1	1	6076401P12	Pin
16	207	-	-	-	-	-	-	1	1	-	-	1	1	177L292P53	Rivet
*	208	-	-	-	-	-	-	1	1	-	-	1	1	846C0839P10	Latch spring, in back of Ref. 205
17	209	-	-	-	-	-	-	1	1	-	-	1	1	148A1946P5	Spacer (left)
16	210	-	-	-	-	-	-	1	1	-	-	1	1	177L292P58	Screw (left)
17	211	-	-	-	-	-	-	1	1	-	-	1	1	148A1946P6	Spacer (right)
17	212	-	-	-	-	-	-	1	1	-	-	1	1	177L292P59	Screw (right)
*	213	-	-	-	-	-	-	1	1	-	-	1	1	6203939P5	Trip paddle
*	214	-	-	-	-	-	-	1	1	-	-	1	1	192A9567P1	Clamp
17	215	-	-	-	-	-	-	1	1	-	-	1	1	801B138G4	Anti rebound hook and slider
*	216	1	1	1	1	1	1	1	1	1	1	1	1	265B237P1	Secondary disconnect support
17	217	x	x	x	x	x	x	x	x	x	x	x	x	386A110G2	Secondary disconnect device (7 pt.)
17	218	1	1	1	1	1	1	1	1	1	1	1	1	362A494P1	Insulation
*	219	2	2	2	2	2	2	2	2	2	2	2	2	6176109P72	Spacer

‡ Original breaker had no suffix letter or numeral.
x Order as required. Quantity of 3 maximum for AK-50 Breakers.
* Not shown.

Fig. No.	Ref. No.	No. Required per Breaker: AK-2-50 Man. ‡	AK-2-50 Man. -1	AK-2-50 Man. -2	AK-2-50 Elec. ‡	AK-2-50 Elec. -1	AK-2-50 Elec. -2	AK-2A-50 Man. ‡	AK-2A-50 Elec. ‡	AK-3-50 Man. ‡	AK-3-50 Elec. ‡	AK-3A-50 Man. ‡	AK-3A-50 Elec. ‡	Cat. No.	Description
19A	220	3	3	3	3	3	3	3	3	3	3	3	3	845C276G6	Movable primary disconnect (not used on AKT)
19B	220A	3	3	3	3	3	3	6	6	6	6	6	6	132C2655G1	Movable primary disconnect (for AKT only)
*	221	-	-	-	1	1	1	-	1	-	1	-	1	568B386G1	Maintenance handle
*	222	-	-	-	1	1	1	-	1	-	1	-	1	805B949G1	Closing switch
2	223	3	3	3	3	3	3	3	3	3	3	3	3	δ	Overcurrent trip device
5	224	-	-	-	2	2	2	-	2	-	2	-	2	174V535P1	Window
4	224	1	1	1	-	-	-	1	-	1	-	1	-	269C272P8	Window (open and close)
4	225	1	1	1	-	-	-	1	-	1	-	1	-	698C997P2	Window (charge indicator) (when ordering window include label Ref. No. 226)
*	226	1	1	1	-	-	-	1	-	1	-	1	-	698C997P4	Label (charge indicator)
17	227	-	-	1	-	-	-	1	-	-	-	1	-	NP148A1048	Bib for front esc. (manual) (blue)
17	227	-	-	-	-	-	1	-	1	-	-	-	1	NP148A1049	Bib for front esc. (elec. breaker w/o closing switch) (blue)
17	227	-	-	-	-	-	1	-	1	-	-	-	1	NP148A1050	Bib for front esc. (elec. breaker with closing switch) (blue)

* Not shown.
‡ Original breaker had no suffix letter or numeral.
δ (1) No parts furnished for field installation on EC-1 trip devices.
(2) Only part furnished for field installation on EC-2 or EC-2A trip devices is plastic cover, Cat. No. 242C645P1.
(3) When replacement trip devices are ordered, it is imperative that order includes complete nameplate reading of the breaker or breakers involved and, if a contemplated ampere rating change is involved, the order should also include information as to ampere rating, time-current characteristic, and instantaneous trip setting desired.

NOTE:
Illustrations and catalog numbers listed on the following pages apply only to Type AK-3-50 and AK-3A-50 breakers.

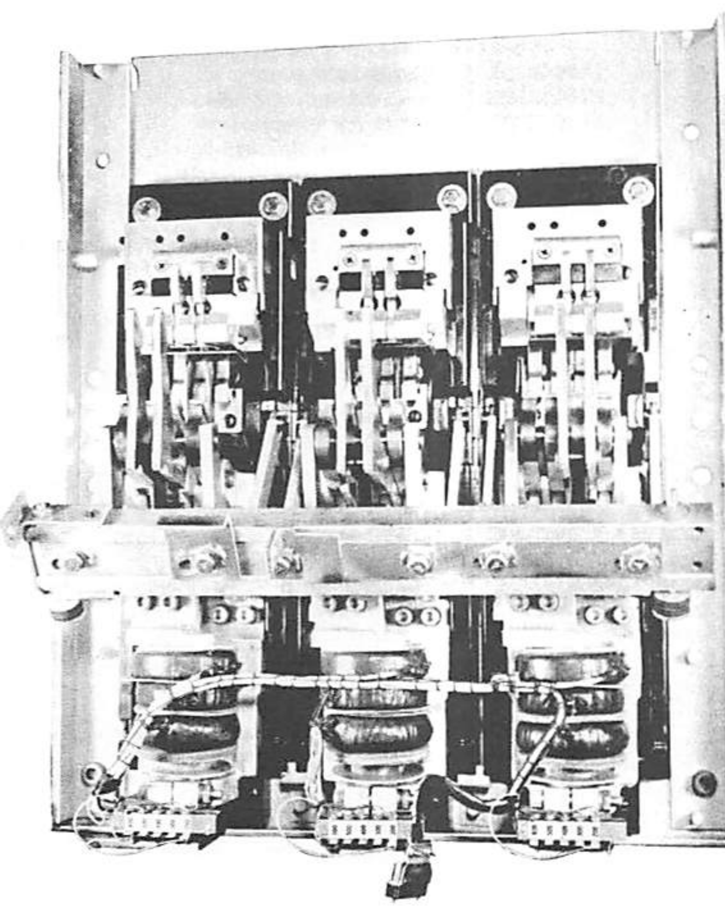


Fig. 19. Front view of back frame assembly—AK-3-50

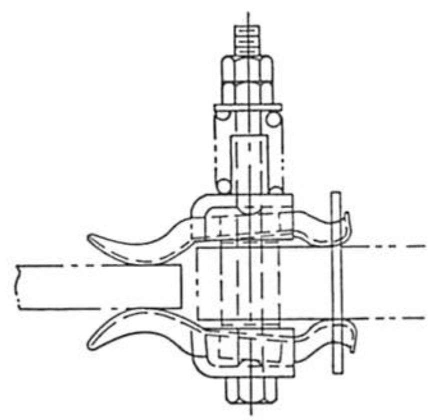


Fig. 19A. Primary disconnect assembly (for AK-50), Ref. No. 220.

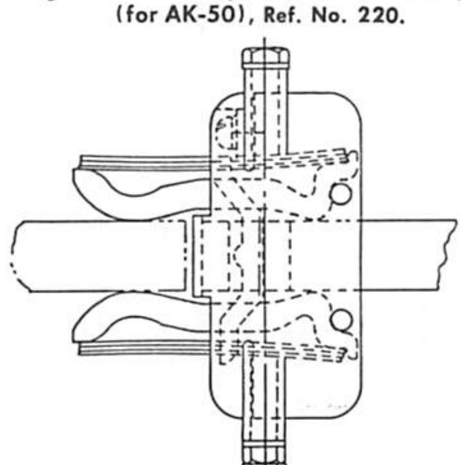


Fig. 19B. Primary disconnect assembly (for AKT-50), Ref. No. 220A.

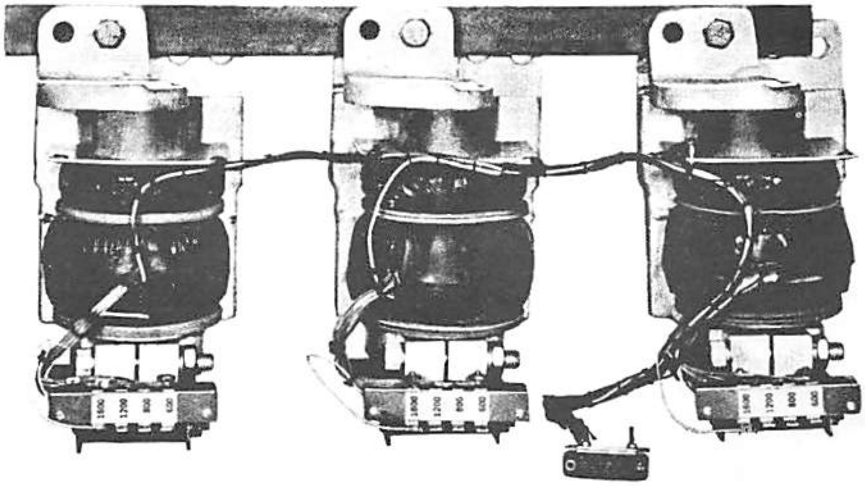


Fig. 20. Magnetic coil assembly for AK-3-50 breakers

Magnetic Sensor Coils - Assembly

TABLE C

Without ground trip			With ground trip		
Pole	Rating	Cat. No.	Pole	Rating	Cat. No.
3P	200/600	0133C1555 G5	3P	200/600	0133C1555 G9
3P	600/1600	0133C1555 G7	3P	600/1600	0133C1555 G11
3P For AKT-3/3A-50	800/2000	0133C1555 G14	3P For AKT-3/3A-50	800/2000	0133C1555 G16

