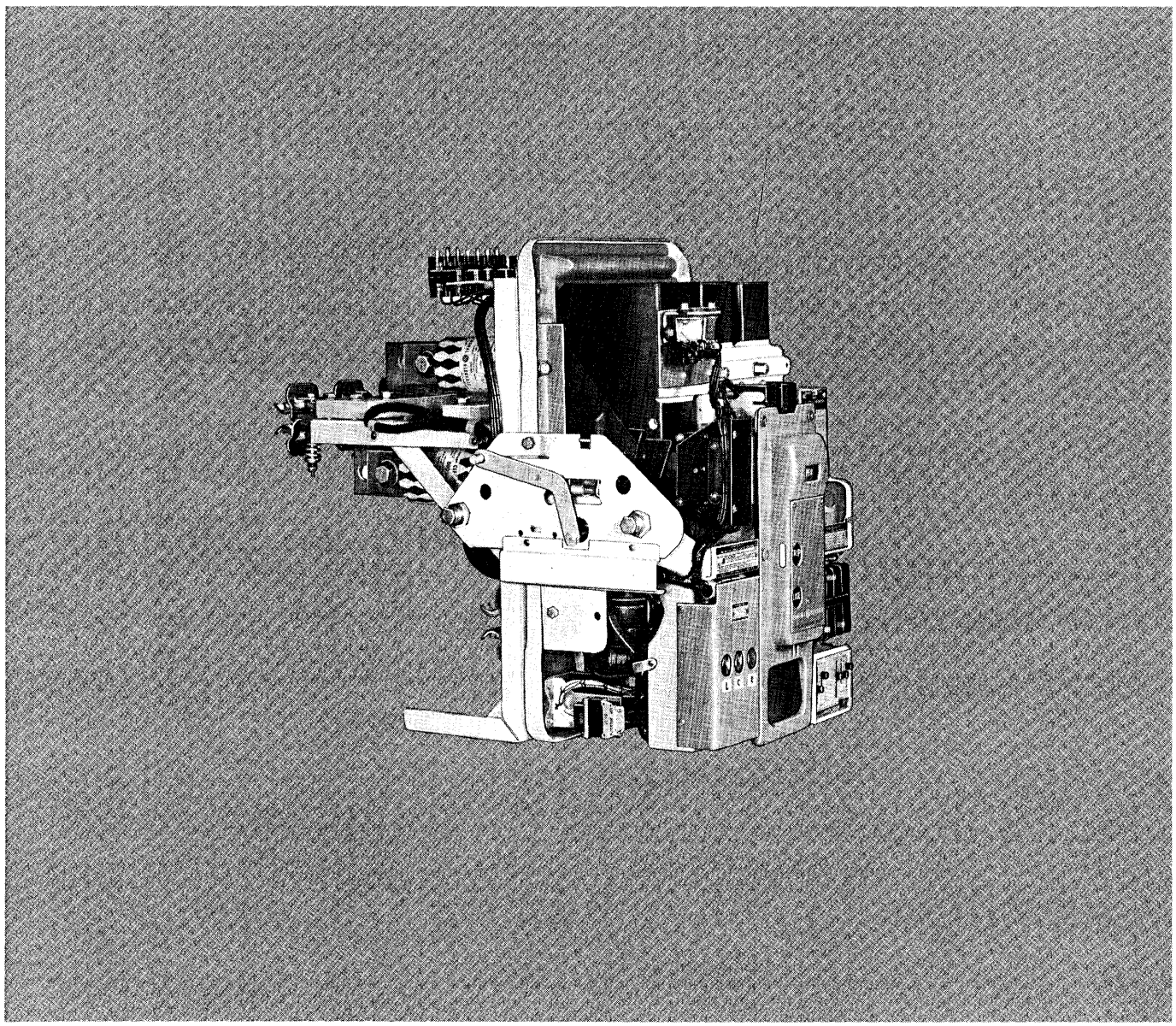
GEI-50299E*

Maintenance
Instructions

Power Circuit Breakers

Types AK-2/2A-15
AK-2/3/2A/3A-25
AKU-2/3/2A/3A-25

**Includes Supplement GEI-86153*



GENERAL ELECTRIC

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POWER CIRCUIT BREAKERS

Types AK-2-15 and AK-2/3-25

INTRODUCTION

The instructions contained herein provide information for performing maintenance procedures and for replacing AK-2/3-15/25 breaker components and accessories. For information regarding the receiving, handling, storage and installation of these breakers, refer to GEK-7302 furnished with all AK breakers.

OPERATION

ELECTRICAL OPERATION
Figure 1

The electrically operated breaker closes whenever the closing solenoid coil is energized. This causes an upward movement of the solenoid armature, which initiates the mechanical closing action. The closing signal may be given either by a remote switch or relay, or by a closing button in the front escutcheon if the breaker is so equipped. Either action (refer to the elementary of the wiring diagram) energizes the coil of the X relay through the bb contacts of cutoff switch G and the normally closed contacts of the Y relay. When the X relay or contactor is energized, it closes its contacts. One of these (X1-2) seals in the X coil. The other three sets of contacts, which are arranged in series, activate the closing solenoid.

The breaker control scheme has an anti-pump feature which allows only one closure of the breaker for a single operation of the closing switch no matter how long the switch may be held closed. This prevents the repeated operations that would ensue if one of the automatic trip devices was activated at the time of closing. The Y relay, together with the cut-off switch, provides the anti-pump feature. The mechanical action of closing operates the cut-off switch, reversing the position of the contacts from that shown on the diagram. This energizes the Y relay, if contact is still maintained at the closing switch, with the result that the X relay circuit is opened by Y contacts 5-6. This prevents the X relay from again becoming energized. Y contact 1-2 seals in the Y coil as long as contact is maintained at the closing switch.

Electrically operated breakers may also be closed by means of the maintenance handle which is furnished with the breaker. This is a separate tool and is simply a lever which permits an operator to push upwards on the closing solenoid armature. Two small hooks on one end of maintenance handle are engaged in slots (9A) Figure 5, located in the lower portion of the front escutcheon (8A) Figure 5. Rotation of the long end of the handle downwards forces the shorter end of the handle upwards against the bottom of the solenoid armature, and closes the breaker.

The breaker may be tripped open by any one of a number of electrical tripping devices which will be described in detail later in these instructions. An individual breaker may have none or any combination of these devices. They are the overcurrent tripping device, shunt tripping device, undervoltage tripping device, reverse current tripping device, and open fuse lockout device. All of them effect tripping by displacing the trip latch of the mechanism. The trip latch is rigidly attached to a trip shaft which runs through the breaker from left to right. Whenever the trip shaft is rotated in a counterclockwise direction looking from the right, the latch is displaced. The tripping devices are all equipped with strikers or trip arms which act against trip paddles rigidly fastened to the trip shaft, causing it to rotate on its bearings in a direction to trip the breaker.

The reverse current device and the shunt tripping device each have a set of auxiliary switch "a" contacts in their circuits. (An "a" contact is open when the breaker contacts are open.) This prevents their operation unless the breaker is closed.

The undervoltage device coil is normally continually energized. When the control voltage is low or non-existent, as when the breaker has been pulled out for inspection or maintenance, the breaker is rendered trip-free by the undervoltage device. If it is desired to close the breaker, the device armature must be tied down or blocked closed against the magnet. The open fuse lockout device is used on all AKU breakers and breaker fuse combinations. The purpose of this device is to trip the breaker upon the blowing of any one of the breaker fuses.

MANUAL OPERATION

The manually operated breaker is closed by first rotating the handle in a counterclockwise direction through 90 degrees, then rotating it clockwise back to its normal vertical position. The counterclockwise stroke resets the mechanism, readying it for the clockwise closing stroke.

The breaker may be tripped manually by pushing the manual trip button. This action pushes

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

a rod against a trip paddle of the trip shaft, rotating it, and causing the mechanism trip latch to be displaced. This allows the mechanism linkage to collapse through the action of the mechanism operating springs.

CAUTION: If the breaker is tripped manually while the operating handle is in the reset position, the handle should be lowered by the right hand while operating the trip button with the left hand.

ELECTRICAL WITH MANUAL OPERATION

This operating mechanism provides both manual and electrical closing. The operating mechanism is similar to the mechanism of the standard electrical breaker with the addition of the manual handle, cam and mechanism connecting link. The solenoid connecting link and manual cam connecting link are both connected to the closing spring pin at the top of the mechanism, thus compressing the springs when force is provided by either means of breaker closing.

The breaker is manually closed by rotating the closing handle 90 degrees counterclockwise. No reset stroke is necessary as is the case with the standard manual breaker. Electrical closing may be performed either locally or remotely in the same manner as the standard electrical breaker.

Tripping is accomplished by the manual trip button on the escutcheon or by any of the electrical tripping devices available for use on the standard breakers.

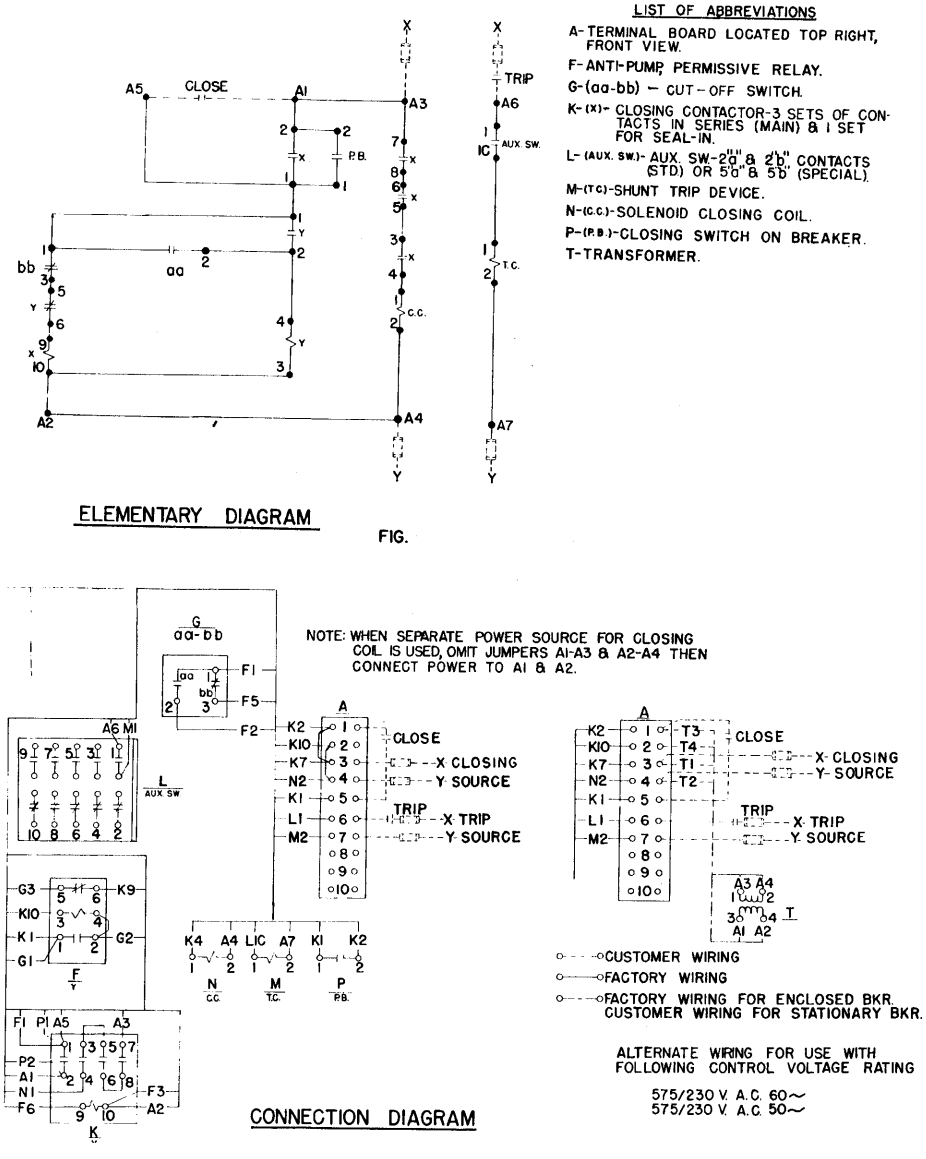


FIG.

Figure 1. (695C160-1) & (695C159-1) Typical Wiring Diagram

MAINTENANCE

INSPECTION

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

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

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

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

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

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

1. Manually operate the breaker several times checking for obstructions or excessive friction.
2. Electrically operate the breaker several times (if breaker has electrical control) to ascertain whether the electrical attachments are functioning properly.
3. Remove and inspect the arc quencher. Breakage of parts or extensive burning will indicate need for replacement.
4. Check contact condition and wipe
5. Check latch engagement.
6. Check operation of tripping devices, including overcurrent trip devices, making sure all have positive tripping action. (Discernible movement in tripping direction beyond point of tripping.)

(For detailed information on breaker features listed, refer to appropriate sections of these instructions.)

SEPARATION OF FRONT AND BACK FRAMES

Figure 3

Many maintenance operations will either require or be greatly facilitated by separating the front frame and mechanism of the breaker from the back frame or base, which consists of the current carrying parts of the breaker and their supporting structure. The procedure for this operation is as follows:

1. Remove the arc quenchers (see section on "Arc Quenchers").
2. Disconnect the two insulated connecting links (6), between the mechanism and the crossbar (10), by removing the tie bolt (7), and slipping the ends of the links off the ends of the shouldered pin, (5) Figure 5 in the mechanism.
3. If the breaker is a drawout type, with secondary disconnects, Figure 2, remove the secondary disconnect supporting bracket from the breaker back frame. Also remove any wiring bundle retainers that may be attached to the back frame.
4. Remove one elastic stop nut from each of two studs (3), which tie the upper ends of the mechanism frame to the back frame of the breaker.
5. Remove the two elastic stop nuts (9/16" Hex.) which fasten the wrap around portion of the front frame to the back frame. One of these is located on each side of the breaker, about 2/3 of the distance down from the top edge of the back frame.

   On drawout breakers for AKD Equipment, the bottom plate must be removed by first removing two #8-36 screws located at the front of the bottom plate and then freeing the plate from the slots located in the bottom of the back frame.
6. The two frames are now disconnected. However, care should be exercised in separating them to avoid damage to the trip shaft arms and paddles. While the back frame is held steady, lift the front frame and mechanism up and out so that the trip paddles on the trip shaft clear the trip arms of the overload trip devices.

   Reassembly of the two breaker halves is accomplished by following the procedure outlined in reverse order.

LUBRICATION

In general, the circuit breaker requires very little lubrication. Bearing points and sliding surfaces should be lubricated very lightly at the regular inspection periods with a thin film of extreme temperature, high pressure, light grease, similar to G.E. Spect. No. D50H15 or RPM No. 5. Hardened grease and dirt should be removed from latch and bearing surfaces by the use of a safe cleaning solvent such as kerosene. Latch surfaces should be left clean and dry and not be lubricated.

ALL EXCESS LUBRICANT SHOULD BE REMOVED WITH A CLEAN CLOTH IN ORDER TO AVOID ANY ACCUMULATION OF DIRT OR DUST.

At each maintenance period, all silver to silver friction points, such as primary disconnects, should be cleaned and given a fresh coat of G.E. Spec. No. D50H47 lubricant.

TROUBLESHOOTING

The following table lists several typical symptoms of breaker malfunction, together with their causes and remedies. If, at any time, these symptoms are observed, their cause should be determined and the necessary corrective action should be taken.

TROUBLE	CAUSE	REMEDY
Overheating AK-2/3 Breakers	Contacts not aligned	Adjust contacts.
	Contacts dirty, greasy or coated with dark film	Clean contacts
	Contacts badly burned or pitted	Replace contacts
	Current carrying surfaces dirty	Clean surfaces of current carrying parts
	Corrosive atmosphere	Relocate or provide adequate enclosure
	Insufficient bus or cable capacity	Increase capacity of bus or cable
	Bolts and nuts at terminal connections not tight	Tighten, but do not exceed elastic limit of bolts or fittings.
	Current in excess of breaker rating	Check breaker application or modify circuit by decreasing load
	Excessive ambient temperature	Provide adequate ventilation
Failure to trip AK-2 Breakers	Travel of tripping device does not provide positive release of tripping latch	Re-adjust or replace tripping device and check mechanism latch adjustment
	Worn or damaged trip unit parts	Replace trip unit
	Bind in overcurrent trip device	Replace overcurrent trip device
False Tripping AK-2 Breakers	Overcurrent trip device pick up too low	Check application of overcurrent trip device
	Overcurrent trip device time setting too short	Check application of overcurrent trip device
	Bind in overcurrent trip device	Replace overcurrent trip device
Failure to Close and Latch AK-2/3 Breakers	Binding in attachments preventing resetting of latch	Re-align and adjust attachments
	Latch out of adjustment	Adjust latch
	Latch return spring too weak or broken	Replace spring
	Hardened or gummy lubricant	Clean bearing and latch surfaces
	Closing solenoid burned out	Replace solenoid coil
	Solenoid control device not functioning properly	Re-adjust or replace device
False Tripping AK-3 Breakers	Captive Thump screw on Power Sensor loose fail-safe circuitry reverts characteristic to minimum setting and maximum time delay	Tighten thumb screw on desired setting
	Tap setting dial on Power Supply incorrectly set	Set dial to correspond with Power Sensor coil tap
	External Ground Sensor Coil improperly connected	Refer to Figure 22, page 29 for polarity and connections. Check continuity of shield and conductors connecting the external Ground Sensor coil.
Failure to Trip AK-3 Breakers	Loose or disconnected power sensor disconnect plugs	Tighten or reconnect disconnect plugs
	Loose or broken power sensor coil tap connections	Tighten or reconnect tap connections

BASIC BREAKER COMPONENTS

DISCONNECTS

PRIMARY DISCONNECTS

The primary disconnects are attached to the ends of the breaker studs on the rear side of the breaker base. Each disconnect assembly consists of two pair of opposed contact fingers. These are secured to the breaker stud by a bolt which passes through the assembly and the stud. When engaged with the stationary stud of the enclosure, the disconnect fingers exert a set amount of force against the stationary stud through the action of the compression springs. Retainers and spacers hold the contact fingers in correct alignment for engagement with the stud. The amount of force which the fingers exert against the stud is determined by degree to which the springs are compressed by the bolt and nut which hold the assembly together. This pressure is factory set between 60 and 70 pounds. If, for any reason, the disconnects must be taken apart, the position of the nut on the bolt should be carefully noted, so that in reassemblying, the original amount of compression can be restored by replacing the nut at its former position on the bolt.

