



**MAINTENANCE
MANUAL**

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GEI-57C

LOW-VOLTAGE POWER CIRCUIT BREAKERS

TYPES

AK-50, AK-75, AK-100, AKF-1C, AKF-1D, AKF-2D

LOW VOLTAGE SWITCHGEAR DEPARTMENT

GENERAL  ELECTRIC

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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.

LOW-VOLTAGE POWER CIRCUIT BREAKERS

Types AK-50, AK-75, AK-100, AKF-1C, AKF-1D, AKF-2D

INTRODUCTION

The instructions contained herein are intended to impart the necessary information required for proper maintenance and replacement of component parts and accessories for AK-50, -75, -100 and AKF-1C, -1D, -2D power circuit breakers. Before performing any maintenance procedures, the associated section(s) of these instructions should be carefully and thoroughly read.

Type AK power circuit breakers are designed for general use on all types of low-voltage circuits. These breakers are particularly applicable for protection and control of feeder and branch circuits in buildings, industry, power stations, and marine applications.

The AKF Type breakers are a special type of AK breaker designed es-

pecially for use in controlling the shunt field circuits of synchronous motors or generators. These breakers are two-pole power circuit breakers with field discharge contacts placed in the center pole. Opening of the breaker's outer poles closes the field discharge contacts, thus connecting a discharge resistor across the field of the generator or motor.

OPERATION

MANUAL CLOSING

For a description of manual closing, refer to the section of these instructions entitled **CLOSING THE BREAKER - MANUALLY OPERATED** AK-1-50 and the section entitled **AK-2-50, 75 AND 100 STORED ENERGY MANUAL MECHANISM**, both under **OPERATING MECHANISMS**.

MANUAL MAINTENANCE CLOSING OF ELECTRICAL BREAKERS

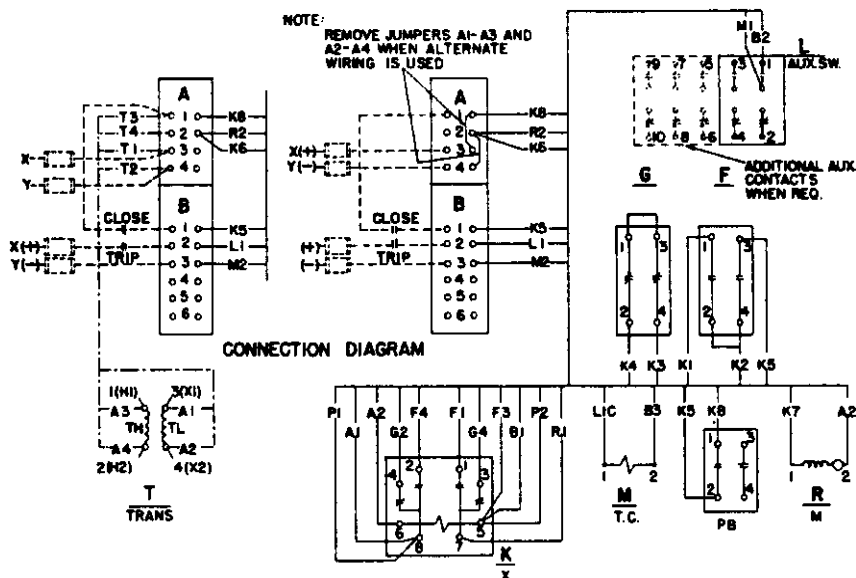
An electrical breaker may be closed manually by means of the maintenance handle furnished with the breaker.

To observe the operation of the breaker without power, with the 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).

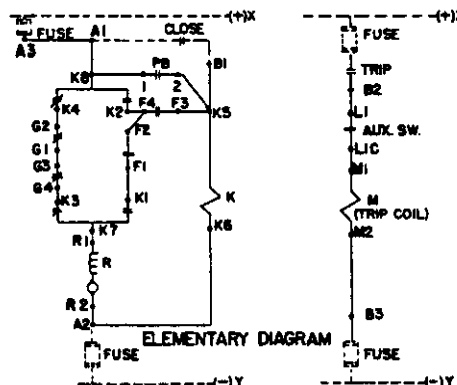
ELECTRICAL CLOSING

Figure 1 shows the typical elementary and connection diagrams for the control system of electrically operated breakers, except breakers which



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 ~



GEI-74600 Low-voltage Power Circuit Breakers

Mechanism. It shows the control circuit when the closing springs are discharged and the breaker open.

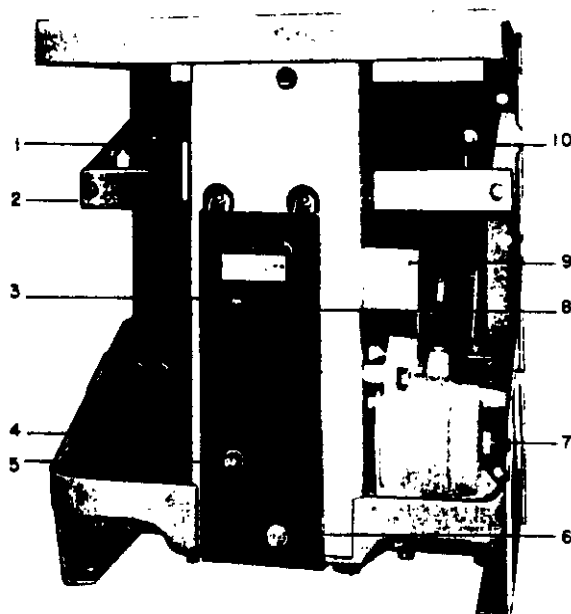
When rated voltage is applied to the control circuit, the motor R(1-2) is energized through closing relay contacts K(8-4) (3-7) and cutoff switch contacts G(2-1) (3-4). As the motor charges the closing springs, the F and G cutoff switches are mechanically operated, opening the G contacts and closing the F contacts. When contacts G(1-2) (3-4) open, the motor is de-energized, with the closing springs now in the "charged" position and ready for a closing signal. The indicator on the front escutcheon will indicate the charged position.

A closing signal now given energizes the closing relay K(5-6), whose contacts K(8-2) (1-7) close, with the relay being sealed in by contacts K(8-2) and F(4-3). With the closing relay energized and the F cutoff switch contacts closed, the motor R(1-2) is again energized through contacts K(8-2), F(2-1), and K(1-7), further charging the closing springs and causing the output crank of the gear reduction unit to go over a top dead-center position. Beyond this position the springs discharge independently of the charging motor and the breaker closes.

When the breaker closes, the cutoff switches revert to their original position and on release of the closing switch, relay x is de-energized and the motor recharges the springs to the pre-charged position. On some models, an auxiliary switch "b" contact is placed in the motor circuit to prevent pre-charging when the breaker is in the closed position.

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.

Warning: On breakers employing stored-energy closing mechanisms, 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



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

Fig. 2. Front view of AK-1-50 breaker

ELECTRICAL TRIPPING

The breaker may be tripped electrically by any of the electrical tripping devices described in these instructions. The breaker may also be tripped by the automatic overcurrent or reverse current tripping devices, if so equipped. All these devices trip the breaker in a similar manner, i.e. the device trip arm moves against the trip paddles fastened on the trip shaft, thus

rotating the trip shaft and displacing the trip latch.

The most commonly used tripping device is the shunt trip device connected in the control circuit as shown in Fig. 1. When a tripping signal is given, the shunt trip coil M(1-2) is energized through a normally-open auxiliary switch "a" contact L(1-1c), thus tripping the breaker.

MAINTENANCE

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.

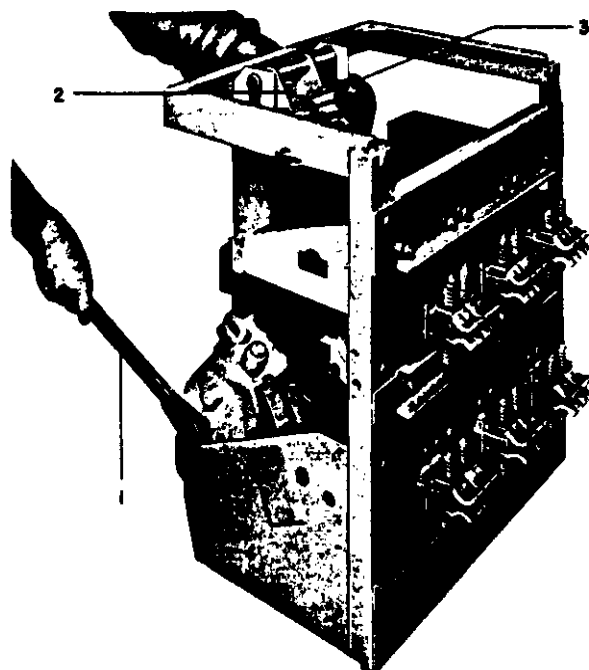
INSERTING SAFETY PIN AK-50, -75 and -100 (Fig. 3)

The closing spring should be charged with the maintenance handle (1) so that the safety pin (3) can be placed in the hole of the push rod (2). Continue to operate the maintenance handle, closing the breaker. This is done

so that the safety pin takes the spring force.

To install the safety pin of the AK-2 manual stored-energy mechanism refer to the section entitled AK-2 STORED-ENERGY MANUAL MECHANISM on page 14 of these instructions.

With the safety pin restraining the closing spring force, the contacts will close slowly when the breaker is manually operated allowing the operation of the mechanism and the contact alignment to be visually observed.



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

Fig. 3. View showing operation of AK-1-50 breaker with manual maintenance handle and installation of safety pin

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 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.

At regular inspection periods the breaker should be operated manually; (stored energy mechanisms with the safety pin restraining the closing spring force) to observe the contact alignment and to make sure all mechanism 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 in-

spection 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 assure that the control circuits are properly connected and that all electrical attachments are functioning properly.

A complete contact inspection, including contact wipe and pressure, should be made at regular inspection periods and always after a known short circuit current has been interrupted, to determine whether the contacts are worn or pitted in which case they should be dressed or replaced. It is necessary to remove the arc quenchers to properly inspect the contacts. Arcing contacts and arc quencher barriers should be replaced when they are eroded to half their original thickness.

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 TO AVOID ANY ACCUMULATION OF DIRT OR DUST.

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

On drawout breakers, the contact surface of the disconnect studs should be greased with G-E Grease Specification D50H47.

SEPARATION OF FRONT AND REAR FRAMES

To repair or replace contacts, operating mechanism, or the overcurrent devices, the 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 outside pole units.
3. Remove the clevis pin (14, Fig. 6) (13, Fig. 7) 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 auxiliary switch operating rod (5, Fig. 17).
6. Check along the trip shaft for a mechanical interference or connection between the overcurrent trip device and the trip paddles. Remove mechanical connection if present, or if interference exists, use extreme care when removing or re-assembling front and back frames to avoid mechanical breakage of trip devices. In reassembling the front and rear frames, the two frames should be positioned vertically so that the trip shaft is horizontally aligned.

NOTE: It is recommended that the breaker be fastened to a suitable mounting base with the front frame supported by a sling or hook as the bolts are being installed.

GEI-74600 Low-voltage Power Circuit Breakers**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. Corrosive atmosphere. Insufficient bus or cable capacity. Bolts and nuts at terminal connections not tight. Current in excess of breaker rating. Excessive ambient temperature. Inductive heating.	Adjust contacts. Clean contacts. Replace contacts. Clean surfaces of current-carrying parts. Relocate or provide adequate enclosure. Increase capacity of bus or cable. Tighten, but do not exceed, elastic limit of bolts or fittings. Check breaker application or modify circuit by decreasing load. Provide adequate ventilation. Correct bus or cable arrangement.
Failure to Trip	Travel of tripping device does not provide positive release of tripping latch. Worn or damaged trip unit parts. Binds in overcurrent trip device.	Re-adjust or replace tripping device. Replace trip unit. Replace overcurrent trip device.
False Tripping	Overcurrent pick up too low. Overcurrent time setting too short. Bind in overcurrent trip device.	Check application of overcurrent trip device. Check application of overcurrent trip device. Replace overcurrent trip device.
Failure to Close and Latch	Binding in attachments preventing resetting of latch Latch out of adjustment. Latch return spring too weak or broken. Hardened or gummy lubricant. Safety pin left in push rod. Motor burned out. Faulty control circuit component.	Re-align and adjust attachments. Adjust latch. Replace spring. Clean bearing and latch surfaces. Remove safety pin. Replace motor. Replace or adjust faulty device.
Burned Main Contacts	Improper contact sequence (main contacts not sufficiently parted when arcing contacts part). Short-circuit current level above interrupting rating of breaker. Loss of contact wipe or pressure.	Increase arcing contact wipe. Adjust contact sequence by raising or lowering main movable contact pivot block. Requires system study and possible replacement with breaker having adequate interrupting capacity. Replace stationary contact springs

BASIC BREAKER COMPONENTS

ARC QUENCHERS (Fig. 4 and 5)

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—AK BREAKERS

1. Be sure the breaker is open.
2. Remove the channel-shaped retaining bar by removing two screws and two nuts.
3. Lift the quenchers clear of the movable arcing contacts.
4. 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.

REPLACEMENT—AKF BREAKERS

The center-pole arc quencher of these breakers is similar to the arc quenchers of the standard breakers and is replaced in a similar manner, except that the breaker must be closed. With the breaker closed the center-pole contacts are open and the arc quencher can be removed.

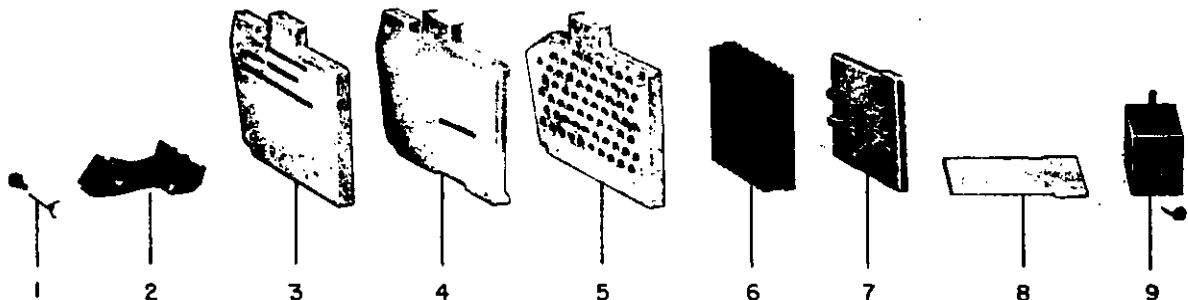
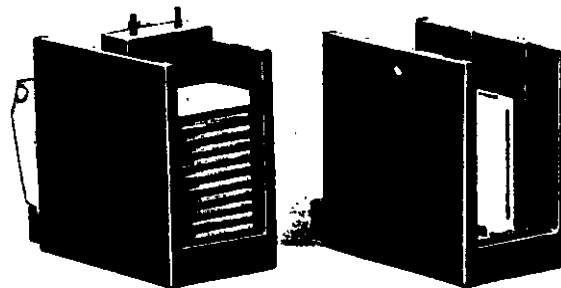
Replace the outer-pole arc quenchers of the Type AKF breaker as follows:

1. Be sure the breaker is open.
2. Remove the two channel-shaped retaining bars which bear against the front of the arc quencher by removing four screws, two on each side.
3. Lift the arc quenchers clear of the movable arcing contacts.
4. Replace arc quenchers and insert the four screws holding the retaining bars in position.

DISASSEMBLY—AK AND AKF CENTER POLE (Fig. 4)

The following instructions apply to both the Type AK and AKF breaker center poles.