Fig. 21. Power supply unit

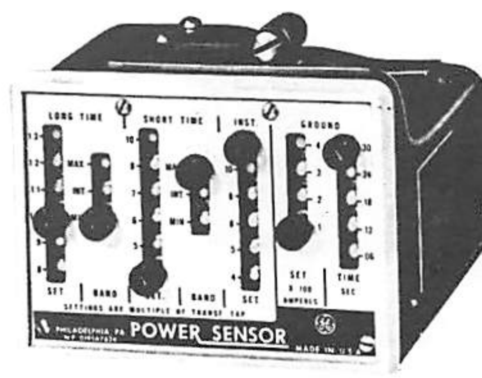


Fig. 22. Power sensor unit
(See Table D)

Powe~ Supply Units - Cat. No. 0152C9262G10

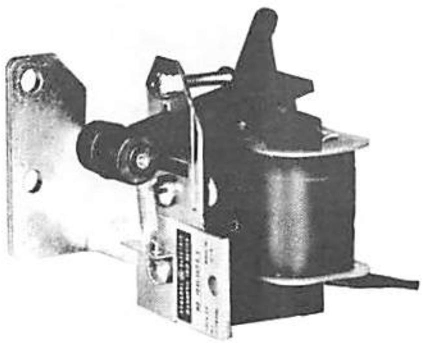


Fig. 23. Magnet trip device with mounting bracket

Magnet Trip Device with Mounting Bracket - Cat. No. 184L369G1

TABLE D POWER SENSOR LOGIC UNIT, TYPE PS-1A

Trip Elements				Cat. No.
L	$S_{(LO)}$	I	G	184L410G52
L	$S_{(HI)}$	I	G	184L410G55
L	$S_{(LO)}$	-	G	184L410G61
L	$S_{(HI)}$	-	G	184L410G64
L	-	I	G	184L410G58
-	$S_{(LO)}$	I	G	184L410G67
-	$S_{(HI)}$	I	G	184L410G70
-	$S_{(LO)}$	-	G	184L410G73
-	$S_{(HI)}$	-	G	184L410G76
-	-	I	G	184L410G79
L	$S_{(LO)}$	I	-	184L410G41
L	$S_{(HI)}$	I	-	184L410G42
L	$S_{(LO)}$	-	-	184L410G44
L	$S_{(HI)}$	-	-	184L410G45
L	-	I	-	184L410G43
-	$S_{(LO)}$	I	-	184L410G46
-	$S_{(HI)}$	I	-	184L410G47
-	$S_{(LO)}$	-	-	184L410G48
-	$S_{(HI)}$	-	-	184L410G49
-	-	I	-	184L410G50

L = Long time-delay element
$S_{(LO)}$ = Short time-delay element (2 to 5X range)
$S_{(HI)}$ = Short time-delay element (4 to 10X range)
I = Instantaneous trip element
G = Ground fault protective element

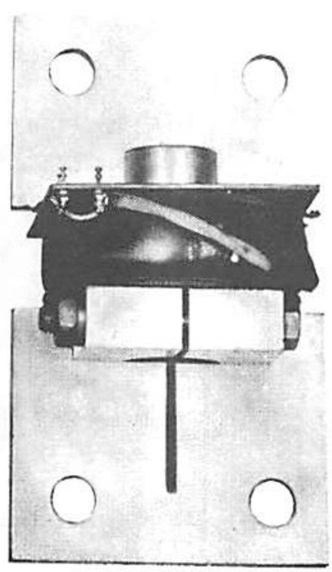


Fig. 24. Ground sensor coil with neutral mounting

Fourth Wire Grid Sensor Coils - Cat. No. 0152C9219G1

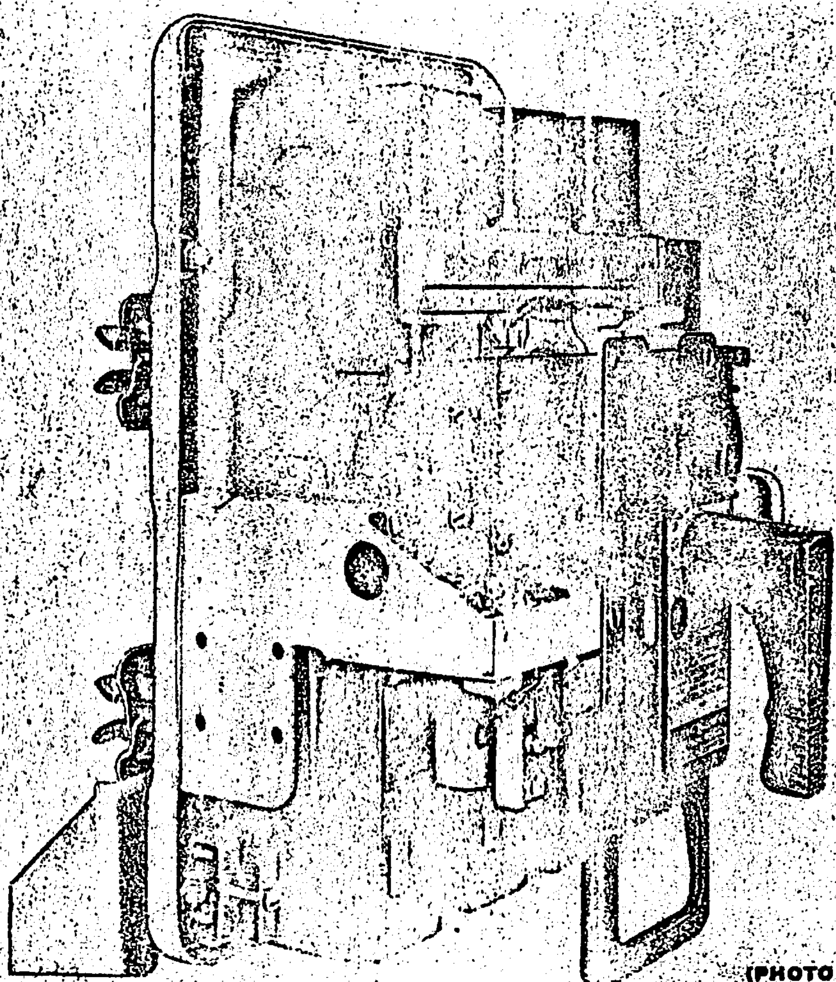
Fig. 25. Power sensor kit

Power Sensor Test Kit - Cat. No. 0102D2526G10

GEF-4140E
Supersedes GEF-[illegible]

RENEWAL PARTS

POWER CIRCUIT BREAKERS
TYPES
AK-2-15 AK-2A-15
AK-2-25 AK-2A-25
AKF-2-25 AKF-2A-25



(PHOTO 8024021)

Fig. 1. Type AK-2-25 manually operated power circuit breaker

ORDERING INSTRUCTIONS

1. Always specify the complete nameplate data of the breaker.
2. Specify the quantity, catalog number (if listed), reference number (if listed), description, and this bulletin number.
3. CAUTION: When local facilities for breaker recalibration are not available, the breaker should be forwarded to the nearest G-E Service Shop, or to the General Electric Company, 6901 Elmwood Avenue, Philadelphia 42, Pa.
4. Standard hardware, such as screws, bolts, nuts, washers, etc., is not listed in this bulletin. Such items should be purchased locally.
5. For prices, refer to the nearest office of the General Electric Company.

GENERAL ELECTRIC

Data subject to change without notice.

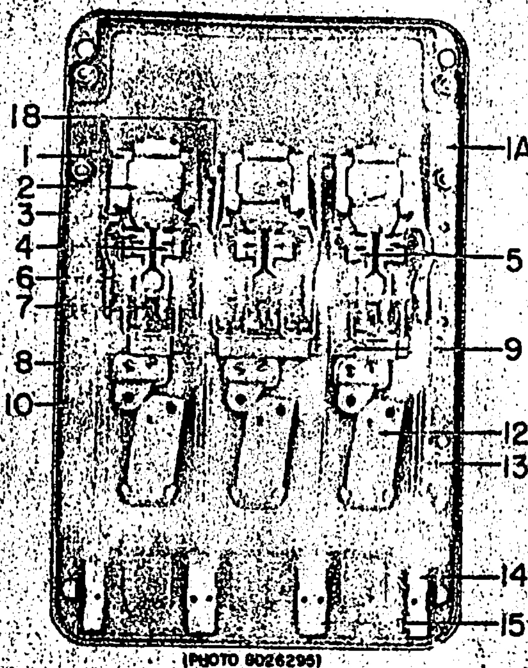


Fig. 2. Type AK-2-25 power circuit breaker back frame (operating mechanism removed)

