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Rev. 1

PROCEDURE FOR FIELD TESTING
I-T-E K-LINE CIRCUIT BREAKER OVERCURRENT TRIP DEVICES
I-T-E TYPES
OD-3 THROUGH OD-82 (K-225 THROUGH K-2000)
OD-300 THROUGH OD-800 (K-3000 AND K-4000)

I. INTRODUCTION

Since the circuit breaker direct acting overcurrent trip device initiates the breaker tripping action that protects both the electrical load and its electrical supply, it is important that this device performs correctly. This procedure should be followed whenever testing is done to check performance. All testing is single phase to insure that each of the overcurrent trip devices operates correctly. Normal variations in ambient temperature (10-55C) have little effect on pickup and short- time delay values. The effect on long-time delay, however, is more noticeable, since the delay is caused by the restriction of oil flow through a predetermined opening. However, over this normal circuit breaker operating temperature range, the long-time delay should still be within the range of the time-current characteristic bands.

Section "III.A." is the recommended field test procedure for testing long-time delay, instantaneous pickup, short-time pickup and short-time delay. These tests are sufficient for detecting faulty overcurrent devices and will insure that all devices successfully tested will operate to protect the electrical equipment.

Section "III.C." is the test for accurately determining long-time pickup. This test is more involved than the above test and, since successful testing of long-time delay at 300% (per Section III.A.) of pickup is a very good indication that the pickup is correct, the long-time pickup test is not recommended as a field test procedure, but is included in Section III.C. in the event this test is desired by the customer who is well versed on calibration methods.

II. GENERAL

FOR SAFETY - MAKE CERTAIN TO KEEP CLEAR WHENEVER THE CIRCUIT BREAKER IS CLOSED AND/OR CLOSING SPRINGS ARE CHARGED.

1. Refer to the appropriate I-T-E instruction bulletins for general circuit breaker instructions and maintenance.

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2. This procedure covers the latest models of overcurrent trip devices. For previous models, the basic procedure may be followed in principal with the knowledge that the calibration nameplate and the method of adjustment may be slightly different.

OD-3 Through OD-82

The latest models supplied since April 1966 are easily recognized by the shape of the nameplate. (See Fig. 1) The earlier models have nameplate that are rectagular in shape. The OD-3 model, supplied from 1958 to November 1963, has the long-time and instantaneous elements incorporated in one armature with an instantaneous spring arrangement similar to the present OD-5. Also, all the earlier models supplied from 1958 to April 1966, having long-time delay, have a common long-time delay adjustment screw.

OD-300

The OD-300 overcurrent devices supplied before July 1964 also have the long-time and instantaneous elements incorporated in one armature, similar to the OD-500.

3. Calibration Multiplier for OD-300 through OD-800 (K-3000 and K-4000)

All K-3000 and K-4000 circuit breakers shipped after January 1, 1972, have had the overcurrent trip devices calibrated using "single-pole calibration multipliers". A 2½ X 2" decal mounted on the breaker left side of the front cover plate, (to the rear of the escutcheon plate) lists these multipliers as being: L. Pole - 1.05; C. Pole - 1.25; and the R. Pole - 1.20. These multipliers are to be used when checking the calibration of these breakers with current flowing only through the pole being tested. This is the usual method and the method used throughout this instruction bulletin. Multipliers are used to compensate for the interphase effect that exists when the breakers are subjected to the normal three phase currents.

The interphase effect on the K-225 through K-2000 breakers is negligible; therefore, calibration multipliers for these breakers are not required.

4. Test Equipment - The test equipment should be a power supply capable of supplying single phase, high current at low voltage, at the same frequency as the overcurrent device is rated. Current output should be adjustable with a minimum current requirement of 600% of coil rating for the OD-3 through 82 and 600% X 1.25 for OD-300 through 800. This is based on checking the instantaneous element for pickup at approximately five times coil rating and checking the short-time delay element set at four times coil rating with current at 1½ times the setting. The test equipment should be capable of maintaining the instantaneous and short-time test currents for a minimum of two seconds which is the time allotted for adjusting the test equipment to the correct current values.