1. Remove arc quenchers (see REPLACEMENT).
2. Remove screws holding spacer block (9).
3. Remove spacer block, steel back plate (8), and compound support (7).
4. Rock muffler (6) slightly and remove. The inner barriers (5) can now be removed for inspection.
5. Remove nut and withdraw stud (1).
6. Remove cap (2). The side (3) and pocket (4) barriers should be free.
7. Reassemble and replace the arc quencher in the reverse order. Tighten the 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

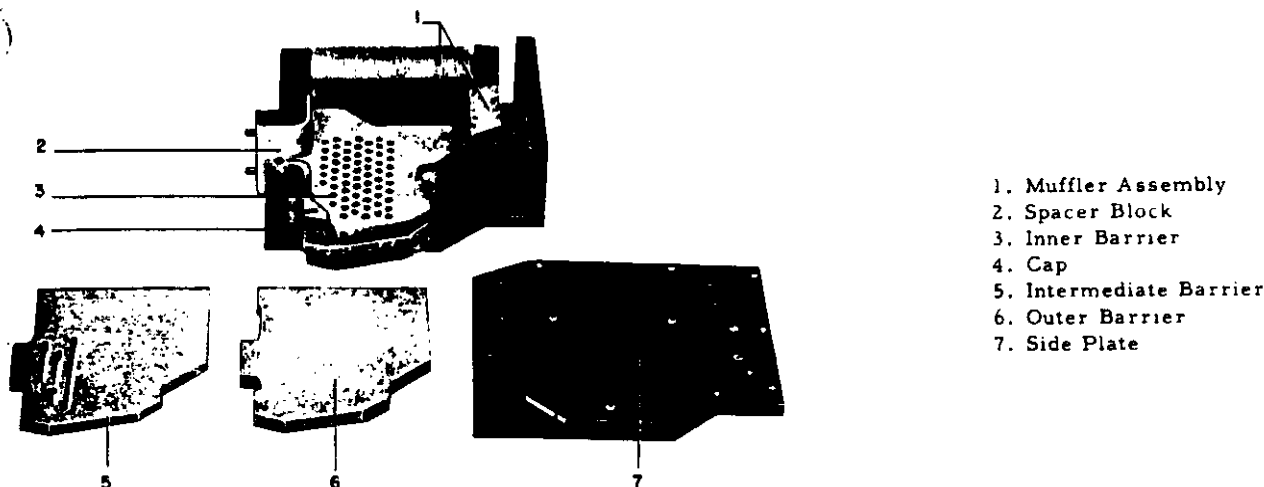


Fig. 5. Disassembled arc quencher—AKF outer poles

DISASSEMBLY—AKF OUTER POLES (Fig. 5)

1. Remove arc quenchers (see above) and lay on sides on a flat surface.
2. Remove hardware from one side of arc quencher as indicated in Fig. 5.
3. Remove boltfastening cap (4) and barrier plate assembly.
4. Barrier plates may now be lifted from assembly for inspection.
5. In reassembling, make sure components are positioned so that holes for self-tapping hardware are in line. Do not strip threads in compound by overstressing screws.

POLE UNIT ASSEMBLY (Fig. 6)

NOTE: The text and part identification numbers contained in this section apply to illustrations covering the AK-50 breaker. The same text is applicable to the AK-75 and 100 breakers by referring to Fig. 7 and identifying the similar parts. These similar parts may not, in every case, be identified by the same number.

Each pole unit assembly consists of a set of arcing contacts, a set of main contacts, the actuating linkage and the mounting base. See Fig. 8 and 9, pole unit assemblies mounted on back frame assemblies.

The stationary arcing-contact assembly 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 (5) shunt the pivot pin to prevent possible pitting at the pivot point when interrupting high currents. On later model breakers shunting springs are used in place of braids.

The movable arcing-contact assembly consists of parallel contact arms (4) carried on two movable pivot pins (8) and (19). The arcing contacts interleave 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.

The stationary main contact assembly includes main 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 breaker 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. In addition to flexible braids shunting the current from the contact directly to the lower contact block, steel springs (17) force the contacts against the pins 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 pressure and contact wipe. Both wipe and pressure should be checked during the regular inspection period.

MEASURING CONTACT WIPE (Fig. 6)

1. Remove arc quenchers (see REPLACEMENT under ARC QUENCHER).
2. With the breaker open, measure the horizontal distance from the edge of the stationary contact to the stationary block behind it. ("B" dim. for arcing contacts, "C" dim. for main contacts.)

3. Close the breaker and repeat item 2. The difference between the readings in items 2 and 3 determines the wipe of the contacts. For safety reasons be extremely careful not to trip the breaker.

MEASURING CONTACT PRESSURE (Fig. 6)

1. Remove arc quenchers (see REPLACEMENT under ARC QUENCHER).
2. Close the breaker and measure dimension "B".
3. Open the breaker. Place a push-type scale against the stationary arcing contacts at a point measured in line with the break between the contact stop and the contact pivot block. Push the contact backward until dimension "B" recorded in item 2 is reached. The scale should then be read.
4. If the pressure is not within the requirements listed on TABLE I, refer to the section of these instructions dealing with ADJUSTING CONTACT WIPE AND PRESSURE.

TABLE I

Breaker Type	Main Contacts			Intermediate Contacts			Arcing Contacts		
	No. of Contacts Per Pole	Pressure in Lbs.	Wipe in Inches	No. of Contacts Per Pole	Pressure in Lbs.	Wipe in Inches	No. of Contacts Per Pole	Pressure in Lbs.	Wipe in Inches
AK-50 for AC	3	55 to 65	1/16 to 3/32	1	55 to 65	*	2	31 to 43	16/64 to 23/64
AK-50 for DC	3	55 to 65	1/16 to 3/32	1	55 to 65	*	3	31 to 43	16/64 to 23/64
AK-75 for AC	5	35 to 45	1/16 to 3/32	1	35 to 45	*	3	31 to 43	16/64 to 23/64
AK-75 for DC	5	35 to 45	1/16 to 3/32	1	35 to 45	*	5	31 to 43	16/64 to 23/64
AK-100 for AC AK-100 for DC	8	25 to 35	1/16 to 3/32	2	25 to 35	*	5	31 to 43	16/64 to 23/64
AKF-1C (Outside Poles)	3	55 to 65	1/16 to 3/32	1	55 to 65	*	2	31 to 43	16/64 to 23/64
AKF-1D(Outside AKF-2D Poles)	5	55 to 65	1/16 to 3/32	1	55 to 65	*	3	31 to 43	16/64 to 23/64
AKF-1C(Field AKF-1D Discharge Contacts)	0	-----	-----	0	-----	---	2**	10 to 16	3/16 to 7/16**

* The intermediate contact wipe should be at least 1/16 in. greater than main contact wipe.

** Left stationary contact extends approximately 3/32 in. \pm 1/32 further than right hand contact.

ADJUSTING CONTACT WIPE AND PRESSURE (Fig. 6)

1. To obtain proper contact wipe and pressure on the center pole, dimension "A" should be increased to increase wipe and decreased to decrease wipe.

2. To change dimension "A" remove the clevis pin (14) and rotate the clevis as necessary.

3. To prevent overstressing the clevis threads (13) dimension "A" should not exceed 3/16 in. and space "A" should be filled with shims to 0.005 in. of being solid.

4. With the proper center pole wipe obtained, moving the crossbar adjusting plate (10A) on the center pole to the right will simultaneously increase the wipe on both outside poles; moving the adjusting plate to the left will have the reverse effect.

5. To increase the wipe on either outside pole individually, move the crossbar adjusting plate of that pole to the left; to decrease the wipe move the adjusting plate to the right.

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

CONTACT SEQUENCE (Fig. 6)

On the horizontal plane, the difference in the making of the arcing contacts on the same pole must be no greater than 1/32 in.; the difference between arcing contacts on separate poles 1/16 in. If it is desired to advance or retard the closing of the main contacts of a pole, loosen the bolts holding the adjustment plate (10A) of that pole and slide plate to the left to advance contact closing, or to the right to retard contact closing. Make this adjustment on the outer poles, using the center pole as a reference. Upon retightening adjustment plate bolts, make sure the locking tabs are turned up around bolt heads, locking the bolts securely in place.

Contact sequence in the vertical plane should be such that when the arcing contacts are just touching, the intermediate contact gap should be at

least 3/16 in., the main contacts gap at least 1/4 in.

NOTE: This check can best be made by means of the maintenance handle, with the safety pin restraining the closing springs.

If the gap is under the required minimum, it is usually possible to form the arcing contacts and obtain the required dimensions. To form the contacts, place a piece of conduit approximately two feet long, over the contact and form the contact either forward or backward. If the proper dimensions are still not obtained the movable arcing contacts should be replaced.

If it has been necessary to make any adjustments while obtaining proper contact sequence, the contact wipe and pressure must be checked, and adjusted, if necessary.

CONTACT GAP (Fig. 6)

When the breaker is open, the gap between the movable and stationary contacts should be between 2 5/8 in.

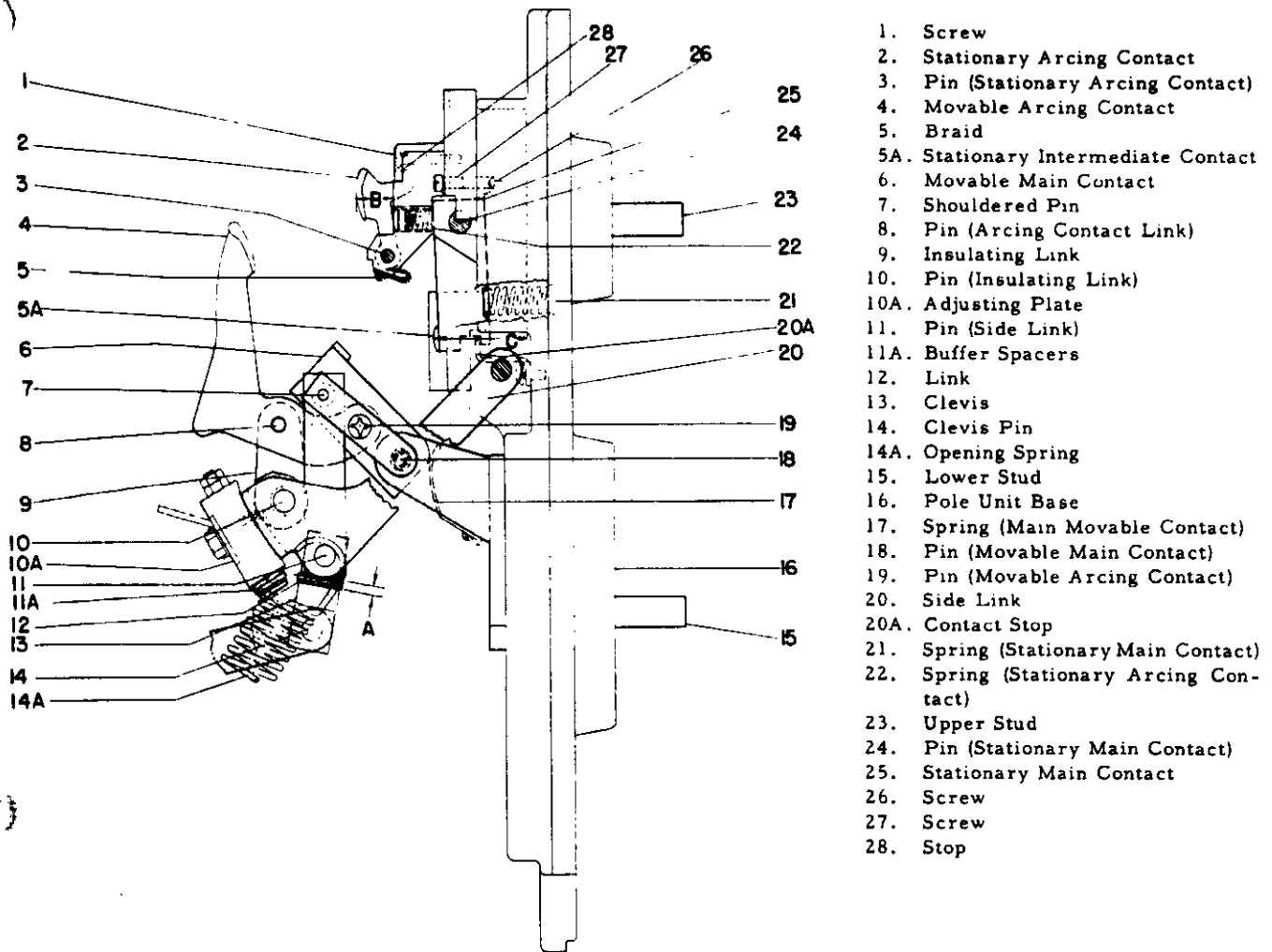


Fig. 6. Pole unit assembly—AK-50

and 2 3/4 in. The gap may be adjusted by varying the number of buffer spacers (11A) on the cross-bar. The locking nuts on the buffer bolts should be locked in such a position that the buffer bolt may be rotated freely.

REPLACEMENT OF CONTACTS (Fig. 6)

Stationary Arcing Contacts (2, Fig. 6) (1, Fig. 7)

1. Remove the upper plate by removing two screws (1). On the AK-75 and -100 remove the top contact block (25, Fig. 7) and remove insulation (3, Fig. 7).

2. Remove screws from shunting braids (5).

3. Remove pin (3) freeing the stationary contacts and springs (22).

4. Install new springs and station-

5. Adjust contact wipe and pressure. (See ADJUSTING CONTACT WIPE AND PRESSURE.)

Movable Arcing Contacts (Fig. 6)

The movable arcing contacts (4) should be replaced when the stationary arcing contacts are replaced.

1. Separate the front frame from the back frame as described under SEPARATION OF FRONT AND REAR FRAMES.

2. Remove pins (8) and (19) and withdraw the contacts.

3. Reassemble parts in reverse order.

Stationary, Intermediate and Main Contacts (Fig. 6)

1. Remove stationary arcing con-

1. Screw
2. Stationary Arcing Contact
3. Pin (Stationary Arcing Contact)
4. Movable Arcing Contact
5. Braid
- 5A. Stationary Intermediate Contact
6. Movable Main Contact
7. Shouldered Pin
8. Pin (Arcing Contact Link)
9. Insulating Link
10. Pin (Insulating Link)
- 10A. Adjusting Plate
11. Pin (Side Link)
- 11A. Buffer Spacers
12. Link
13. Clevis
14. Clevis Pin
- 14A. Opening Spring
15. Lower Stud
16. Pole Unit Base
17. Spring (Main Movable Contact)
18. Pin (Movable Main Contact)
19. Pin (Movable Arcing Contact)
20. Side Link
- 20A. Contact Stop
21. Spring (Stationary Main Contact)
22. Spring (Stationary Arcing Contact)
23. Upper Stud
24. Pin (Stationary Main Contact)
25. Stationary Main Contact
26. Screw
27. Screw
28. Stop

2. Remove screws (27) and remove bracket which holds pin (24) in place.

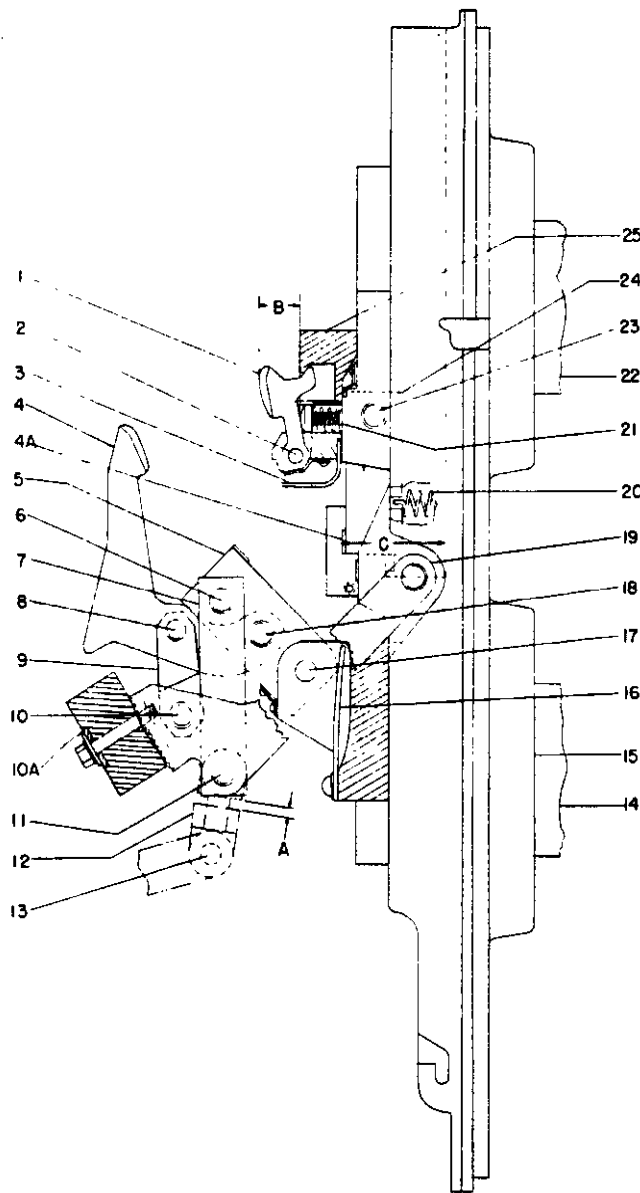
3. Remove main- and intermediate-contact stop (20A) which holds the lower part of stationary contact. Removal will be facilitated if the force on the contact springs (21) is neutralized. This can be accomplished by operating the breaker with the maintenance handle, with the safety pin in place, until the load on the contact stop is relieved.

4. Loosen the hardware which fastens the upper stud to the pole unit base until the contact-spring load on pin (24) is relieved.

