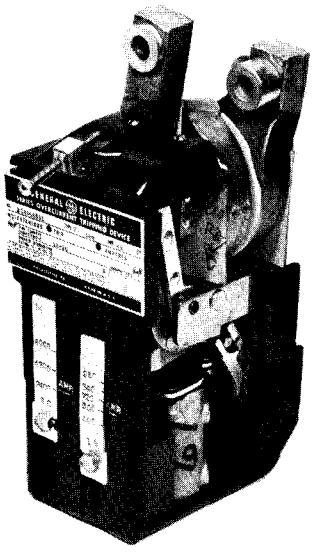
Installation
Instructions
and Maintenance
Manual

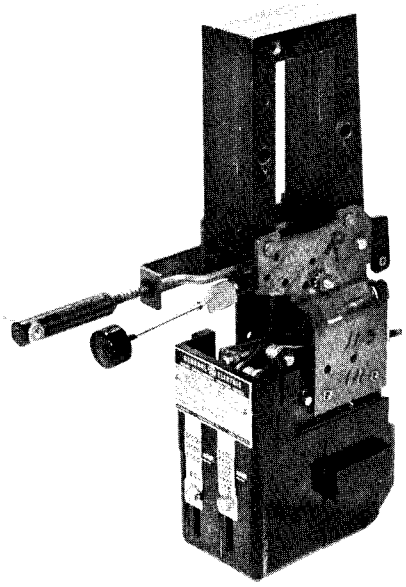
EC Trip Devices

For AKR and AKS Low-voltage Power Circuit Breakers

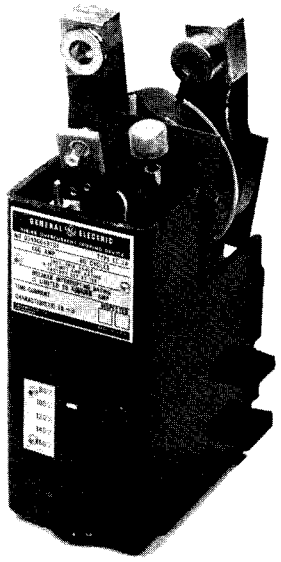
LOW-VOLTAGE POWER CIRCUIT BREAKER



EC-1



EC-1B



EC-2A

Contents

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

GENERAL ELECTRIC

RECEIVING

These instructions describe the installation, operation and adjustments of EC tripping devices in AKR low voltage power circuit breakers.

Before installing, operating or adjusting EC trips, carefully read these instructions.

Upon receipt of a EC trip device, immediately examine for any damage or loss sustained in shipment. If damage, loss or rough handling is evident, file a damage claim at once with the transportation company and notify the nearest General Electric Sales Office.

Exercise care in unpacking to avoid damage to the EC parts. Be sure that no loose parts are missing or left in the packaging material. Blow out any dirt or loose particles of packaging material remaining on or in the trip units.

INTRODUCTION

Type EC overcurrent trip devices are magnetically operated, using a series coil or single conductor, and an associated magnetic structure to provide tripping force.

There are three basic characteristics: long time delay, short time delay and instantaneous, which can be used in various combinations to suit the application.

AKR and AKS breakers with EC trips are for use on DC system voltages, and may be used (special order) on AC systems.

One EC trip device is mounted in each breaker pole and contains function adjustments.

EC trip devices are available as type EC-2A (standard for frames up to 2000 Amp), EC1 (optional for frames up to 2000 Amp) and EC1B (standard for 3000, 4000 and 6000 Amp frames DC.)

ADJUSTMENT

Before attempting any checks or adjustments on breaker with EC trip devices, the breaker mechanism and trip latch should be checked to assure their proper functioning so that the breaker trip shaft is free of high friction loads. The trip latch of the breaker should also be checked for proper trip latch engagement.

AKR30 and AKR50 trip latch adjustments are in maintenance manual GEK-64459

AKS50, AKR75 and AKR100 trip latch adjustments are in maintenance manual GEK-64460