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If the test set does not have the capacity for checking the instantaneous element for pickup or short-time element for time delay, then the armatures of these elements should be pushed toward the magnet with no noticeable burden and then released to see that they reset and seat at the armature stops. (See Figures 2 and 5.) The equipment should contain a timer which will operate during current flow and be capable of accurately measuring times between .05 and 300 seconds.

5. When removing breaker from switchboard and/or moving to test location, keep in upright position so as not to affect long-time delay results. Generally, to insure proper operation of direct-acting trip devices, whether new or in service, exercise the long-time armature (wide) to insure that there is resistance to motion. This exercise will remove any trapped air which could lead to false operation.

6. Connect the upper and lower breaker terminals of one pole to the test unit. If the breaker and test unit are not equipped with stab adapters, use cable or bus of sufficient size and as short as possible to hold heat rise and voltage drop to a minimum.

7. On transformer trip devices, the overcurrent coil (5 ampere rating) is energized by a current transformer whose primary is the bus that connects to the breaker primary contacts; since it may not be convenient to test the breaker with the current transformers in the circuit, the test current may be applied directly to the overcurrent trip device coil. This coil terminates at a terminal block on the back of the circuit breaker, and it is necessary to connect the test power supply to this block and not to the upper and lower primary breaker terminals. Refer to the basic circuit breaker auxiliary wiring diagram.

8. After each test that results in the breaker tripping, reclosing the breaker is required before proceeding with the next test.

9. Since much of the testing is done with currents exceeding the continuous current rating of the overcurrent devices, care should be exercised in not overheating the overcurrent coil. Allow sufficient cooling time between tests. Also, use of an air hose can expedite the cooling.

10. After conclusion of the test, make sure the calibration indicators are reset to the required operating settings.

11. The OD-32 and OD-82 are overcurrent devices with sealed instantaneous and long-time delay elements for fire pump circuit breakers. These seals should not be broken unless sanctioned by authorized personnel.

12. The air gap distance between magnet and armature is set to a fixed dimension at the factory. This air gap should not be changed in the field.

13. When the breaker is not energized or the current is below the pickup value, the armatures of overcurrent device (see Fig. 2 & 5) should be seated on the stops. After an armature has actuated to trip the breaker, the reset time (time for the armature to seat on the stop) is 4 seconds

maximum for the long-time armature and one second maximum for the short-time or instantaneous armatures.

14. In order to save time and to keep the breaker from overheating, the tests are made at one setting. From experience, if the overcurrent device checks out at one calibration setting with an overcurrent through the breaker, the overcurrent device will also check out at other calibration settings and overcurrents. Therefore, 300% overcurrent is used as representative for long-time delay and 150% (of S.T. calibration setting) for short-time delay testing.

15. Due to extensive equipment required, field testing for resettable delay is not justified and, therefore, not covered by this procedure.

16. Clean Contacts - The main contacts may become marked from repeated tests since at the low voltage values, with the arc contact material being so high in resistance, the current may interrupt on the mains. Clean with non-metallic material such as "Scotch Brite". Blow residue from the breaker before placing in service.

III. FIELD TEST PROCEDURE

A. Timing and Calibration Test Using an Electrical Test Set

1. Long-Time Delay Test

In order to keep test time to a minimum, it is sufficient to test the overcurrent devices at the calibration point and time band at which they are already set. (Note that the OD-3 and OD-32 and OD-300 have only one time band.)

Set the current through the breaker (one pole at a time) as shown in the chart below. The time for tripping the breaker should be within the limits shown. Test time delay three times, but allow a minimum of four seconds between tests to give the armature time to reset completely.

TABLE I

OD-3, 300	
Test Current	OD-3 - 3 X Long-Time Pickup Setting
	OD-300 - 3 X Long Time Pickup Setting X Calibration Multiplier
Time Delay	8 to 34 Seconds

Should trip between 13-18

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4, 5, 6, 400, 500, 600		
Test Current	OD-4, 5, 6 - 3 X Coil Rating OD-400 Thru 600 - 3 X Coil Rating X Calibration Multiplier	Long-Time Delay Limits (Sec.)