5. Remove pin (24) and screws (26) and lift out contacts.

6. Reassemble contacts in reverse order, being careful to replace the intermediate contact in the proper position.

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1. Stationary Arcing Contact
2. Pin (Stationary Arcing Contact)
3. Insulation
4. Movable Arcing Contact
- 4A. Stationary Intermediate Contact
5. Movable Main Contact
6. Shouldered Pin
7. Link
8. Pin (Arcing Contact Link)
9. Insulating Link
10. Pin (Insulating Link)
- 10A. Adjusting Plate
11. Pin (Side Link)
12. Clevis
13. Clevis Pin
14. Lower Stud
15. Pole Unit Base
16. Spring (Main Movable Contact)
17. Pin (Movable Main Contact)
18. Pin (Movable Arcing Contact)
19. Side Link
20. Spring (Stationary Main Contact)
21. Spring (Stationary Arcing Contact)
22. Upper Stud
23. Pin (Stationary Main Contact)
24. Stationary Main Contact
25. Top Contact Block

Fig. 7. Pole unit assembly—AK-75 and AK-100

Movable Intermediate and Main Contacts (Fig. 6)

1. Remove the movable arcing contacts as described above.
2. Loosen spring (17).
3. Remove braid if present by removing screw at bottom of contact.
4. Slide link (12) to the side and off of pin (7).
5. Slide pins (7) and (18) far enough to the side to allow the movable intermediate contacts to be replaced.
6. Reassemble parts in reverse order.

Always check contact wipe and pressure following contact replacement. (See ADJUSTING CONTACT WIPE AND PRESSURE.)

OPERATING MECHANISMS

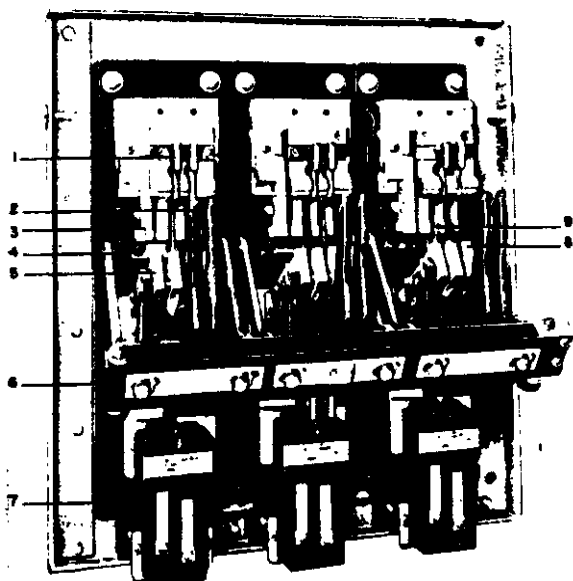
ELECTRICALLY OPERATED AK-50, -75 and -100; MANUAL AK-1-50

The electrically operated mechanism includes a motor and a gear reduction unit, which charges the closing springs (16, Fig. 10) through a crank shaft (14, Fig. 10). The crank shaft has an arm with a roller (12, Fig. 10) which rides on the closing cam (2, Fig. 11). The position of this closing cam roller is shown in Fig. 11A, 11B,

and 11C. The closing cam is connected to the center-pole unit through a clevis and through a crossbar it controls the opening and closing of the contacts on all pole units.

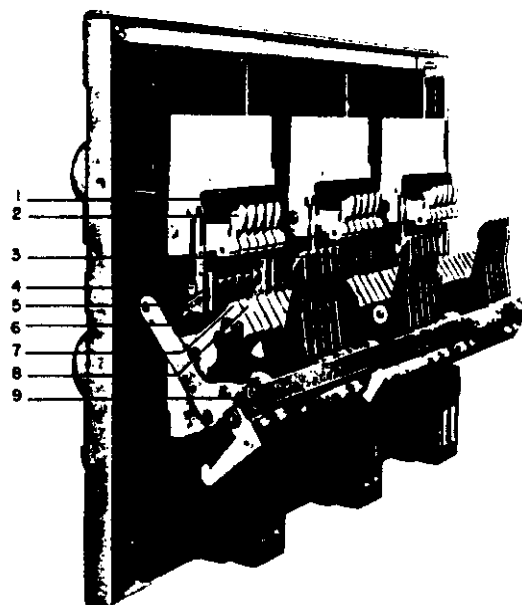
The electrical operating mechanism of Types AKF-1C and AKF-1D may be equipped with an operating mechanism similar to the standard breaker. This mechanism can be quickly recognized by the presence of two cut-off switches (1 and 3, Fig. 20). Later Type AKF-1C and AKF-2D breakers are equipped with dynamic-brake type mechanisms. These mechanisms can easily be identified by the presence of three cut-off switches. Refer to the section of these instructions entitled DYNAMIC BRAKE for a description of the operation and adjustments.

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



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

Fig. 8. Front view of back frame assembly—AK-50



- | | |
|------------------------------------|---------------------------------|
| 1. Upper Contact Block | 6. Lower Contact Block |
| 2. Stationary Arcing Contact | 7. Movable Main Contact |
| 3. Movable Arcing Contact | 8. Movable Intermediate Contact |
| 4. Stationary Main Contact | 9. Crossbar |
| 5. Stationary Intermediate Contact | |

Fig. 9. Front view of back frame assembly—AK-10C

Charging the Closing Springs (Fig. 10)

1. The mechanism in position is shown in Fig. 11A.

2. The motor turns the crank (10) 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 when a closing signal is given.

6. With the breaker resting at the precharge position, the trip latch may or may not be in the reset position. This depends on the position of roller (15, Fig. 11B) with respect to the cam (2, Fig. 11B).

Closing the Breaker

Electrically Operated (Fig. 10)

1. With the mechanism in the po-

sition shown in Fig. 11A, a closing signal will cause the motor to continue to charge the closing springs allowing the mechanism to reset, if not already reset, to the position shown in Fig. 11B.

2. As the crank roller (7) passes its top dead-center position, (maximum spring charge position) the closing springs are free to discharge. Crank (10) can be overdriven independently of the motor so that roller (7) assumes its bottom dead-center position without restraint.

3. As the springs discharge, the rotation of the crank shaft (14) causes roller (15, Fig. 11) to rotate cam (2, Fig. 11) and raise clevis (13, Fig. 11). Prop (16, Fig. 11) holds cam (2, Fig. 11C) in this position.

4. Raising clevis (13, Fig. 11C) closes the breaker contacts through the pole base linkage.

Manually Operated (AK-1-50)

Functionally, the manual breaker closing action is the same as the electrical breaker, except the resetting action is accomplished by rotating the manual closing handle counterclockwise to reset the latch. The closing

handle clockwise to its normal position. It is recommended that the clockwise closing stroke be performed with a relatively fast-snapping action to avoid burning of the breaker contacts, if closed under load.

Tripping the Breaker (Fig. 11)

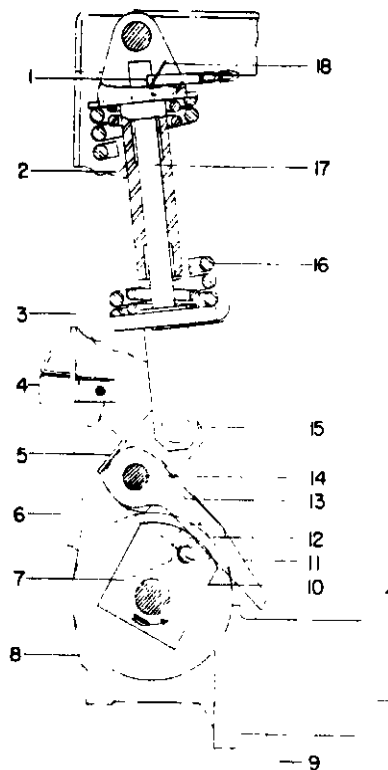
Operation of any of the trip devices rotates the trip shaft (11) which allows the trip latch (10) to release the latch prop (5). This allows the forces of the contact and opening springs to reposition the operating mechanism linkage to the position shown in Fig. 11A. In this position, the operating cycle may be repeated.

Adjustments (Fig. 11)

All adjustments should be made with the operating mechanism in the reset position as shown in Fig. 11B. (The mechanism should be reset by manual operation with the safety pin in place.)

1. The gap between the trip latch (10) and the roller (9) of the reset latch should be between 1/64 in. and 1/32 in. This adjustment can be obtained by turning screw (6).

2. The center line of the trip latch



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

Fig. 10. Closing spring and charging mechanism

the roller (9). On Types AK-1-50-1 to 10 and AK-1-75-1 to 3 breakers, form the latch buffer stop (14) to maintain the adjustment. On Types AK-2-75 and AK-2-100 breakers, the latch buffer stop is on the mechanism frame and can be adjusted by loosening the retaining screws to reposition the latch buffer stop.

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

Replacement

When replacing the operating mechanism, refer to the section titled SEPARATION OF FRONT AND BACK FRAMES under MAINTENANCE in these instructions.

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. 10) with a reduction 1000:1. To remove the motor and gear-reduction unit, proceed as follows:

1. Remove the front frame (see SEPARATION OF FRONT AND REAR FRAME.)

2. Remove closing springs and crank-shaft as illustrated in Fig. 12 and 13.

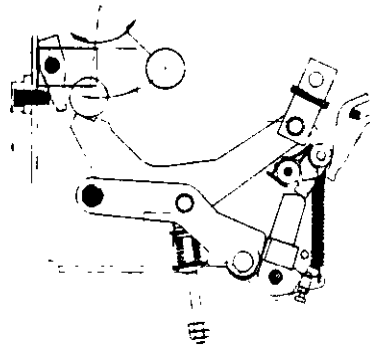


FIG-11A
MECHANISM IN MOTION BEFORE
RESETTING AS SHOWN IN FIG-11B

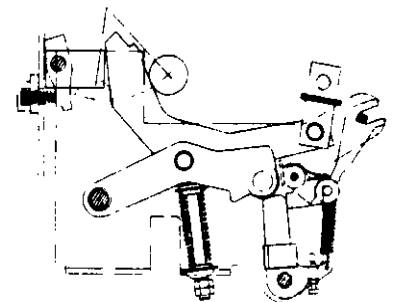


FIG-11B
MECHANISM IN RESET POSITION

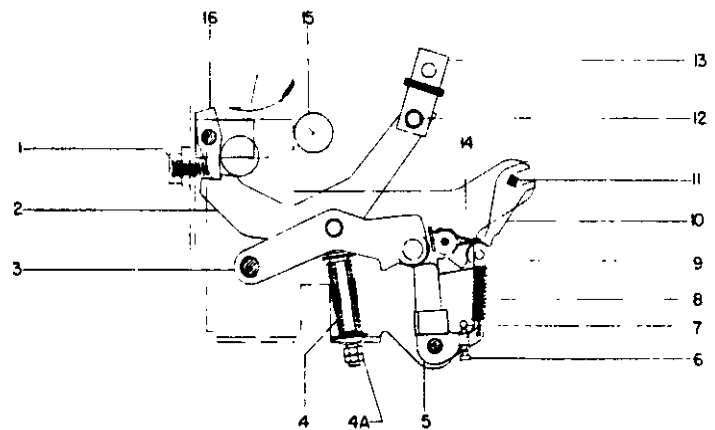


FIG-11C
MECHANISM IN CLOSED POSITION
(CLOSING SPRING DISCHARGED)

- | |
|--|
| 1. Spring |
| 2. Cam |
| 3. Link |
| 4. Reset Spring |
| 4A. Spring Adjusting Nuts |
| 5. Prop |
| 6. Adjusting Screw |
| 7. Adjusting Screw Stop Pin |
| 8. Prop Return Spring |
| 9. Roller |
| 10. Trip Latch |
| 11. Trip Shaft |
| 12. Clevis Pin |
| 13. Clevis |
| 14. Latch Buffer Stop
(Bronze Material) |
| 15. Roller |
| 16. Prop |

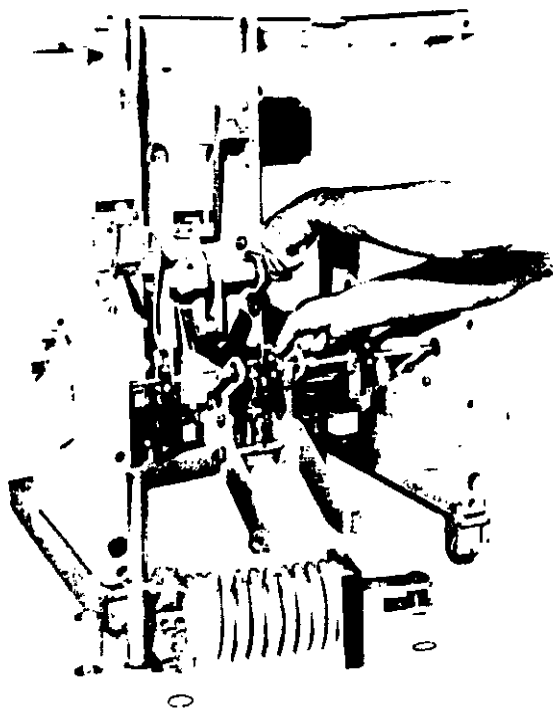


Fig. 12. Rear view of front frame—AK-1-50 showing cam shaft locking plate being loosened

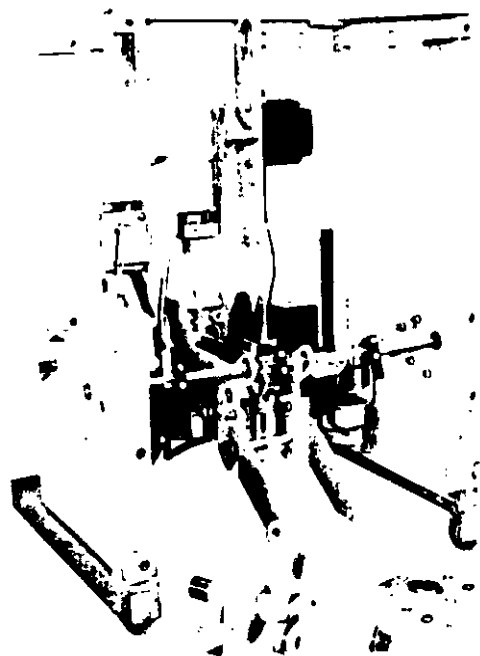


Fig. 13. Rear view of front frame—AK-1-50 showing cam shaft locking plate and cam shaft removed

3. Disconnect the leads from motor and remove the wires attached to gear unit housing.

4. Remove four bolts at the bottom of the front frame and one bolt at top of gear reduction unit. The motor and gear unit may now be removed.

NOTE: If it is desired to replace only the motor unit, disconnect the motor leads and remove only the hardware fastening it to the gear-reduction unit. When removing the motor only, the front frame should be placed front side down to prevent the oil escaping from the gear unit.

The gear reduction unit contains 4 ounces of oil similar to Atlantic Refining Company's Grade HFS No. 3. It should not be necessary to add or change oil except when the gear-reduction unit and motor are disassembled.

STORED-ENERGY MANUAL MECHANISM (Fig. 14)

—AK-2-50, -75 and -100

This breaker is equipped with a spring-charged stored-energy mechanism

similar to the mechanism used on the AK-2-50, -75 and -100 electrical breakers. The closing springs (5) are charged by operating the manual closing handle (22) on the front of the breaker, instead of the closing motor as is the case with the electrical breaker. Closing this breaker is accomplished by pumping the operating handle four complete cycles, first counterclockwise through 120 degrees from its normal vertical position and then clockwise back through 120 degrees. When approximately 70 degrees of the fourth clockwise stroke have been completed, the closing springs, which have been charged during the previous strokes of the closing handle, are driven over-center and the breaker closes.

This mechanism consists basically of a closing spring assembly, ratchet wheel and output crank assembly, handle shaft and pawl assembly, and the closing handle.