ADJUSTMENT RANGES FOR EC TRIP DEVICES

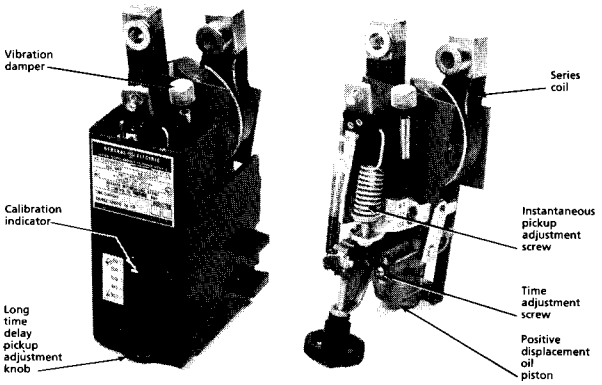
Trip Device	Long Time		Short Time		Instantaneous Pickup
	Pickup (1)	Delay (2)	Pickup	Delay (3)	
EC-2A	80-160% X (± 10%)	(1A) MAX. — adj. 15-38 sec or (1B) INTER. — adj. 7.5-18 sec. or (1C) MIN. — adj. 3.3-8.2 sec.			4-9X, 6-12X, 9-15X or 80-250%X (4)
EC-1	80-160% X (± 10%)	(1A) MAX. — 30 sec. or (1B) INTER. — 15 sec. or (1C) MIN. — 5 sec.	2-5X, 3-7X or 4-10X	(2A) MAX. — .23 sec. or (2B) INTER. — .15 sec. or (2C) MIN. — .07 sec.	High Set up to 15X, Non-Adjustable
EC-1B	80-160% X (± 15%)	(1BB) MAX. — 4.5 sec. or (1CC) MIN. — 2 sec.	2-5X, 3-7X or 4-10X	(2AA) MAX. — .20 sec. or (2BB) INTER. — .13 sec. or (2CC) MIN. — .07 sec.	4-9X, 6-12X, 9-15X or 80-250% X (4)

1 X = Trip device ampere rating. If trip devices are set above 100% for coordination purposes, such settings do not increase the breaker's continuous current rating.

2 At lower limit of band at 6 times pickup setting.

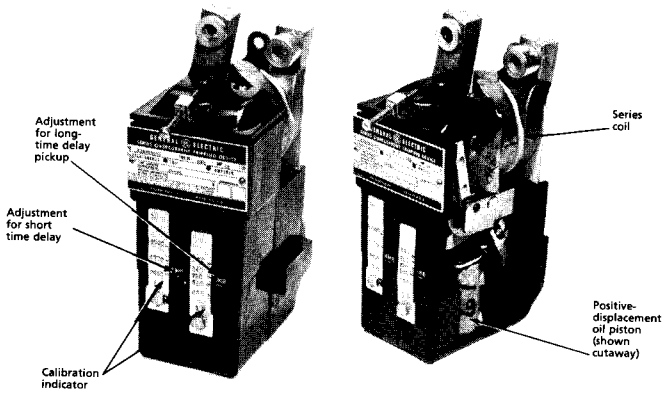
3 At lower limit of band at 2½ times pickup setting.

4 Low-set instantaneous. Not available in combination with long time delay.



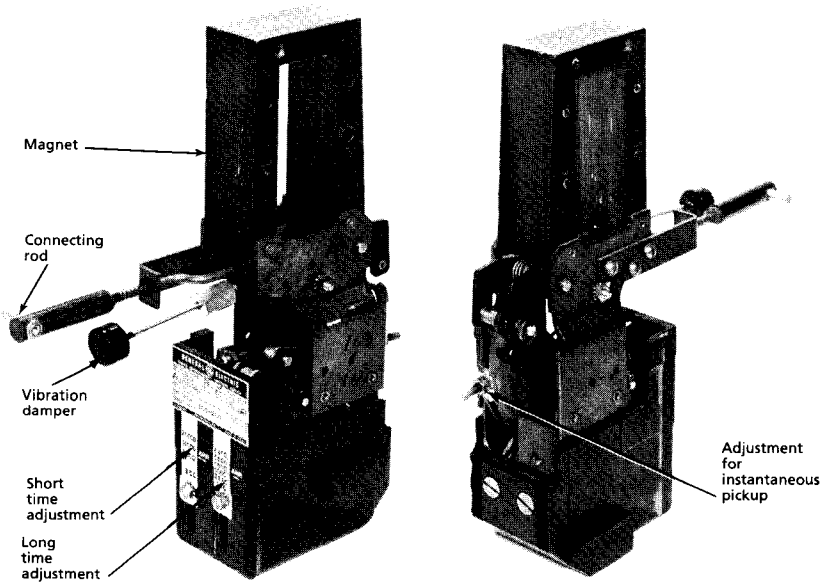
Type EC-2A

Standard for frames up to 2000 Amps. Available in combinations of long time and instantaneous elements.



Type EC-1

Optional for frames up to 2000 Amps. Combines long time and short time elements for intentional delay up to the short time rating of the breaker. Instantaneous may be added.



Type EC-1B

Trip Device for 3000, 4000 and 6000 amp frame breakers. Combines long time and short time elements for intentional delay up to the short time rating of the breaker. Instantaneous may be added.