SECONDARY DISCONNECT, FIGURE 2.

The secondary disconnects serve as connections between breaker control circuit elements and external control circuits. They are used only on drawout type breakers. A terminal board serves the same purpose on stationary mounted and general purpose enclosure mounted breakers. The secondary disconnects allow removal of the breaker without the necessity of having to detach external connections.

The movable part of the secondary disconnect consists of an insulating body which holds a conducting spring loaded plunger to which a flexible lead is attached. As the breaker moves into its enclosure, the plunger is depressed by sliding onto the stationary disconnects of the enclosure.

REPLACEMENT OF MOVABLE SECONDARY DISCONNECTS

1. Unfasten disconnect body from breaker back frame.
2. Open tabs which hold wires on inner side.
3. Pull contact tip loose from hollow tube.
4. Remove contact tip by cutting wire at its base.
5. Push wire through hollow tube of new disconnect assembly.
6. Strip insulation off end of wire to about 1/4 of an inch from end.
7. Place new contact tip on end of wire and crimp.
8. Pull wire through hollow tube until contact tip fits snugly against end of hollow tube.
9. Crimp tab on other side of assembly to hold wire in place.
10. Any hollow tubes which are not used should be pushed into the disconnect body and held in that position by placing fibre spacers over inner ends of tubes and spreading tabs.

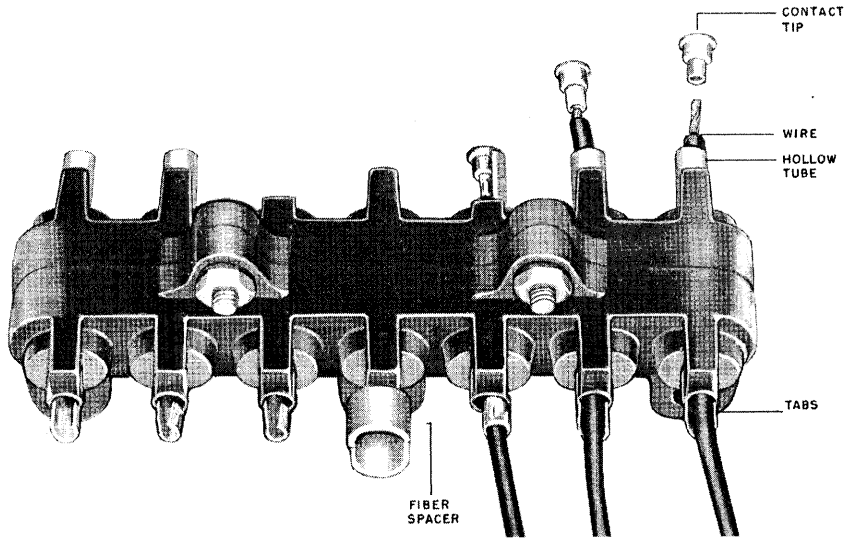


Figure 2. (8017973) Movable Secondary Disconnects

11. When all wires have been connected, refasten the body of the assembly to the breaker back frame.

ARC QUENCHER

The arc quencher is an integral riveted assembly composed of two ceramic side plates, a series of steel plates, and a muffler. The assembly is covered by a wrap around of insulating material which inhibits any sidewise emission of gases. The steel plates are held in position and supported by the ceramic sides which are grooved vertically to provide recesses for the vertical edges of the steel plates. The bottom edges of the latter form an inverted "V" along the path of the arc that may be drawn between the breaker contacts during interruption. The steel plates have the effect of breaking up the arc, and cooling it and the gases that result from interruption. The entire assembly provides a "chimney" effect which directs the hot, ionized gases upwards through the steel plates and mufflers and allows their safe and controlled escape at a cooler temperature.

The muffler at the top of the assembly is a serpentine shaped strip of perforated, copper plated steel. It is important that the perforations of the muffler be kept open, since their closure could tend to prevent the escape of the gases along the desired path. At the regular maintenance inspection, it would be well to check their condition and open any of the perforations that appear to be clogged.

If any very extensive burning or corrosion is noted in the arc quencher, it should be replaced. Replacement is also indicated if any breaks or cracks are noted in the ceramic material.

REPLACEMENT

Removal of the arc quencher is simply a matter of lifting the assembly up and out, after the steel retainer across the front of the arc quenchers has been removed. The upper edge of the steel arc runner, fastened to the back plate of the breaker, fits into a recess in the back portion of the arc quencher which locates it in its proper position upon replacement. Make sure the steel retainer is replaced and fastened firmly to its mounting studs after the arc quenchers have been replaced.

BREAKER CONTACT STRUCTURE

The copper current carrying parts of the breaker are all mounted on a common base of insulating material made of polyester glass mat. The copper of each pole consist of an upper stud and pivot, stationary contacts, two movable contact arms, a movable contact pivot, and the lower stud.

The upper stud branches into two pivot surfaces on its inner end on the forward or front side of the breaker base. Each of these convex pivot surfaces mates with the concave pivot surface on the rear side of the stationary contacts. Each of the stationary contacts pivot in a horizontal plane approximately at their mid-points. The end of the contact opposite to the contact tip end is formed into the shape of a small hook. A tension spring engages this hook and provides the necessary contact pressure at the pivot and also at the point of contact with the movable contact arm. When the breaker contacts open, a projection on the contact tip end of the stationary contact bears against a stop pin restricting the movement of the stationary contact. This arrangement results in a continual high force existing between the mating pivot surfaces.

The movable contact arms pivot in a vertical plane, each making contact with a pair of stationary contacts, and thus providing four low resistant parallel paths of current for each breaker pole. The movable contacts rotate about a burnished, silver plated, copper pin which, in turn, is held by a pivot support. Each side of the pivot support bears against the lower, outer surface of the contact arm and supplies a second low resistance path through the pivot. A "U" shaped spring clip made of silver plated conducting material provides an additional current path and protects the other contact surfaces of the pivot against pitting when in motion. It also contributes to the force tending to increase the contact pressure between the lower ends of the movable contacts and the pivot support.

The movable contact pivot support is mounted securely to the breaker base. If, as is normally the case, the pole is equipped with an overcurrent trip device, one of the terminals of the series coil of the trip unit is fastened to the lower end of the pivot support. The other terminal of the coil fastens to the lower stud.

CONTACT ADJUSTMENTS

The only adjustment to be made on the breaker contacts is that of contact wipe. This may be described as the distance the movable and stationary move while they are touching one another in the process of breaker closing. The amount of contact wipe can be measured by comparing the position of the front surface of the stationary contact when the breaker is open to its position when the breaker is closed, in reference to some absolutely stationary part of the breaker. The most convenient stationary part of the breaker to use as a reference point is the steel arc runner above and behind the stationary contacts.

The amount of wipe the contacts should have is nominally 1/8 of an inch. A plus or minus tolerance of 1/32 of an inch is allowed.

The means of adjusting contact wipe is provided by an eccentric pin which passes through the center of the movable contact assembly. Each end of this pin has a free, projecting, hexagon

shaped section which is easily accessible to a small, open end, 1/4 inch wrench. Two cantilever springs, which bear on each end against a portion of the hexagon section of the pin, lock the adjusting pin in place and provide index stops for the process of adjustment. The right hand hexagon shaped end of the pin is numbered from 1 to 6, which provides a reference for making wipe adjustments.

When contacts are to be adjusted, the recommended procedure is as follows:

1. With the breaker in the open position and using the numbers on the right end of each adjusting pin as a reference, set each pin in the same position. In many cases, the number 3 is a good beginning point. The proper view of the number on the adjusting pin is obtained by viewing the breaker from the front and the adjusting pin from approximately a 15 degree angle with respect to the movable contacts. Note that the numbers on the pin are not in numerical sequence as the pin is rotated.

2. By measurement, establish the position of the front surfaces of the stationary contacts with reference to the steel arc runners above and behind the contacts.

3. Close the breaker, and establish the amount of wipe by again measuring as in step two, and comparing the measurements with those taken with the breaker open.

4. If any set of contacts lead or lag the others, open the breaker and advance or retard the adjusting pin to the next higher or lower number. Moving the adjusting pin to a higher number will increase the contact wipe and moving to a lower number will decrease the contact wipe.

   NOTE: No attempt should be made to move the adjusting pin when the breaker is closed. Besides being more difficult, the additional force required to move the pin will tend to round off the flats of the hex section of the pin.

5. When all the contacts have the recommended wipe of 3/32 to 5/32 of an inch, the contact adjustments are complete.

CONTACT REPLACEMENT

Figure 3

The normal situation that will exist in the matter of contact replacement will call for replacement of all the movable and stationary contacts at the same time. This will be the case

where long use of the breaker in service has resulted in extensive wear or erosion of the silver alloy contact tips. A commonly used "rule of thumb" is that contact replacement is indicated if less than one-half of the original thickness (1/8 of an inch) of the contact tip material remains.

GENERAL PREPARATION

1. Remove arc quencher retainer (1), Figure 5 by loosening the two captured nuts with a 7/16" wrench.

2. Lift off the three arc quenchers.

3. Remove the U shaped insulation (5) Figure 3 from each pole by lifting it and disengaging the rivet heads thru the keyholed slots in the insulation.

4. As an aid to future reassembly of the movable contacts, note the position of all stationary insulation barriers with respect to barriers mounted on the cross bar.

REMOVAL OF MOVABLE CONTACTS (18) Figure 3.

1. Screw the threaded end of the steel rod lightly into pivot pin (11) on the right pole.

2. With a pair of long nosed pliers, unhook safety pin type spring clip (9) and extract pin (11) and remove spring clip (9).

3. Grasp movable contact assembly and remove it from its seat on the cross bar.

4. Repeat procedure 1, 2, and 3 above on the left pole.

5. Move the cross bar downward to disengage it from the contact wipe adjusting pin (15) on the center pole, then move the cross bar toward the front of the breaker.

6. Remove the split pin retaining the center pole pivot pin.

7. Remove the pivot pin and movable contact assembly.

REMOVAL OF STATIONARY CONTACTS (21) Figure 3.

1. Slip the blade of a heavy screw driver between the two upper contacts and force the contacts toward their pivot point sufficiently far to disengage the contact stop surface from the pin.

2. The contact can then be removed by disengaging the end of the contact from its spring.

3. The two lower contacts can be similarily removed.

REPLACEMENT OF STATIONARY CONTACTS (21) Figure 3.

1. Coat the contact pivot area only of each of the four contacts with a thin coat of D50H47 grease. Use only D50H47 grease.

2. Note the difference between the two types of

stationary contacts and be sure to locate them in the breaker with the upper and lower contacts having their stop projecting surfaces as shown in the section AA, Figure 3. The upper left and lower right contacts are identical as are the lower left and upper right contacts.

3. By placing the hook on the end of the contact through the loop of the contact spring, the contact can be pushed toward the pivot surface and slipped behind the stop pin. Install all stationary contacts in all poles.

REPLACEMENT OF MOVABLE CONTACTS (18) Figure 3.

1. Coat the pivot area only of the new movable contacts with a thin coat of D50H47 grease.

2. Assemble the center pole movable contacts, align the pivot pin holes with the bullet nosed rod, and install the pivot pin and split pin.

3. Move the cross bar assembly into position and insert the eccentric contact wipe adjust-

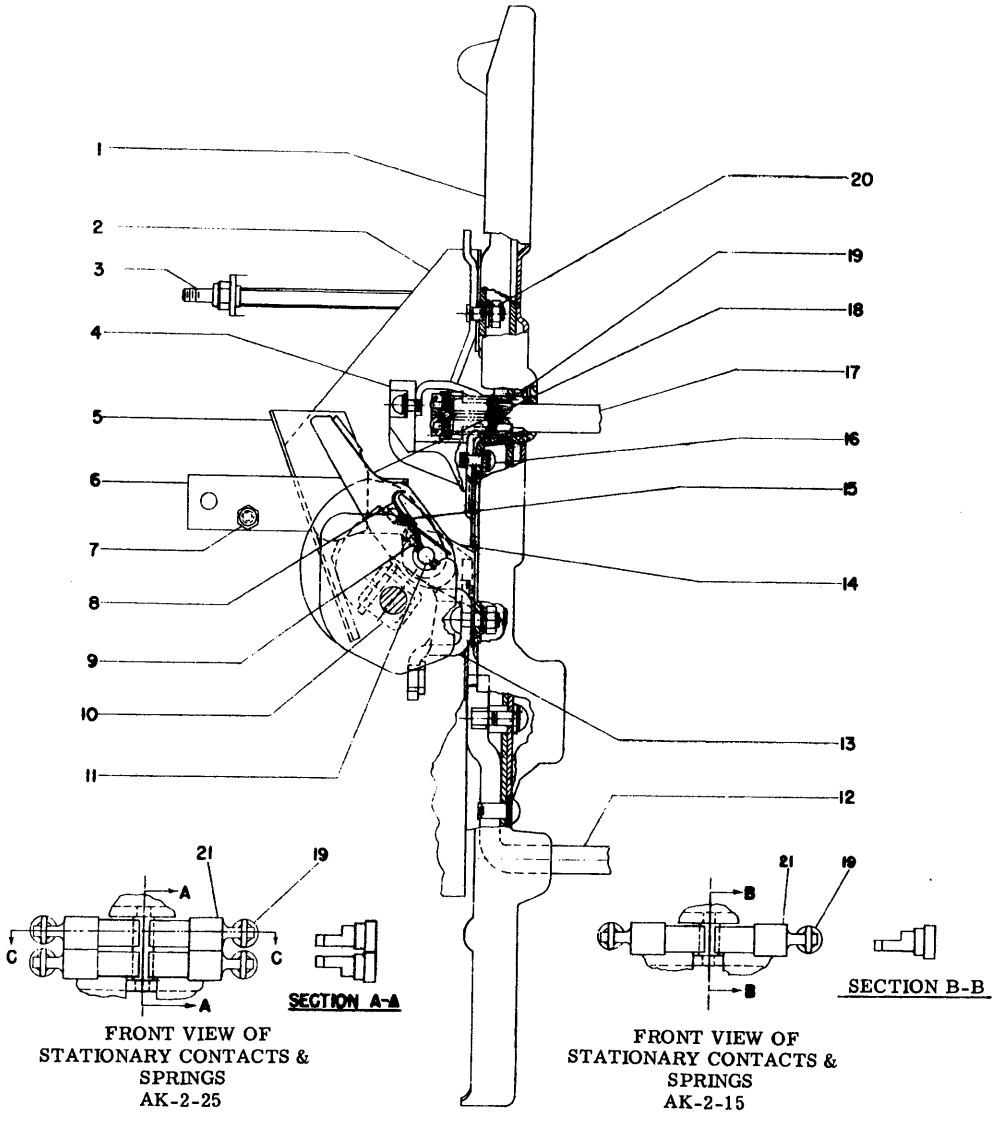


Figure 3. (549D409-2) Contact Assembly

1. Breaker Base
2. Insulation
3. Insulated Stud
4. Upper Stud Barrier
5. Insulation
6. Links (Insulated)
7. Tie Bolt
8. Spring
9. Spring Clip (Retainer)
10. Cross Bar
11. Pivot Pin
12. Lower Stud
13. Contact Pivot Support
14. Spring
15. Contact Wipe Adjustment Pin
16. Screw
17. Upper Stud & Arc Runner
18. Movable Contact
19. Spring
20. Nut
21. Stationary Contacts

ment pin (15) on the center pole into position. Be sure the stationary insulation barriers are correctly located.

4. Align the cross bar with the left and right pole pivot supports and install the left and right pole movable contacts. Use the bullet nosed steel pin to aid in aligning the holes in the cross bar, the contacts and the pivot supports.

5. Install the left and right pole pivot pins while threading them through the spring clips and lock the spring clips (9). Be sure the pivot pins are fully inserted.

6. Adjust the contact wipe to 1/8" ± 1/32" by adjusting the eccentric contact wipe adjusting pin (15). The breaker must be open to adjust the wipe. In the event acceptable wipe cannot be obtained by moving the contact wipe adjusting pin (15), from the movable contact forward or backward as necessary to bring the wipe within the range of the contact wipe adjusting pin (15). Do not exceed the recommended settings for wipe; otherwise the breaker may not close completely. When viewed from the top with the breaker closed, the movable contact should be centrally located with respect to the stationary contacts. If the movable contacts are not centrally located as shown in section CC, form the movable contacts until they are nominally centered.

   If the moving contacts are not centered with 1/8" separation when closed against the fixed contacts, they should be bent laterally (after opening the breaker contacts). To do this without squeezing the two movable contact arms together, a 1/8" spacer plate should be inserted between them; then the pair can be grasped with pliers and bent in the desired direction for centering.

   New contacts should be adjustable using eccentric numbers 1, 2, or 3. These numbers are the ones visible when viewing the breaker from the front, not from above. (The higher numbers should be reserved for tightening at future maintenance readjustments after wear.) Also, if higher numbers are used, where adequate wipe is obtainable at settings 1, 2, or 3, it is possible that the stationary contacts will bottom, producing excessive back force on the breaker closing mechanism so that the toggle link will not pass center. As a result, the breaker will not complete its stroke, and inadequate pressure and wipe will result; burn-up of contacts from just load current will follow.

   If the required wipe of new contacts cannot be obtained with eccentric number of 3 or lower, bending of the contact arms toward the closed position is required. This should be done individually, using an 8" Crescent or 1/2 - 5/8" tapered open end wrench to grasp the contact and a 10" Crescent or the 1" - 1-1/8" tapered open-end wrench to grasp the pivot portion of the arm. The soft copper arm will bend with little difficulty. Both arms should be bent identically.

   Operate breaker several times, and recheck wipe to make sure bending of movable arms did not occur in these operations.