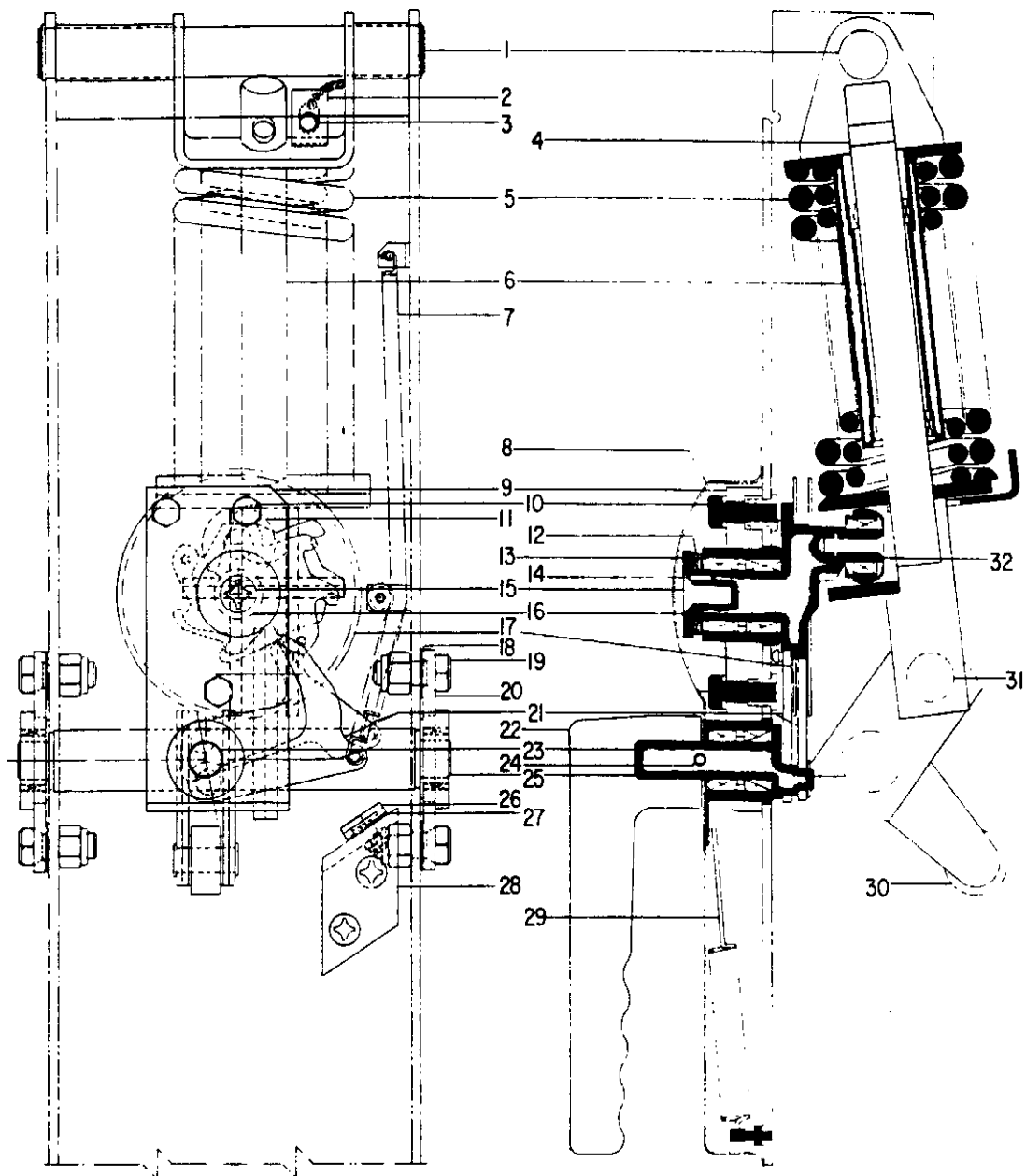
Closing the Breaker (Fig. 14)

The first stroke of the closing handle causes the ratchet pawls (21) attached to the handle shaft (23), to engage the

first tooth of the ratchet wheel (17), thus beginning to charge the closing springs. The subsequent closing handle strokes perform the same function as the pawls (21) engage the teeth in the ratchet wheel (17), thus rotating the ratchet wheel and output crank (32) and completely charging the closing springs. This rotation of the ratchet wheel and output crank is in a counterclockwise direction from the lower position, through slightly more than 180 degrees, to a position just beyond dead center. In this position the closing springs are free to release their energy, closing the breaker at a high speed.

Inserting the Safety Pin (Fig. 14)

If it is desired to slowly close the breaker contacts to check contact wipe and sequence, operate the closing handle $3\frac{1}{2}$ complete cycles as described above. At the end of the fourth counterclockwise stroke and before performing the fourth clockwise stroke, insert the safety pin (3) into the hole (4) in the guide rod (6), thus preventing the closing springs (5) from releasing their energy to close the breaker contacts.



PARTIAL FRONT VIEW
WITH HANDLE AND ESCUTCHION REMOVED

- | | | |
|----------------------------------|----------------------------------|--|
| 1. Upper Spring Pin | 11. Output Crank Roller | 21. Ratchet Pawls |
| 2. Safety Pin Holder | 12. Thrust Bearing | 22. Manual Closing Handle |
| 3. Safety Pin and Chain | 13. Shims | 23. Closing Handle Shaft and Pawl Asm. |
| 4. Safety Pin Hole | 14. Groove Pin | 24. Roll Pin |
| 5. Closing Springs | 15. Nylok Screw | 25. Main Closing Crank |
| 6. Guide Rod | 16. Ratchet Wheel Shaft and Asm. | 26. Pawl Buffer Stop |
| 7. Pawl Springs | 17. Ratchet Wheel | 27. Buffer Stop Shims |
| 8. Front Escutcheon | 18. Side Plate Shims | 28. Buffer Stop Support |
| 9. Front Bearing Plate | 19. Side Plate Mounting Bolts | 29. Handle Return Spring |
| 10. Bearing Plate Mounting Bolts | 20. Bearing Side Plate | 30. Mechanism Roller |
| | 31. Lower Spring Pin | 32. Output Crank |

Fig. 14. Stored-energy manual closing mechanism charged position—AK-2

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Replacement (Fig. 14)

If it is necessary to replace any of the mechanism parts, the following total procedure is recommended. This procedure may be halted at the step required to replace any particular part:

1. Install the safety pin (3) as described above.
2. Separate the front and rear frames as described under "SEPARATION OF FRONT AND REAR FRAMES" in the "MAINTENANCE" section of these instructions.
3. Remove the closing spring assembly by removing the upper and lower spring pins (1, 31).
4. Remove the right hand bearing side plate (20), and the side plate shims (18) if present, by removing four mounting bolts (19), thus allowing the main closing crank (25) to be removed.
5. Remove the closing handle (22) by removing two set screws threaded in same hole.
6. Remove the front escutcheon by removing four screws holding it to the front frame center support.
7. Remove the handle return spring (29) by unhooking either end of the spring.
8. Disconnect the top end of each pawl spring (7).
9. Remove the roll pin (24), thus allowing the closing handle shaft (23) and pawl assembly (23) to be removed.
10. Remove the ratchet wheel (17) and its assembly (16) by removing Nylok* screw (15) and thrust bearing (12). If shims (13) are present they must also be removed.
11. Remove front bearing plate (9) by removing three mounting bolts (10) accessible from the front of the breaker. The mechanism is now completely disassembled. It is not recommended that any of the subassemblies removed during the above operation be further disassembled in the field. Replacement sub-assemblies should be obtained from the factory.
12. To reassemble the mechanism, reverse the procedure described above.

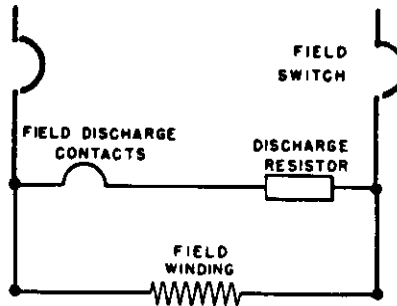


Fig. 15. Typical connection diagram

NOTE: When reassembling the mechanism, the adjustments listed below should be checked at the appropriate time of reassembly. The appropriate time for each adjustment is indicated in the adjustment text.

Adjustments (Fig. 14)

Frequent adjustments to the mechanism should not be required. If the mechanism has been disassembled, it will be necessary to check the following adjustments:

1. It may be necessary to add shims (13) to reduce the end play of the ratchet wheel shaft (16). An end play of 0.010 to 0.020 of an inch is recommended. Shims should be obtained from the factory.
2. It may be necessary to add buffer stop shims (27) to the buffer stop (26) to provide a clearance of 1/64 to 1/32 inch between the pawls (21) and the buffer stop, when the pawls are touching the ratchet wheel teeth extending a maximum distance from the center of rotation of the ratchet wheel (17). This measurement should be made while operating the closing handle during the four spring charging operations and before the closing springs are reassembled.
3. The ratchet pawls (21) should operate freely throughout the closing strokes. They should engage the ratchet wheel teeth near the end of each counterclockwise and clockwise stroke of the closing handle with a definite clicking sound, indicating a free non-binding operation. After the clicking sound is detected, the closing handle should have a minimum overtravel of 1/2 in. or 3 1/2 degrees, measured at the end of each handle stroke.
4. The groove pin (14) in the front of the ratchet wheel assembly (16) must be assembled in a manner that will allow Nylok screw (15) to be tightened

in. should exist between the front of the groove pin and the rear surface of the Nylok screw head.

Other adjustments to the closing and operating mechanisms, such as complete contact and latch adjustments, may be made by following the previously described instructions for the AK-50, -75 and -100 breaker mechanisms.

AKF MECHANISM (Fig. 16)

The Type AKF breakers are two-pole breakers with field discharge contacts placed in the center pole. When this breaker is opened, the field discharge contacts close, thus connecting an external discharge resistor across the field of the generator or motor. When the breaker is closed, the field discharge contacts are opened. See Fig. 15 for a typical circuit connection.

When the breaker is tripped, the opening springs pull crossbar (9) downward, opening the breaker's outer poles. As the crossbar moves downward, link (A) rotates about a fixed center (17), collapsing toggle links (B) and (C) upward, thereby closing center-pole contacts through connecting link (D). Link (C) consists of two links riveted together, forming a single triangular link.

Contact Adjustments

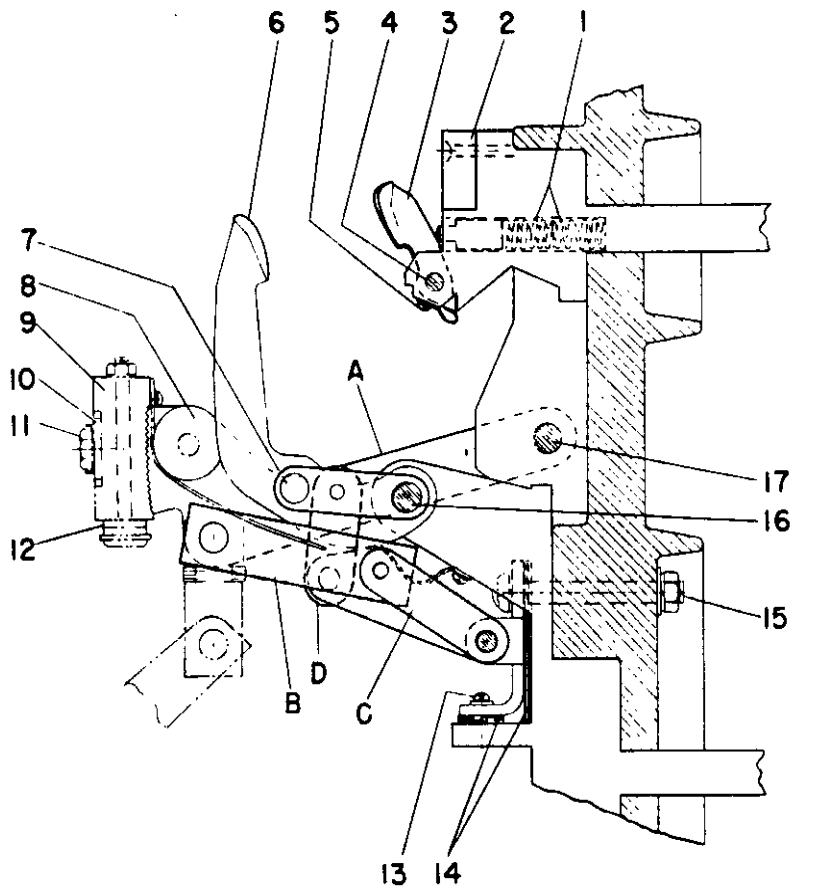
Measurements

For contact measurements and adjustments of the two outside poles of the breaker, refer to POLE UNIT ASSEMBLY.

Contact measurements of the center-pole field discharge contacts should be made on the left contact and be within the following limits:

1. Contact wipe, 3/16 in. to 7/16 in.
2. Contact pressure, 10 lb. to 16 lb.
3. Gap between contacts when center pole is open, 1 1/2 in. to 1 3/4 in.
4. Overlap between the center-pole contacts and the arcing contacts of the outer poles, 3/16 in. to 7/16 in.

Measurements of the center-pole contact wipe and pressure may be made by following the same procedure as outlined for the standard pole unit



- | | | | |
|-----------------------|--------------------|---------------------|-----------|
| 1. Springs | 6. Movable Contact | 10. Adjusting Plate | 14. Shims |
| 2. Insulation | 7. Pin | 11. Bolt | 15. Bolt |
| 3. Stationary Contact | 8. Buffer | 12. Buffer | 16. Pin |
| 4. Pin | 9. Crossbar | 13. Screw | 17. Pin |
| 5. Screw | | | |

Fig. 16. Field discharge contacts (center pole)

of the center-pole contacts and the outer pole arcing contacts may be checked by the following procedure:

1. Remove arc quenchers (see ARC QUENCHER).

2. Insert safety pin in push rod. (See Fig. 3 under MAINTENANCE.)

3. Operate closing mechanism with maintenance handle until arcing contacts of outer poles just touch.

4. Measure distance between forward edge of left stationary contact of center pole and surface of insulation block behind contact.

5. Continue to operate maintenance closing handle until center-pole contact opens fully.

6. Repeat measurement described in step 4. Difference between meas-

Adjusting Center-pole Contact Wipe and Overlap (Fig. 16)

If measurements reveal either incorrect center-pole contact wipe or incorrect overlap of contacts, adjustments should be made by the following procedure:

1. With outside poles open, loosen adjustment plate (10) of center pole on crossbar (9) by freeing bolt locking tab and loosening bolts (11).

2. If center-pole wipe or overlap is to be increased, move the adjustment plate to the left; if it is to be decreased, move it to the right.

3. After proper adjustment is made, tighten adjustment plate bolts until plate is snug. Then tap adjustment plate in such a way as to bring lower edge of slot in plate to bear against bolt. Tighten bolt until lockwasher is fully compressed. Then form locking tabs over bolt heads so that bolts are

NOTE: If the above adjustment has been made, it is necessary to recheck the outer-pole wipe. If this is outside the prescribed limits, correct as described in POLE UNIT ASSEMBLY.

4. If proper wipe cannot be obtained within the range of the adjustment described above, it will be necessary to obtain further adjustment by means of the vertical shims (14) provided for the purpose. In order to accomplish this, proceed as follows:

a. Separate the front frame from the back frame (see SEPARATION OF FRONT AND REAR FRAMES).

b. Loosen screw (13) and remove bolt (15).

c. Remove vertical shims (14) to decrease wipe; add to increase.

d. Replace bolt (15) and tighten screw (13).

e. Reassemble front and back frame.

Adjusting Center-pole Open Contact Gap (Fig. 16)

Improper open contact gap of the center pole may be adjusted by the following procedure.

1. Loosen screw (13) and bolt (15).

2. If gap is to be increased, horizontal shims (14) should be removed. If it is to be decreased, they should be added. Shims may be removed by sliding them to the front of the breaker. They are slotted for easy removal. (Effect of this adjustment on contact wipe and overlap is negligible.)

3. Tighten hardware.

Contact Replacement

Stationary Contacts (Fig. 16)

1. Remove arc quencher (see ARC QUENCHER).

2. Remove screw (5) from braid.

3. Drift out pin (4) and remove contacts.

4. Reassemble in reverse order with new contacts.

5. Check contact overlap and wipe,

GEI-74600 Low-voltage Power Circuit Breakers

Movable Contacts (Fig. 16)

1. Remove arc quencher (see ARC QUENCHER).

2. Remove tru-arc retainers on right side of pins (7) and (16).

3. Drift pins (7) and (16) to the left far enough to free movable contacts.

4. Reassemble in reverse order with new contacts.

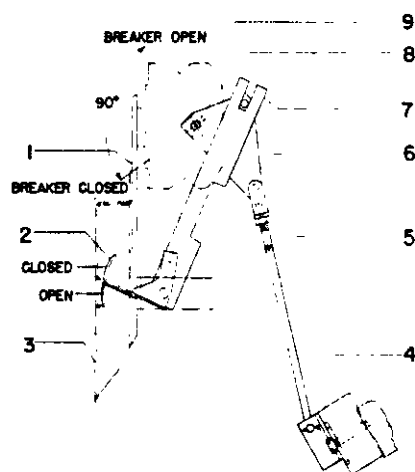
5. Check contact overlap and wipe and readjust if necessary (see above).

AUXILIARY SWITCH

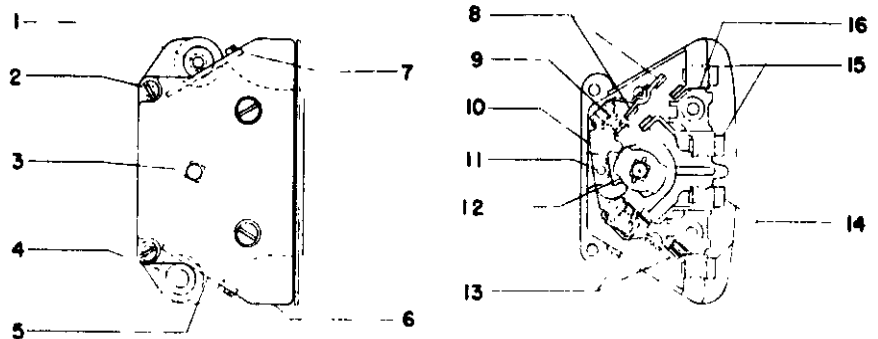
AK BREAKERS (Fig. 17)

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

The auxiliary switch is mounted on the left side of the front frame. As the crossbar (4) moves, with the contacts, to the open 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.