Time-current Curves

Trip Device	Trip Elements ①	Trip Characteristic (EC Devices only)	Curve
EC-1	LSI	(See Curves)	GES-6000A
EC-1B	LI	1BB-3	GES-6003
	LI	1CC-3	GES-6004
	LSI	(See Curves)	GES-6005
EC-2/2A	LI	1A-3	GES-6010
	LI	1B-3	GES-6011
	LI	1C-3	GES-6012

① L = Long Time
S = Short Time
I = Instantaneous

DIRECT ACTING TRIPPING DEVICE EC-1B

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

The EC-1B is adjustable on high-set instantaneous tripping. The adjustable setting mechanism of the EC-1B is shown in Fig. 1.

Low-set instantaneous tripping is adjustable from 80 percent to 250 percent of the continuous current rating of the device. Whenever this is used, it is the only characteristic of the device. Instantaneous tripping used in conjunction with any other characteristic is always high-set.

When armature (1 or 22) closes against the magnet (11), motion is transmitted through the mechanism linkage, rotating tripping link (8) so that connecting rod (10) is pulled towards the rear of the breaker. By means of trip paddle (14) this results in the displacement of the breaker mechanism trip latch which causes the breaker to trip open. Long and short time delay tripping is achieved through separate timing devices as described below:

SHORT TIME-DELAY TRIPPING (Fig. 1)

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

LONG TIME DELAY TRIPPING (Fig. 1)

The long time delay armature (22) is restrained by the long time delay calibration spring (15). After the magnetic force produced by the overcurrent condition overcomes this restraint, the velocity of the armature movement is governed by the flow of oil through an orifice in the piston of the dashpot (17). The time required to displace the piston is inversely proportional to the force tending to close the magnetic circuit.

INSTANTANEOUS TRIPPING

High-set, Adjustable—EC1B

Adjustable instantaneous tripping is accomplished by varying the amount of tensile force on the high-set instantaneous spring (21). When a magnetic force greater than the restraining spring force is produced by an over-current condition, the armature (22) is pulled upward against the magnet (24), thus tripping the breaker by the movement of the connecting rod (13) against the trip paddle (14).

The pickup value of the device may have one of the following ranges: 4 to 9, 6 to 12, or 9 to 15 times coil rating. Three calibration marks will appear on the calibration scale (18) and the value of these calibration marks will be indicated by stampings on the scale as follows: (4X - 6.5X - 9X) or (6X - 9X - 12X) or (9X - 12X - 15X), depending on the desired range. To set the device at a particular pickup value, loosen the clamping nut (20) and slide the index pointer on the calibration washer (19) to a position which lines up horizontally with the desired pickup value on the calibration scale (18).

Low-set, Adjustable

If the characteristic of the device is low-set, adjustable instantaneous, a link is installed in place of spring (21) and the instantaneous calibration spring is located where spring (15) is shown in Fig. 26. Dashpot (17) is omitted from assembly.

REPLACEMENT (Fig. 1)

1. Remove stud (23).
2. Remove mounting clamp.
3. Remove two screws fastening magnet (11) to lower stud.
4. Device is now free of breaker. Reassembly is accomplished by reversing the procedure.

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

ADJUSTMENTS (Fig. 1)

Before the EC-1B overcurrent device is calibrated at the factory, the air gaps between magnet (11) and armatures (1 and 22) are set. These gaps are measured at their widest point, between the front edge of the armature and magnet. The gap for the short time delay armature is 17/64 in., and for the long time delay armature is 17/64 in. Both have a plus and minus tolerance of 1/64 in.

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

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

After the device is mounted on the breaker, a final adjustment that must be made in the length of the connecting rod (10). This is made by varying the amount of thread engagement between the connecting rod and the insulated coupling which ties onto the trip paddle (14). The approximate distance between the pivot centers on the ends of the connecting rod assembly is six inches. The correct exact distance is that which will just cause tripping of the breaker when the armature is closed to a point 1/32in. short of contact with the magnet. A step-by-step procedure for making this adjustment follows.

1. Before mounting the trip device, set the center distance between the pivot centers of the connecting rod at six inches.
2. Close the breaker and insert a feeler gage 1/32 in. thick between the armature and magnet. This should be done from the rear of the breaker. The feeler gage should be no wider than 1/2 in. and at least 4 inches long.
3. Close the armature against the gage and magnet.
4. If the breaker does not trip, form paddle 14 to obtain positive trip.
5. Check visually to make sure that the connecting rod does not restrict the engagement of the breaker trip latch when the breaker mechanism resets. It should always be possible to adjust its length to a point where resetting is not interferred with and yet positive tripping by the overcurrent device is achieved.