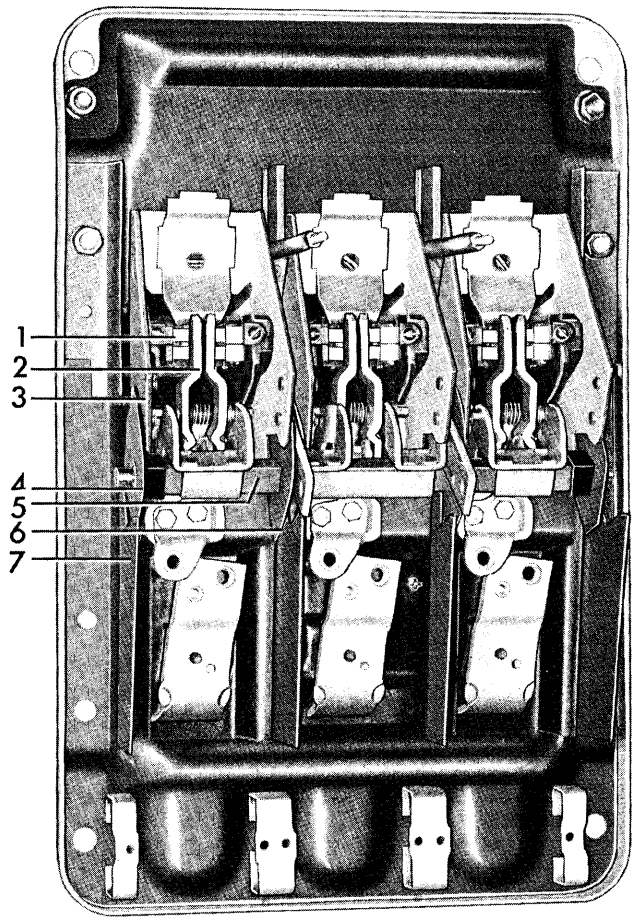


Figure 4. (8039851) AK-2-25 Back Frame - Location of Crossbar and Pole Shields

1. Stationary Contacts
2. Movable Contacts
3. Upper Stud Asbestos Shield
4. Crossbar Plastic End Shield
5. Crossbar Assembly
6. Crossbar Asbestos Inner Shield
7. Lower Stud Asbestos Shield

7. Operate the breaker manually several times to assure proper functioning occurs, then replace the U shaped insulation (5) Figure 3 and arc quenchers. When replacing the arc quenchers be sure the quencher is seated downward completely and that the quencher clamp covers the knobs protruding through the arc quencher insulation.

CONTACT SPRINGS
(19) Figure 3

A minimum force of 5 lbs and a maximum force of 9 lbs. should be required to begin movement of a single stationary contact from the open position towards the closed position. This may be checked by using a push scale applied at the point at which the movable contact touches the stationary contact. If these pressures are not obtained or if the spring is damaged, replacement is required.

In order to replace the contact spring the upper stud (17) must be removed. The hardware which fastens the stud to the breaker base consists of two screws (16), and nut (20). When These are removed, the stud may be withdrawn from the base in a forward direction. After the stud has been removed, it is a simple matter to disconnect the two ends of the spring (19) and replace it with a new one.

MECHANISM

The breaker mechanism is a spring actuated, over-center toggle type of mechanism. As the closing force is applied, either by movement of the operating handle or the closing solenoid armature, energy is stored in the operating springs. After the springs have gone over center, movement of the output crank of the mechanism is still blocked for a time by a cam arrangement. As the springs are further extended, the blocking cam moves away from the output crank, and the springs are allowed to discharge part of their stored energy, closing the breaker contacts.

This assures a fast-snapping closing action regardless of the speed at which the closing handle is operated.

The breaker mechanism is tripped by the displacement of the trip latch (7), Figure 6. Looking at the breaker from the right hand side as in Figure 5, the tripping movement of the latch is counter-clockwise. Operation of any of the automatic trip devices or the trip push button causes the latch to move in the tripping direction. When the latch moves off the trip latch roller (7), the remaining force in the operating spring causes the mechanism toggle to collapse, resulting in the opening of the breaker contacts.

ADJUSTMENT

Since all the mechanism adjustments are carefully set by experienced factory personnel after assembly at the factory, it should normally not be necessary to make any adjustments in the field. At the time of installation, and also in the course of a maintenance inspection, if the breaker functions properly through several repeated operations, it is best to assume that adjustments are satisfactory.

If the breaker mechanism does not function properly, it is best to first perform the available remedial measures listed in the "Trouble Shooting" chart of these instructions. One of the remedies listed is that of proper mechanism latch engagement, the amount of engagement between the latch (7) and latch roller (5), Figure 6. This is the only adjustment that is required on the breaker mechanism, and proper latch engagement is obtained in the following manner:

(NOTE - Before making latch adjustments, check to make sure that the buffer paddle which stops against the end of the latch adjustment screw is rigidly fastened to the trip shaft. Hold the trip shaft (8), Figure 5, steady and attempt to move the buffer paddle. If any relative movement between the two is noted, tighten the fasteners holding the buffer paddle to the trip shaft.)

Latch Adjustment - Manual Breaker

1. Locate the latch adjustment screw on the lower, outer side of the right-hand mechanism side frame. This screw is threaded through a nylon insert locknut which, in turn, is welded to a projecting bracket on the side frame.

2. Rotate the closing handle 90 degrees counter-clockwise, setting the closing mechanism in the reset position. Turn the adjusting screw into the locknut until the closing mechanism trips open, the closing handle returning to its normal vertical position. NOTE: KEEP HANDS CLEAR OF THE CLOSING HANDLE WHEN MAKING THIS ADJUSTMENT.

3. Withdraw the adjusting screw from the locknut 1/4 turn at a time, attempting to close the breaker after each 1/4 turn, and observing whether the contacts move toward closing before tripping occurs. If the contacts move before tripping occurs, you have established the position of the adjusting screw where the latch and latch roller begin to engage. In some cases, it may be necessary to turn the adjusting screw less than 1/4 turn in order to establish the position where the contacts begin to move before tripping occurs. When this position is established, note the position of the slot in the head of the adjusting screw.

4. Withdraw the adjusting screw three and one-half turns from the position noted in step 3. This sets the proper amount of latch engagement.

Latch Adjustment - Electrical Breaker

1. Locate the latch adjustment screw on the lower, outer side of the right mechanism side frame. This screw is threaded through a nylon insert locknut which, in turn, is welded to a projecting bracket on the side frame.

2. With the breaker in the open position turn the adjusting screw into the locknut one complete turn at a time, closing the breaker after each complete turn of the adjusting screw, until

the breaker will not close. Use the maintenance closing handle whenever closing or attempting to close the breaker during this entire operation.

3. Withdraw the adjusting screw from the locknut 1/4 turn at a time, attempting to close the breaker after each 1/4 turn, and observing whether the contacts move toward closing before tripping occurs. If the contacts move toward closing before tripping occurs, you have established the position of the adjusting screw where the latch and latch roller begin to engage. In some cases, it may be necessary to turn the adjusting screw less than 1/4 turn to establish the position where the contacts move before tripping occurs. When this position is established, note the position of the slot in the head of the adjusting screw.

4. Withdraw the adjusting screw three and one-half turns from the position noted in step 3. This sets the proper amount of latch engagement.

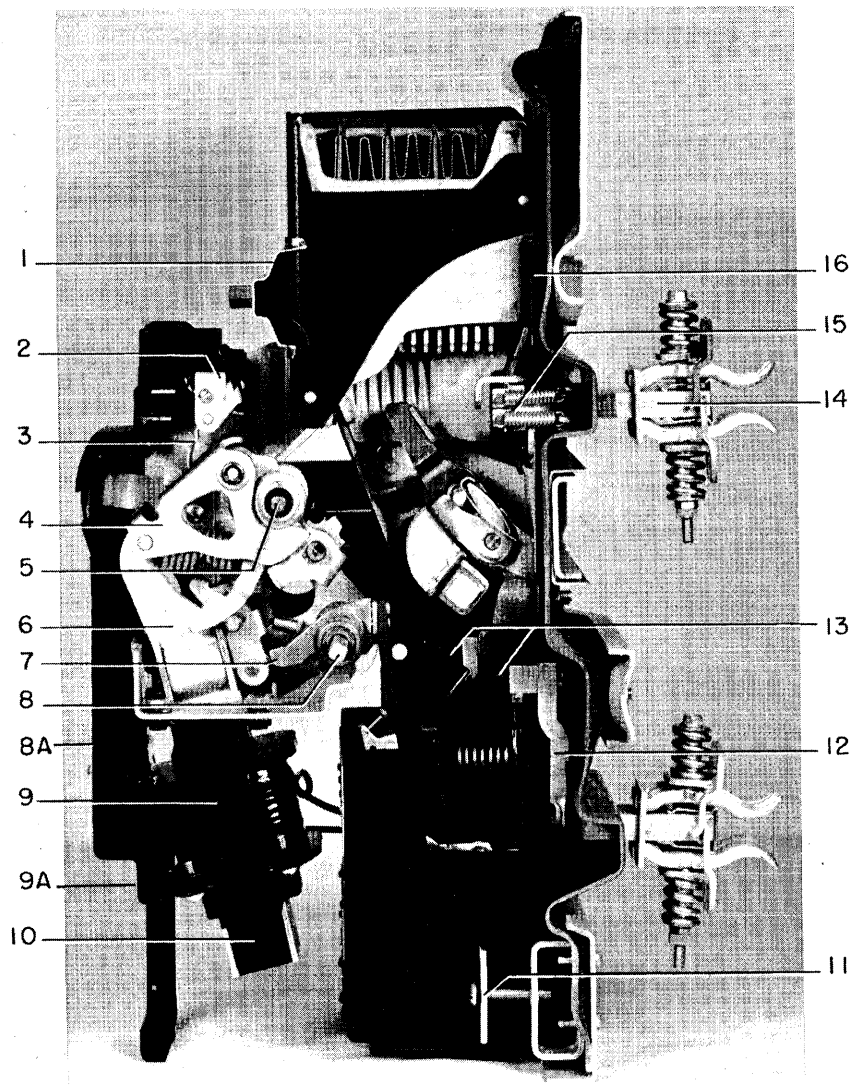


Figure 5. (8024457) Cut Away Model of Electrically Operated AK-2 Breaker

1. Arc Quencher Retainer
2. Cut off Switch
3. Cut off Switch Actuator
4. Spring Carrier
5. Shoulder Pin
6. Connecting Link
7. Trip Latch Roller
8. Trip Shaft
8A. Front Escutcheon
9. Closing Solenoid
9A. Location of Slots for Maintenance Handle
10. Closing Solenoid Armature
11. Cover Retainer of Overload Device
12. Lower Stud
13. Socket Head Screws
14. Upper Stud
15. Stationary Contacts and Springs
16. Arc Runner

Should the mechanism continue to function improperly after the proper latch engagement has been set and the corrective measures listed in the "Trouble Shooting" chart carried out, it is generally recommended that no attempt be made to repair the mechanism interior but that a replacement mechanism assembly be obtained from the factory.

REPLACEMENT

1. If the breaker is electrically operated, remove the front escutcheon by taking four screws from flange. If the breaker is a drawout type, two small round head screws must also be removed from the bottom edge of the escutcheon. (For removal of front escutcheon from manually operated breakers, see procedure described below.)

2. Remove arc quenchers (See "Arc Quencher").

3. Disconnect the two insulated connecting links between the mechanism and the contacts as in step 2 of the procedure for "Separation of Front and Back Frames".

4. Remove the two elastic stop nuts, which fasten the upper extensions of mechanism frame to studs connecting with rear frame.

5. Remove four screws which fasten the bottom of the mechanism frame to the horizontal cross member of the front frame.

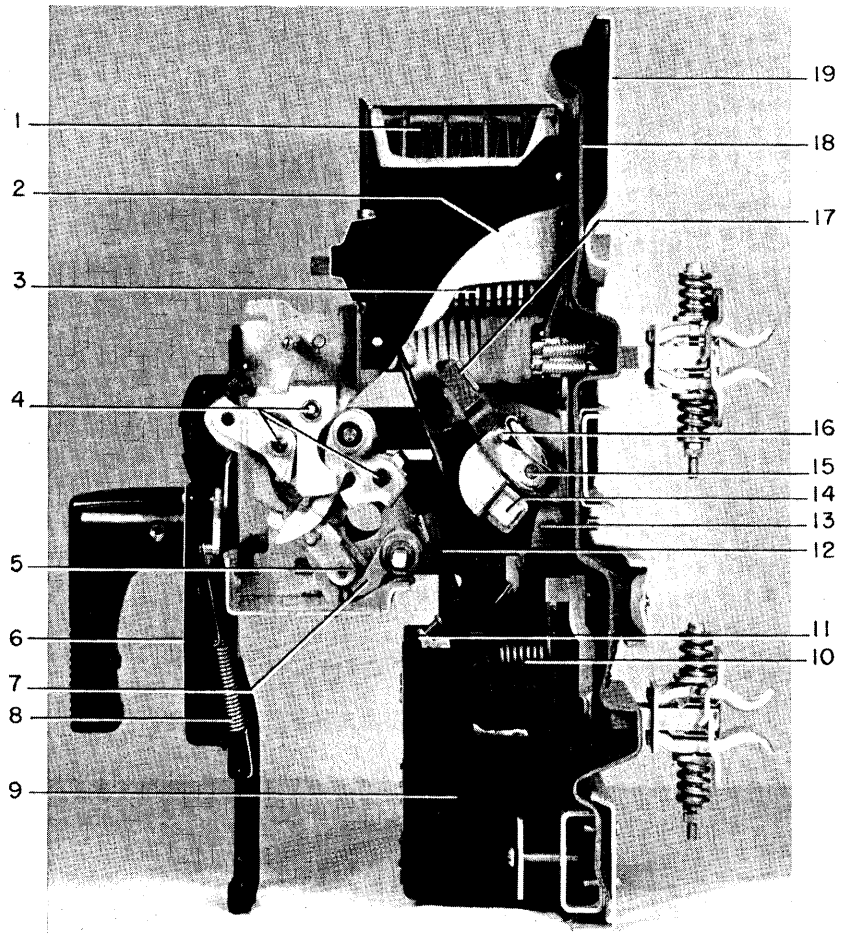


Figure 6. (8024516) Cut Away Model of Manually Operated AK-2 Breaker

1. Arc Quencher Muffler
2. Ceramic Side Plates
3. Steel Plates
4. Fixed Centers in Mechanism
5. Latch Roller
6. Escutcheon
7. Trip Latch
8. Handle Return Spring
9. Overload Device
10. Series Coil of Overload Device
11. Trip Arm of Overload Device
12. Trip Paddle
13. Movable Contact Pivot Support
14. Crossbar
15. Movable Contact Pivot
16. Contact Wipe Adjustment Pin
17. Movable Contact
18. Moulded Compound Bar
19. Steel Back Plate

6. If the breaker is manually operated, and has no auxiliary switch, it is now free to be lifted clear of the breaker. If it has an auxiliary switch, this may be disconnected from the mechanism as described under "Auxiliary Switch - Replacement, elsewhere in these instructions.

7. If the breaker is electrically operated, it will be necessary to disconnect the mechanism from the solenoid armature. In order to do this, raise the mechanism as far as the travel of the armature will permit and remove the screw which binds together the two extensions of the armature. After this is removed, the armature extensions must be spread apart to release them from the link connecting with the mechanism. This can be done by threading a #10-32 screw at least 1-3/4 inches long into the top hole of the armature extension. This hole is just above the one from which the binding screw has been removed. As the end of the screw butts against the far extension, the two extensions will be spread open, releasing the mechanism link.

8. The replacement mechanism may be installed by reversing the order of procedure for disassembly. After reassembly, check the operation of the breaker and, if necessary, adjust the latch engagement.

REMOVAL OF FRONT ESCUTCHEON OF MANUAL BREAKERS

1. Remove set screw fastening the plastic handle to steel operating shaft and remove the operating

2. Open and remove annealed (soft) retainer and two flat washers from shaft.

3. Remove four screws from flange of escutcheon If the breaker is a drawout type, two small round head screws must also be removed from the bottom edge of the escutcheon.

4. Push steel operating shaft through escutcheon bushing.

5. Remove handle reset spring (8) Figure 6, and escutcheon is free of breaker.

6. Handle and escutcheon assembly can be assembled most easily by exactly reversing the procedure for disassembly. In replacing the escutcheon it may be necessary to use pliers to pull the operating shaft fully into the escutcheon in order to have space enough to replace the flat washers and the soft retainer. The latter may be closed on its groove in the shaft by ordinary gas pliers. After replacement, check operation of breaker.

AUXILIARY SWITCH

The auxiliary switch is mounted on the left side of the operating mechanism frame. Its operating shaft is linked to the output crank of the breaker mechanism. Through a cam arrangement, the operating shaft of the switch controls the open and closed positions of the individual contact pairs. Each stage of the switch, which is usually two-stage or five-stage, contains one "a" and one "b" set of contacts. An "a" pair of contacts is always in the same position as the main breaker contacts. That is, open when the breaker contacts are open, and closed when the breaker contacts are closed. Just the oposite is true of the "b" contacts. The terminals of the switch are covered by a sheet of insulating material held in place by two screws fastened along its left edge. When this is removed, the terminals are exposed. The upper pairs of terminals are those which connect to "a" switches. The lower terminals connect to "b" switches.

REPLACEMENT

1. Remove auxiliary switch cover.

2. Disconnect leads to switch terminals.

3. Remove two screws which fasten switch to side of mechanism frame.

4. Remove switch by moving towards left.

5. Before mounting replacement switch, turn the crank end of the switch operating shaft in position to engage the hole in the link connecting with with the breaker mechanism. Be sure the bearing washer is in place between the mechanism link and the switch operating shaft.

6. Complete mounting by following disassembly steps in reverse order.

ELECTRICAL CONTROL COMPONENTS

These consist of the following:

1. Closing solenoid

2. "X" contactor (relay)

3. "Y" permissive relay

4. Cut-off switch

5. Closing switch

6. Shunt-trip device

The last two of these components may or may not be present in the control arrangement.

CLOSING SOLENOID

The closing solenoid consists of a magnet, armature and coil. This assembly is located directly beneath the breaker mechanism to which it is connected by a link which ties the upper end of the armature to the spring carrier of the mechanism. (See Figure 5.)