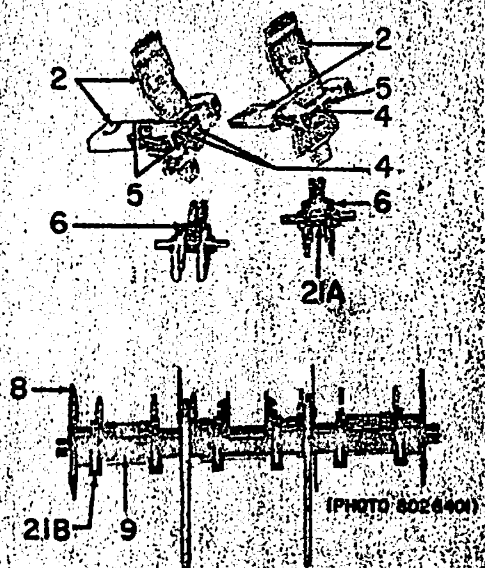


Fig. 3. Moving and stationary contacts and cross bar assembly

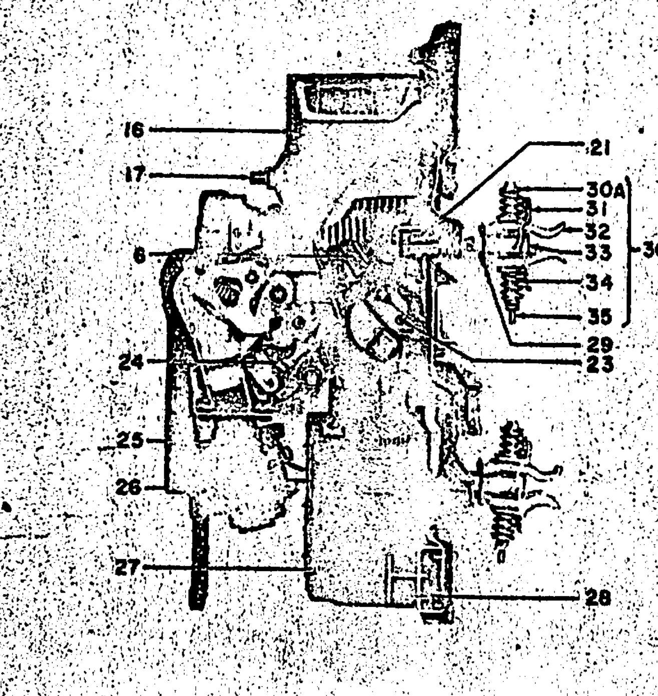


Fig. 4. Cutaway view of type AK-2-25 electrically operated power circuit breaker

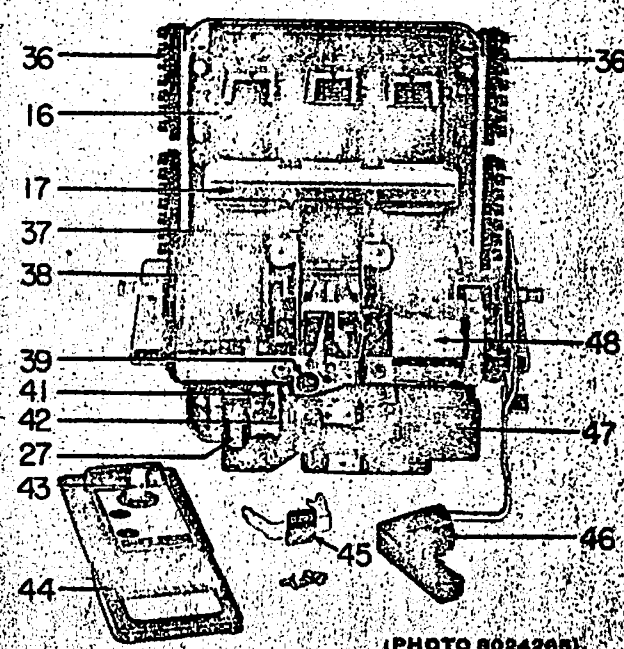


Fig. 5. Type AK-2-25 electrically operated power circuit breaker (escutcheon removed and dismantled)

Ref. No.	Quantity Required for 3-pole Breaker Type AK-2-15- ▲	AK-2-15- 1	AK-2-15- 2	AK-2-25- ▲	AK-2-25- 1	AK-2-25- 2	Catalog Number	Description
1A	1	1	1	1	1	1	073-227D190P1	Back plate
1	3	3	3	3	3	3	269C260G1	Insulation for upper stud, rear
†1B	3	3	3	3	3	3	269C260G2	Insulation for upper stud, front
2	3	3	3	-	-	-	269C283G1	Upper stud assembly
2	-	-	-	3	3	3	269C283G2	Upper stud assembly
3	3	3	3	3	3	3	295B460P1	Barrier
*4	3	3	3	6	6	6	269C257G1	Stationary contact assembly
*5	3	3	3	6	6	6	269C257G2	Stationary contact assembly
*6	3	3	3	-	-	-	269C257G14	Moving contact
*6	-	-	-	3	3	3	269C257G15	Moving contact
*7	2	2	2	2	2	2	412A250	Spring (outside poles)
*7A	1	1	1	1	1	1	269C280P5	Spring clip (center pole)
8	2	2	2	2	2	2	269C277P9	Barrier
9	1	1	1	1	1	1	269C277G1	Cross bar assembly
10	3	3	3	3	3	3	269C258G3	Pivot
*†11	3	3	3	3	3	3	269C280P8	Spring (back of pivot)
12	-	-	-	3	3	3	269C258G1	Lower stud assembly
12	3	3	3	-	-	-	269C258G2	Lower stud assembly
13	2	2	2	2	2	2	263C526P1	Insulation (under lower stud)
14	2	2	2	2	2	2	269C280P7	Support (outside)
15	2	2	2	2	2	2	269C280P6	Support (intermediate)
16	3	3	3	3	3	3	293B288G1	Arc quencher
17	1	1	-	1	1	-	269C273G1	Arc quencher clamp
17	-	-	1	-	-	1	269C273G2	Arc quencher clamp
18	2	2	2	2	2	2	269C280P4	Stud, arc quencher clamp
†19	2	2	2	2	2	2	177L215P219	Insulation for Ref. No. 18
†20	2	2	2	2	2	2	393A993P9	Stop nut for Ref. No. 18
*21	6	6	6	12	12	12	412A286	Stationary contact spring
21A	3	3	3	3	3	3	412A208	Movable contact spring
21B	6	6	6	6	6	6	269C277P11	Spring clip
†22	1	1	1	1	1	1	269C280P1	Moving contact pivot pin (center pole)
23	2	2	2	2	2	2	269C280P2	Moving contact pivot pin (outside poles)
*24	1	1	1	1	1	1	0412A0290	Spring
25	1	1	1	1	1	1	622C521G1	‡Magnet and armature assembly
26	1	1	1	1	1	1	See table B	‡Closing coil
27	3	3	3	3	3	3	See note below	Overcurrent trip device
28	6	6	6	6	6	6	386A163P1	Clamp for EC-2 trip device
28	3	3	3	3	3	3	6555445P1	Clamp for EC-1 trip device
29	-	-	-	6	6	6	269C281P5	Retaining ring
29	6	6	6	-	-	-	269C281P6	Retaining ring
30	3	3	3	-	-	-	845C276G2	Primary disconnect assembly
30	-	-	-	3	3	3	845C276G4	Primary disconnect assembly
30A	12	12	12	12	12	12	412A222	Spring
31	12	12	12	12	12	12	269C281P3	Retainer
*32	24	24	24	24	24	24	453A100P2	Contact finger
33	6	6	6	-	-	-	453A129P1	Retainer
33	-	-	-	6	6	6	453A129P2	Retainer
34	12	12	-	12	12	-	6176109P23	Spacer
34	-	-	12	-	-	12	457A681P4	Spacer
35	6	6	6	6	6	6	----------	Screw, hex. hd, 1/4 in.-20 by 3,3/8 in.

* Recommended for stock for normal maintenance.

▲ Original breaker had no suffix numeral or letter.

† Not shown.

‡ Electrically operated breakers

Note for overcurrent trip devices:

(1) No parts furnished for field installation on EC-1 trip devices.
(2) Only part furnished for field installation on EC-2 or EC-2A trip devices is plastic cover, Cat. No. 242C645P1.
(3) When replacement trip devices are ordered, it is imperative that order includes complete nameplate reading of the breaker or breakers involved and, if a contemplated ampere rating change is involved, the order should also include information as to ampere rating, time-current characteristic, and instantaneous trip setting desired.

Note for operating mechanisms:

(1) Individual parts cannot be furnished for operating mechanisms.
(2) When replacement is necessary give complete nameplate reading when ordering.