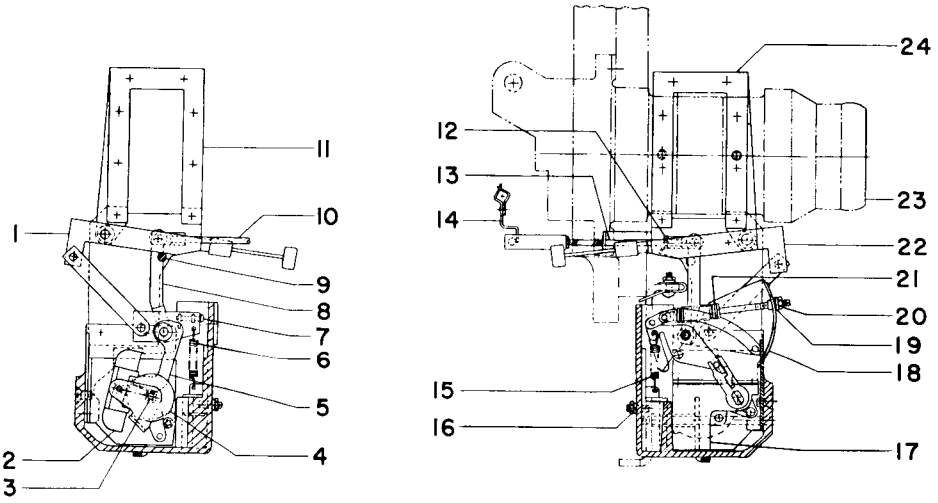


Figure 1.
Direct-acting
tripping device EC-1B

SHORT TIME MECHANISM

1. S.T.D. Armature
2. Pallet
3. Pinion
4. Escape Wheel
5. Driving Segment
6. S.T.D. Calibration Spring
7. S.T.D. Trip Adj.
8. Trip Link
9. Air Gap Adj.
10. Connecting Rod
11. Magnet
12. Lock Nut
13. Connecting Rod
14. Trip Paddle
15. L.T.D. Calibration Spring
16. Calibration Clamp Nut

LONG TIME & HIGH SET INST. MECHANISM

17. Dashpot
18. Calibration scale
19. Calibration Washer
20. Clamping Nut
21. Inst. Calibration Spring
22. L.T.D. Armature
23. Stud
24. Magnet

SERIES OVERCURRENT TRIPPING DEVICE EC-1 (Fig. 3)

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

The device can be provided with the same tripping combinations as the EC-1B direct acting device.

SHORT TIME-DELAY TRIPPING (Fig. 3)

The armature (7) is restrained by calibrating spring (8). After the magnetic force produced by an overcurrent condition overcomes this restraining force, the armature movement is further retarded by an escapement mechanism which produces an inverse time delay characteristic. The mechanism is shown on Fig. 3.

LONG TIME-DELAY TRIPPING (Fig. 3)

The armature (10) is restrained by the calibration spring (11). After the magnetic force produced by an overcurrent condition overcomes this restraining force, the armature movement is further retarded by the flow of silicone oil in a dashpot, which produces an inverse time delay characteristic. The mechanism is shown on Fig. 3.

INSTANTANEOUS TRIPPING (Fig. 3)

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

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

EC-1 Adjustments

EC-1 Devices may have their pick-up settings varied by changing the positions of the sliding calibration plates on the front of each device. The clamping nut holding the plate must be loosened to make the change, and then retightened.

If a new device is installed, the adjusting screw on the tripping arm must be set to give 1/32nd of an inch overtravel in tripping. The method for making this check is demonstrated in Figure 2. The rod shown is used for pushing the armature of device closed. If this is done with the device mounted on a closed breaker, it will simulate the action which occurs when the device reacts to an overload condition.

Adjustments, EC-1 and EC-2A

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 (9) Figure 3 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 screws (9), Figure 3, 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 (9), Figure 3 can best be manipulated by an extended 1/4 inch hex socket wrench.

REPLACEMENT

1) On AK25 and AKS50 type breakers only, you must remove front frame (see SEPARATION OF FRONT AND BACK FRAME in maintenance manual.)

AK25-GEK-50299

AKS50-GEK-64460

2) Remove the bolts holding coil to the lower stud and frame to base.

3) Remove bracket and mounting screws.

4) Replace new device in reverse order

5) Adjust device as described.

Replacement AKR30 and AKR50

Overcurrent devices on AKR30 & AKR50 breakers may be dismounted by removing the fastening hardware at the rear of the breaker and withdrawing the device. EC devices, after being unfastened as shown in Figures 4 and 5, and having the clamps on the case in the front removed, may be lowered clear of the breaker. You do not have to separate frames on these breakers.