When voltage is applied to the coil, the magnetic force generated pulls the armature up into the coil and magnet assembly. This, in turn, rotates the spring carrier about its pivot, extending the mechanism spring and causing its line of action to move "over center", resulting in a closing operation.

REPLACEMENT

The only replacement operation that might conceivably be required on this assembly is that of the solenoid coil. To replace this, proceed as follows:

1. Remove escutcheon by unfastening four flat head screws in flange.
2. Remove closing switch. (See "Closing switch".)
3. Cut off or disconnect the coil leads.
4. Remove four screws which fasten lower section of magnet to upper section.
5. Allow lower section of magnet and coil to slide downward until clear of armature.
6. Reassemble with new coil by reversing order of procedure.

"X" CONTACTOR

The "X" contactor is a heavy-duty relay which performs the function of closing the circuit of the breaker solenoid during electrical operations. Three of the four sets of contact of the device are arranged in series to minimize the duty required of any one contact. As explained under "Operation", the fourth contact is used to "seal-in" the "X" coil.

The "X" contactor is located on the right beneath the horizontal front frame member. It is mounted on three studs which fasten it to a mounting bracket which is suspended from the frame. Rubber bushings on the mounting studs provide anti-vibration and anti-shock protection for the relay. The relay contacts and their terminals are covered by a molded piece of insulation which fits over spring clips that hold the cover in place.

REPLACEMENT

Removal of the complete device is accomplished by removing the cover, disconnecting the leads from the terminals, and removing the nuts from the three mounting studs. If the replacement unit includes the mounting bracket, the relay need not be removed from the old bracket. This can be taken off the breaker simply by removing the two screws which fasten it to the breaker frame. If the breaker is a drawout type, the supporting bracket of the "Y" relay may be temporarily displaced to provide access to the screws.

Since the expendable parts of the "X" contactor are the contacts and the coil, ease of replacement of these parts has been designed into the relay. Methods of procedure are as follows:

Contacts

1. Remove relay cover.
2. Remove terminal binding screw of stationary contact to be replaced.
3. Lightly pinch with pliers (pointed end) the split section of the contact which enters the hole in the compound body of the device and lift out the stationary contact.
4. With the fingers, pull forward on the spring guide of the movable contact, compressing the contact spring as far as possible.
5. With the spring thus held, grip the end of the contact strip with pointed pliers, turn it through 90 degrees on its long axis, and withdraw it.
6. Replace new contacts by reversing the procedure.

Coil

1. Remove relay cover.
2. Turn the two retaining spring clips on the ends of the device through 90 degrees about their pivots.
3. Pull out the two halves of the body of the device which carry the stationary contacts. When these are clear of the frame, the armature and movable contact assembly will move aside, exposing the coil.
4. Remove the terminal screws of the coil and pull it free of its retaining spring clips.
5. Place new coil on pole piece inside of the spring clips and fasten terminals to leads.
6. Just start the replacement of one of the compound blocks which hold the stationary contacts into its groove in the frame.
7. Position the armature and movable contact assembly to allow the entrance of the second stationary contact block.
8. When these parts are all properly aligned, with the stationary contacts under the movable contacts, push them into their guiding grooves in the frame until they bottom.

9. Rotate the retaining spring clips to the locked position, making sure that each clip is in its proper recess, and replace the device cover.

"Y" RELAY

As described under "Operation", the "Y" relay is a permissive relay which limits to one the number of breaker closures possible on one closing signal.

On drawout breakers, the "Y" relay mounting bracket is fastened to the right hand side member of the breaker frame by two mounting screws. On terminal board breakers, it is fastened to the rear side of the terminal board support. The relay itself is fastened to an intermediate bracket which is detachable from the main support. The junctures between the relay and the intermediate bracket and between the two brackets are rubber cushioned against vibration and shock.

REPLACEMENT

If replacement of the "Y" relay becomes necessary, it may be detached from its supporting brackets by removal of the fastening hardware. The leads to the relay should be cut off as closely as possible to the soldered connections so that enough wire will remain for connection to the new relay. Sufficient original wire is allowed for this purpose.

After the old relay has been removed, the wire leads to the relay should be stripped of insulation to about 1/4 of an inch from the ends. A good mechanical connection should be made before soldering.

After all connections are completed, the relay may should again be mounted to the breaker by means of its supporting brackets and hardware.

After replacement has been completed, the relay may be checked electrically in the following manner:

1. Apply closing voltage to terminal board or secondary disconnects.

2. Push button of closing switch and hold closed.

3. Continuing to hold push button in closed position, manually trip the breaker open.

4. If the breaker stays open, and makes no attempt to close, the "Y" relay is functioning properly.

5. While releasing the close button, observe the "Y" relay. It should open as the closing switch is released.

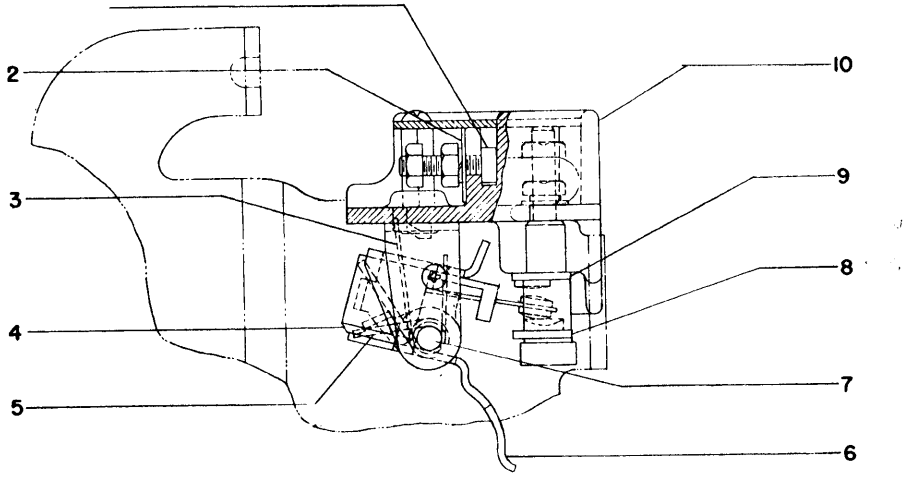


Figure 7. (695C162) Cut-Off Switch

1. Screw
2. Washer
3. Spring
4. Movable Contact Assembly
5. Spring
6. Actuator
7. Pivot Pin
8. Contact (BB)
9. Contact (AA)
10. Support

CUT-OFF SWITCH

Figure 7.

As explained under "Operation", the function of the cut-off switch is to de-energize the "X" contactor coil and energize the "Y" relay coil as the breaker mechanism moves from the opened to the closed position.

The switch is operated by the movement of a mechanism link against the switch actuator (6). This causes the actuator and movable contact assembly (4) to rotate counterclockwise about pin (7), opening the "bb" contacts (8) and closing the "aa" contacts at (9). Overtravel of the actuator (6) beyond the point of making contact at (9) is absorbed by spring (5) which couples the movable contact (4) to the actuator. Spring (3) resets the switch after the breaker contacts open and the breaker mechanism resets.

The point at which the cutoff switch operates during the breaker closing cycle is after the spring charged mechanism has been driven over-center. This assures that the cutoff switch cannot operate too early in the breaker closing cycle, thus the X and Y relays are de-energized and energized, respectively, at the proper time and the circuits anti-pump feature is maintained. When the closing mechanism is driven over-center, the force of the previously charged closing springs is released, closing the breaker.

REPLACEMENT

The cut-off switch is located above the breaker mechanism. It is fitted between the upper portions of the steel side plates that make up the mechanism frame. A raised horizontal ridge on each side of the molded body of the switch fits into a corresponding groove in each of the steel side plates. A round head screw on each side fastens the switch and side plate together. Replacement of the switch is accomplished by the following procedure:

1. Remove the cover on the top of the switch by taking out the two screws which hold it in place.
2. After taking careful note of the connection arrangements, disconnect the leads from the switch terminals.
3. Remove the two screws, one on each side, which fasten the switch to the mechanism side plates. Note that the one on the right hand side also holds a wiring cleat and spacer which serves to hold the wires clear of the link connecting the mechanism and the breaker position indicator.
4. Remove the front escutcheon from the breaker.
5. Slide the cut-off switch out from between the steel side plates by pulling straight forward.
6. Mount the replacement switch by reversing the order of procedure.

CLOSING SWITCH

Figure 8.

The closing switch is mounted on the upper flange of the closing solenoid coil. A hole in the escutcheon (3) permits access to the switch button (4). When the button is pressed, movable contact (5) deflects and impinges upon stationary contact (2). This energizes the "X" relay coil which seals itself in, and, in turn, energizes the closing solenoid.

REPLACEMENT

1. Remove escutcheon (3).
2. Disconnect leads from switch terminals.
3. Deflect the left end of hinge (7) to the left so that the movable contact (5) may be disengaged from the switch assembly.
4. Removal of the two screws (10) from speednuts (9) completes the disassembly of the switch.
5. Reassembly with new parts is a matter of reversing the described procedure. In reassembling, be sure the tab on the left end of hinge (7) is bent to the right far enough to avoid any possibility that movable contact (5) might become free of the assembly.

SHUNT TRIP DEVICE

Figure 9.

The shunt trip device is mounted underneath the horizontal cross frame member, just to the left of the front escutcheon. It is composed of a magnet, coil and armature. The armature has an extended arm or striker (11) which bears against the trip paddle (12) on the trip shaft when the coil (8) is energized. This displaces the trip latch in the breaker mechanism, opening the breaker contacts.

The trip device is generally activated by a remote switch or relay which closes the shunt trip coil circuit.

In order to avoid unnecessary heating of the coil of the device, an auxiliary switch "a" contact is wired in series with the coil. This prevents the energization of the coil if the breaker is open.

REPLACEMENT

The entire shunt trip device may be dismounted by disconnecting the coil leads and removing nuts (1). However, the only part of the device that might conceivably need replacement during the life of the breaker is the coil (8). This

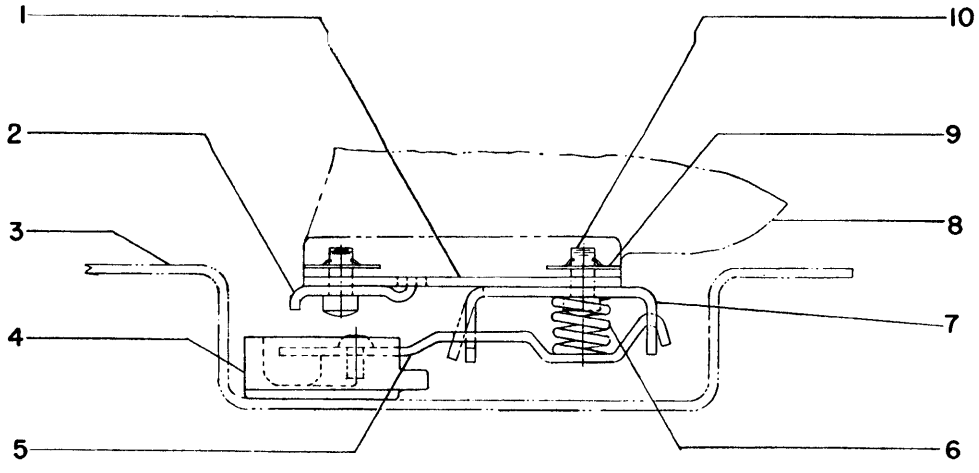


Figure 8. (805B905) Closing Switch (Top View)

1. Insulation
2. Stationary Contact
3. Front Escutcheon
4. Push Button
5. Movable Contact
6. Spring
7. Hinge
8. Closing Solenoid
9. Speed Nut
10. Screw

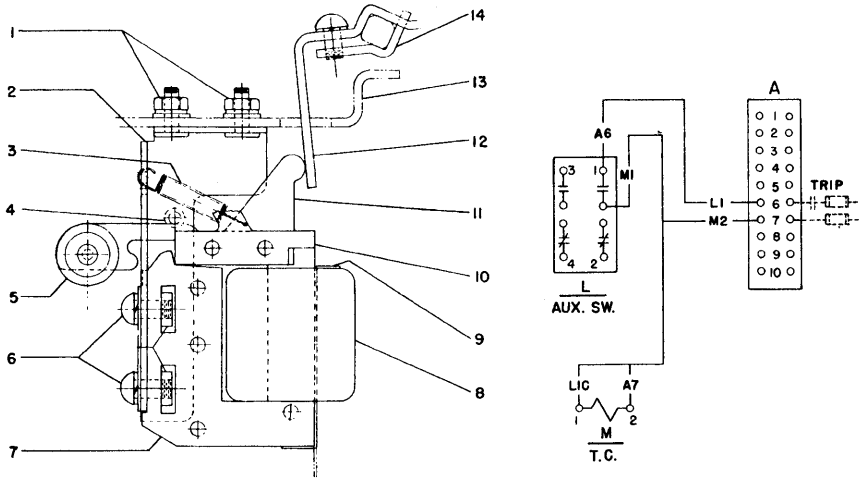


Figure 9. (695C161) Shunt Trip Device

1. Nut
2. Frame
3. Spring
4. Rivet
5. Weight
6. Screws
7. Magnet
8. Coil
9. Clamp
10. Armature
11. Armature Arm
12. Trip Paddle
13. Mechanism Frame
14. Trip Shaft Clamp

may be replaced without removing the device from the breaker by proceeding as follows:

1. Disconnect leads of coil (8).
2. Remove two screws (6) which fasten magnet (7) and coil to the frame (2).
3. Having removed the magnet from the device, straighten the end of clamp (9).
4. Remove the coil from the magnet.
5. Install new coil, again forming end of clamp (9) as shown.
6. Reassemble to frame.
7. Connect coil leads.

ADJUSTMENT

The only adjustment required on the shunt trip device is that which ensures positively that the breaker will trip when the device is activated. In order to be sure of this, armature arm (11) must travel from 1/32 to 1/16 of an inch beyond the point at which the breaker trips. A good method of checking this is to hold a 1/32nd shim between the magnet and armature at (10), and with the breaker closed, push upwards at (5), closing the armature against the magnet. If the breaker trips, there is sufficient overtravel. If adjustment is necessary, trip paddle (12) may be formed towards or away from armature arm (11).

PROTECTIVE DEVICES

An AK-2/3 breaker may be equipped with the following protective devices:

1. Overcurrent trip (Magnetic) AK-2
2. Power Sensor Trip (Static) AK-3
3. Reverse Current Trip AK-2
4. Under Voltage Trip & Lockout Device
5. Bell Alarm and/or Lockout device
6. Open Fuse lockout device.
7. AKD-5 Interlock AK-2A/AK-3A

OVERCURRENT TRIP DEVICE (Magnetic)

The typical overcurrent trip device consists of a magnetic structure, a series current coil, and a pivoted armature.

When current flow through the series coil generates a magnetic field strong enough, the armature overcomes the restraining force of a calibration spring attached to it, and closes against the magnet. This trips the breaker by means of an extension on the armature which strikes against a trip paddle on the trip shaft.

Depending on the type of individual device, the movement of the armature may be delayed for a time by a timing device. If a relatively long time-delay (seconds or minutes) is desired, the velocity of armature movement is governed by a piston moving through an oil dashpot. If only a short-time delay (cycles or milli-seconds) is required, movement is controlled by an escapement gear and pallets arrangement.

An AK-2-15/25 breaker may be equipped with either the EC-2 or EC-1 overcurrent trip device. The majority of applications will require the use of the EC-2 device. The EC-1 device is normally used when the short-time delay feature is required, or when the trip device is used to operate a special over-current alarm switch.

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

EC-2 OVERCURRENT TRIP DEVICE

The Type EC-2 overcurrent tripping device is available in three forms:

1. Dual overcurrent trip, with long-time delay and high-set instantaneous tripping.
2. Low-set instantaneous tripping.
3. High-set instantaneous tripping.

The dual trip has adjustable long-time and instantaneous pick-up settings and adjustable time settings. Both forms of instantaneous trips have adjustable pick-up settings.

DUAL OVERCURRENT TRIP, WITH LONG-TIME DELAY AND HIGH-SET INSTANTANEOUS TRIPPING.

By means of the adjustment knob (5), Figure 10, which can be manipulated by hand, the current pick-up point can be varied from 80 to 160 percent of the series coil rating. The indicator and a calibration plate (4), Figure 10, on the front of the case provide a means of indicating the pick-up point setting in terms of percentage of coil rating. The calibration plate is indexed at percentage settings of 80, 100, 120, 140 and 160.