Ref. No.	Quantity Required for 3-pole Breaker Type						Catalog Number	Description
	AK-2-15-			AK-2-25-				
	▲	1	2	▲	1	2		
36	4	4	4	4	4	4	073-386A110G2	Movable secondary disconnects (drawout breaker)
37	1	1	1	1	1	1	622C505G1	Cutoff switch (electrically operated breaker)
38	1	1	1	1	1	1	432A671G2	Auxiliary switch, 2 stages
38	1	1	1	1	1	1	432A671G5	Auxiliary switch, 5 stages
39	1	1	1	1	1	1	269C268P1	Manual trip button
†39A	1	1	1	1	1	1	269C269P12	Trip label
†40	1	1	1	1	1	1	412A133	Spring for manual trip button
41	1	1	1	1	1	1	622C502G1	Shunt trip device with coil
42	1	1	1	1	1	1	622C529G1	Closing switch
43	1	1	1	1	1	1	101C7891G1	Shaft assembly (Manual Breaker only) order Ref. 43 and 43A together
†43A	1	1	1	1	1	1	101C7891G2	Link assembly
44	1	1	1	1	1	1	259C607G1	Escutcheon, manual breaker (black)
44	1	1	1	1	1	1	259C607P10	Escutcheon, electrically operated breaker (black)
44	1	1	1	1	1	1	259C607G2	Escutcheon, electrically operated breaker (with handle) (black)
†44	1	1	1	1	1	1	259C607G3	Escutcheon, manual breaker (blue)
†44	1	1	1	1	1	1	259C607P11	Escutcheon, electrically operated breaker (blue)
†44	1	1	1	1	1	1	259C607G4	Escutcheon, electrically operated breaker (blue)
45	1	1	1	1	1	1	259C608G1	Indicator
46	1	1	1	1	1	1	276B191P1	Handle (black)
46	1	1	1	1	1	1	669D807P1	Handle (sand gray)
47	1	1	1	1	1	1	----------	"X" relay (see Table A, page 6)
*48	1	1	1	1	1	1	----------	"Y" relay (see Table A, page 6)
†49	1	1	1	1	1	1	148A2238	Return spring, rear of escutcheon
Δ*50	8	-	-	8	-	-	295B445P221	Stationary contacts, "X" relay
Δ*51	4	-	-	4	-	-	295B445P222	Moving contacts, "X" relay
†Δ52	4	-	-	4	-	-	295B445P223	Springs, moving contacts, "X" relay
†Δ*52A	-	8	8	-	8	8	116B7197P221	Stationary contacts, "X" relay
†Δ*52B	-	4	4	-	4	4	116B7197P223	Molded moving arm, "X" relay
†Δ52C	-	4	4	-	4	4	116B7197P222	Armature return spring, "X" relay
Δ*53	1	1	1	1	1	1	----------	Operating coil, "X" relay (see Table A, page 6)
Δ54	1	1	-	1	1	-	622C501P1	Cover, "X" relay
Δ55	2	2	-	2	2	-	622C501P2	Jumper, "X" relay
*56	1	1	1	1	1	1	----------	Coil for shunt trip device (see Table B, page 7)
	1	1	1	1	1	1	269C282G2	‡Instantaneous undervoltage device, a-c (with coil)
	1	1	1	1	1	1	269C282G5	‡Instantaneous undervoltage device, d-c (with coil)
57	1	1	1	1	1	1	‡	Time-delay undervoltage device, a-c
57	1	1	1	1	1	1	‡	Time-delay undervoltage device, d-c
*58	1	1	1	1	1	1	----------	Coil for undervoltage device (see Table B, page 7)
59	1	1	1	1	1	1	Á	Static time delay, a-c or d-c (replaces complete time delay and volt device coil only)
*†60	1	1	1	1	1	1	6172594	Spring, for undervoltage device
61	1	1	1	1	1	1	269C299G2	‡Bell alarm device
62	1	1	1	1	1	1	6293908G275	Terminal board, 6 poles
62	1	1	1	1	1	1	6293908G274	Terminal board, 10 poles
63	1	1	1	1	1	1	846C865G1	Link and bushing for auxiliary switch
64	1	1	1	1	1	1	6314936P1	Cover for auxiliary switch, 1 stage
64	1	1	1	1	1	1	6314936P2	Cover for auxiliary switch, 2 stages
64	1	1	1	1	1	1	6314936P3	Cover for auxiliary switch, 5 stages
65	3	3	3	3	3	3	295B475P2	Base for wall mounted, general purpose breaker
66	6	6	6	-	-	-	394A144P1	Angle for wall mounted, general purpose breaker
67	6	6	6	-	-	-	275B995P1	Terminal for wall mounted, general purpose breaker
67	-	-	-	6	6	6	695C131P1	Terminal for wall mounted, general purpose breaker
68	6	6	6	-	-	-	394A106P1	Cable clamp for wall mounted, general purpose breaker
68	-	-	-	6	6	6	457A673G1	Cable clamp for wall mounted, general purpose breaker
69	1	1	1	1	1	1	269C276G2	Maintenance handle

* Recommended for stock for normal maintenance.

▲ Original breaker had no suffix numeral or letter.

† Not shown.

‡ If at any time a breaker is to have added to it either shunt trip, undervoltage device, or bell alarm device, the order for the device must include the following information:

(1) Complete nameplate reading of breaker involved.
(2) Desired voltage rating of device, whether a-c or d-c, and if a-c, the frequency.
(3) In the case of undervoltage devices, specify whether instantaneous or time delay.

Δ On -1, specify Cat. No. of "X" relay when ordering these parts.

Á Order by circuit breaker Serial No.

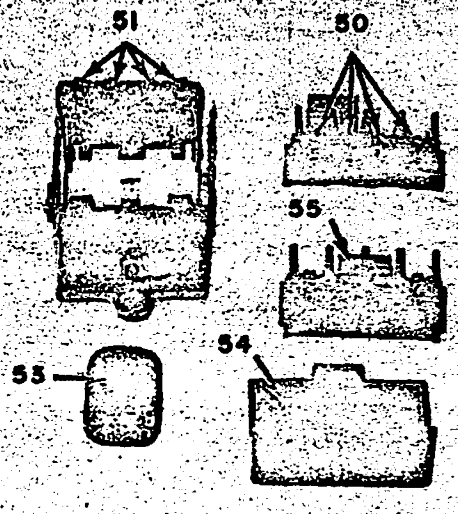


Fig. 6. "X" contactor (ref. 47)

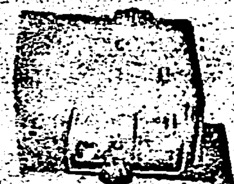


Fig. 7. "Y" relay (ref. 48)

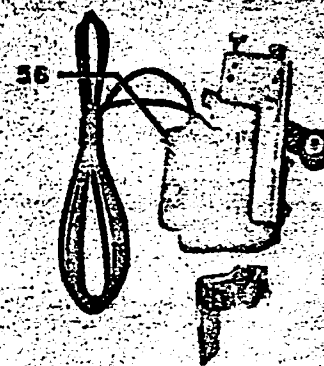


Fig. 8. Shunt trip device (ref. 41)

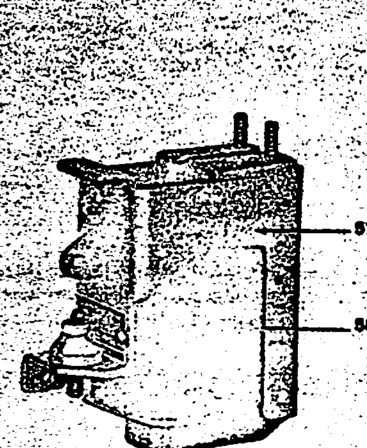


Fig. 9. Time delay undervoltage device (ref. 57)

Fig. 10. Cutoff switch (ref. 37)

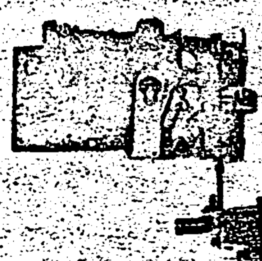


Fig. 11. Bell alarm device (ref. 61)

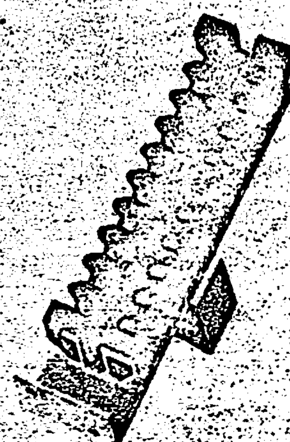


Fig. 12. Terminal board (ref. 62)

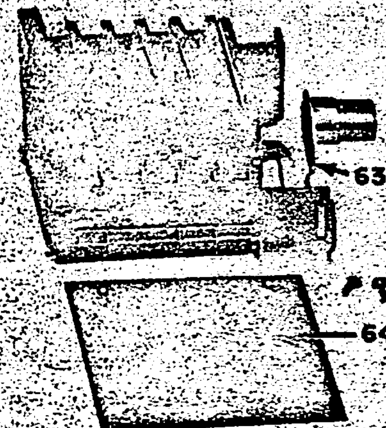


Fig. 13. Auxiliary switch (ref. 38)

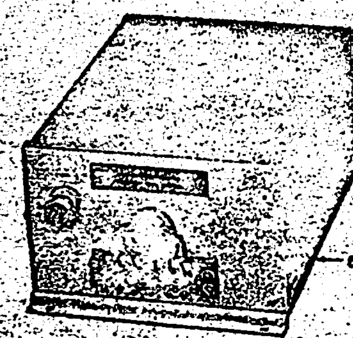
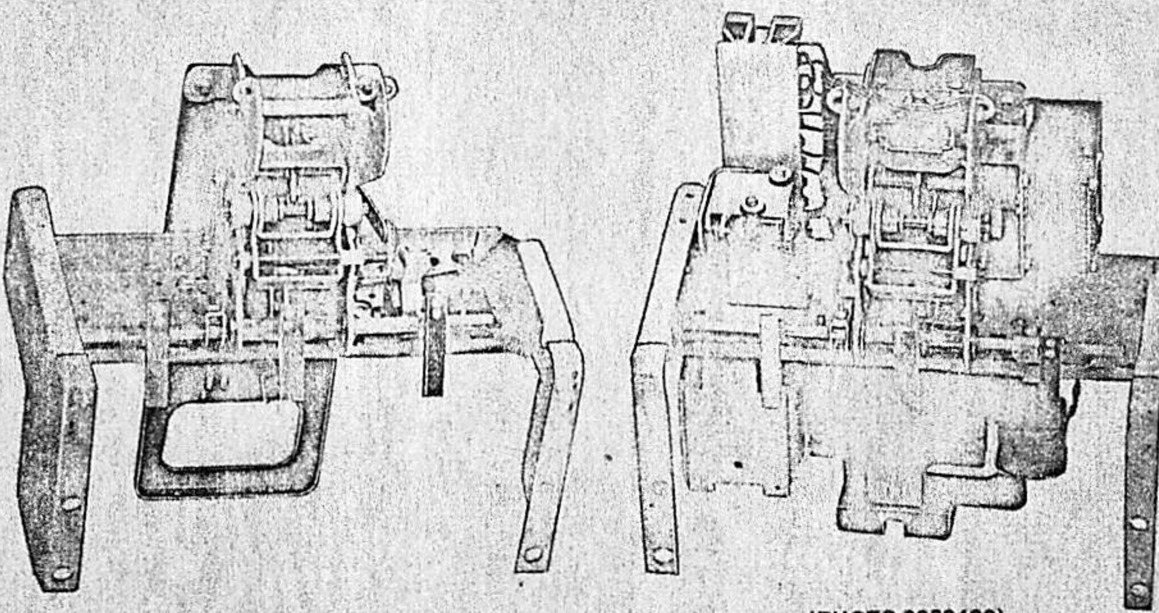


Fig. 13A. Static time delay



(PHOTO 8026400)

Fig. 14. Manual (left) and electrical (right) front frame assemblies for Type AK-2-15 and -25 power circuit breakers

NOTES FOR FIG. 14:

(1) Should it become necessary to replace the complete front frame of the breaker, it is necessary that the order include complete nameplate reading of existing breaker.