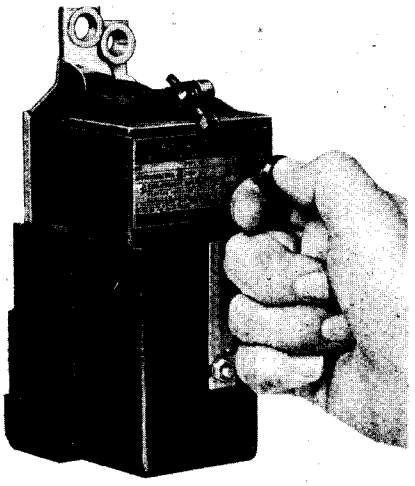
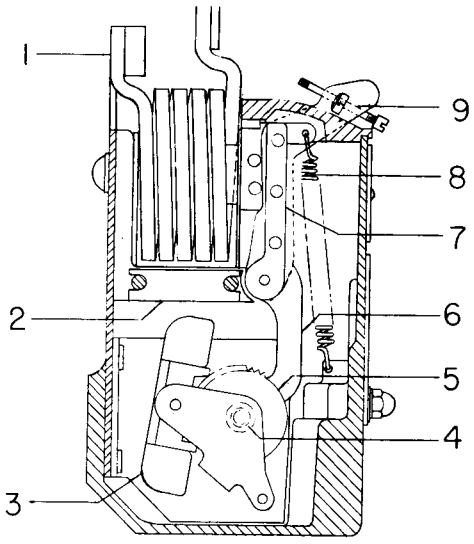
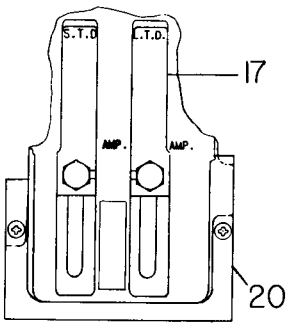


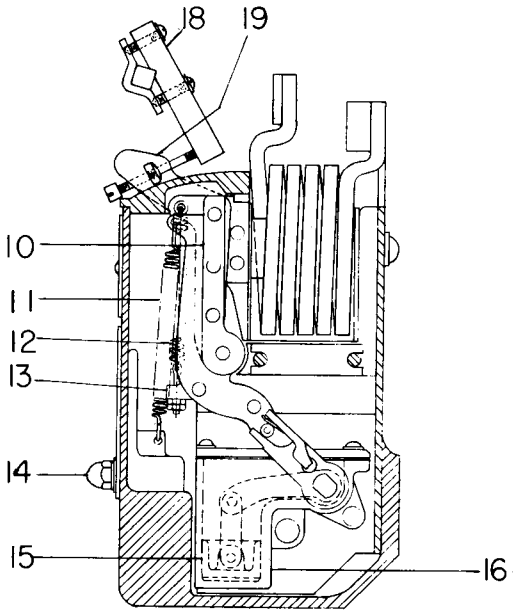
Figure 2. Checking travel distance of Series Overcurrent Tripping Device.