1. Frame
2. Open and Closed Indicator
3. Front Escutcheon
4. Crossbar
5. Operating Rod
6. Triangular Link
7. Link
8. Operating Shaft
9. Auxiliary Switch



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

Fig. 18. Auxiliary switch—standard breaker

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. 17)

1. Disconnect all leads to auxiliary switch.
2. Remove two mounting bolts.
3. Disengage auxiliary switch shaft (8) from the triangular link (6).

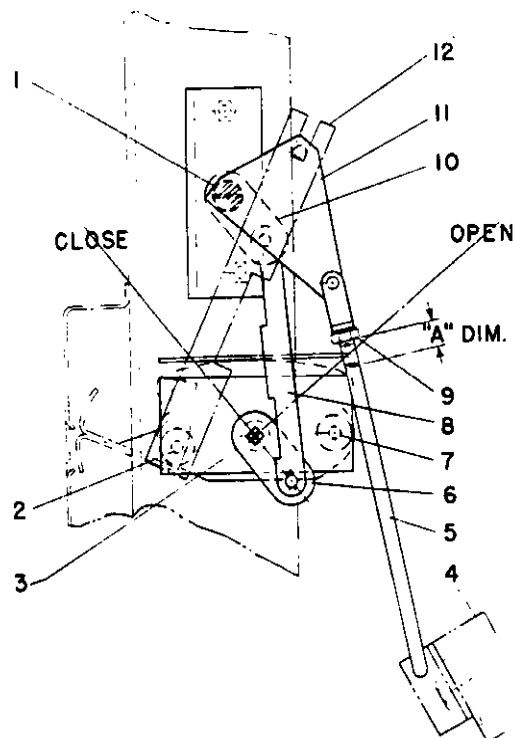
4. Set arrow on new auxiliary switch shaft.

5. Push auxiliary switch shaft (8) into square hole in link (breaker open).

6. Replace mounting hardware and wiring.

Adjustment (Fig. 17)

The "a" contacts of the auxiliary switch should close before the arcing contacts of the breaker close. This may be checked by slowly closing the



1. Pin
2. Switch Mounting Bolt
3. Auxiliary Switch Shaft
4. Crossbar
5. Operating Rod
6. Link
7. Bolt
8. Link
9. Locknut
10. Link
11. Triangular Link
12. Link

breaker with the maintenance handle, with the safety pin restraining the closing springs, and with a bell set across the "a" terminals of the auxiliary switch.

The closing of the "a" contacts can be advanced or retarded by extending or reducing the external length of the operating rod (5). The length of the operating rod (5) should be adjusted so that the switch "a" contacts close when the arcing contacts are parted by 1/8 to 1/4 in. The operating rod should also be aligned vertically so that it is parallel with the sides of the breaker frame center channel and perpendicular with the crossbar (4). This alignment may be secured by relocating the washers on the pin which connects the operating rod to the crossbar.

AKF BREAKERS (Fig. 19)

The auxiliary switch mounting and linkage on the AKF breakers are dif-

ferent from that of the standard AK breakers. Figures 17 and 19 show the difference in the mounting positions, with the AKF switches rotated 90 degrees with respect to the mounting position of the standard breaker switch. There is also a slight difference between the linkage of the AKF breaker switches, however the principle of operation remains the same.

When the breaker operates, the movement of the crossbar (4) rotates triangular link (11) about fixed center (1). This rotational motion is transmitted to the auxiliary-switch shaft (3) by the linkage comprised of links (10), (8) and (6). The breaker position indicator is also operated by this mechanism through link (12).

Replacement (Fig. 19)

1. Disconnect all leads to auxiliary switch.

2. Remove mounting hardware at (2) and (7).

3. Withdraw auxiliary switch.

4. Insert new switch with arrow on shaft pointing up and towards the back of the breaker as in Fig. 17.

5. Replace mounting hardware and wiring.

Adjustments (Fig. 19)

The auxiliary switch operating rod (5) should be adjusted so that the switch "a" contacts close when the arcing contacts of the outer poles are parted by 1/8 to 1/4 in. This dimension may be checked in the same manner described for the standard breakers. The length of the operating rod may be varied by changing dimension "a" (see Fig. 19) and aligning the operating rod as described for the standard breakers.

ELECTRICAL CLOSING DEVICES AND CONTROLS

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

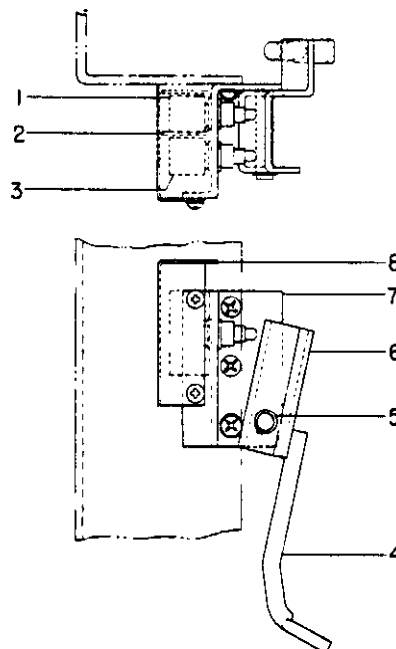
CLOSING SWITCH

The closing button, when provided, is mounted on 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 (Fig. 20)

The motor cut-off switches are mounted on the side of the front frame. When the breaker control circuit is energized the motor circuit is maintained through the closed contacts of switch (1), thus charging the closing springs. At the end of the charging stroke the cut-off switch is mechanically operated by the charging of the



- | | |
|---------------|---------------------|
| 1. 'G' Switch | 5. Retaining Ring |
| 2. Insulation | 6. Lever Bracket |
| 3. 'F' Switch | 7. Mounting Bracket |
| 4. Rod | 8. Cover |

Fig. 20. Motor cut-off switch

springs and through the operating rod (4), thus opening switch (1) contacts and closing switch (3) contacts. This opens the motor circuit until a closing signal is given. When a closing signal is given the motor is energized through switch (3) contact, further charging the closing springs and closing the breaker. When the breaker closes, the cut-off switch is again mechanically operated, reverting to its original position with switch (1) contact now closed and switch (3) open, thereby allowing the motor to charge the closing springs for a subsequent closing operation.

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

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. Refer to Fig. 1 for control relay circuit connections.

PROTECTIVE DEVICES

TIME-DELAY UNDERVOLTAGE TRIPPING DEVICE (Fig. 21)

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, if desired, when certain undervoltage conditions exist. 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 causes a minimum time delay of three 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. 21)

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

Adjusting screw (2) and spring (4) are used to adjust the armature so that it will pick up at 80 percent of normal voltage and drop out between 30 percent and 60 percent of normal voltage.

When any time delay of 3 to 10 seconds exists from loss of voltage, the device is considered satisfactorily adjusted. This device is factory set, non-adjustable in the field.

From 1/4 in. to 3/8 in. 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.

REPLACEMENT (Fig. 21)

Device

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)

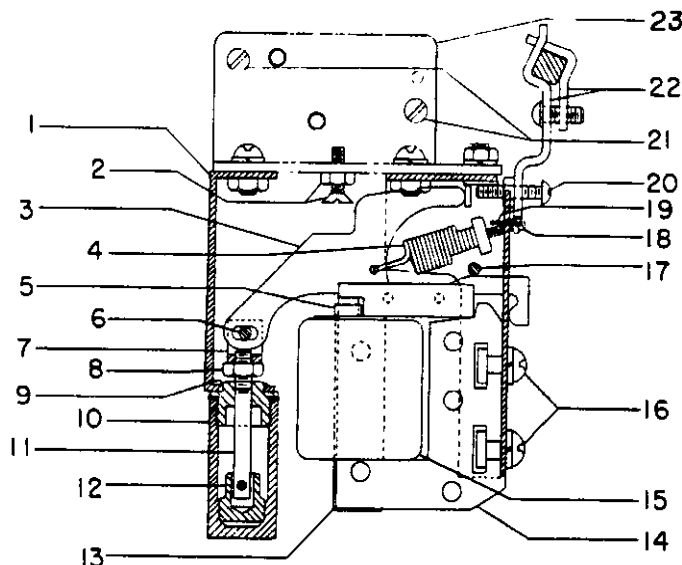
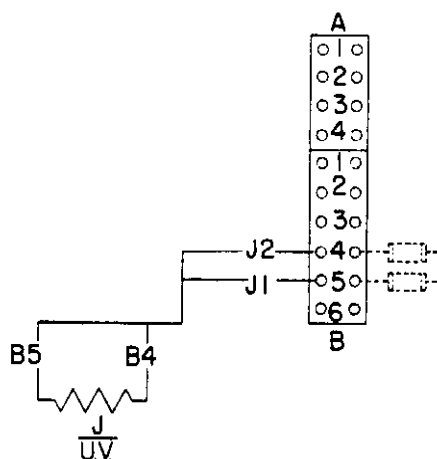
1. Disconnect leads to coil

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 UNDERVOLTAGE TRIPPING DEVICE (Fig. 21)

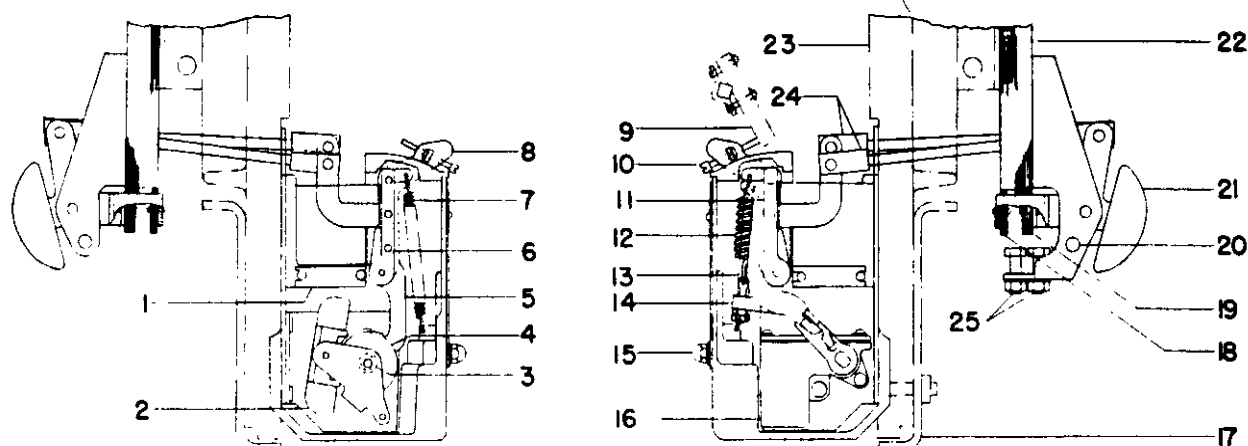
The instantaneous undervoltage device is mounted in the same location and manner as the time-delay device. Its construction is similar to the time-delay device with the exception of the time-delay feature. The omission of this feature eliminates the cylinder (10), plunger (12), connecting rod (11), clevis (7), bracket (1), and adjusting nut (8) from the device.

The adjustments and replacement of this device are the same as those described above for the time-delay undervoltage device.



- | | | | | |
|----------------------------|---------------------------|--------------------|------------------------|----------------------|
| 1. Bracket | 5. Shading Ring | 9. Cap | 13. Clamp | 17. Pin |
| 2. Adjusting Screw and Nut | 6. Pin | 10. Cylinder | 14. Magnet | 18. Adjusting Screws |
| 3. Armature | 7. Clevis | 11. Connection Rod | 15. Coil | 19. Locking Wire |
| 4. Spring | 8. Adjusting Nut | 12. Plunger | 16. Screws | 20. Adjusting Screws |
| 21. Mounting Screws | 22. Trip Paddle and Clamp | | 23. Supporting Bracket | |

Fig. 21. Time-delay undervoltage tripping device



- | | | | |
|--------------------|----------------------------------|-------------------------------|---------------------|
| 1. Magnet | 7. S.T.D. Calibration Spring | 13. L.T.D. Calibration Spring | 19. L.T.D. Armature |
| 2. Pallet | 8. Trip Arm | 14. Spring Holder | 20. Stop Pin |
| 3. Pinion | 9. Trip Paddle | 15. Calibration Clamp Nut | 21. Counter Weight |
| 4. Escape Wheel | 10. Trip Paddle Adjusting Screw | 16. Cylinder | 22. Magnet |
| 5. Driving Segment | 11. L.T.D. Lever | 17. Frame | 23. Pole Unit |
| 6. S.T.D. Lever | 12. Inst. Trip Spring (High Set) | 18. S.T.D. Armature | 24. Connecting Rods |
| | | 25. Armature Adjusting Screw | |

Fig. 22. Direct-acting tripping device—EC-1

DIRECT-ACTING TRIPPING DEVICE EC-1 (Fig. 22)

(USED ON AK-1-75 AND AK-1-100)

The direct-acting overcurrent tripping device causes the breaker to open within a predetermined time range, depending on the magnitude of the overcurrent. This 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:
adjustable (Low Set) or
non-adjustable (High Set)

The short time delay and long time delay armatures for the AK-1-75-1 are located as shown in Fig. 22, but their positions are reversed for the AK-1-100-1.

SHORT TIME-DELAY TRIPPING (Fig. 22)

The armature (18) is restrained by

netic 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.

LONG TIME-DELAY TRIPPING (Fig. 22)

The armature (19) is restrained by a calibrating spring. 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 cylinder (16). This mechanism produces an inverse time delay characteristic.

INSTANTANEOUS TRIPPING (Fig. 22)

1. Adjustable instantaneous tripping is similar to long time delay tripping, except that the long time delay escapement mechanism is removed to eliminate the intentional time delay.

2. Nonadjustable instantaneous tripping is accomplished when the magnetic force overcomes the force of a heavy restraining spring (12) connected between the armature and the support fastened to the frame of the device.

REPLACEMENT (Fig. 22)

1. Remove the front frame (see SEPARATION OF FRONT AND REAR FRAMES under MAINTENANCE).

2. Remove retainers and pins from

3. Remove the screws which secure the device to the breaker pole unit base. The device is now free.

4. Remove magnet (22) and armature assemblies (18) and (19) by removing screws which secure the assemblies to the lower stud.

5. Follow the above procedure in the reverse order and adjust the device as described below under ADJUSTMENTS.

ADJUSTMENTS (Fig. 22)

1. The air gaps between magnet (22) and armatures (18) and (19) are set by adjusting screws (25). When replacing the device refer to the drawing which accompanies each new device for specific gap dimensions. The gap dimension is measured from the magnet to the armature at the point where the gap is largest. Tighten the locking nuts on adjusting screws (25) after setting proper air gaps.

2. With the air gap set as in item 1, and the armatures (18) and (19) resting against the adjusting screws (25), move the crank, which attaches to the connecting rods (24), toward the front of the device. Adjust the connecting rods (24) to the proper length by turning them in the clevis which attaches them to the crank. Connecting rod pins should be in the right-hand direction (facing the back of the breaker), before attaching the tru-arc retainers for 4000-ampere frame size. Position should be opposite for 3000-ampere frame size.

3. Place a 1/32-in. gage between magnet (22) and armature (18).

4. Push the armature solidly against the magnet with the gage in place. The breaker should trip.

5. If the breaker does not trip, turn the adjusting screw (10), and repeat steps 1 and 2.

6. This adjustment must be made for both armatures.

7. When the armatures are resting against the adjusting screws (25) and the breaker is reset, there should be 1/32-in. clearance between the adjusting screw (10) and trip paddle (9).

DIRECT-ACTING TRIPPING DEVICES EC-1A and EC-1B (Fig. 23)

(USED ON AK-2-75 AND AK-2-100)

The Type EC-1A or EC-1B overcurrent tripping device is a direct-acting device that causes the power circuit breaker with which it is associated to open within a predetermined time range which depends upon the magnitude of the current overload. The EC-1A or EC-1B tripping devices can be constructed to supply a variety of different types of time-current characteristics, either alone or in combination. These are long time delay, short time delay, and instantaneous, and they are identified respectively by numbers 1, 2 and 3. Characteristics are further broken down within each of the first two of these general classifications into maximum, intermediate, and minimum values of the time delay period. These are coded respectively as AA, BB and CC. Time and current relationships for the various device characteristics are given by curve drawing 289B198.

The EC-1A and EC-1B tripping devices differ only in that the EC-1B is adjustable on high-set instantaneous tripping. The EC-1A is not adjustable on high-set instantaneous tripping and its pickup value for this setting is given in a particular current magnitude inscribed on the device nameplate. The adjustable setting mechanism of the EC-1B is shown at the top of Fig. 23.