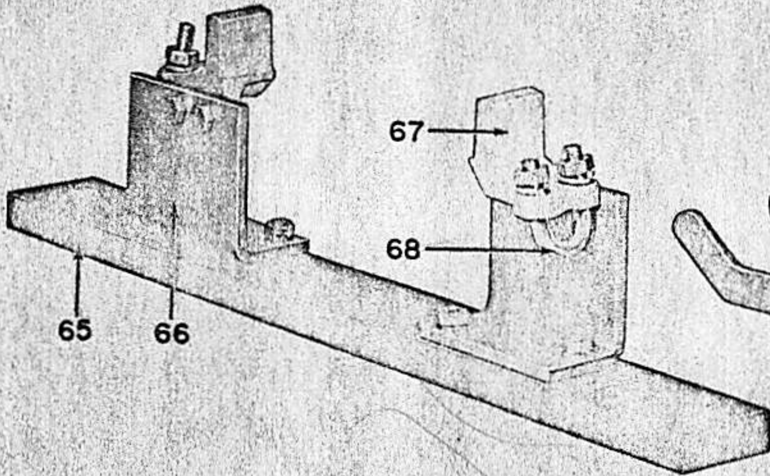
(2) If an existing manual breaker is to be converted to electrical operation, the order must include, in addition to complete nameplate reading, a description of desired change and complete voltage and frequency rating of both closing and tripping circuits.

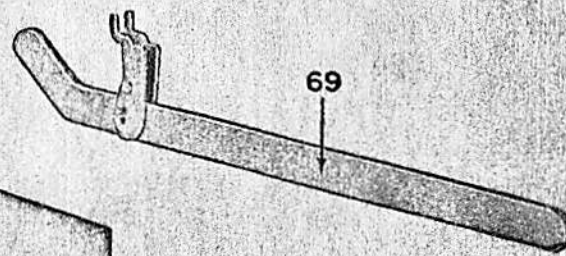
TABLE A

Rating		Catalog Number "X" Relay				"Y" Relay Complete (Ref. 48) §
Volts	Cycles	Relay Complete, Ref. 47 for Δ and Early -1 Breakers	Coil, only (Ref. 53) for Δ and Early -1 Breakers	Relay Complete, Ref. 47 for Late -1, and all -2 Breakers	Coil, only (Ref. 53) for Late -1, and all -2 Breakers	
24	D-C	295B445P1	295B445P201	116B7197P1	116B7197P201	295B444P1
48	D-C	295B445P2	295B445P202	116B7197P2	116B7197P202	295B444P2
125	D-C	295B445P3	295B445P203	116B7197P3	116B7197P203	295B444P3
250	D-C	295B445P4	295B445P204	116B7197P4	116B7197P204	295B444P4
115	25	295B445P7	295B445P207	116B7197P7	116B7197P207	295B444P7
208	25	295B445P10	295B445P210	116B7197P10	116B7197P210	295B444P10
230	25	295B445P13	295B445P213	116B7197P13	116B7197P213	295B444P13
460	25	-----------	------------	116B7197P16	116B7197P216	-----------
230	40	295B445P12	295B445P212	------------	-------------	295B444P11
115	50	295B445P6	295B445P206	116B7197P6	116B7197P206	295B444P5
208	50	295B445P9	295B445P209	116B7197P9	116B7197P209	295B444P8
230	50	295B445P12	295B445P212	116B7197P12	116B7197P212	295B444P11
380	50	295B445P17	295B445P214	116B7197P17	116B7197P217	295B444P17
460	50	295B445P15	295B445P216	116B7197P15	116B7197P215	295B444P14
115	60	295B445P5	295B445P205	116B7197P5	116B7197P205	295B444P5
208	60	295B445P8	295B445P208	116B7197P8	116B7197P208	295B444P8
230	60	295B445P11	295B445P211	116B7197P11	116B7197P211	295B444P11
460	60	295B445P14	295B445P215	116B7197P14	116B7197P214	295B444P14

Δ Original breaker had no suffix numeral or letter.

§ Only complete relay furnished.





(PHOTO 8026586)

Fig 15. Accessories for wall mounting (ref. 65, 66, 67, 68)

Fig. 16. Maintenance handle for electrically operated breakers not equipped with manual handles (ref. 69)

TABLE B

Rating		Catalog Number		
Volts	Cycles	Closing Solenoid Coil (Ref. 26)	Shunt Trip Device Coil (Ref. 56)	Undervoltage Device Coil (Ref. 58)
24	D-C	- - -	6275081G55	6275081G15
48	D-C	366A773G17	6275081G28	6275081G9
125	D-C	366A773G13	6275081G29	6275081G18
250	D-C	366A773G15	6275081G30	6275081G19
115	25	366A773G3	6275081G26	6275081G12
208	25	366A773G6	6275081G29	6275081G10
230	25	366A773G14	6275081G29	6275081G10
460	25	366A773G11	6275081G7	6275081G17
575	25	366A773G12	6275081G5	6275081G21
115	50	366A773G2	6275081G56	6275081G4
208	50	366A773G3	6275081G26	6275081G12
230	50	366A773G5	6275081G26	6275081G12
380	50	366A773G6	6275081G27	6275081G31
460	50	366A773G8	6275081G4	6275081G3
575	50	366A773G10	6275081G29	6275081G8
115	60	366A773G1	6275081G25	6275081G26
208	60	366A773G3	6275081G26	6275081G27
230	60	366A773G4	6275081G26	6275081G7
460	60	366A773G7	6275081G27	6275081G31
575	60	366A773G9	6275081G7	6275081G20