Left Side View Showing
Short Time Delay Mechanism



Front View Showing
Mounting Bracket



Right Side View Showing
Long Time Delay Mechanism

Figure 3. Series overcurrent tripping device - EC-1

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

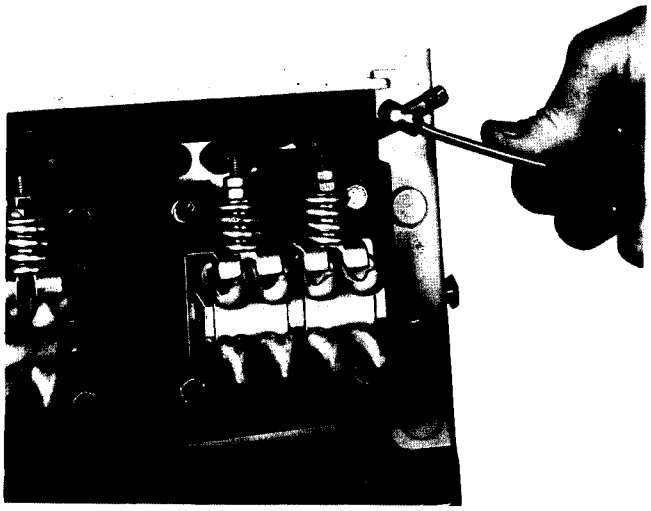


Figure 4. Disconnecting EC Coil

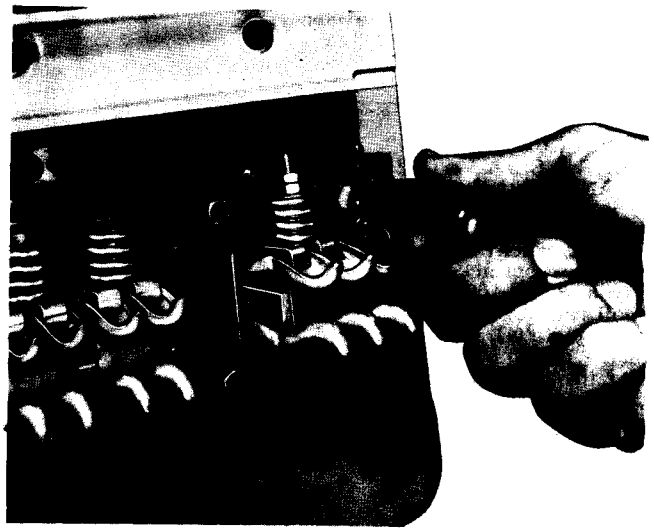


Figure 5. Disconnecting EC Frame

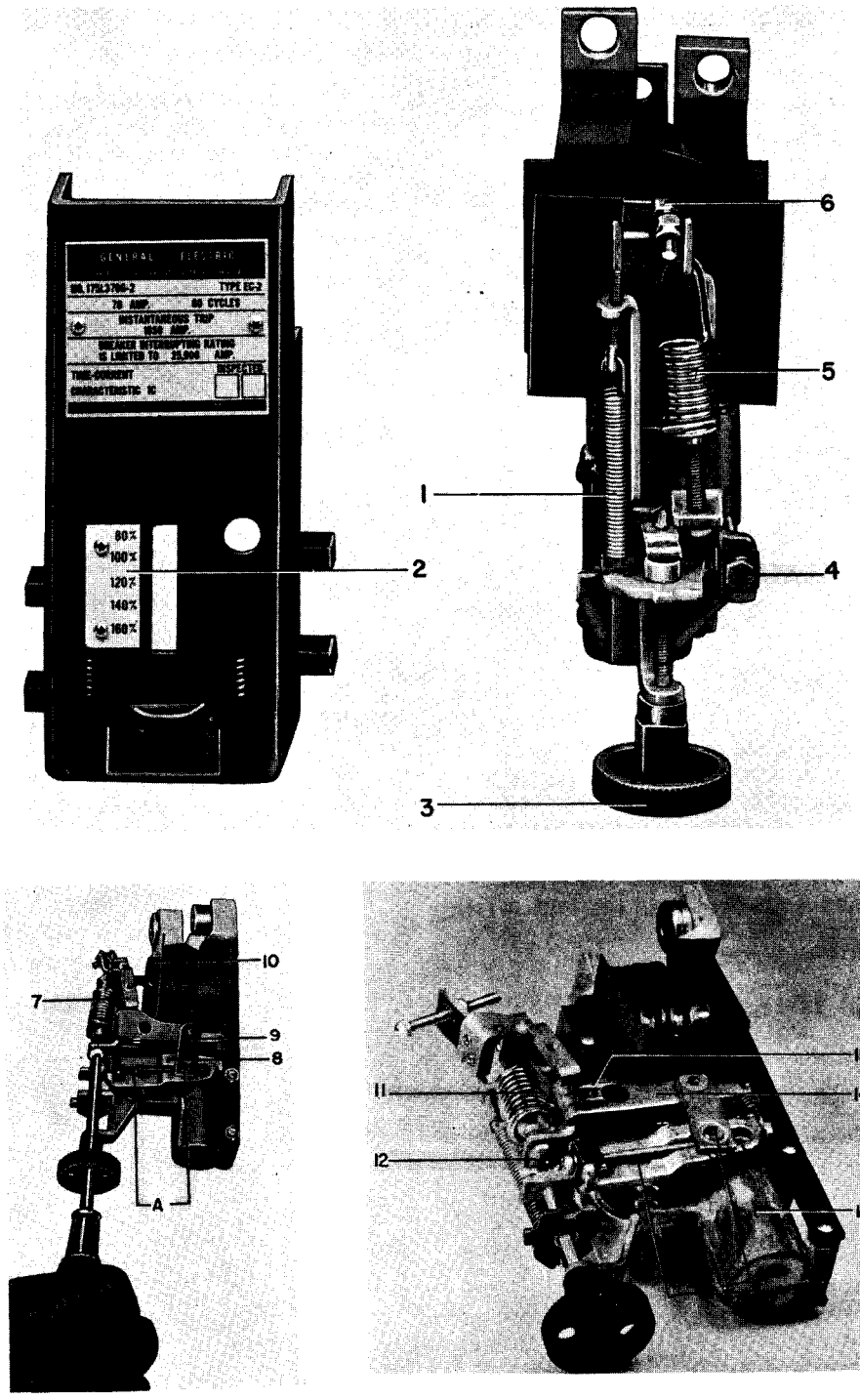


Figure 6. Overcurrent tripping device - EC-2A

SERIES OVERCURRENT TRIPPING DEVICE EC-2A

The Type EC-2A, (see Fig. 6) 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 trip have adjustable pick-up settings.