Low-set instantaneous tripping is adjustable from 80 percent to 250 percent of the continuous current rating of the device. Whenever this is used, it is the only characteristic of the de-

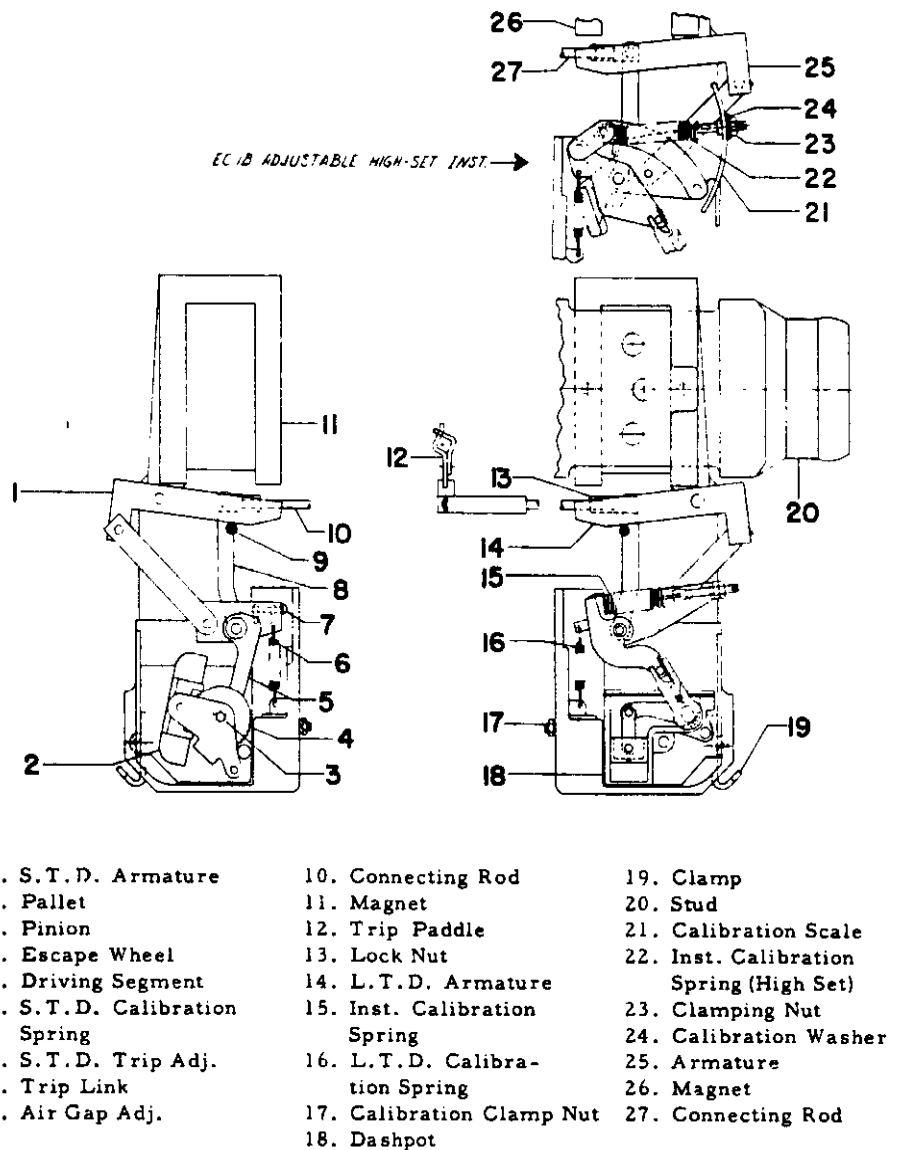


Fig. 23. Direct-acting tripping devices—EC-1A and EC-1B

conjunction with any other characteristic is always high-set, non-adjustable on the EC-1A.

A single EC-1A or EC-1B overcurrent device may incorporate the same combination of tripping characteristics described under the EC-1 DIRECT ACTING DEVICE.

Whenever either armature (1 or 14) closes against the magnet (11), motion is transmitted through the mechanism linkage, rotating tripping link (8) so that connecting rod (10) is pulled towards the rear of the breaker. By means of trip paddle (12) this results in the displacement of the breaker mechanism trip latch which causes the breaker to trip open. Long and short time delay tripping is achieved through separate timing devices as described

SHORT TIME-DELAY TRIPPING (Fig. 23)

The short time delay armature (1) is restrained by a calibration spring (6). If the force tending to close the armature against the magnet (11) is great enough to overcome the spring force, the speed of movement is governed by the mechanical escapement mechanism consisting of parts (2), (3), (4) and (5).

LONG TIME-DELAY TRIPPING (Fig. 23)

The long time delay armature (14) is restrained by the long time delay calibration spring (16). After the magnetic force produced by the overcurrent condition overcomes this re-

movement is governed by the flow of oil through an orifice in the piston of the dashpot (18). The time required to displace the piston is inversely proportional to the force tending to close the magnetic circuit.

INSTANTANEOUS TRIPPING (Fig. 23)

High-set, Non-adjustable

When an overcurrent is of the magnitude of the instantaneous trip setting, the magnetic force generated is great enough to extend the instantaneous spring (15), tripping the breaker instantly. If the overcurrent is below this value, the heavy instantaneous spring acts as a link, transmitting the force to the other control elements. If the device has only the instantaneous characteristic, the front end of spring (15) is hooked onto a pin fastened on the frame.

High-set, Adjustable—EC-1B Only

Adjustable instantaneous tripping is accomplished by varying the amount of tensile force on the high-set instantaneous spring (22). When a magnetic force greater than the restraining spring force is produced by an overcurrent condition, the armature (25) is pulled upward against the magnet (26), thus tripping the breaker by the movement of the connecting rod (27) against the trip paddle (12).

The pickup value of the device may have one of the following ranges: 4 to 9, 6 to 12, or 9 to 15 times coil rating. Three calibration marks will appear on the calibration scale (21) and the value of these calibration marks will be indicated by stampings on the scale as follows: (4X - 6.5X - 9X) or (6X - 9X - 12X) or (9X - 12X - 15X), depending on the desired range. To set the device at a particular pickup value, loosen the clamping nut (23) and slide the index pointer on the calibration washer (24) to a position which lines up horizontally with the desired pickup value on the calibration scale (21).

Low-set, Adjustable

If the characteristic of the device is low-set, adjustable instantaneous, a link is installed in place of spring (15) and the instantaneous calibration spring is located where spring (16) is shown in Fig. 23. Dashpot (18) is omitted from the assembly.

REPLACEMENT (Fig. 23)

1. Disconnect trip paddle (12) and connecting rod (10) by taking out cotter pin and removing coupling pin.
2. Remove clamp (19) by loosening locking nut and unscrewing slotted stud.
3. Remove stud (20).
4. Remove two screws fastening magnet (11) to lower stud.
5. Device is now free of breaker. Reassembly is accomplished by reversing the procedure.

When reassembling the magnet to the lower stud, be sure to replace any spacing washers in the same location in which they were found during disassembly. If this is not done, misalignment and consequent malfunction may result.

ADJUSTMENTS (Fig. 23)

Before the EC-1A or EC-1B overcurrent device is calibrated at the factory, the air gaps between magnet (11) and armatures (1 and 14) are set. These gaps are measured at their widest point, between the front edge of the armature and magnet. The gap for the short time delay armature is 11/64 in., and for the long time delay armature is 17/64 in. Both have a plus and minus tolerance of 1/64 in.

The air gap setting is a factory adjustment and is not to be attempted in the field. If any change occurs, the calibration of the device will not be true. If any calibration difficulties are experienced, they may be due to the fact that the air gap setting has been altered by rough handling or shipment damage. If a check of the air gap measurement reveals that the setting is beyond the tolerance, the device should be returned to the factory for recalibration.

The adjustment screw (7) is provided so that the short-time mechanism will pick up the trip link (8) at the same point at which it is picked up by the long-time mechanism. This may be checked before the device is mounted by pulling forward on the connecting link (10) and checking visually to see that trip link (8) contacts both the set pin in the long time linkage and the end of adjustment screw (7).

After the device is mounted on the breaker, a final adjustment that must

be made is the length of the connecting rod (10). This is made by varying the amount of thread engagement between the connecting rod and the insulated coupling which ties onto the trip paddle (12). The approximate distance between the pivot centers on the ends of the connecting rod assembly is six inches. The correct exact distance is that which will just cause tripping of the breaker when the armature is closed to a point 1/32 in. short of contact with the magnet. A step-by-step procedure for making this adjustment follows.

1. Before mounting the trip device, set the center distance between the pivot centers of the connecting rod at six inches.
2. Mount the device as described under replacement and insert the pin which couples the connecting rod and the trip paddle.
3. Close the breaker and insert a feeler gage 1/32 in. thick between the armature and magnet. This should be done from the rear of the breaker. The feeler gage should be no wider than 1/2 in. and at least 4 inches long.
4. Close the armature against the gage and magnet.
5. If the breaker does not trip, shorten the length of the connecting rod (10) gradually until it does.
6. Check visually to make sure that the connecting rod does not restrict the engagement of the breaker trip latch when the breaker mechanism resets. It should always be possible to adjust its length to a point where resetting is not interfered with and yet positive tripping by the overcurrent device is achieved.

SERIES OVERCURRENT TRIPPING DEVICE EC-1 (Fig. 24)

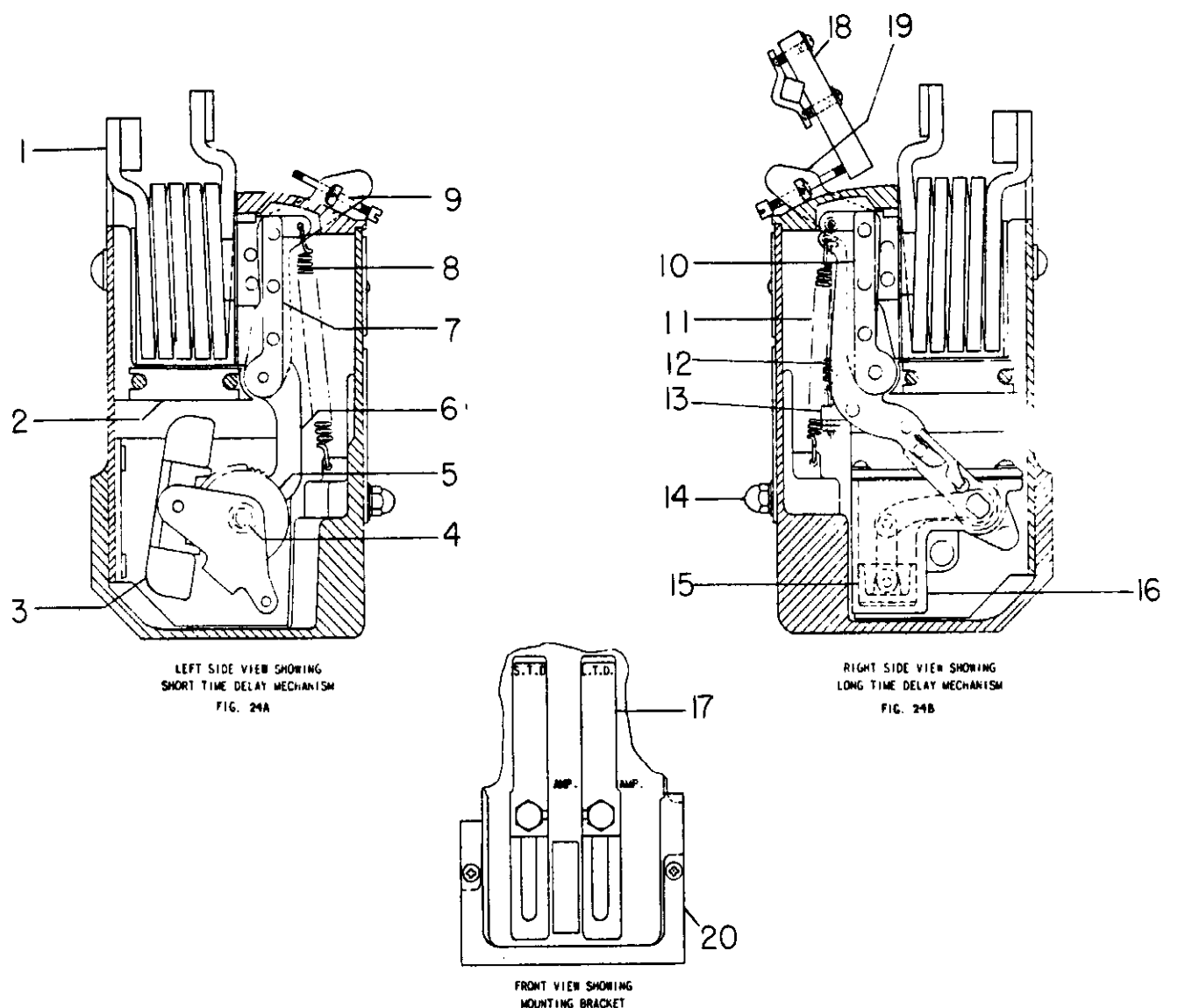
(USED ON AK-50 ONLY)

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 same tripping combinations as the EC-1 direct acting device.

SHORT TIME-DELAY TRIPPING (Fig. 24)

The armature (7) is restrained by calibrating spring (8). After the magnetic force produced by an overcurrent



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. and Low-set Inst. Calibration Spring
12. Inst. Trip Spring (High Set)
13. Spring Holder
14. Calibration Clamp Nut

15. Plunger
16. Cylinder
17. Calibration Plate
18. Trip Paddle
19. Trip Arm
20. Clamping Bracket

Fig. 24. Series overcurrent tripping device—EC-1 (AK-50 only)

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. 24A.

LONG TIME-DELAY TRIPPING (Fig. 24)

The armature (10) is restrained 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. 24B.

ment 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. 24B.

INSTANTANEOUS TRIPPING (Fig. 24)

(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.

ADJUSTMENTS (Fig. 24)

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

To adjust for approximately 1/32-in. overtravel of trip arm (19) after

1. Check trip latch engagement. See ADJUSTMENTS - OPERATING MECHANISM.

2. Loosen the locknut* and turn the adjusting screw (9) on the trip arm (19). 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-in.

3. Tighten the adjusting screw locknut* on the trip arm.

* Note: In lieu of locknuts, some devices are equipped with self-locking nylon insert nuts.

REPLACEMENT (Fig. 24)

1. Remove front frame (see SEPARATION OF FRONT AND REAR FRAMES).

2. Remove the bolts holding the coil to the lower stud.

3. Remove bracket and mounting screws.

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. 25). The trip arm should travel at least 5/32-in.

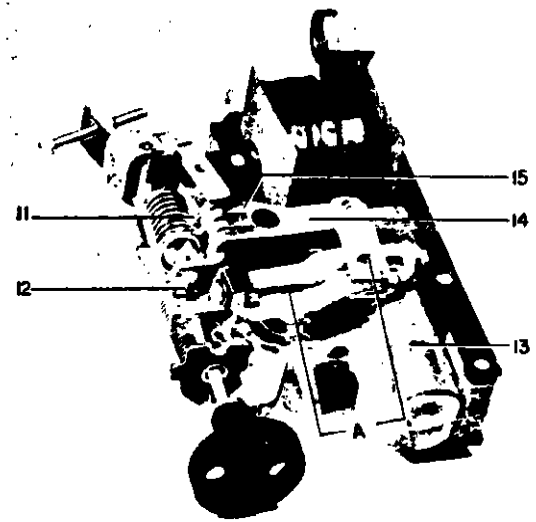
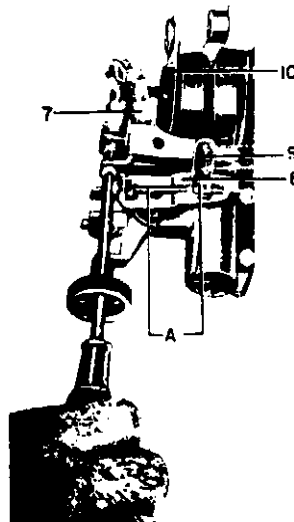
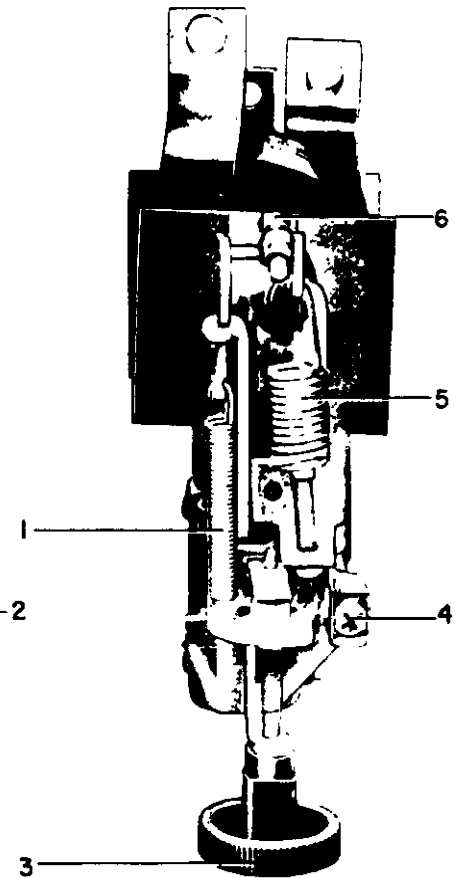
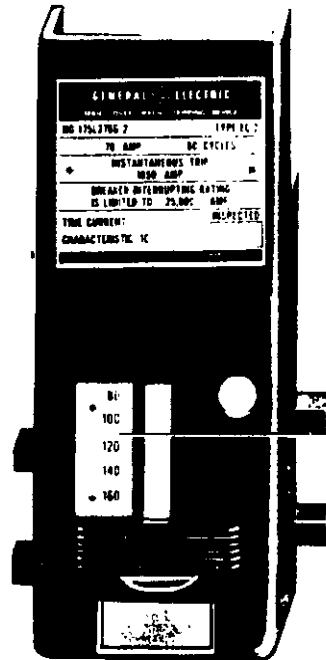
5. Replace new device in reverse order.