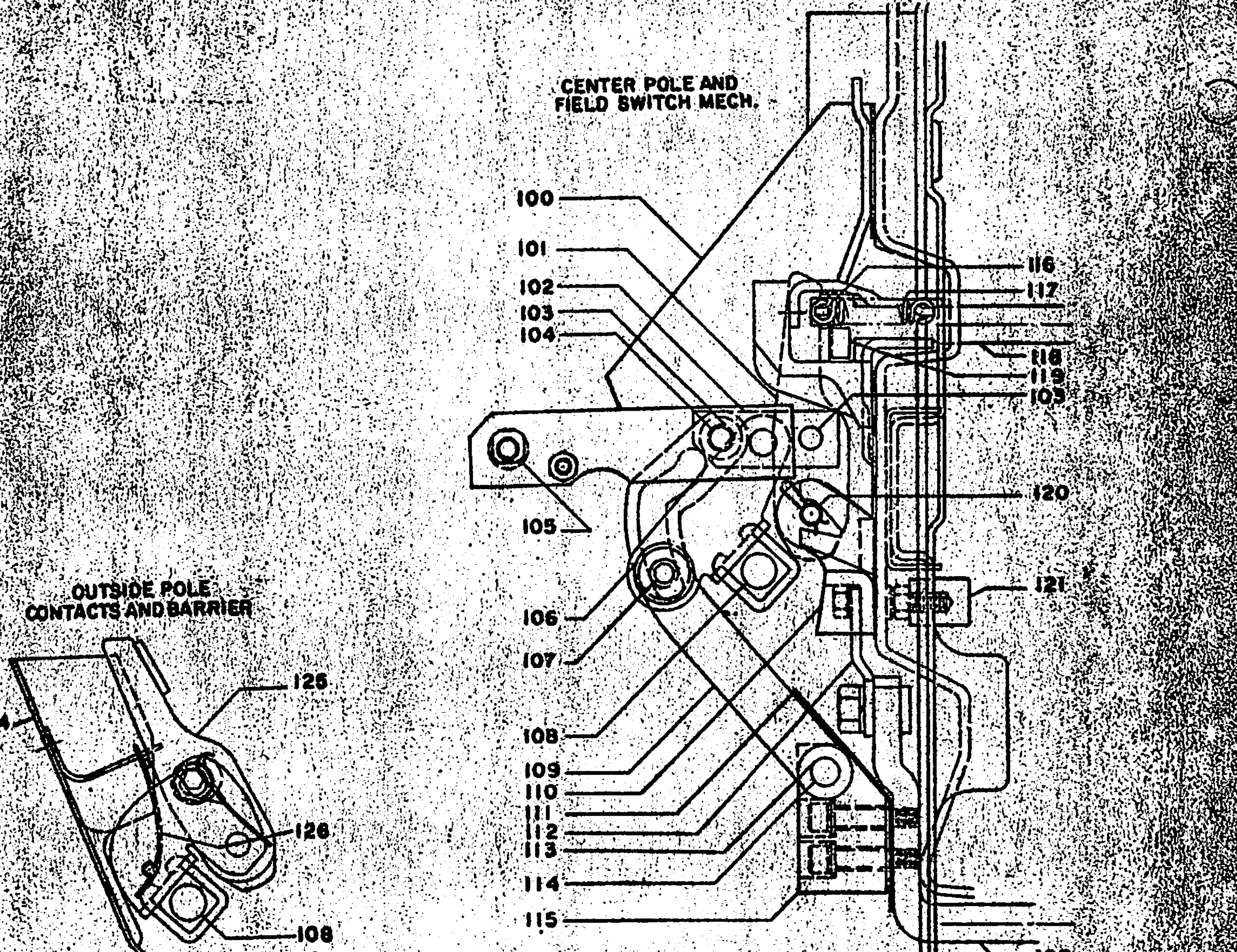


Fig. 17. Field switch mechanism and contact assemblies

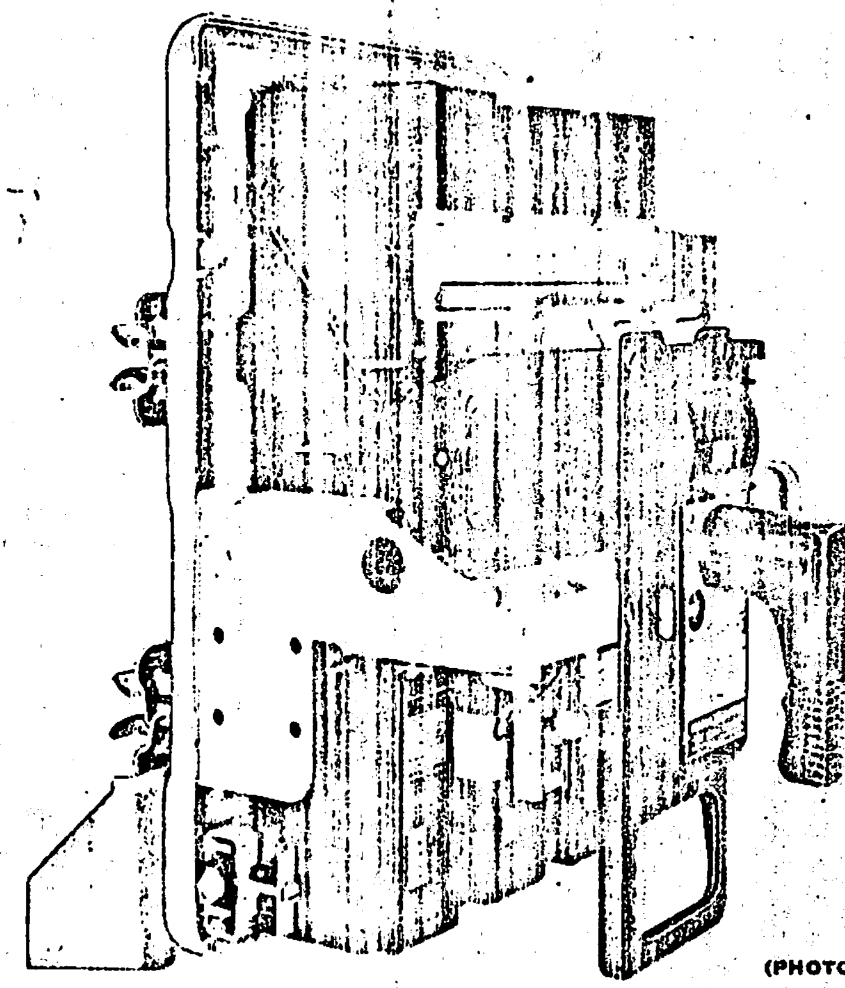
NOTE: Parts listed below apply only to Types AKF-2-25 and AKF-2A-25. All other parts are identical to those used on Type AK-2-25.

Ref. No.	Qty. Per Center Pole	Catalog No.	Description
100	1	073-108C9697P9	Insulation
*101	1	108C9698G1	Moving contact
102	2	108C9695P2	Link
103	4	394A133P8	Retaining ring
104	1	108C9695P9	Pin
105	2	148A2279P1	Adjustable bushing
106	2	377A871P12	Bearing
107	1	108C9695P10	Cam follower
108	1	108C9696G1	Crossbar
109	1	108C9695G3	Cam assembly, left
109	1	108C9695G4	Cam assembly, right
110	1	108C9695P6	Pivot
111	1	108C9694P8	Lower stud insulation
112	1	108C9695P3	Connector
113	2	394A133P9	Retaining ring
114	1	073-412A404P136	Pin
115	1	108C9694P7	Lower pivot
*116	1	269C257G1	Stationary contact
*116	1	269C257G2	Stationary contact
117	2	412A286	Stationary contact spring
118	1	269C283G4	Upper stud
119	1	108C9697P11	Contact spacer right side
119	1	108C9697P12	Contact spacer left side
120	1	269C280P1	Moving contact pivot pin
121	1	108C9698P14	Spacer
122	1	269C258G13	Lower stud
†123	1	293B288G1	Arc quencher
124	1	108C9697G3	Insulation
*125	1	108C9698G2	Moving contact
126	2	108C9694P5	Spring

*Recommended for stock for normal maintenance.
†Not shown.

RENEWAL PARTS

TYPES AK-2-15 AND AK-2-25 POWER CIRCUIT BREAKERS



(PHOTO 8024021)

Fig. 1. Type AK-2-25 manually operated power circuit breaker

ORDERING INSTRUCTIONS

1. Always specify the complete nameplate data of the breaker.
2. Specify the quantity, catalog number (if listed), reference number (if listed), description, and this bulletin number.
3. CAUTION: When local facilities for breaker recalibration are not available, the breaker should be forwarded to the nearest G-E Service Shop, or to the General Electric Company, 6901 Elmwood Avenue, Philadelphia 42, Pa.
4. Standard hardware, such as screws, bolts, nuts, washers, etc., is not listed in this bulletin. Such items should be purchased locally.
5. For prices, refer to the nearest office of the General Electric Company.

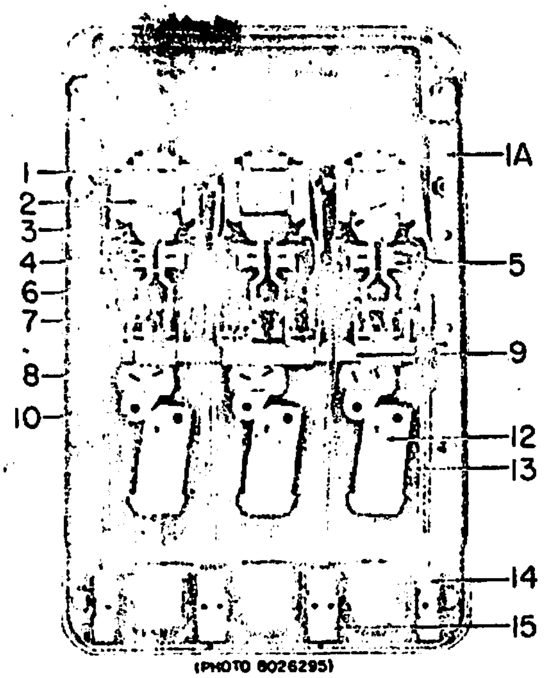


Fig. 2. Type AK-2-25 power circuit breaker back frame (operating mechanism removed)