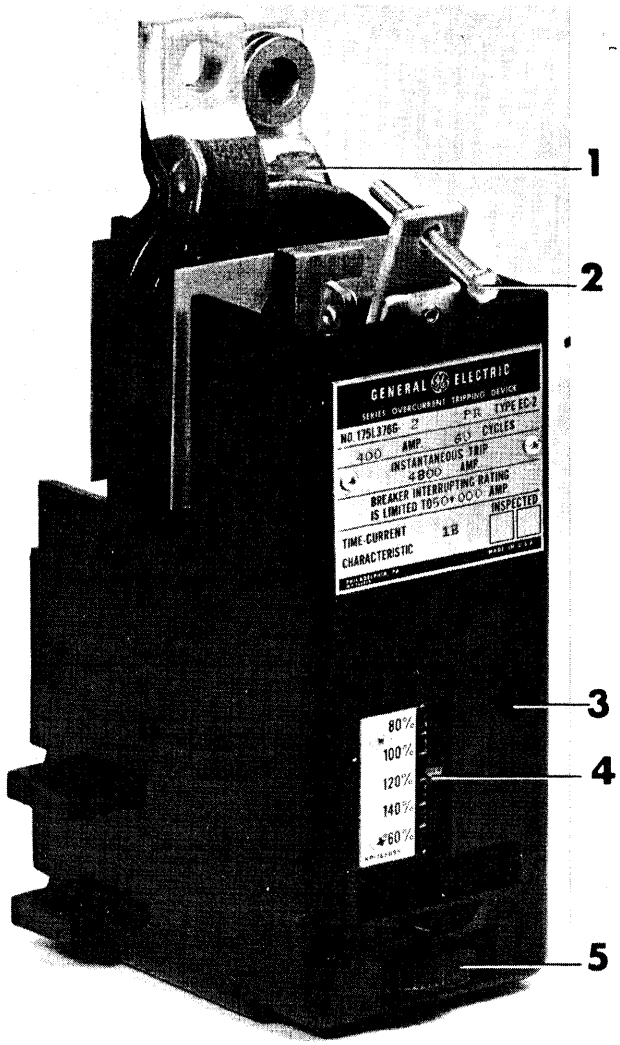


Figure 10. (8024842) EC-2 Overcurrent Trip

1. Series Coil
2. Trip Adjustment Screw
3. Opening for Time Adjustment
4. Pickup Indicator & Calib. Plate
5. Pickup Adjustment Knob

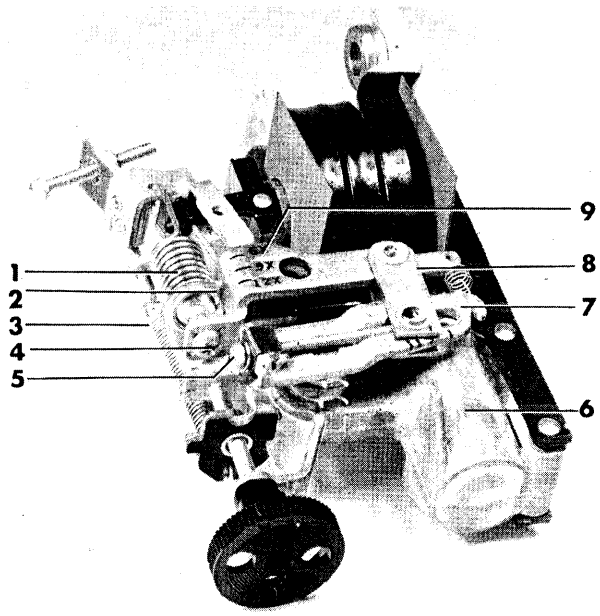


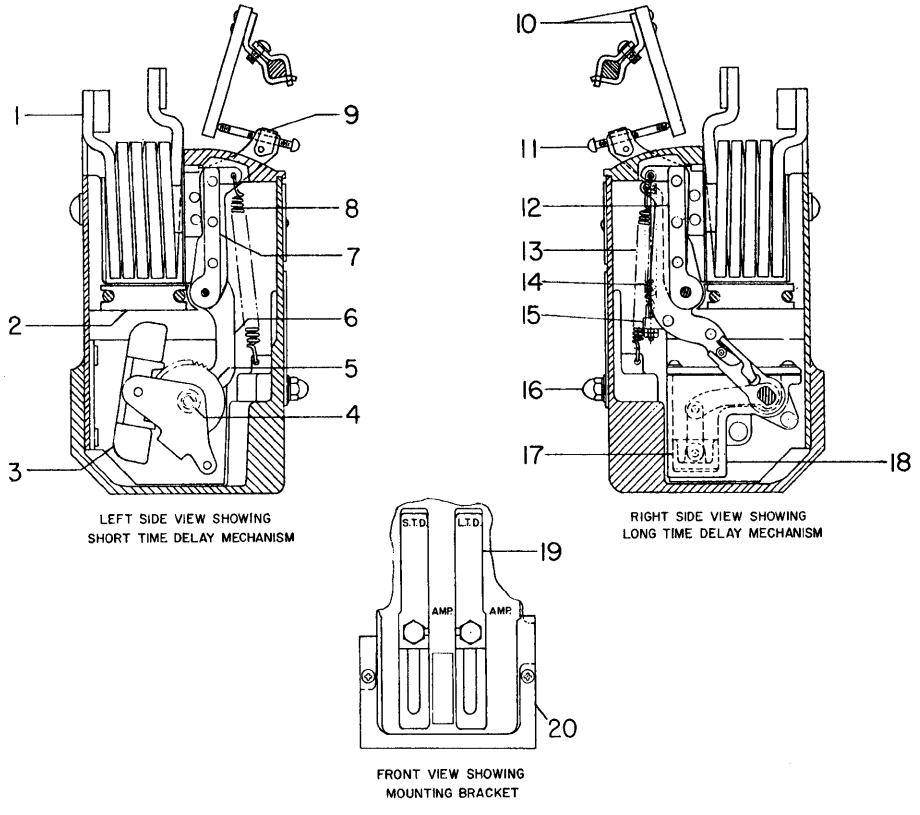
Figure 11. (8024843) EC-2 Overcurrent Trip With Cover Removed.

1. Instantaneous Calibration Spring
2. Movable Nut (Index Pointer)
3. Time-Delay Calibration Spring
4. Instantaneous Pickup Adjustment Screw
5. Time-Delay Adjustment Screw
6. Oil Dashpot
7. Dashpot Arm
8. Connecting Link
9. Instantaneous Pickup Calibration Marks

The long-time delay tripping feature can be supplied with any one of three time-current characteristics which correspond to the NEMA standards maximum, intermediate and minimum long-time delay operating bands. These are identified as 1A, 1B and 1C characteristics, respectively. Approximate tripping time for each of these, in the same order are 30, 15 and 5 seconds at 600% of the pick-up value of current. (See time-current characteristic curves 286B201A, B, and C).

The tripping time may be varied within the limits shown on the characteristic curves by turning the time adjustment screw (5), Figure 11. Turning in a clockwise direction increases the tripping time; counter-clockwise motion decreases it. The dashpot arm (7), Figure 11 is indexed at four points, maximum - 2/3 - 1/3 - minimum from the left, as viewed in Figure 11. When the index mark on the connecting link (8), Figure 11, lines up with a mark on the dashpot arm, the approximate tripping time as shown by the characteristic curve is indicated . The 1A and 1B characteristic devices are shipped with this setting at the 2/3 mark and the 1C characteristic at the 1/3 mark. The standard characteristic curves are plotted at the same settings.

Time values are inversely proportional to the effective length of the dashpot arm. Therefore, the linkage setting that gives the shortest time value is the one at which dimension "A" Figure 11, is greatest. The time adjustment screw (5), Figure 11, may be turned by inserting a Phillips head screwdriver through the hole in the front of the case, but if it is desired to relate the linkage setting to the index marks on the linkage it will be necessary to remove the case. This may be done by removing the two mounting screws, one on each side of the case, which may be taken off without disturbing the trip unit itself.



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

Figure 12. (695C189) EC-1 Type Overcurrent Trip Device

NOTE: Forcing the adjusting screw to either extreme position may cause binding of the device and should be avoided.

INSTANTANEOUS LOW-SET TRIPPING

The low-set instantaneous pick-up point may be varied by the adjustment knob (5), Figure 10. The calibration in this case usually ranges from 80% to 250% of the series coil rating, the calibration plate being indexed at values of 80%, 100%, 200% and 250% of the rating.

INSTANTANEOUS HIGH-SET TRIPPING

The high set instantaneous pick-up value may have one of the following three ranges: 4 to 9 times coil rating; 6 to 12 times coil rating or 9 to 15 times coil rating. The pick-up setting may be varied by turning the instantaneous trip adjusting screw (4), Figure 11.

Three standard calibration marks will appear on the operating arm at (9), Figure 11, and the value of these calibration marks will be indicated by stampings on the arm as follows:

4X		6X		9X
6X	or	9X	or	12X
9X		12X		15X

At the factory, the pick-up point has been set at the nameplate value of the instantaneous trip current. (Usually expressed in times the ampere rating of the trip coil.) The variation in pick-up setting is accomplished by varying the tensile force on the instantaneous spring. Turning the adjustment screw changes the position of the movable nut (2), Figure 11, on the screw. The spring is anchored to this movable nut so that when the position of the nut is changed, there is a corresponding change in the spring load. As the spring is tightened, the pick-up point is increased. The top edge of the movable nut (2), Figure 11 serves as an index pointer and should be lined up with the center of the desired calibration mark, punched slots on operating arm, to obtain the proper instantaneous trip setting.

EC-1 OVERCURRENT TRIP DEVICE

The EC-1 device can be provided with the following tripping combination

1. Long time delay, short time delay and instantaneous -tripping.
2. Long time and short time delay tripping only.
3. Long time delay and instantaneous tripping.
4. Short time delay and instantaneous tripping.
5. Short time delay tripping only.
6. Instantaneous tripping only.

   a. Adjustable (Low set)
   or
   Non-adjustable (High set)

SHORT TIME DELAY TRIPPING, Figure 12.

The armature (7) is retained by calibrating spring (8). After the magnetic force, produced by an overcurrent condition, overcomes this restraining force, the armature movement is further retarded by an escapement mechanism which produces an inverse time delay characteristic. The mechanism is shown in the left side view of Figure -12.

The pickup for this device can be field set between limits having a ratio of 2-1/2 to 1 in the range of 200 to 1000% of the coil rating.

LONG TIME DELAY TRIPPING, Figure 12

The armature (12), is retained by the calibration spring (13). After the magnetic force, produced bs an overcurrent condition, overcomes this restraining force, the armature movement is further retarded by the flow of silicone oil in a dashpot, which produces an inverse time delay characteristic. The mechanism is shown in the right side view of Figure 12.

INSTANTANEOUS TRIPPING, Figure 12.

a. Adjustable instantaneous tripping takes place after the magnetic force produced by an overcurrent condition, overcomes the restraining force of the adjustable calibration spring (13).

b. Nonadjustable instantaneous tripping takes place after the magnetic force produced by an overcurrent condition overcomes the restraining force of a nonadjustable spring (14).

ADJUSTMENTS, EC-1 AND EC-2

In addition to the pick-up settings and time-delay adjustments already described, overcurrent trip devices must be adjusted for positive tripping. This adjustment is made at the factory on new breakers, but must be made in the field when the breaker mechanism or the overcurrent trip devices have been replaced.

Positive tripping is achieved when adjustment screw (2), Figure 10, is in such a position that it will always carry the trip paddle on the trip shaft beyond the point of tripping the mechanism, when the armature closes against the magnet.

In order to make the adjustment, first unscrew trip screw (2), Figure 10, until it will not trip the breaker even though the armature is pushed against the magnet. . Then, holding the armature in the closed position, advance the screw until it just trips the breaker. After this point has been reached, advance the screw two additional full turns. This will give an overtravel of 1/16 of an inch and will make sure that activation of the device will always trip the breaker.

Adjustment screw (2), Figure 10, can best be manipulated by an extended 1/4 inch hex socket wrench.

In order to gain access to the adjustment screw on the center pole overload device, it will be necessary to remove the nameplate from the front escutcheon of the breaker. This will reveal a hole, centrally located in the escutcheon, by means of which the extended socket wrench can engage the adjustment screw.

REPLACEMENT, EC-1 and EC-2

Replacement of either the EC-1 or EC-2 overcurrent trip device is accomplished by the following procedure:

1. Separate the breaker's front and back frames as described in the section under "Maintenance".
2. Remove the steel clamps which fasten the cover of the device to the back of the breaker. NOTE: Pickup settings on the cover of each device are calibrated for the specific device. When replacing covers, replace on associated device.
3. Remove the 3/8 inch hexagon headed bolts which fasten the coil of the overload device to the breaker copper.
4. Remove the round head screw which fastens the frame of the overload to the breaker base.
5. After reassembling breaker with new overload device, adjust for "positive trip" as described under "Adjustments" of this section.

REVERSE CURRENT TRIP DEVICE

Figure 13.

The reverse current trip device sometimes used with d-c breakers will trip the breaker open if the direction of current flow is reversed.

This device is similar in appearance and is mounted in the same way as the overcurrent trip.

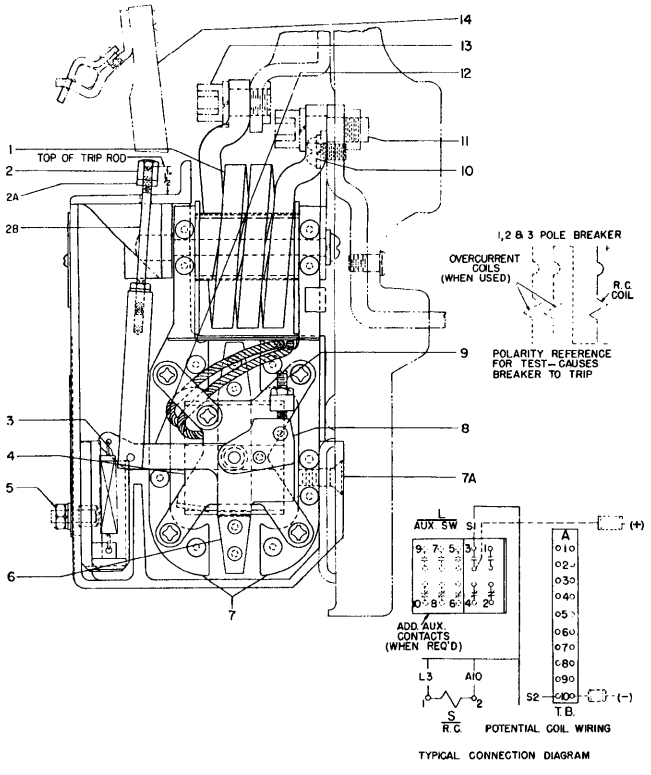


Figure 13. (286B209) Reverse Current Tripping Device

1.	Series Coil	7A.	Screws
2.	Adjusting Nut	8.	Counterweight
2A.	Locking Nut	9.	Stop Screw
2B.	Trip Rod	10.	Mounting Screw
3.	Spring	11.	Screw (Lower Stud)
4.	Potential Coil	12.	Trip Crank
5.	Calibration Nut	13.	Screw (Lower Stud)
6.	Armature	14.	Trip Paddle
7.	Pole Pieces		

The device consists of a series coil (1), with an iron core mounted between two pole pieces (7) and a potential coil connected across a constant source of voltage and mounted around a rotary type armature (6). Calibration spring (3) determines the armature pick-up value when a reversal of current occurs.

As long as the flow of current through the breaker is in the normal direction, the magnetic flux of the series coil and the magnetic flux of the potential coil produce a torque which tends to rotate the armature counterclockwise. The calibration spring (3) also tends to rotate the armature in the same direction. This torque causes the armature to rest against stop screw (9) attached to a bearing plate on the right side of the device.

If the current through the series coil (1) is reversed, armature (6) tends to move in a clockwise direction against the restraint of calibration spring (3). When the current reversal exceeds the calibration setting, the armature will move in a clockwise direction. This causes trip rod (2B) to move upwards against trip paddle (14), tripping the breaker open.

ADJUSTMENTS

The only adjustment to be made on the reverse current device is to make sure that the trip rod has a minimum overtravel of 1/32 of an inch beyond the point of tripping the breaker. The only occasion this adjustment should have to be made is when an old device is being replaced by a new one.

The new device will be factory adjusted so that the top end of the trip rod (2B) will extend 1/2 inch above the top of the device case, and no additional adjustments of the trip rod should be required. To obtain the proper 1/32 of an inch overtravel, close the breaker and proceed as follows:

1. Loosen the locking nut (2A).
2. Manually lift the trip rod and vary the position of the adjusting nut (2), thus establishing the position of the adjusting nut where the breaker is just tripped. (NOTE - Be sure that all parts of the person are kept clear of moving breaker parts when tripping the breaker.
3. With this position of the adjusting nut established, advance the adjusting nut upward one and one half turns.
4. Tighten the locking nut and the minimum 1/32 of an inch overtravel of the trip rod should be obtained.

REPLACEMENT

Replacement of the ED-1 Reverse Current Device is accomplished by means of the same procedure as that followed in the case of the EC Overcurrent Trip Devices. There is, however, one additional step to the taken. This consists of disconnecting the leads of the potential coil. These are connected to a small two point terminal board mounted between two of the phases on the breaker base. After the new device has been installed, adjust for overtravel of the trip rod as described above.

POWER SENSOR TRIP

GENERAL DESCRIPTION

All AK-3 Type Air Circuit Breakers contain Power Sensor Overcurrent Trip Devices. The Power Sensor Trip functions with solid state components with the exception of the Magnetic Trip Device which is used to trip the breaker on signal from the Power Sensor Unit. The Power Sensor Overcurrent Trip Device consists of four major components.

1. The magnetic coils around the breaker conductors (Figure 14).
2. The Power Supply which provides both the tripping energy and the comparison basis for overcurrent detection (Figure 15).
3. The Power Sensor Unit with the various pick-up settings and time delay selection taps (Figure 16).
4. The Magnetic Trip Device which physically trips the breaker (Figure 17).

In addition to the phase overcurrent protection, a ground fault sensing feature may be provided. The Ground Sensing Device works on the principle that the instantaneous value of current flowing in the three conductors (or; in four conductors on four wire systems) must add to zero unless ground current is flowing. Therefore, if the electrical system is a four wire wye system with the neutral grounded at the transformer, the fourth sensing coil (Figure 18) must be included on the neutral conductor with its secondary combined with the secondaries of the three phase sensors which are mounted on the breaker. On Draw-out breakers, the output of the external neutral sensor must enter the breaker by a control disconnect (Figure 19) which is mounted low and on the centerline on the back of the breaker. Refer to Figure 20 for Power Sensor Cabling diagram.

MAINTENANCE

When mal-functioning of the Power Sensor Trip is indicated the trouble should be traced to one or more of these four components involved, and that component should be replaced as a unit. The following steps should be taken to detect a mal-functioning unit.