6. Adjust device as described above.

NOTE: Component parts of any overcurrent tripping devices are not replaceable. It will be necessary to install a new device when parts are worn or damaged.



Fig. 25. Checking travel distance of series overcurrent tripping device



1. Long-time-delay and Low-set Inst. Calibration Spring
2. Calibration Plate
3. Adjustment Knob
4. Time Adjustment Screw
5. Instantaneous Trip Spring (High Set)
6. Trip Screw

7. Armature
8. Dashpot Arm
9. Connecting Link
10. Pole Piece
11. Movable Nut (Index Pointer)
12. Inst. Adjusting Screw (High Set)
13. Oil Dashpot
14. Operating Arm
15. Calibration Marks

Fig. 26. Overcurrent tripping device—EC-2

SERIES OVERCURRENT TRIPPING DEVICE EC-2 (AK-1-50 ONLY)

The Type EC-2 (see Fig. 26) 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.

LONG TIME-DELAY AND HIGH-SET INSTANTANEOUS TRIPPING (Fig. 26)

By means of the adjustment knob (3), 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 (2) 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.

As in the case of the EC-1 overcurrent trip, 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 percent of the pick-up value of current. (See time-current characteristic curves, Fig. 29.)

The tripping time may be varied within the limits shown on the characteristic curves by turning the time adjustment screw (4). Turning in a clockwise direction increases the tripping time; counterclockwise motion decreases it. The dashpot arm (8) is indexed at four points, MIN-1/3-2/3-MAX, as indicated in Fig. 27. When the index mark on the connecting link (9) lines up with a mark on the dashpot arm, the approximate tripping time as shown by the characteristic curves is

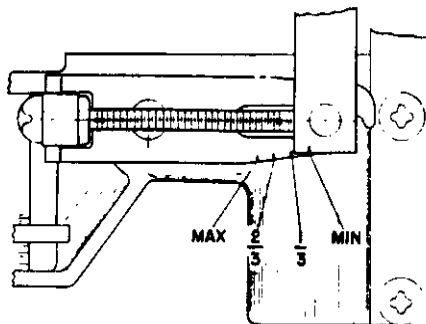


Fig. 27. Time-adjustment indexing

istic 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 these 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. 26, is greatest. The time adjustment screw (4) may be turned by inserting a Phillips head screwdriver through the hole in the front of the case. 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.

If the breaker is provided with a shunt trip or undervoltage device, the EC-2 case on the center pole must be taken off first before the cases on the outer poles can be removed.

INSTANTANEOUS LOW-SET TRIPPING (Fig. 26)

The low-set instantaneous pick-up point may be varied by the adjustment knob (3). The calibration in this case usually ranges from 80 percent to 250 percent of the series coil rating, with the calibration plate indexed at values of 80, 100, 150, 200, and 250 percent of the rating.

INSTANTANEOUS HIGH-SET TRIPPING (Fig. 26)

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

Three calibration marks (15) will appear on the operating arm (14) 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 (5). Turning the adjustment screw changes the position of the movable nut (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 (11) serves as an index pointer and should be lined up with the center of the desired calibration mark (15) to obtain the proper instantaneous trip setting.

The trip screw (6) on the end of the armature (7) should be set so that it does not contact the trip paddle on the trip shaft until the air gap between armature and pole piece is reduced to 3/32 in. or less, measured at the rivet in the pole piece. Also, the armature must have a minimum of 1/32 in. of travel beyond the point in its motion at which the breaker is tripped.

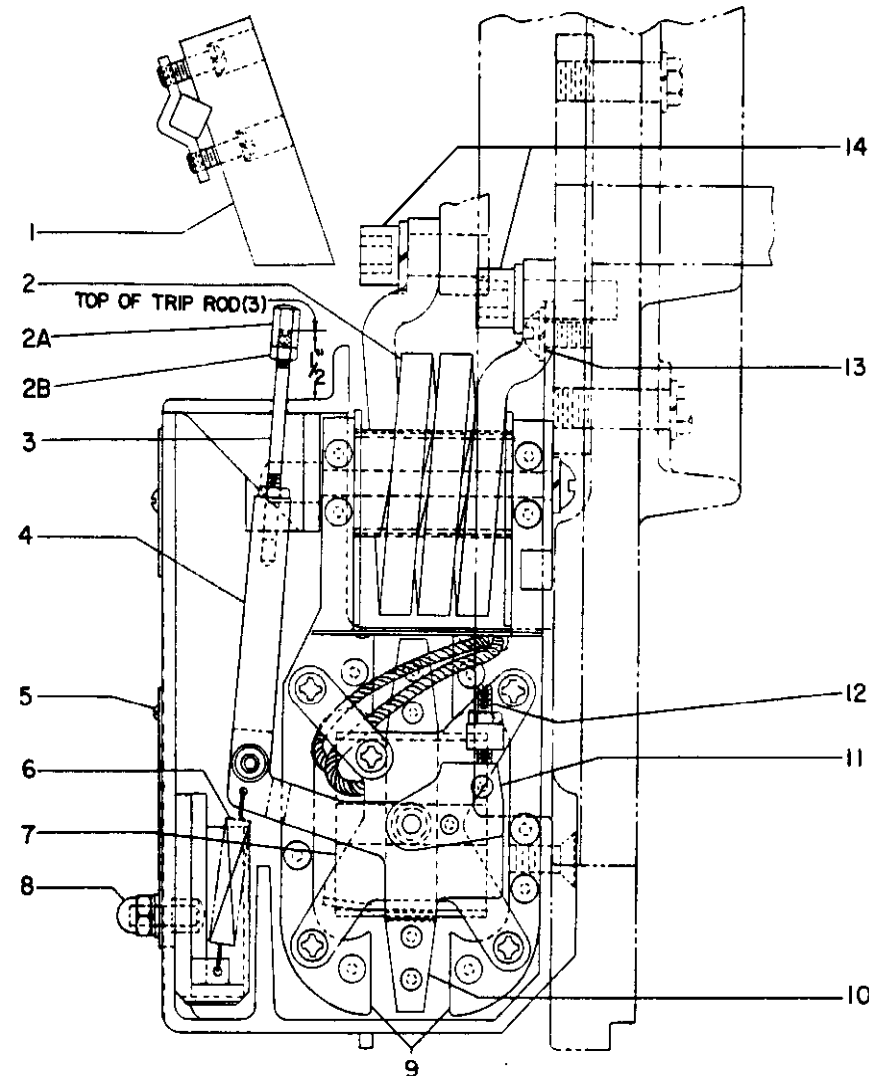
REPLACEMENT

Replacement of the EC-2 device is accomplished by the same procedure described for the EC-1 series trip device; however, in some cases, when replacing an EC-1 device with an EC-2, it will be necessary to replace the trip paddles on the trip shaft with ones which are slightly longer. When required these will be provided with the replacement trip units.

NOTE: Pickup settings on the cover of the EC-2 device are calibrated for the specific device. When replacing covers, replace on associated device.

REVERSE CURRENT TRIPPING DEVICE AK-50 ONLY (Fig. 28)

The device is enclosed in a molded case and is mounted on the right pole



the armature counterclockwise. 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 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. 28)

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 in. beyond the point of tripping the breaker. This adjustment should have to be made only 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 (3) will extend 1/2 in. above the top of the device case, and no additional adjustments of the trip rod should be required. To obtain the proper 1/32-in. overtravel, close the breaker and proceed as follows:

1. Loosen the locking nut (2B).

2. Manually lift the trip rod and vary the position of the adjusting nut (2A), thus establishing the position of the adjusting nut where the breaker is just tripped.

NOTE: Be sure to keep 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-in. overtravel of the trip rod should be obtained.

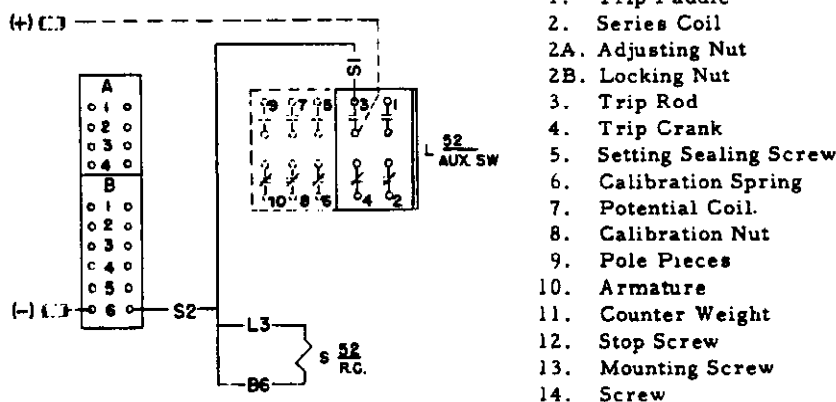


Fig. 28. Reverse current tripping device

The reverse current tripping device (see Fig. 28) 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

REPLACEMENT (Fig. 28)

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. 28.

SELECTIVE TRIPPING

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 five or ten times the breaker rating are removed in a matter of a few cycles while currents in excess of this value are removed instantaneously.

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.

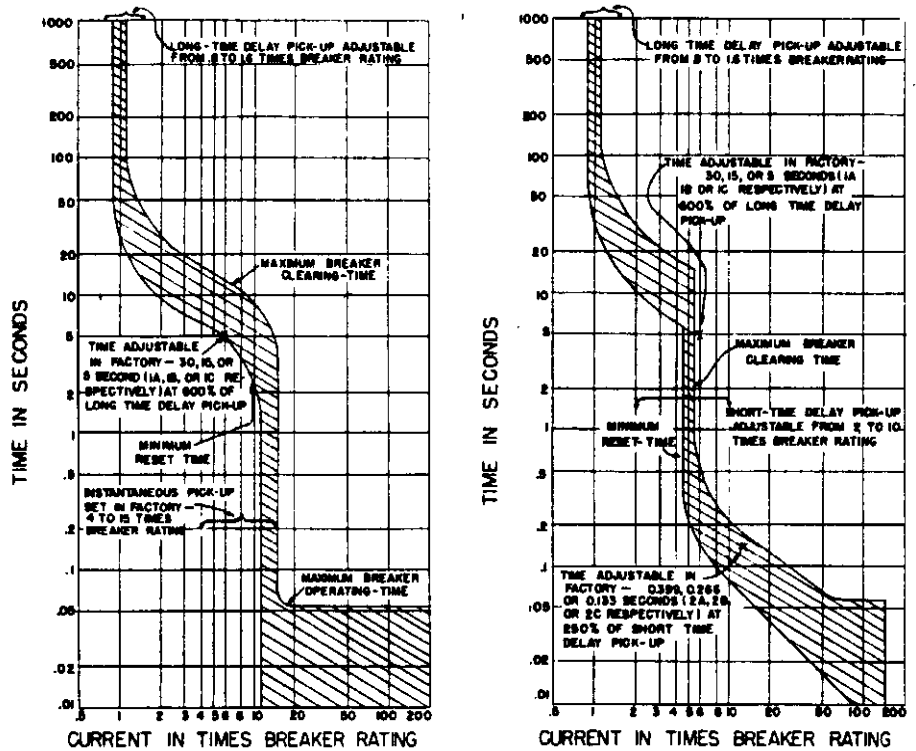


Fig. 29. Typical time-current characteristics

BREAKER ACCESSORIES

PRIMARY DISCONNECTS AK-50 ONLY

The primary disconnects are attached to the circuit breaker studs at the rear of the breaker base. Each disconnect assembly consists of four pairs of opposed contact fingers. The contact fingers are secured to the breaker stud by two bolts which pass 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 the degree to which the springs are compressed by the bolt and

REPLACEMENT

If for any reason the disconnects must be replaced or removed, the position of the nuts on the bolts should be carefully noted and the number of turns of the nuts should be counted, so that in reassembly the original amount of compression can be restored by replacing the nuts to their former position on the bolts.

The primary disconnects should always be kept lubricated with G.E. Co. D50H47 grease.

SECONDARY DISCONNECTS

The secondary disconnects for all breakers serve as connections between breaker control circuit elements and external control circuits. They are used only on drawout breakers and are

at the top rear of the breaker. A terminal board serves the same purpose on stationary mounted and general purpose enclosure mounted breakers. These secondary disconnects allow removal of the breaker without the necessity of having to detach external connections.

The movable part of the secondary disconnects 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

1. Unfasten disconnect body from breaker cross-channel.
2. Open tabs which hold wires on

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 in. from the 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 fiber spacers over inner ends of tubes and spreading tabs.
11. When all wires have been connected, refasten the body of the movable disconnect assembly to the breaker cross-channel.

DRAWOUT MECHANISM (Fig. 30)

Drawout breakers are furnished with a drawout mechanism which facilitates the inserting and withdrawing of the breaker from its enclosure. It provides a suitable means of forcing the breaker through the part of the inserting and withdrawal operations when the

stationary and movable halves of the disconnects engage and disengage. For complete details of inserting and withdrawing the breaker, such as the number of racking handle strokes required to install or withdraw the breaker, refer to instruction GEH-2021 furnished with the breaker.

The drawout mechanism is equipped with a drawout trip interlock which prevents a racking operation from being performed when the breaker is closed. Inserting the breaker into the housing causes the racking pins on the housing to engage the semi-circular slot in the racking cam (4). In this position the breaker is ready to be fully racked-in by operating the racking handle (1). The first upward stroke of the racking handle causes the racking pin on the housing to engage the trip interlock link and pin assembly (2, 3), rotating the link (2) and causing the pin (3) to move upward against the adjusting screw on the interlock trip paddle. This trips the breaker and holds it trip-free during the entire racking operation. The fifth and final stroke of the racking handle releases the trip interlock and allows the breaker to be closed, since the breaker is now fully racked-in.

ADJUSTMENTS (Fig. 30)

One adjustment on the trip interlock is required. With the breaker mechanism in the reset position and the racking cam (4) not engaging the racking pins on the housing, there should be at least 1/8-in. clearance between the top

edge of the trip interlock pin (3) and the adjusting screw on the interlock trip paddle.

SHUNT-TRIPPING DEVICE (Fig. 31)

The shunt tripping device 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.

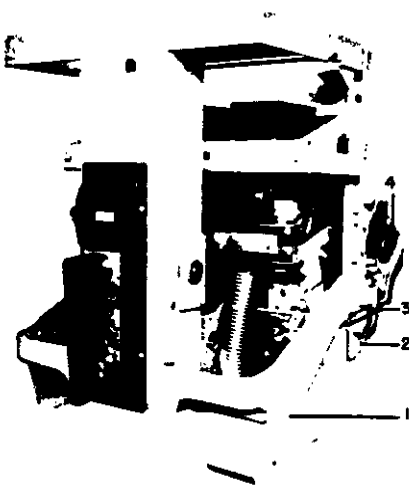
To prevent overheating, the coil (7) is cut off by contacts of the auxiliary switch which are open when the breaker is open.

ADJUSTMENTS

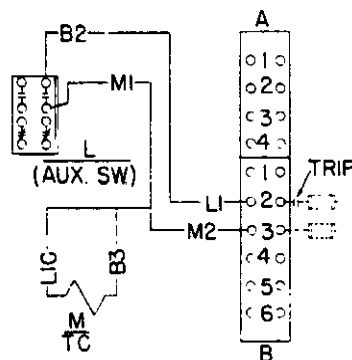
From 1/32-in. to 1/16-in. overtravel of the armature is required when the breaker is tripped. If any adjustment is necessary to provide this amount of overtravel, the trip lever is bent in or out accordingly.

REPLACEMENT OF COIL (Fig. 31)

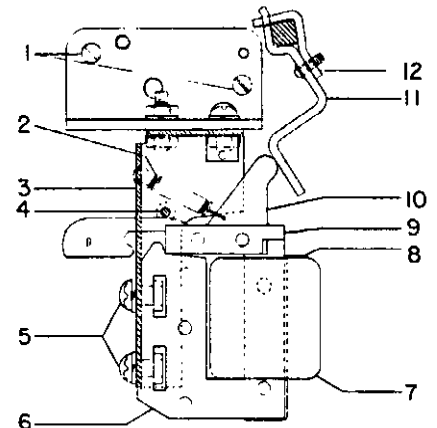
1. Disconnect leads to coil (7).
2. Remove magnet (6) and coil from frame (3).
3. Bend lower end of clamp (8) straight and remove.
4. Remove coil and install new coil in reverse order.