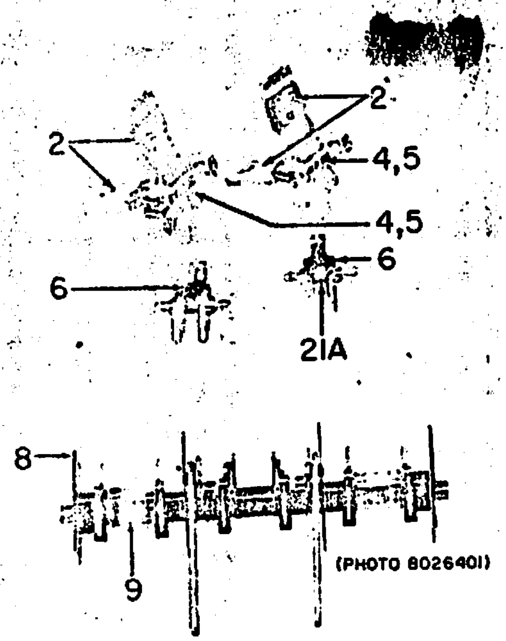


Fig. 3. Moving and stationary contacts and cross bar assembly

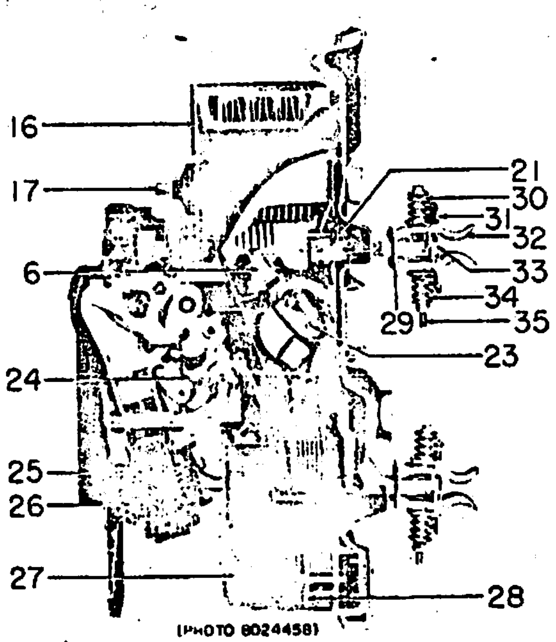


Fig. 4. Cutaway view of type AK-2-25 electrically operated power circuit breaker

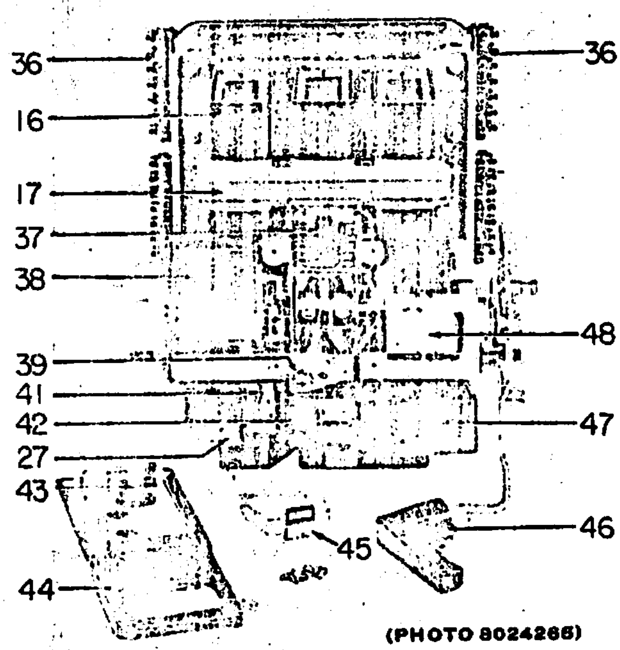


Fig. 5. Type AK-2-25 electrically operated power circuit breaker (escutcheon removed and dismantled)

Ref. No.	Quantity Required for 3-pole Breaker		Catalog Number	Description
	Type AK-2-15	Type AK-2-25		
1A	1	1	227D190P1	Back plate
1	3	3	269C260G1	Insulation
2	3	-	269C283G1	Upper stud assembly
2	-	3	G2	Upper stud assembly
3	3	3	295B460P1	Barrier
*4	3	6	269C257G1	Stationary contact assembly
*5	3	6	G2	Stationary contact assembly
*6	3	-	G14	Moving contact
*6	-	3	G15	Moving contact
*7	2	2	412A250	Spring
8	2	2	269C277P9	Barrier
9	1	1	G1	Cross bar assembly
10	3	3	269C258G3	Pivot
*†11	3	3	269C280P8	Spring (back of pivot)
12	-	3	269C258G1	Lower stud assembly
12	3	-	G2	Lower stud assembly
13	2	2	263C526P1	Insulation (under lower stud)
14	2	2	269C280P7	Support (outside)
15	2	2	P6	Support (intermediate)
16	3	3	293B288G1	Arc quencher
17	1	1	269C273G1	Arc quencher clamp
†18	2	2	269C280P4	Stud, arc quencher clamp
†19	2	2	177L215P219	Insulation for Ref. No. 18
†20	2	2	393A993P9	Stop nut for Ref. No. 18
*21	6	12	412A286	Stationary contact spring
21A	3	3	412A208	Movable contact spring
22	1	1	269C280P1	Moving contact pivot pin (center pole)
†23	2	2	P2	Moving contact pivot pin (outside poles)
*24	1	1	412A290	Spring
25	1	1	622C521G1	‡Magnet and armature assembly
26	1	1	See table B	‡Closing coil
27	3	3	See note below	Overcurrent trip device
28	6	6	386A163P1	Clamp for EC-2 trip device
28	3	3	453A169P1	Clamp for EC-1 trip device
29	-	6	269C281P5	Retainer
29	6	-	P6	Retainer
*30	12	12	412A222	Spring
31	12	12	269C281P3	Retainer
*32	24	24	453A100P2	Contact finger
33	6	-	453A129P1	Retainer
33	-	6	P2	Retainer
34	12	12	6176109P23	Spacer
35	6	6	-----	Hex. head steel screw, 1/4 in.-20 by 4 -/4 inches

* Recommended for stock for normal maintenance.

† Not shown.

‡ Electrically operated breakers.

Note for overcurrent trip devices:

(1) No parts furnished for field installation on EC-1 trip devices.
(2) Only part furnished for field installation on EC-2 trip devices is plastic cover, Cat. No. 242C645P1.
(3) When replacement trip devices are ordered, it is imperative that order includes complete nameplate reading of the breaker or breakers involved and, if a contemplated ampere rating change is involved, the order should also include information as to ampere rating, time-current characteristic, and instantaneous trip setting desired.

Note for operating mechanisms:

(1) Individual parts cannot be furnished for operating mechanisms.
(2) When replacement is necessary give complete nameplate reading when ordering.

Ref. No.	Quantity Required for 3-pole Breaker		Catalog Number	Description
	Type AK-2-15	Type AK-2-25		
36	4	4	386A110G2	Movable secondary disconnects (drawout breaker)
37	1	1	622C505G1	Cutoff switch (electrically operated breaker)
38	1	1	432A671G2	Auxiliary switch, 2 stages
38	1	1	G5	Auxiliary switch, 5 stages
39	1	1	269C268G1	Manual trip button
†40	1	1	412A133	Spring for manual trip button
41	1	1	See Ref. 55, 56	Shunt trip device
42	1	1	622C529G1	Closing switch
43	1	1	269C272G1	Shaft assembly
44	1	1	259C607G1	Escutcheon, manual breaker (black)
44	1	1	P10	Escutcheon, electrically operated breaker (black,
44	1	1	G2	Escutcheon, electrically operated breaker (with handle) (blank)
†44	1	1	259C607G3	Escutcheon, manual breaker (blue)
†44	1	1	P11	Escutcheon, electrically operated breaker (blue)
†44	1	1	G4	Escutcheon. electrically operated breaker (with handle) (blue)
45	1	1	259C608G1	Indicator
46	1	1	276B191P1	Handle (black)
46	1	1	669D807P1	Handle (sand gray)
47	1	1	See table A	"X" contactor
*48	1	1	See table A	"Y" relay
†49	1	1	412A158	Opening spring, rear of escutcheon
*50	8	8	295B445P221	Stationary contacts, "X" contactor
*51	4	4	P222	Moving contacts, "X" contactor
†52	4	4	P223	Springs, moving contacts, "X" contactor
*53	1	1	See table A	Operating coil, "X" contactor
54	1	1	622C501P1	Cover, "X" contactor
55	2	2	P2	Jumper, "X" contactor
55	1	1	622C502G1	‡Shunt trip device
*56	1	1	See table B	Coil for shunt trip device
57	1	1	269C282G2	‡Instantaneous undervoltage device, a-c
57	1	1	G5	‡Instantaneous undervoltage device, d-c
57	1	1	G6	‡Time delay undervoltage device, a-c
57	1	1	G7	‡Time delay undervoltage device, d-c
*58	1	1	See table B	Coil for undervoltage device
59	1	1	269C282G1	Time delay dashpot for undervoltage device
*†60	1	1	6172594	Spring, for undervoltage device
61	1	1	269C299G2	‡Bell alarm device
62	1	1	6293908G275	Terminal board, 6 poles
62	1	1	G274	Terminal board, 10 poles
63	1	1	269C268G1	Link and bushing for auxiliary switch
64	1	1	6314936P1	Cover for auxiliary switch, 1 stage
64	1	1	P2	Cover for auxiliary switch, 2 stages
64	1	1	P3	Cover for auxiliary switch, 5 stages
65	3	3	295B475P2	Base for wall mounted, general purpose breaker
66	6	-	394A144P1	Angle for wall mounted, general purpose breaker
67	6	-	275B995P1	Terminal for wall mounted, general purpose breaker
67	-	6	695C131P1	Terminal for wall mounted, general purpose breaker
68	6	-	394A106P1	Cable clamp for wall mounted, general purpose breaker
68	-	6	457A673G1	Cable clamp for wall mounted, general purpose breaker
69	1	1	269C276G2	Maintenance handle

* Recommended for stock for normal maintenance.

† Not shown.

‡ If at any time a breaker is to have added to it either shunt trip, undervoltage device, or bell alarm device, the order for the device must include the following information:

(1) Complete nameplate reading of breaker involved.

(2) Desired voltage rating of device, whether a-c or d-c, and if a-c, the frequency.

(3) In the case of undervoltage devices, specify whether instantaneous or time delay.