LONG TIME-DELAY AND HIGH-SET INSTANTANEOUS TRIPPING. (Fig. 6)

By means of the adjustment knob (3), which can be manipulated by hand, the current pick-up point can be varied from 80 to 160 percent of the series coil rating. The indicator and a calibration plate (2) on the front of the case provide a means of indicating the pick-up point setting in terms of pecentage of coil rating. The calibration plate is indexed at percentage settings of 80, 100, 120, 140, and 160.

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

The tripping time may be varied within the limits shown on the characteristic curves by turning the time adjustment screw (4). Turning in a clockwise direction increases the tripping time; counterclockwise motion decreases it. The dashpot arm (8) is indexed at four points, MIN-1/3-2/3-MAX, as indicated in Fig. 7. When the index mark on the connecting link (9) lines up with a mark on the dashpot arm, the approximate tripping time as shown by the characteristic 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 these same settings.

Time values are inversely proportional to the effective length of the dashpot arm. Therefore, the linkage setting that gives the shortest time value is the one at which dimension "A", Fig. 6, is greatest. The time adjustment screw (4) may be turned by inserting a Phillips head screwdriver through the hole in the front of the case. If it is desired to relate the linkage setting to the index marks on the linkage it will be necessary to remove the case. This may be done by removing the two mounting screws, one on each side of the case, which may be taken off without disturbing the trip unit itself.

INSTANTANEOUS LOW-SET TRIPPING (Fig. 6)

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

INSTANTANEOUS HIGH-SET TRIPPING

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 time coil rating. The pick-up setting may be varied by turning the instantaneous pick-up adjusting screw (12).

Three calibration marks (15) will appear on the operating arm (14) and the value of these calibration marks will be indicated by stampings on the arm as follows: (4X - 6.5X - 9X) or (6X - 9X - 12X) or (9X - 12X - 15X).

At the factory, the pick-up point has been set at the nameplate value of the instantaneous trip current. (Usually expressed in times the ampere rating of the trip coil). The variation in pick-up setting is accomplished by varying the tensile force on the instantaneous spring (5). Turning the adjustment screw changes the position of the movable nut (11) on the screw. The spring is anchored to this movable nut so that when the position of the nut is changed, there is a corresponding change in the spring load. As the spring is tightened, the pick-up point is increased.