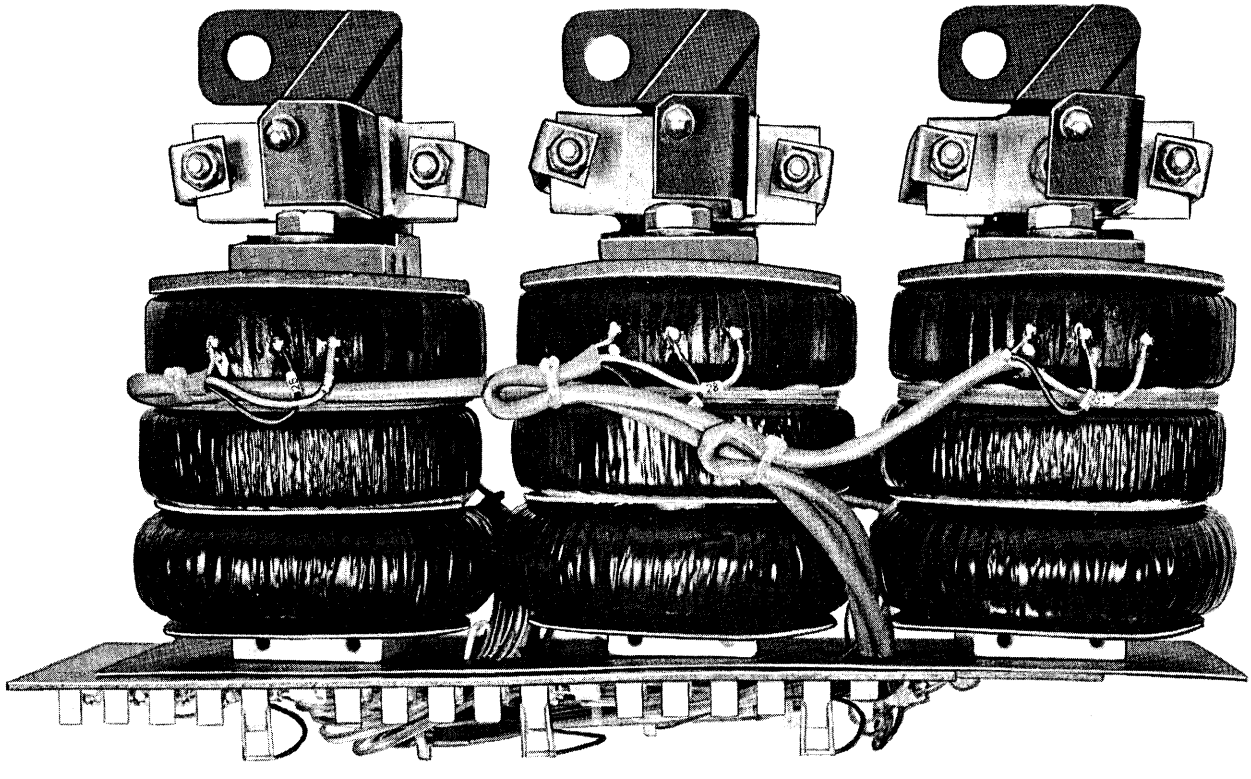


Figure 14. (8041866) Magnetic Coils

NOTE: No adjustment to the taps controlling pick-up or timing should be made with the breaker carrying current.

In the event the Power Sensor Device must be made non-operative to allow the breaker to continue carrying current without overcurrent protection, it is recommended that the leads to the tripping solenoid be removed to completely eliminate the possibility of the breaker tripping. Do not close breaker with power on the main contacts while the disconnect plug to the magnetic coils is disconnected

1. Check for the existence of overcurrent or ground fault conditions that may be causing the breaker to trip as a proper response to these abnormal circuit conditions.

2. The possibility of the breaker being trip free by mechanical interferences along the trip shaft or inadvertent shunt trip operations should be positively eliminated before investigating the Power Sensor. Successful operations in the test position should be obtained before proceeding with the Power Sensor trouble shooting.

3. A PST-1 Power Sensor Test Kit must be available. (Figure 21). Check the Power Sensor Unit for correct function for each pick-up setting and one point on each time delay characteristic. Then check for the correct operation of each phase of the Power Supply Unit. This procedure is described in the instruction manual (GEK-7301) for the PST-1 Test Kit, and GEK-7309 Power Sensor Instructions. If the test results for this test do not deviate more than 10% from the published curves, proceed to step 4. If the deviation is more than 10% contact the factory for possible replacement of the Power Sensor Unit.

4. If the breaker is equipped with ground fault protection, determine whether the false tripping is the result of falsely answering an overcurrent trip or a ground trip signal. This may be determined by temporarily eliminating the ground trip signal by shorting out the ground signal points 1 and 5 at the ground signal terminal board on the back frame bottom of the breaker. Terminals 1 and 5 can be identified by the 0.15UF capacitor connected

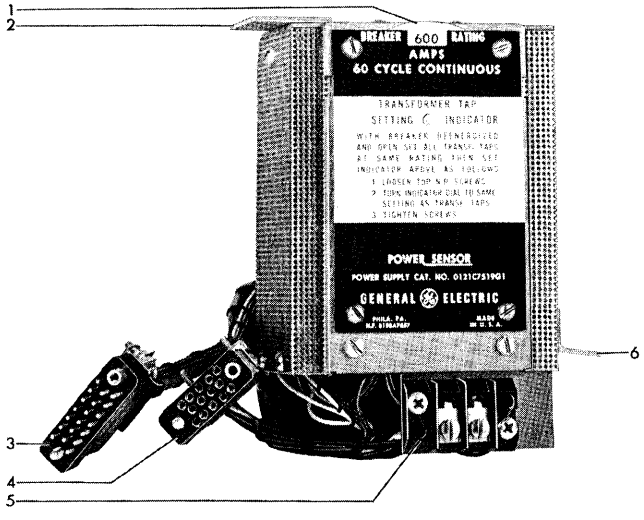


Fig. 15. (8039850) Power Supply

1. Rating Disc
2. Mounting Bracket
3. Male Disconnect Plug
4. Female Disconnect Plug
5. Terminal Block
6. Mounting Bracket

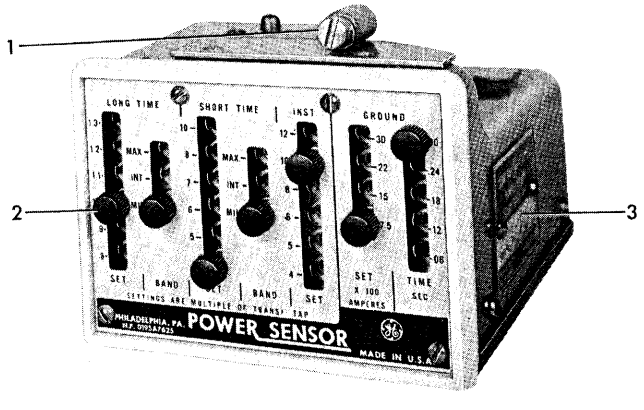


Figure 16. (8041864) Power Sensor Unit

1. Mounting Screw
2. Captive Thumb Screw
3. Name Plate

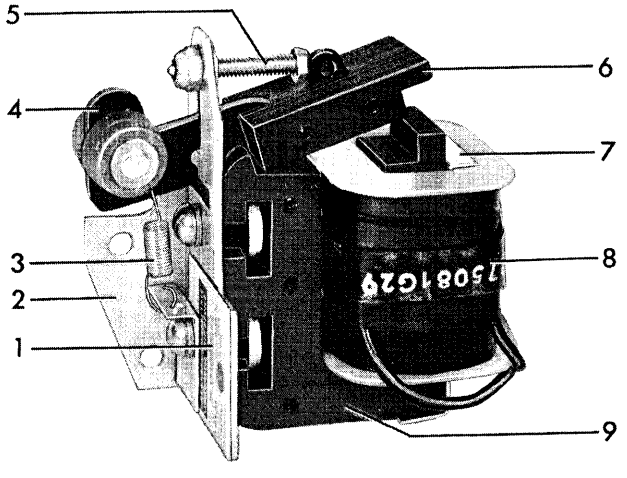


Figure 17. (8041863) Magnetic Trip Device

1. Name Plate
2. Mounting Bracket
3. Spring
4. Trip Arm
5. Adjusting Screw
6. Armature
7. Clamp
8. Coil
9. Magnet

between them. See drawing 138B2454 (Figure 22) with the breaker restored to service with the ground fault detector deactivated, establish whether there is false tripping due to overcurrent.

FALSE TRIPPING CAUSED BY FAULTY GROUND FAULT DETECTION

If the breaker is equipped for four wire service (fourth C.T. remotely mounted, Figure 18) it is important that the shielding be effective by having continuity from the disconnect plug at the Power Sensor Unit to the external C.T. and further, that this shield be isolated from the signal conductors. It is also important that continuity exists through the ground signal circuit. Check these conditions as follows; referring to Figure 22.

1. Remove connection plug at Power Sensor Unit and check continuity between A and C (Signal). Letters are located on end of plug.
2. Check to be sure no continuity exists between R and A, or between R and C.
3. Temporarily connect jumper from shield to either terminal at remote C.T. and check to assure the shield is continuous from Power Sensor Plug to remote C.T. by checking for continuity between R and A. If continuity does not now exist, shield is not continuous and point of discontinuity must be found. Check the control disconnect as the possible point of discontinuity. Remove jumper at remote C.T. after shield continuity is established.

Note the polarity marks on the ground sensors. Be sure the external ground C.T. senses the neutral current associated with the particular breaker load current and that polarity marks are in accordance with 138B2454 (Figure 22). If the breaker bottom studs connect to the source, the external C.T. must also have its polarity mark toward the source.

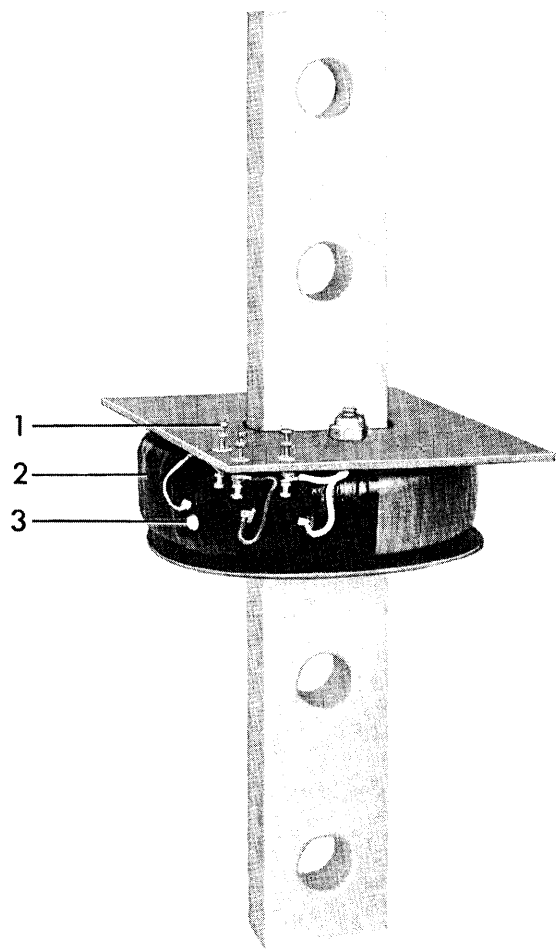


Figure 18. (8041867) Ground Sensor Coil (Remotely Located)

1. Terminal
2. External Ground Sensor Coil
3. White Polarity Dot

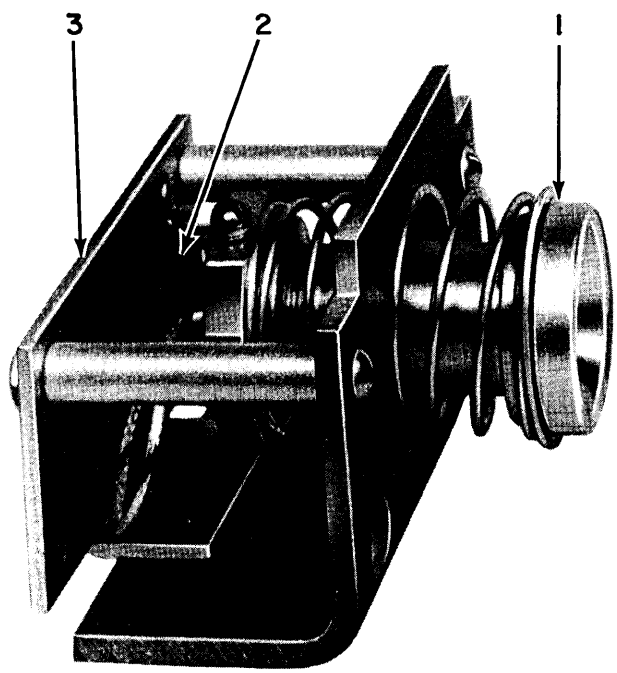


Figure 19. (8918380A) Control Disconnect Plug

1. Female Disconnect Plug
2. Terminal Board
3. Mounting Bracket

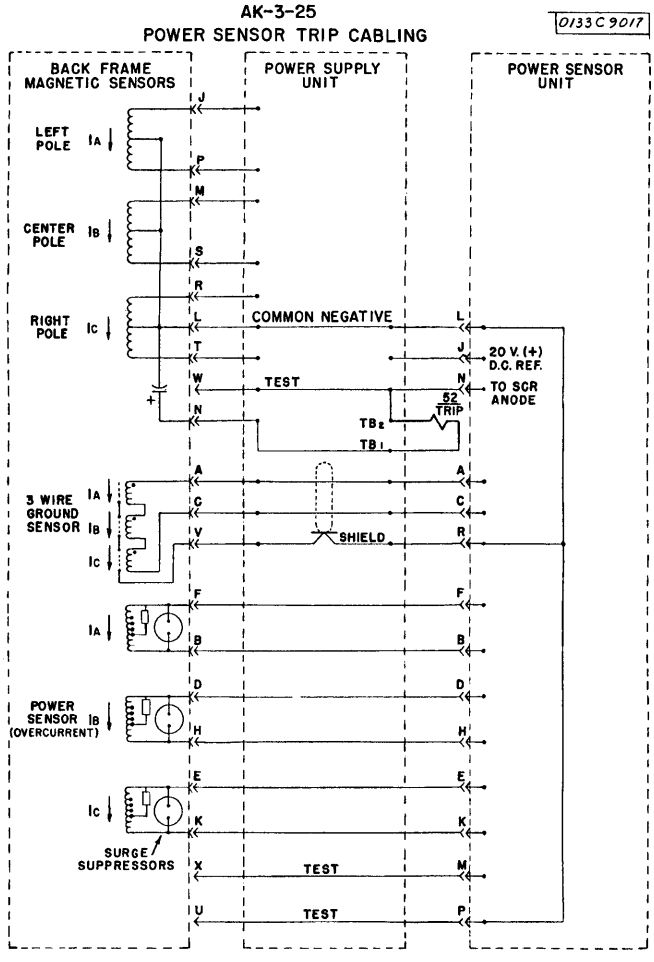


Figure 20. (0133C9017) Power Sensor Cabling Diagram

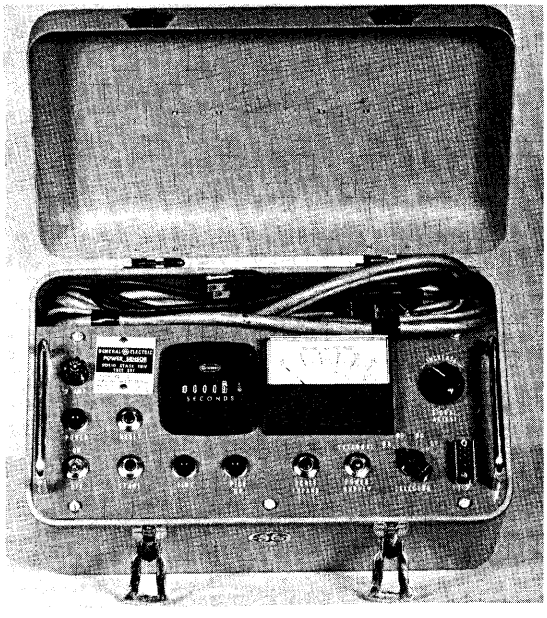


Figure 21. (8039962) Power Sensor Test Kit

TESTING MAGNETIC COILS

After the PST-1 Test Kit has been used to determine the adequacy of performance of the Power Sensor Unit, it may be advisable or required to test the magnetic coils by the use of a hi-current Low voltage type test set. In this event, only one test per phase need be made. This test should be made at some convenient multiple of pick-up setting such as 300% for comparison with published time-current curves.

In the event the breaker is equipped with ground sensor, the ground sensor will cause tripping on single phase testing unless the signal is shorted at the terminal board (Figure 22). Jumper points 1 and 5 during overcurrent test.

The above considerations should indicate which of the four major components is faulty and in need of replacement.

REPLACEMENT OF POWER SENSOR COMPONENTS

POWER SENSOR UNIT (Figure 16).

1. Loosen screw connecting the unit to the front frame.
2. Slide unit forward.
3. Remove control plug by alternately loosening the two retaining screws.
4. Replace in reverse order.

MAGNETIC TRIP DEVICE (Figure 17).

1. Remove trip solenoid wires from the terminal board on power supply.
2. Remove four screws holding power supply to breaker frame.
3. Pull power supply forward until restricted by wiring.
4. Remove two bolts holding trip device to breaker frame.
5. Lift out trip device.
6. Replace in reverse order.

POWER SUPPLY (Figure 15).

1. Remove magnetic trip wires from the terminal board on POWER SUPPLY
2. Remove four screws holding power supply to breaker frame.