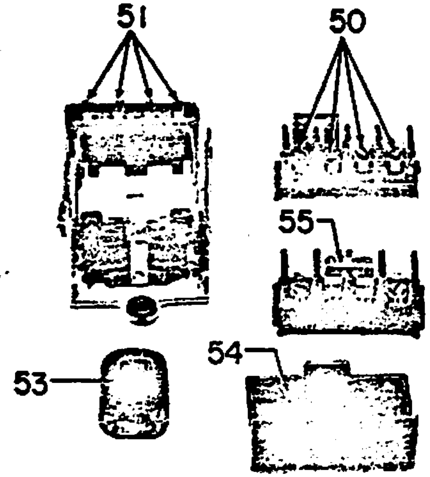


Fig. 6. "X" contactor (ref. 47)

Fig. 7. "Y" relay (ref. 48)

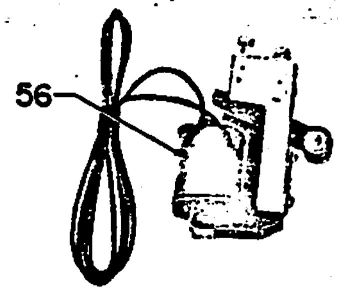


Fig. 8. Shunt trip device (ref. 41)

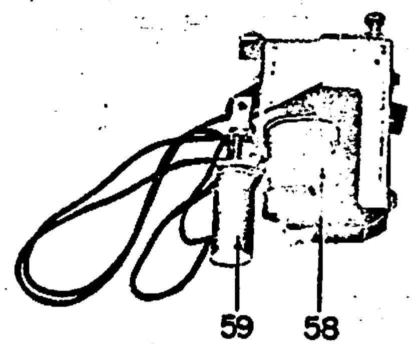


Fig. 9. Undervoltage device (ref. 57)

Fig. 10. Cutoff switch (ref. 37)

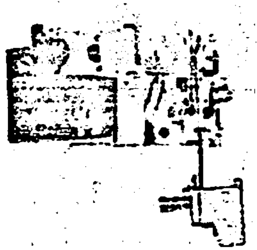


Fig. 11. Bell alarm device (ref. 61)

(PHOTO 8026402)

Fig. 12. Terminal board (ref. 62)

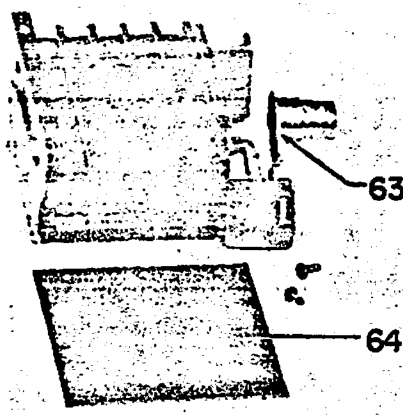


Fig. 13. Auxiliary switch (ref. 38)

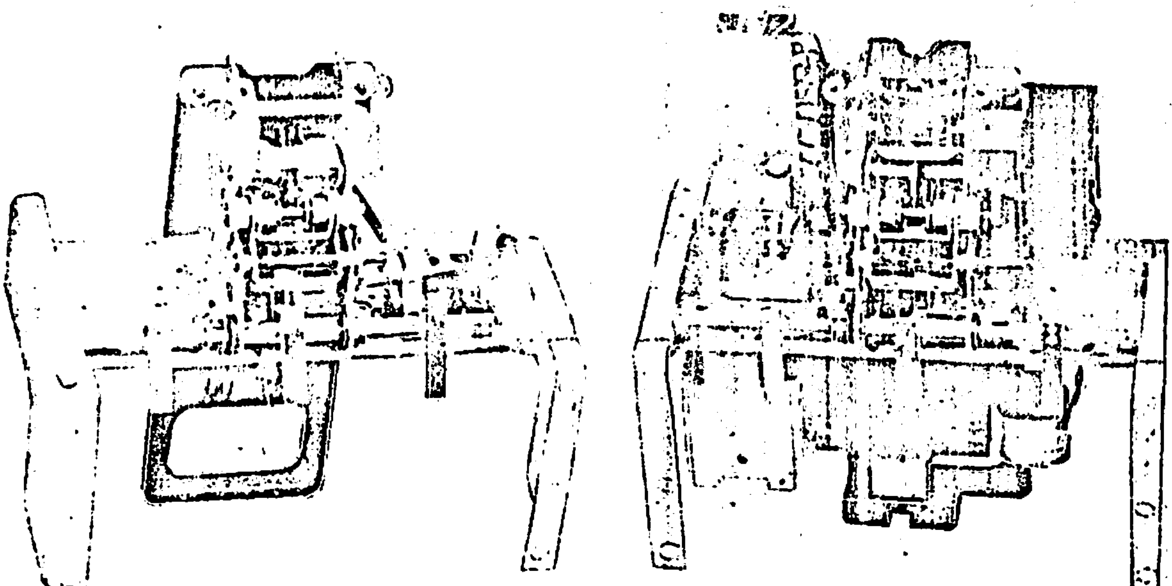


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Fig. 14. Manual (left) and electrical (right) front frame assemblies for Type AK-2-15 and -25 power circuit breakers

NOTES FOR FIG. 14:

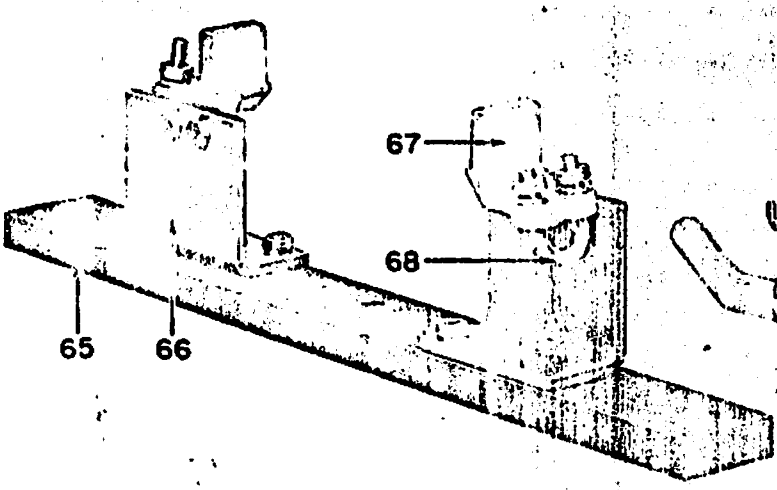
(1) Should it become necessary to replace the complete front frame of the breaker, it is necessary that the order include complete nameplate reading of existing breaker.

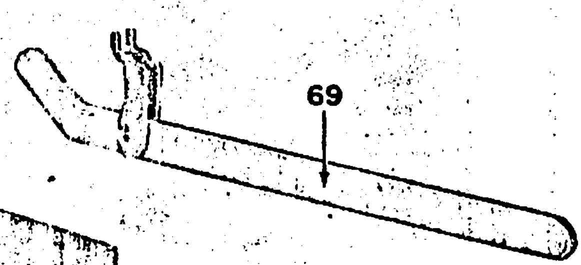
(2) If an existing manual breaker is to be converted to electrical operation, the order must include, in addition to complete nameplate reading, a description of desired change and complete voltage and frequency rating of both closing and tripping circuits.

TABLE A

Rating		Catalog Number		
		"X" Contactor		"Y" Relay Complete (Ref. 48) §
Volts	Cycles	Contactor Complete (Ref. 47)	Coil Only (Ref. 53)	
24	D-C	295B445P1	295B445P201	295B444P1
48		P2	P202	P2
125		P3	P203	P3
250		P4	P204	P4
115	25	P7	P207	P7
208		P10	P210	P10
230		P13	P213	P13
230	40	P12	P212	P11
115	50	P6	P206	P6
208		P9	P209	P9
230		P12	P212	P12
380		P17	P214	P17
460		P15	P216	P15
115	60	P5	P205	P5
208		P8	P208	P8
230		P11	P211	P11
460		P14	P215	P14

§ Only complete relay furnished.





(PHOTO 8028586)

Fig 15. Accessories for wall mounting (ref. 65, 66, 67, 68)

Fig. 16. Maintenance handle for electrically operated breakers not equipped with manual handles (ref. 69)

TABLE B

Rating		Catalog Number		
Volts	Cycles	Closing Solenoid Coil (Ref. 26)	Shunt Trip Device Coil (Ref. 56)	Undervoltage Device Coil (Ref. 58)
24	D-C	- - -	6275081G55	6275081G15
48		366A773G17	6275081G28	6275081G9
125		366A773G13	6275081G29	6275081G18
250		366A773G15	6275081G30	6275081G19
115	25	366A773G3	6275081G26	6275081G12
208		366A773G6	6275081G29	6275081G10
230		366A773G14	6275081G29	6275081G10
460		366A773G11	6275081G7	6275081G17
575		366A773G12	6275081G5	6275081G21
115	50	366A773G2	6275081G56	6275081G4
208		366A773G3	6275081G26	6275081G12
230		366A773G5	6275081G26	6275081G12
380		366A773G6	6275081G27	6275081G31
460		366A773G8	6275081G4	6275081G3
575		366A773G10	6275081G29	6275081G8
115	60	366A773G1	6275081G25	6275081G26
208		366A773G3	6275081G26	6275081G27
230		366A773G4	6275081G26	6275081G7
460		366A773G7	6275081G27	6275081G31
575		366A773G9	6275081G7	6275081G20

The following tools are recommended for proper maintenance of of the AK-2-15 and AK-2-25 Power Circuit Breakers.
NOTE:- Obtain direct from manufacturer indicated.

Description	Catalog Number	Manufacturer
SCREW DRIVERS		
For slotted head	K-304	Crescent
For slotted head	K-505 1/2	Crescent
For Phillips head, No. 2 super	1202	Apex
PLIERS		
Pointed	1661-6	Kraeuter
Truarc (straight)	#2	Waldes
END WRENCHES		
Adjustable	91-8	Utica
1/4 inch, open end	S-00	Armstrong
SOCKET WRENCHES (3/8" DRIVE)		
Ratchet handle	F-710A	Snap On
Extension bar, 12 inch	FX-11	Snap On
3/8 inch socket	F-121	Snap On
7/16 inch socket (long)	FD-1214	Armstrong
9/16 inch socket	F-181	Snap On
ALLEN HEAD WRENCHES		
1/8 inch	----	----
5/16 inch	----	----
MISCELLANEOUS		
1/4 inch spintite wrench (long shank)	3208	Stevens-Walden
7/16 inch spintite wrench	3414	Stevens-Walden
*Maintenance operating handle	269C276G2	G. E. Co., Phila

* For electrically operated breakers not equipped with manual handles.

LOW VOLTAGE SWITCHGEAR DEPARTMENT

GENERAL ELECTRIC

PHILADELPHIA, PA.

11-62 (4M)