1. Racking Handle
2. Link
3. Pin
4. Racking Cam



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. 30. Typical drawout mechanism

Fig. 31. Shunt tripping device

BELL ALARM AND LOCKOUT DEVICE

FOR AK-1-50-(1-7), AK-1-75 and AK-1-100 (Fig. 32)

When the breaker is tripped by an overload device, auxiliary shaft (9) rotates counterclockwise 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 its contacts can be used to sound 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.

When a breaker is equipped only with the bell alarm feature, catch (11) is omitted and the reset rod (12) operates directly against latch arm (5). In this case, the bell alarm linkage can be reset either by operation of the reset button (1) or by closing the breaker.

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 in. to 3/32 in.

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-in. overtravel after the overload device trips the breaker. See **DIRECT ACTING OVERCURRENT DEVICE**, under **ADJUSTMENTS**.

FOR AK-1-50-(8 and above) and AK-2-50, -75 and -100 (Fig. 33)

This later design device is operated directly by the movement of the breaker crossbar rather than by movement of an auxiliary trip shaft as is the case with the previous device. This feature is the basic difference between the two

is engaged with the breaker crossbar side-link pin (1), thereby operating the device whenever the breaker is tripped by the overcurrent trip devices, the undervoltage device and the drawout trip interlock. The shunt trip device and the manual trip button will defeat the device. The bell alarm and lockout device can be reset only by the manual trip button on the front escutcheon. If the lockout device is omitted, the device can be reset by manual trip button or by closing the breaker, provided the fault has been eliminated.

Adjustments

1. Adjust the bell alarm-device latch (4) so that a clearance of 1/16 in. \pm 1/64 in. is maintained with the catch (15) when the breaker is closed.

2. With the breaker fully open, adjust the device adjusting screw (12), on the operating arm (13), for an overtravel of 1/16 to 3/32 of an in. after

the device contacts are just touching. This will assure that the device is operated when the breaker is by an overcurrent or undervoltage condition, and by the drawout trip interlock.

3. The lockout adjusting screw (3) should be adjusted so that it engages the lockout trip paddle (5) and displaces the trip shaft (6) when the breaker is opened. This assures that the breaker is locked open until the device is reset as described above. The lockout adjusting screw is furnished only with the lockout feature.

4. With the manual trip button fully depressed, position the trip-rod release collar (16) on the trip rod (14) so that the latch (4) and catch (15) are disengaged before the breaker opens.

5. This device is equipped with latch release strap (7) which is en-

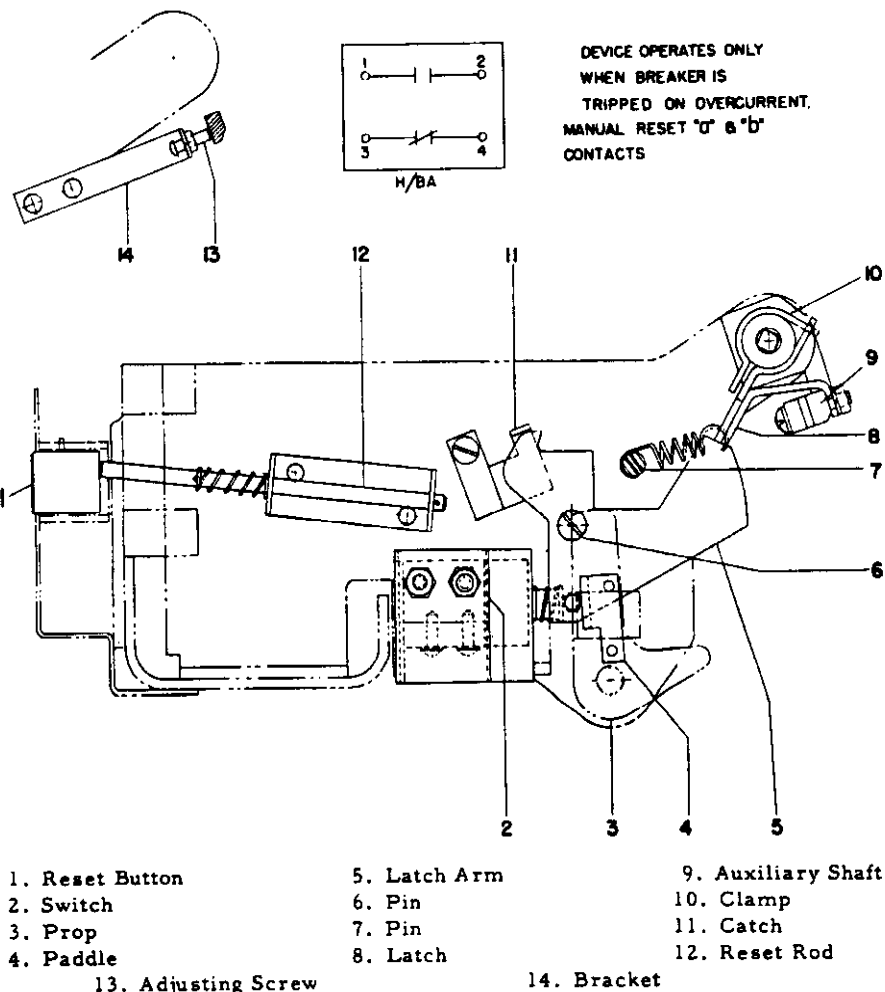


Fig. 32. Bell alarm and lockout device—AK-1-50-(1-7), AK-1-75-(1-3), AK-1-100-(1-3)

gaged by the shunt trip armature lever (8) when the shunt trip device is operated. This defeats the device when the shunt trip device operates. The latch release strap (7), which is a part of the device latch (4), must be formed to hook around the shunt trip armature lever (8) in a manner that will assure the device latch and catch are disengaged before the breaker opens.

1. Crossbar Side-link Pin
2. Operating Link
3. Lockout Adjusting Screw
4. Device Latch
5. Lockout Trip Paddle
6. Trip Shaft
7. Latch Release Strap
8. Shunt Trip Armature Lever
9. Shunt Trip Armature
10. Shunt Trip Device
11. Bell Alarm Plunger
12. Device Adjusting Screw
13. Operating Arm
14. Manual Trip Rod
15. Catch
16. Trip-rod Release Collar

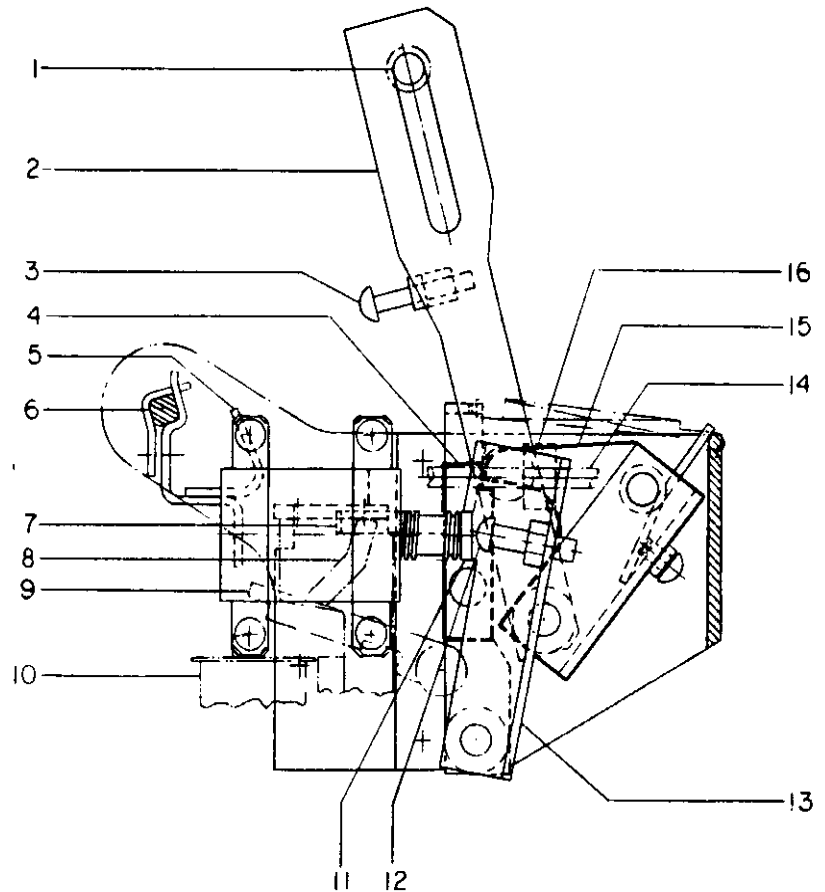


Fig. 33. Bell alarm and lockout device—AK-1-50-(8 and above), AK-2-50, AK-2-75 and AK-2-100

DYNAMIC BRAKE FOR ELECTRICAL BREAKERS (Fig. 34)

When the application requires less closing time than the 60- to 90-cycle closing time provided by the standard electrically operated breaker, a mechanism equipped with a dynamic brake is used. This section applies to the dynamic brake feature only and modifies the description of operation shown in the basic instructions for the breakers.

Functionally, the dynamic brake control scheme differs from the standard control scheme in that the pre-charge operation is extended to charge the closing springs more fully. At the end of the pre-charge operation, the dynamic brake is applied to prevent the charging mechanism coasting to an overcenter position and allowing discharge of the closing springs. With the closing springs being more fully charged in the pre-charged position, less time is required to complete the final spring charging when a closing operation is desired. The closing time for breakers equipped with dynamic breaker mechanisms is approximately 30 cycles.

Figure 34A shows a typical elementary diagram of a breaker equipped with a dynamic brake. The circuit is shown with the breaker open and the springs fully discharged. The conducting portion of the circuit is shown solid while the non-conducting components (during the pre-charge operation) are shown dotted. With voltage applied across + (X) and - (Y), the circuit from + (X) is completed through control switch F 3-4, control switch G 3-4, motor field R 1-2, control relay contact K 8-4, control switch 3-4 motor armature 3-4 to - (Y). With the motor energized, the springs are charged to the end of the pre-charged position. At the end of the pre-charge operation, control switches E, F, and G reverse their contacts and the circuit assumes the position of Fig. 34B.

In Fig. 34B, the motor control circuit has been isolated from the source voltage by the opening of control switches F 3-4 and G 3-4. A residual current circulates through the motor in such direction that the field is reversed with respect to the armature. This reversal of the field with respect to the motor brings the motor to a very sudden stop.

When a closing operation is desired, the remote closing button is closed to energize the K relay and the circuit assumes the conducting circuit shown by the solid circuit in Fig. 34C. The circuit from + (X) is through K 1-7, R 1-2, K 8-2, F 1-2, R 3-4 to - (Y). The polarity of the field with respect to the armature is such that the motor will run in the forward direction (same as in pre-charge operation Fig. 34A). After the motor completes the spring charging operation, the springs are released to close the breaker. Although the circuit through the "Remote Close" switch is shown closed in Fig. 34C, it is not necessary that the "Remote Close" switch be maintained closed because the K relay is sealed closed through the resistor N, G 1-2, relay K 7-1 to + (X) until the breaker closes.

ADJUSTMENTS

Control switches E, F, and G should be adjusted so that at the end of the pre-charge operation F toggles first, followed immediately by G and then by E. The switches should be adjusted on their mounting so that the overtravel button has no more than 1/16-in. movement. Excessive overtravel of the overtravel button will damage the switch.

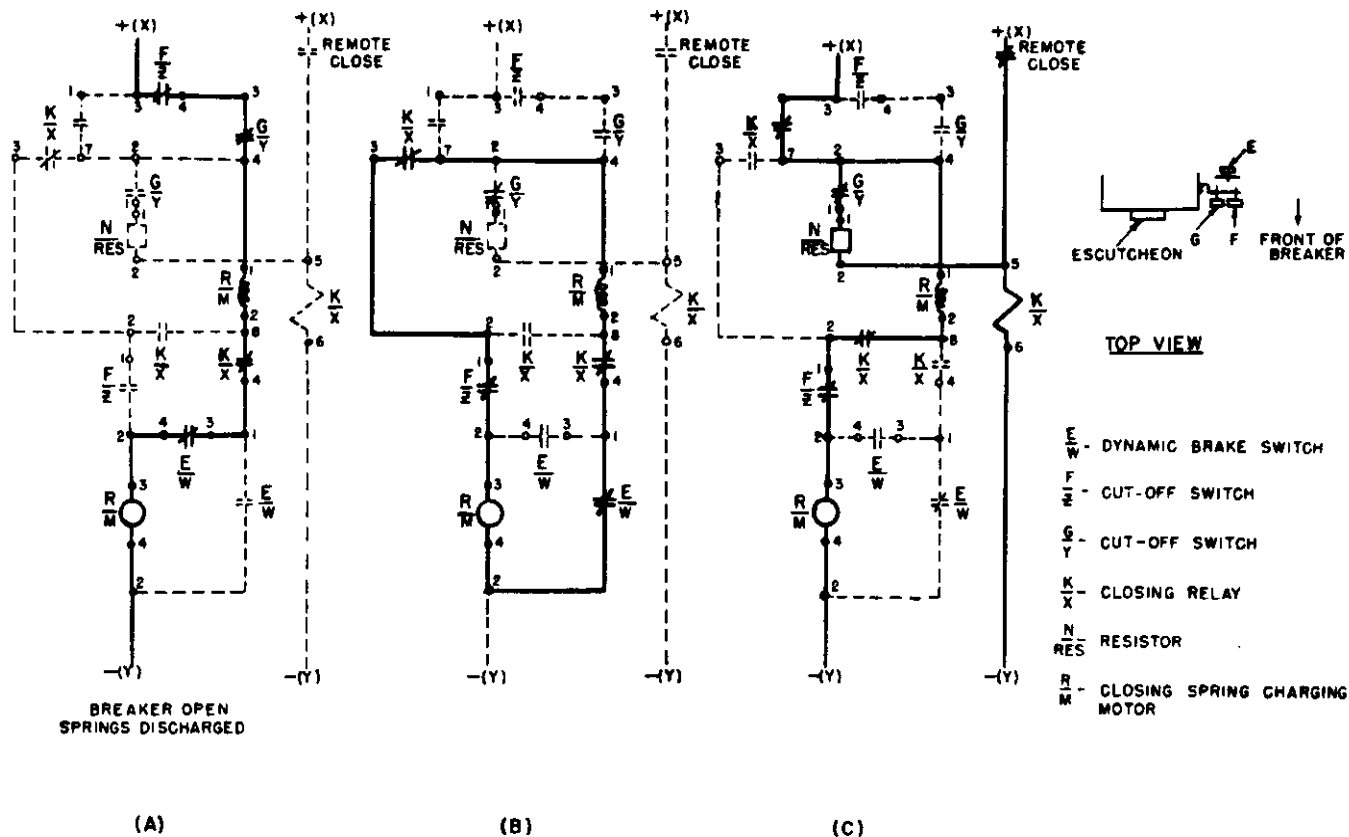


Fig. 34. Typical breaker elementary diagram

MISCELLANEOUS

TOOLS

The following tools are recommended for proper maintenance of the breakers to which this maintenance manual applies.

Screwdrivers

Phillips No. 1
Phillips No. 2, 8 in. shank
Phillips No. 3
Long thin, slotted screw
Standard, slotted screw
Short shank, slotted screw
Offset ratchet screwdriver, slotted (No. 3400) Yankee
Offset ratchet screwdriver, Phillips (No. 3412) Yankee

Pliers

Gas pliers, 8 in.
Long nose, side cutting, 6 in.
Waldes Truarc No. 2, straight
Waldes Truarc No. 2, 90 degree angle

Trade-mark of Stevens-Walden, Inc.

Socket Wrench (1/2 in. drive)

Ratchet handle	5/8 in. socket
Extension, 10 in.	3/4 in. socket
Extension, 6 in.	13/16 in. socket
7/16 in. socket	15/16 in. socket
9/16 in. socket	

End Wrenches

8 in. adjustable
1/4 in. - 5/16 in. open end
1/2 in. - 9/16 in. open end
5/8 in. - 3/4 in. open end
3/8 in. - 7/16 in. open end
11/32 in. - 5/16 in. open end
5/8 in., 6 point open, box

Allen 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 with adapter shank for 1/2 in. drive ratchet
3/8 in. for 1/2 in. screw

Miscellaneous

8 oz. ball peen hammer

1/4 in. Spintite* wrench, long shank
3/8 in. Spintite* wrench

NOTE: Obtain tools from local hardware; do not order from the General Electric Co.

RENEWAL PARTS

When ordering renewal parts, address the nearest General Electric Company Sales Office specifying the quantity required and describing the parts by the Catalog Number as shown in the renewal parts bulletins.

In the absence of a parts bulletin or breakers for which no parts bulletin are available, the part should be fully 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 design improvements are made from time to time. However, parts which are furnished will be interchangeable.