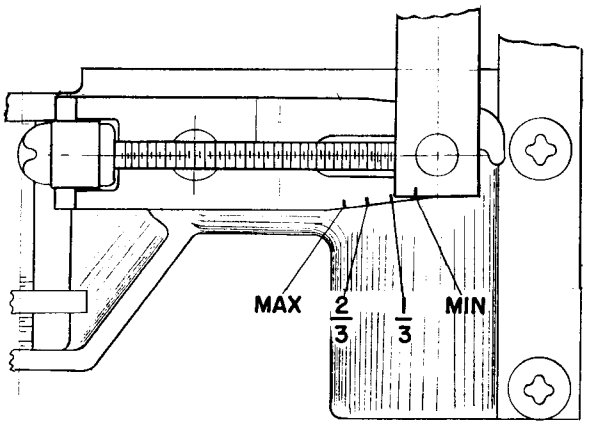
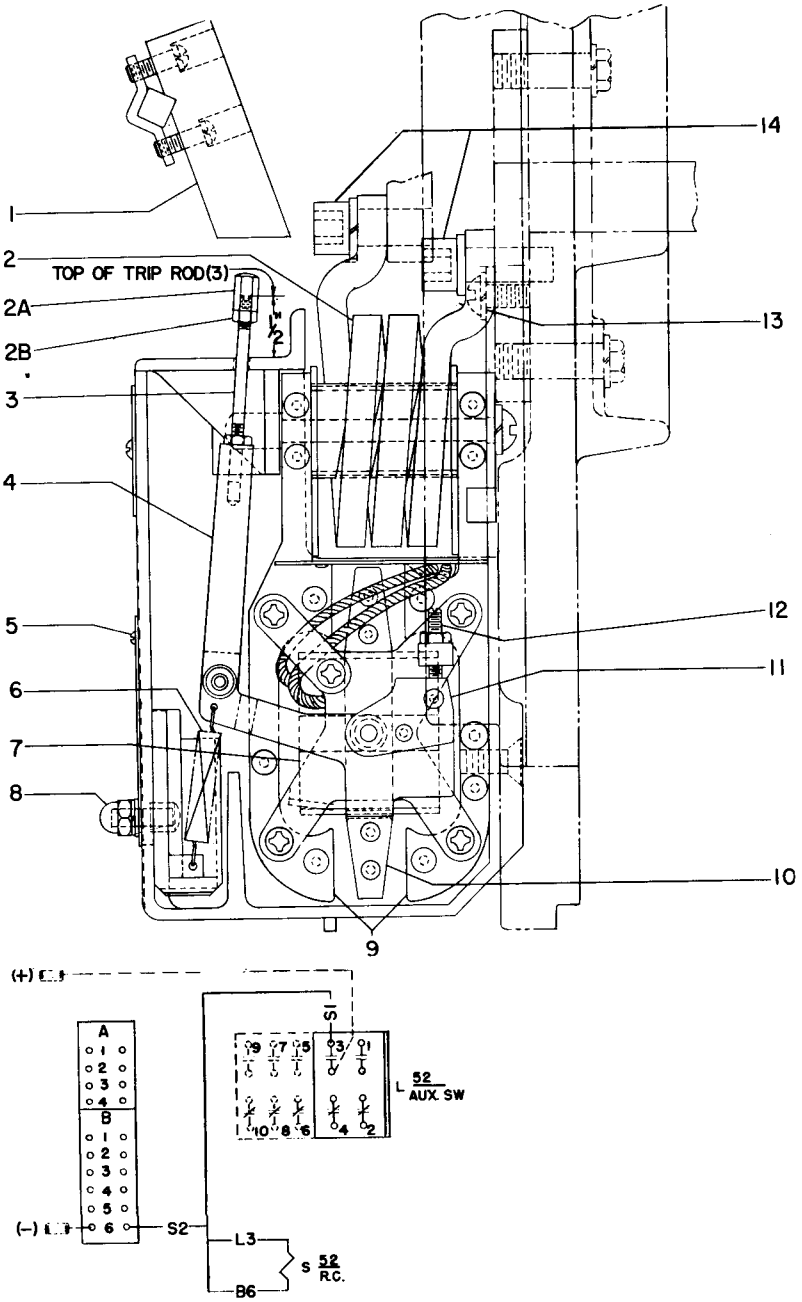


Figure 7. Time-adjustment indexing



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

Figure 8. ED-1 Reverse current tripping device

The top edge of the movable nut (11) serves as an index pointer and should be lined up with the center of the desired calibration mark (15) to obtain the proper instantaneous trip setting.

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

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

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

REVERSE CURRENT TRIPPING DEVICE AKR50 and AKS50 only (Fig. 8)

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

The reverse current tripping device (see Fig. 8) consists of a series coil (2) with an iron core mounted between two pole pieces (9), also a potential coil (7) connected across a constant source of voltage and mounted around a rotary-type armature (10). Calibration spring (6) determines the armature pick-up when a reversal of current occurs.

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

If the current through the series coil (2) is reversed, the armature (10) tends to move in the clockwise direction against the restraint of the calibration spring (6). When the current reversal exceeds the calibration setting, the armature revolves clockwise causing the trip rod (3) to move upward engaging the trip paddle (1), thereby tripping the breaker.

ADJUSTMENTS (Fig. 8)

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

The new device will be factory adjusted so that the top end of the trip rod (3) will extend 1/2 in. above the top of the device case, and no additional adjustments of the trip rod should be required. To obtain the proper 1/32 in. overtravel, close the breaker and proceed as follows:

1. Loosen the locking nut. (2B).
2. Manually lift the trip rod and vary the position of the adjusting nut (2A), this establishing the position of the adjusting nut where the breaker is just tripped.

NOTE: Be sure to keep clear of moving breaker parts when tripping the breakers.

3. With this position of the adjusting nut established, advance the adjusting nut upward one and one-half turns.
4. Tighten the locking nut and the minimum 1/32-in. overtravel of the trip rod should be obtained.

REPLACEMENT (Fig. 6)

After removing the wiring for the potential coil the reverse current device can be removed and replaced by following the procedure outlined for replacing the series overcurrent device. For wiring, see Fig. 6.

SWITCHETTE FEATURE

(Switchette available in EC-1 devices only)

Switchette is operated by the long-time delay function. its purposes is to provide a set of contacts that will close before an overload occurs. This device will not trip the breaker on overload it will trip on instantaneous only.

Switchette is used in one pole and standard EC trips in the other poles. For the alarm to be effective in indicating the overload before the other poles trip the breaker, the device must have less time delay then the other two poles, this is accomplished by using a lower characteristic on the alarm device then the other poles or setting the alarm devices long time setting at 80%.

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