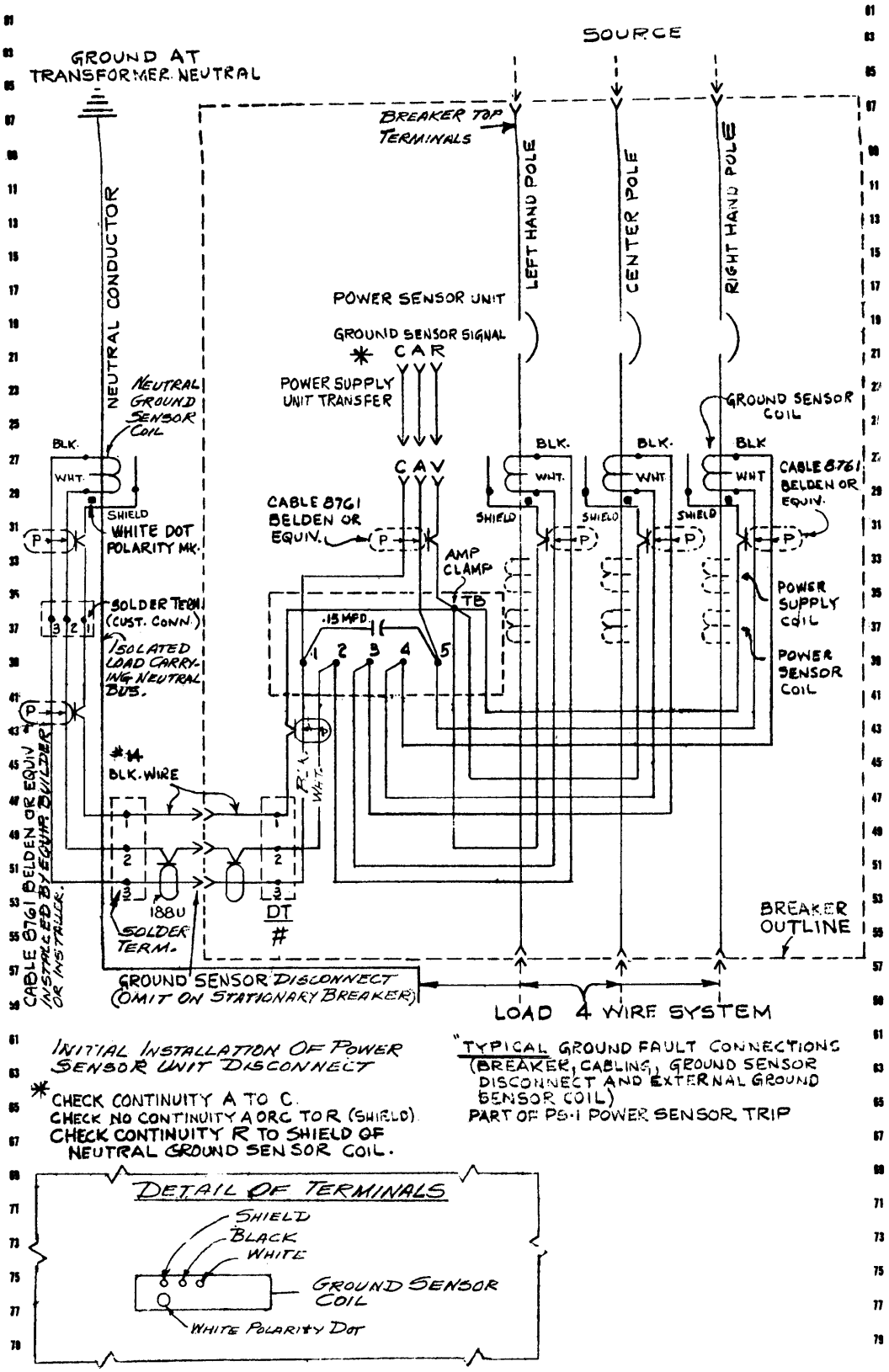


Figure 22. (138B2454) Ground Fault Wiring Diagram

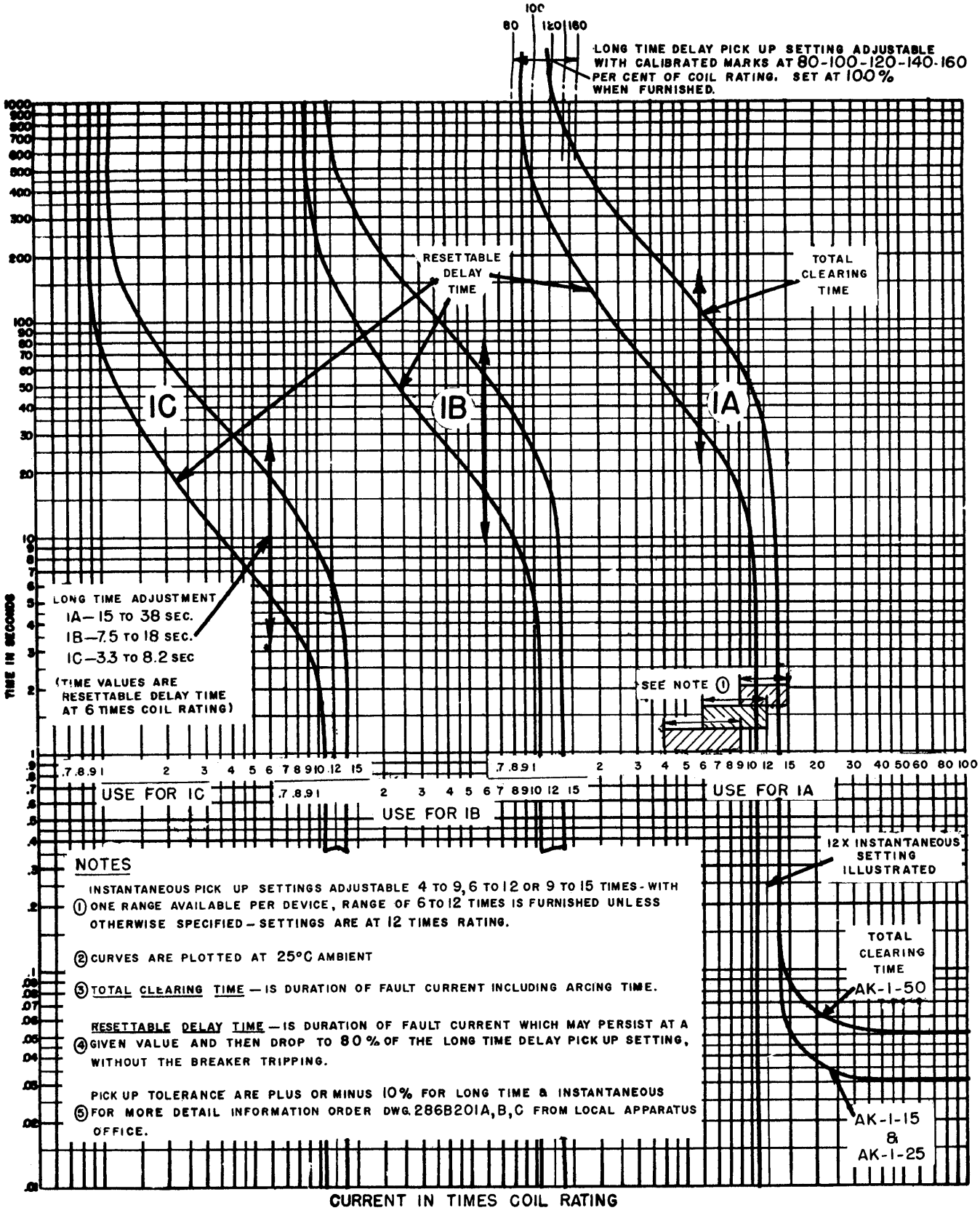


Figure 23. (286B209) Time-Current Characteristic - EC Devices

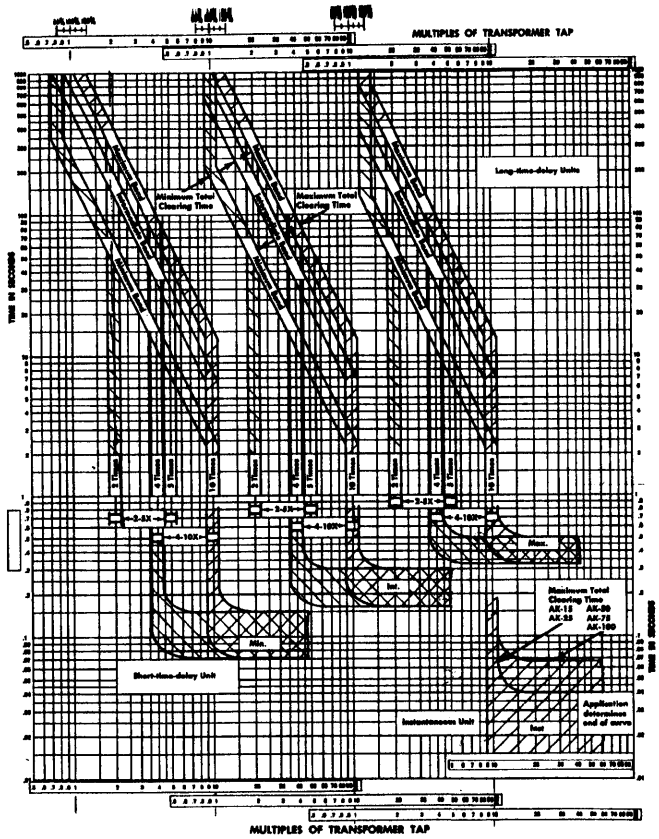


Figure 24. (109HL687) Time Curve

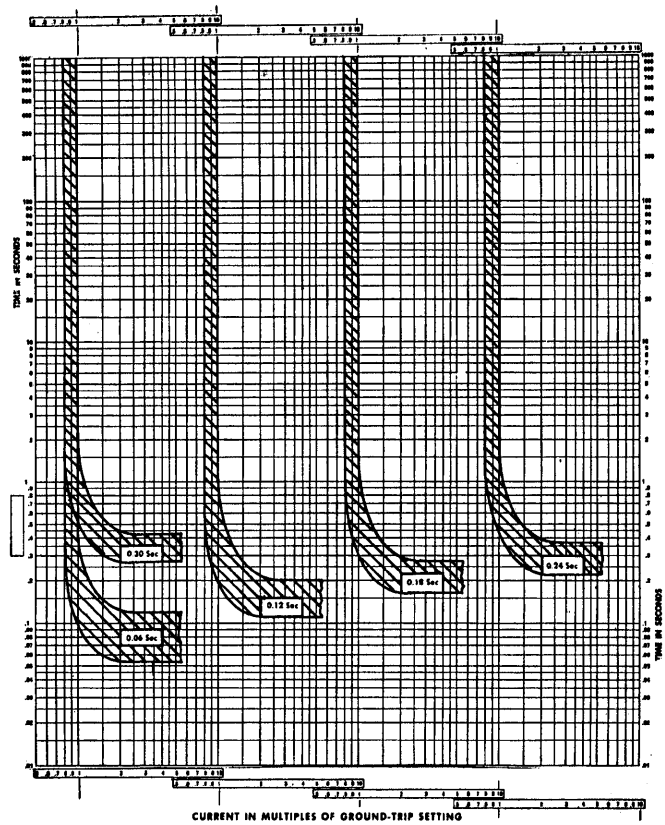


Figure 25. (109HL689) Time Curve

3. Remove four screws holding escutcheon to mechanism frame and remove escutcheon.

4. Disconnect control plug to power sensor coils and power sensor unit.

5. Remove cable clamps holding cabling in place.

6. Remove power supply unit with attached cabling.

7. Replace in reverse order.

SENSOR COILS (Figure 14).

1. Separate the breaker front and back frame as described in the section under "Maintenance".

2. Remove two screws holding sensor coil disconnect plug bracket to back frame.

3. Remove bolt holding resistor bracket to back frame.

4. Remove 2 screws holding capacitor bracket to back frame.

5. Unsolder three leads at ground disconnect and pull wire through hole in back frame. On stationary breakers with fourth wire ground disconnect, unsolder leads at external ground coil and pull wire through hole in back frame.

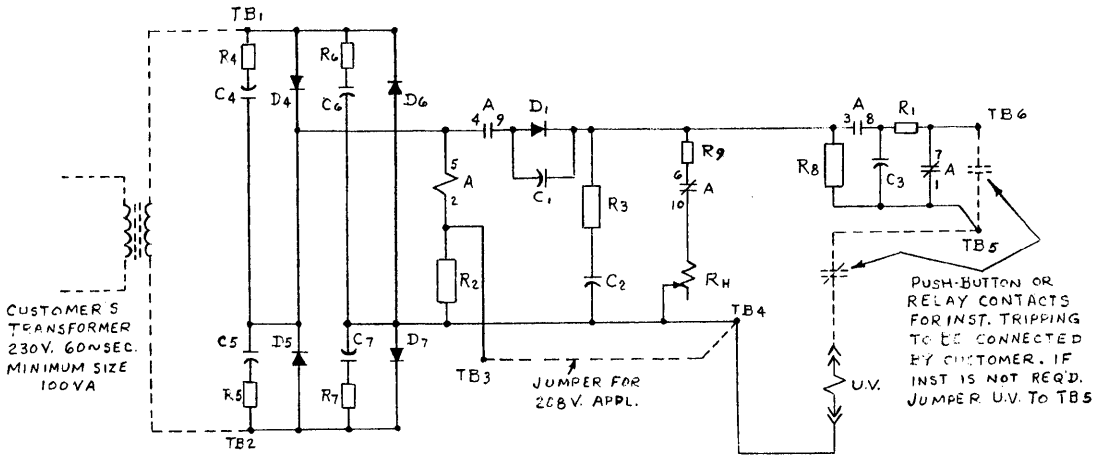
6. Remove primary disconnects per instructions under disconnects.

7. Remove three 3/8 hexagon headed bolt connecting coils to breaker copper.

8. With the back frame in the vertical position, and supported, grasp the outside coils and lift coil assembly from back frame. When carrying or moving sensor coil assembly, always support the outside coils.

SELECTIVE TRIPPING

Selective overcurrent tripping is the application of circuit breakers in series so that only the circuit breaker nearest the fault opens. Anyone or combination of two or more of the preceding over-current devices may be used in a selective system. The breaker having the shorter time setting and lower pickup will trip before the



A - 250V. D.C. RELAY
C_1, C_4, C_5, C_6, C_7 - .10 μf ±10% 600 WVDC.
C_2 - 550 μf 350 WVDC
C_3 - 1000 μf 200 WVDC
D_1, D_4, D_5, D_6, D_7 - IN560 - 600 ma @ 30°C
R_1 - 15 Ω 2W ±5%
R_2 - 1500 Ω 5W ±5%
R_3 - 75 Ω 5W ±5%
R_4, R_5, R_6, R_7 - 10 Ω ½W
R_8 - 2750 Ω 20W ±5%
R_H - 0-25,000 Ω 25 W
R_9 - 500 Ω 3W ±5%

breaker having the longer setting and higher pick-up, provided the fault is on the part of the line protected by the breaker having the lower setting.

For the exact characteristics and setting of each breaker in a selective system, reference should be made to a coordination chart for the particular system. (Figures 23, 24, and 25)

STATIC TIME DELAY UNDERVOLTAGE TRIPPING DEVICE

The Static Time Delay Undervoltage Tripping Device consists of an undervoltage device mounted on the breaker, a static time delay box mounted separately from the breaker and a control power transformer which is also mounted separately from the breaker when the reference voltage is other than DC., 208V AC or 230V AC. Refer to wiring diagram 0102C3698 (Figure 26).

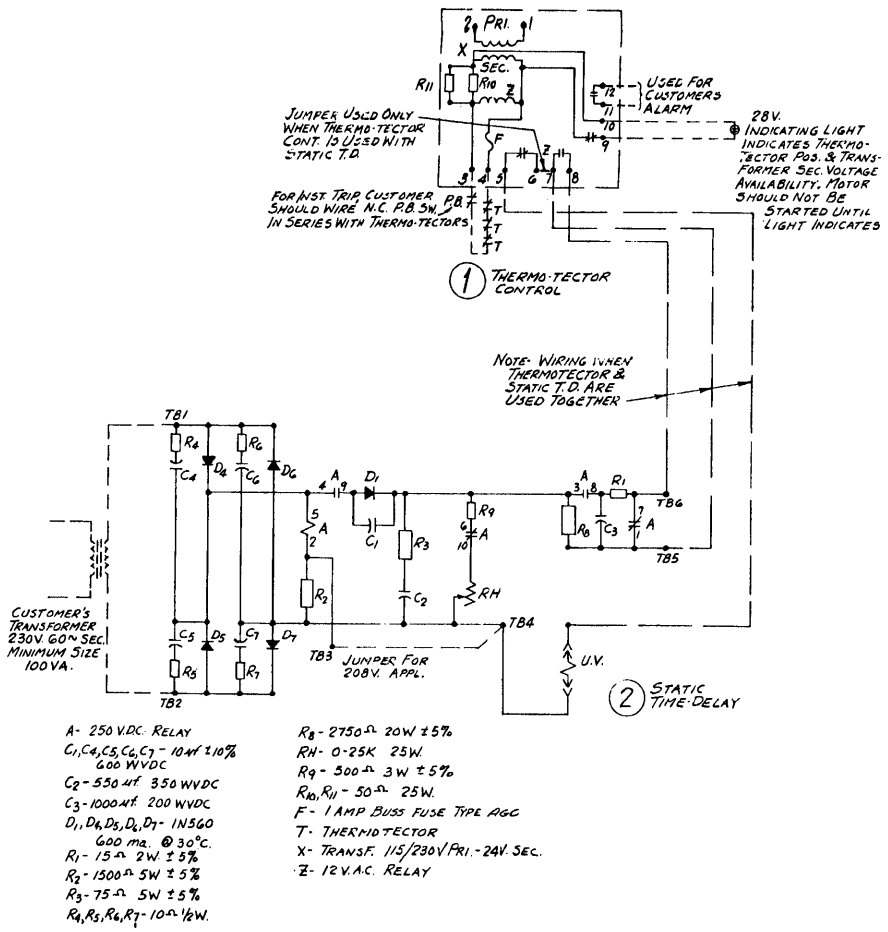
The voltage 208V AC or 230V AC, to be monitored is connected to terminals #1 and #2 of the time delay box. The undervoltage device on the breaker is always connected through either its secondary disconnects or terminal board, to terminals #4 and #5 of the time delay box.

The undervoltage device is set to pickup at approximately 80% of bus voltage and drop out between 30% and 60%.

The undervoltage device coil circuit is continuously rated and will remain picked up as long as the voltage remains above the predetermined drop out voltage. The time delay is field adjustable between 1 and 5 seconds, it is factory set at the minimum setting, and once the time delay is established, it is consistent.

No more than one undervoltage device should be connected to a static time delay box.

The Static Time Delay Undervoltage can also be furnished in conjunction with the termotector control package, as shown on wiring diagram 0102C3699 (Figure 27). Overheating of the motor windings causes the termotector, imbedded in the motor windings, to open and allow the "Z" relay of the control box to instantaneously trip the



breaker through a normally closed "Z" contact in series with the undervoltage device mounted on the breaker.

WARNING - Do not use bell set to check continuity of bridge circuit in static time delay box, only a volt-ohm meter or vacuum tube volt meter should be used.

In the event the device fails to pick-up, the following checks are recommended to determine whether the magnetic device on the breaker or the static time delay unit is the faulty component.

A. Check input voltages across terminals 1 & 2 on static box. These voltages should be as follows:

   1. Device 177L316G-12-208 or 230 volts A.C.
   2. Device 177L316 G-14-125 volts D.C.
   3. Device 177L316 G-15-250 volts D.C.

B. Check output voltages on terminals 4 & 5 with the under voltage device connected. The approximate voltages are as follows:

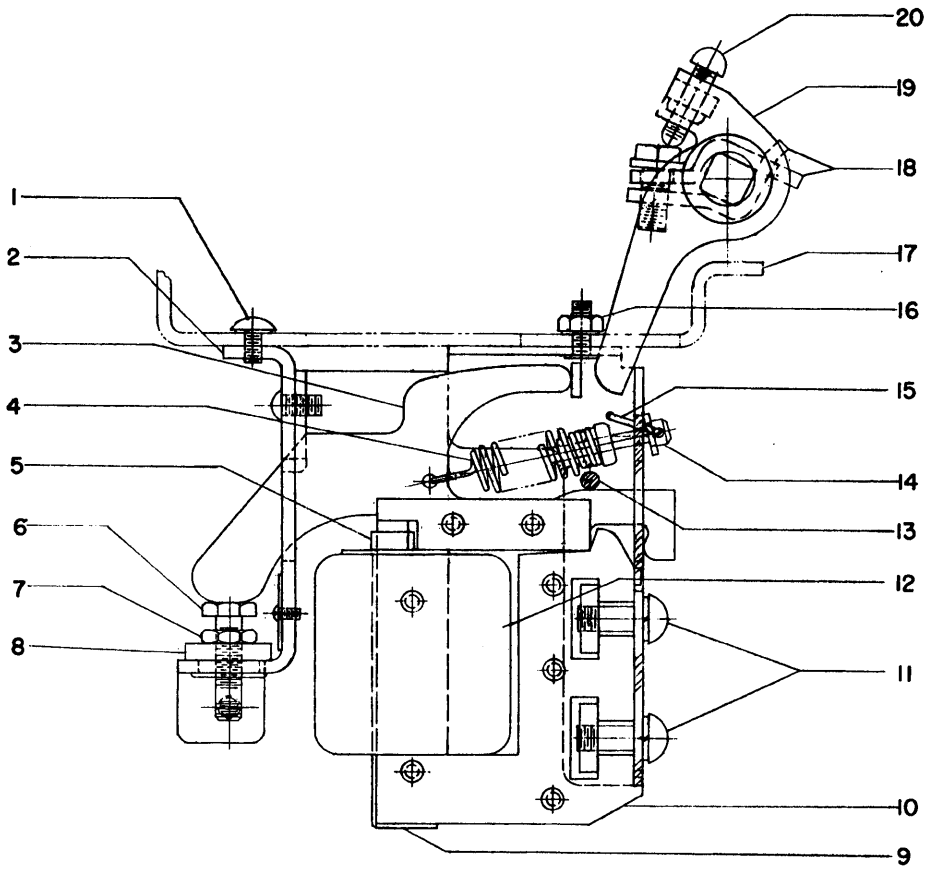
   1. 208 Volt A.C. 177L316G-12-110 volts D.C.
      230 Volt A.C. 177L316G-12-120 volts D.C.
   2. 125 Volt D.C. 177L316G-14 50 volts D.C.
   3. 250 Volt D.C. 177L316G-15-100 volts D.C.

C. The resistance of the under-voltage coils are as follows:

   1. 6275080 G-59 - 1830 Ohms.
   2. 6275081 G-61 - 440 Ohms.

REPLACEMENT

The entire device may be dismounted by disconnecting the coil leads and removing screw (1) and nuts 16. Normally, only the coil (12) will ever need replacement. This may be removed from the device by taking out screws (11) which will free both the magnet (10) and the coil. Straight-



1. Mounting Screw
2. Frame
3. Armature
4. Spring
5. Shading Ring
6. Adjusting Screw
7. Locking Nut
8. Bushing
9. Clamp
10. Magnet
11. Screws
12. Coil
13. Rivet
14. Adjusting Screw
15. Locking Wire
16. Mounting Nut
17. Mechanism Frame
18. Trip Paddle Clamps
19. Trip Paddle
20. Adjusting Screw

Figure 28. (0152C9206) Undervoltage Tripping Device

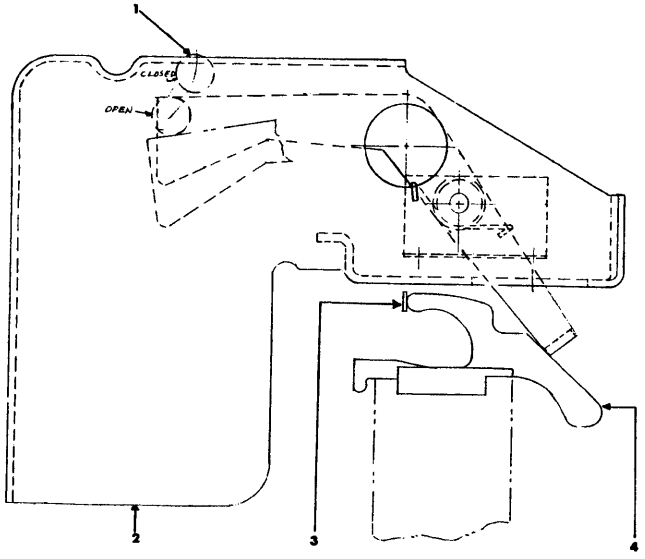


Figure 29. (0101C7842) Undervoltage Lockout Device

1. Cross Bar
2. Left Side Frame
3. Trip Paddle
4. Undervoltage Armature

ening of the bend in clamp (9) will separate the coil from the magnet. The coil leads, of course, must be disconnected.

INSTANTANEOUS UNDERVOLTAGE TRIPPING DEVICE

The instantaneous undervoltage device is mounted in the same location and manner as the static time-delay device and its construction is similar.

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

UNDERVOLTAGE LOCKOUT DEVICE
(Figure 29)

The undervoltage lockout device holds an open breaker trip-free when the coil of the device is deenergized. When the breaker is in the closed position, linkage operated by the breaker mechanism cam positions itself to mechanically hold the undervoltage device armature in the closed air gap position to prevent tripping the breaker in the event the undervoltage device coil is deenergized. This feature when used in conjunction with normally-closed auxiliary contacts of an

alternate breaker presents a convenient method of mechanically interlocking two or more breakers to assure that no two breakers may be closed at the same time.

BELL ALARM SWITCH AND/OR LOCKOUT ATTACHMENTS

(Figure 30)

The bell alarm device is mounted on top of the horizontal cross frame member just to the left of the mechanism frame when the breaker is viewed from the front. This device operates a switch with two sets of contacts, one normally open, the other normally closed. The switch may be used to open or close an external circuit, giving a bell or light indication of a protective trip device operation.

If the breaker is tripped open by any means other than the manual trip button or the shunt trip device, the bell alarm mechanism is activated. The alarm is shut off and the bell alarm and lockout mechanism is reset by operation of the manual trip button or shunt trip device. If the device is a bell alarm only, the bell alarm mechanism is also reset simply by closing the breaker.

OPERATION

Lever (2) is connected to the breaker mechanism so that when the breaker opens lever (2) rotates counterclockwise about pin (14). The motion is transmitted through links (1) and (13) to paddle (12) which operates bell alarm switch (11). If the device has the lockout feature, the movement of link (13) also causes lockout link (8) to slide in a direction that results in its striking trip paddle (5) which, by displacement of the breaker mechanism trip latch, makes it impossible to reset the breaker mechanism until the bell alarm mechanism is reset.

Link (6) serves as a latch in the bell alarm mechanism. If it is displaced, link (10) is free to rotate about its lower pin. This deprives the linkage of its normally fixed center of rotation about pin (15) and defeats both the bell alarm and the lockout operation. Operation of either the manual trip button or the shunt trip device will displace latch (6) and have this effect. Thus if the breaker is tripped by either of these means, the bell alarm and/or lockout will not operate. Also, operation of either of these devices will reset the switch and inactivate the lockout.

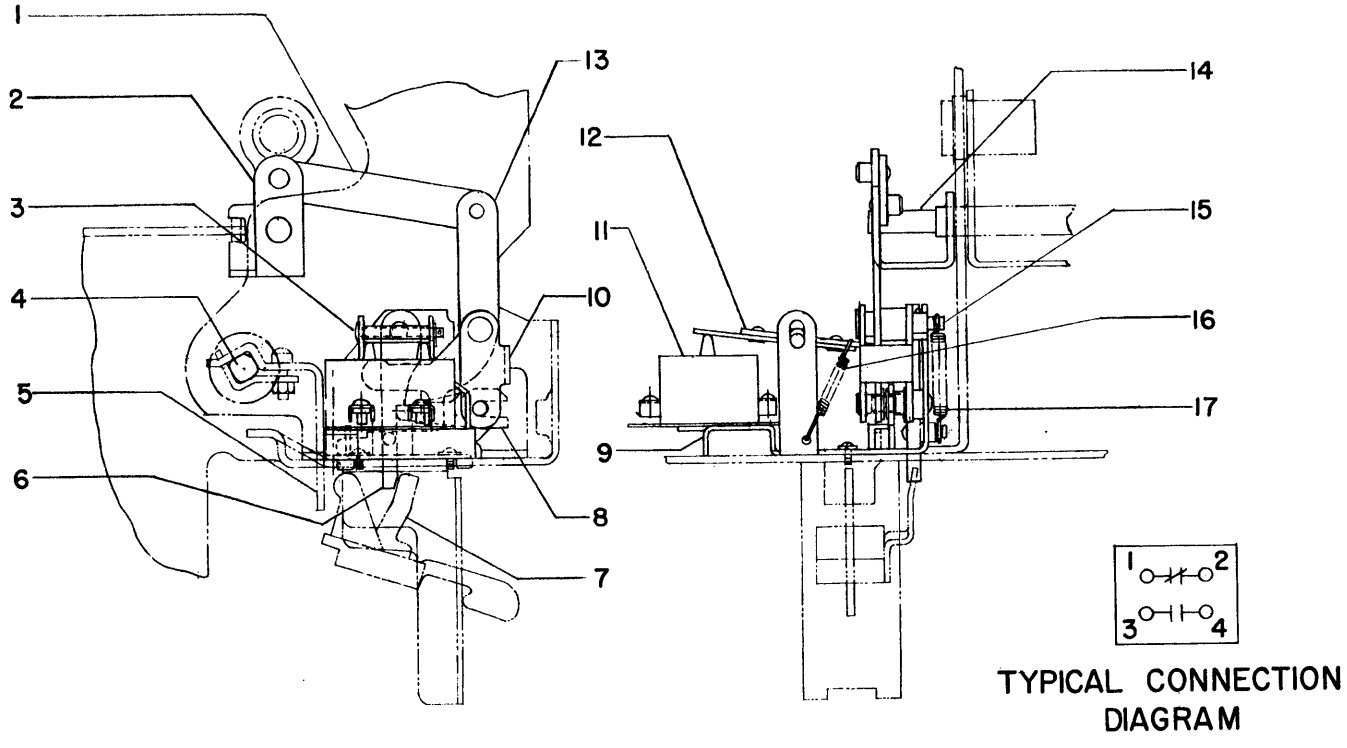


Figure 30. (695C158) Bell Alarm and Lockout Device

1. Link
2. Lever
3. Pin
4. Trip Shaft
5. Trip Paddle
6. Link
7. Trip Arm
8. Lockout Link
9. Frame
10. Link
11. Switch
12. Paddle
13. Link
14. Pin
15. Pin
16. Springs
17. Spring

OPEN FUSE LOCKOUT DEVICE
(Figure 31)

The Open Fuse Lockout Device consists of two or three separately operated devices (one per phase). Each wired in parallel to corresponding breaker fuses. This device is furnished on all AKU breakers. The purpose of this device is to trip the breaker upon the blowing of any one of the breaker fuses and render the breaker trip free until the blown fuse is replaced and the associated coil assembly reset.

OPERATION, Figure 31.

When any one of the breaker fuses blow, the coil (6) in that phase is energized and the armature (5) closes. With the armature closed, leaver (2) slips under the armature and latches it in the closed position. The latched closed armature holds the breaker in the trip free position until it is released by pushing the associated reset button (1). The coil is deenergized as soon as the breaker opens.

ADJUSTMENTS

1. Set top cylindrical collor (not shown) to engage the trip shaft paddle in the tripped position.
2. Check that each armature holds the breaker trip free when the armature position is limited in reset by the lower latch surface on the indicator.
3. With the breaker in the closed position, the top collor must clear the trip shaft paddle by more than 1/32 inch.

REPLACEMENT

1. Remove three mounting screws at top of device.
2. Remove coil leads from fuses and work wire harness back to the device. Remove device from breaker.
3. Replace new unit in reverse order and check procedure under ADJUSTMENTS.

AKD-5 INTERLOCK
(Figure 32)

The rackout mechanism is interlocked so that the circuit breaker must be open before the operating handle can be inserted. When the breaker is closed, the interlock link (1) operated by the breaker cross bar blocks the interlock linkage on the rackout mechanism.

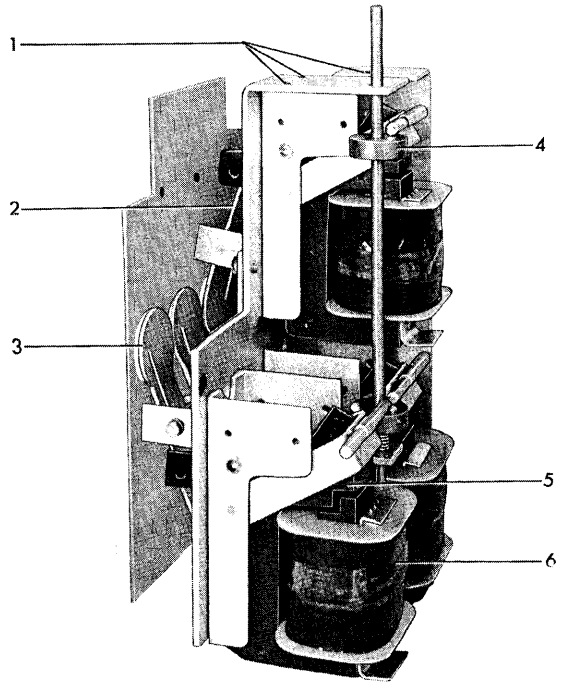


Figure 31. (8041865) Open Fuse Lockout Device

1. Mounting Holes
2. Lever
3. Reset Button
4. Collor
5. Armature
6. Coil

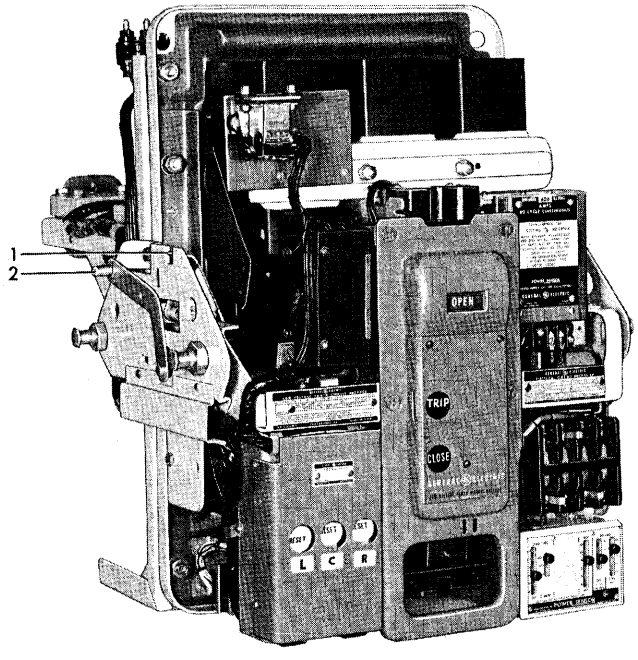


Figure 32. (8039852) AKD-5 Interlock

1. Rackout Mechanism Interlock
2. Trip Interlock

MISCELLANEOUS

Changes in breaker requirements may occasionally bring about the necessity of adding or changing breaker components or accessories in the field. The AK-2 breaker has been designed so that such additions or conversions are simple and easy to make, requiring only a minimum of time or skill on the part of the operator.

Special instructional drawings are available which will further simplfy the addition of such accessories to breakers which were originally shipped without them.

These drawings will accompany the necessary material when it is shipped from the factory. They will also be available upon request. The drawings and the accessory additions which they cover are listed below.

When an accessory is added to a breaker, it is recommended that the section of instructions contained herein covering that particular accessory be reviewed, in addition to referring to the following instructional drawing. Any adjustments described in these instructions should be carefully made after the device has been assembled on the breaker.

Conversion of breakers from manual to electrical operation is also covered on an instructional drawing. This operation consists simply of separation of the front and back frames of the breaker as described under "Maintenance" in these instructions and the reassembly of the existing back frame with the new front frame.

Addition of	Covered By
Shunt Trip Device	698C900
Auxiliary Switch	698C901
Undervoltage Device	698C902
Bell Alarm & Lockout Device	698C904
Drawout Mechanism	698C922
Conversion to Elec. Oper.	698C904

MAINTENANCE TOOLS

The following tools are recommended for proper maintenance of AK-2-15 and AK-2/3-25 breakers. (NOTE: Obtain from local hardware firm; do not order on General Electric Company.)

Screw Drivers

Long thin, slotted screw
Standard, slotted screw
Phillips, No. 2, (8" shaft)

Pliers

Waldes Truarc, No. 2 straight
Long Nose, side cutting, 6"

End Wrenches

Adjustable, 8"
1/4" open end

Allen Head Wrenches

5/16" for 3/8" screw
1/8" for 1/4" screw

Socket Wrenches (3/8" drive)

Ratchet Handle
12" extension bar
3/8" socket
9/16" socket
7/16" socket (long)

Miscellaneous Tools

1/4" Spintite (long shank)
7/16" Spintite
8/32 screw (at least 2" long)

RENEWAL PARTS

When ordering renewal parts, address the nearest Sales Office of the General Electric Company, specifying the quantity required. Complete nameplate data of the breaker involved should be given as well as an accurate description of the parts required. If the parts needed are illustrated in this book, refer to the figure number and part number involved.

Renewal Parts which are furnished may not be identical to the original parts since from time to time design changes may be made. The parts supplied, however, will be interchangeable with the original parts.

Renewal Parts Bulletin

Bulletin	Breaker Type
GEF-4149F	AK-2-15/25 AK-3-25

For further information
call or write your local
General Electric
Sales Office or...

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Division
41 Woodford Avenue
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