Pickup Setting	Min. Band	Int. Band	Max. Band
1st Point (80% Coil Rating)	9-23	24-43	41- 72
2nd Point (100% Coil Rating)	11-28	30-52	50- 90
3rd Point (120% Coil Rating)	14-37	36-66	60-110
4th Point (140% Coil Rating)	19-48	42-80	69-135
5th Point (160% Coil Rating)	23-63	50-98	86-160

OD-32 (Firepump)	
Test Current	200% of Long-Time Pickup Setting
Time Delay	5 to 19 Seconds

If the first test for long-time delay results in time delay not within the limits, check as follows:

a. Repeat the test two more times. If times for these two tests are within the limits, it is possible the breaker may have been tilted during removal from the switchboard to the test location. (Re: II.4.)

b. If the breaker does not trip with the test current applied for several minutes, then, with current removed, push up the long-time armature at Point "A", Figures 2 and 5, with a rod to trip the breaker. Allow time for the dashpot to time out. If the breaker cannot be tripped, then the trip screw should be checked for adjustment. (See circuit breaker instruction bulletin for adjustments.)

c. If there is no long-time delay or low time delay, observe that the long-time armature resets, with current removed, to touch at the stop. Failure to touch the stop will result in reduced or no time delay.

d. Check for oil leaking from the dashpot.

If it is necessary to readjust to obtain the correct time, the long-time delay adjusting screw should be turned to move the long-time delay indicator toward the maximum band (high) to increase the time or toward the minimum band (low) to decrease the time.

2. Instantaneous Pickup Test

In order to keep from overheating the overcurrent device and test set, the instantaneous pickup should be adjusted to the minimum calibration point. Successful testing at the minimum setting is sufficient to assume that the other settings are also within the specified limits. On OD's 5, 9, 500 and 900, it also will be necessary to either block the short-time armature (thin armature) or to change the short-time pickup to the maximum calibration. This is done to prevent the short-time element from tripping the breaker, since the short-time is normally set to a lower value than the instantaneous. The first step in determining the instantaneous pickup current is to set the variable hand control to the lowest current value that results in the breaker always (approximately 5 times in succession) tripping as soon as the current is instantaneously applied to the breaker. (A setting lower than this will result in no tripping or delayed tripping in at least one of five tries.) Once this lowest setting is obtained, do not move the variable hand control setting.

The second step is to determine at what instantaneous current the test equipment is set. Since the instantaneous current is only several cycles in duration, a special method is required to determine this current. Most test sets incorporate an ammeter whose indicator can be preset to any value. By "trial and error", the ammeter indicator is preset so that it just quivers when the test current is applied to trip the breaker instantaneously. (A higher preset will result in no quiver, a lower preset in visible movement.)

This current should be within ±20% of the calibration point on the nameplate for the OD-3 through 82 and within ±20% of the calibration point on the nameplate X calibration multiplier for the OD-300 through 800.

Readjust the pickup indicators to their original settings.

3. Short-Time Pickup Test

In order to keep from overheating the overcurrent device and test set, the short-time pickup should be adjusted to the minimum calibration point; also on OD's 5, 9, 500 and 900, the long-time armature (wide armature) should be blocked or the instantaneous should be set to the maximum calibration point. This is to prevent the instantaneous from inadvertently tripping the breaker, since, with the minimum instantaneous pickup of five times coil rating ±20% and minimum short-time pickup of four times coul rating +15%, there is a possibility that the instantaneous element could trip the breaker.

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The first step in determining the short-time pickup current is to set the variable hand control to the lowest current value that results in the breaker always (approximately 5 times in succession) tripping when the current is applied instantaneously to the breaker; however, since there is time delay in the short-time element, it may take as long as one second from inception of current until the breaker trips.

The second step is to determine at what short-time current the test equipment is set. Most test sets incorporate an ammeter that can be preset to any value. By "trial and error" the ammeter indicator is preset so that it just "quivers" when the test current is applied to trip the breaker. (A higher preset would result in no "quiver", a lower preset in visible movement.)

This current should be within ±15% of the calibration point on the nameplate for the OD-3 through 82 and within ±15% of the calibration point on the nameplate X calibration multiplier for the OD-300 through 800.

Readjust the pickup indicators to their original settings.

4. Short-Time Delay

The short-time pickup should be set at the minimum point, and, on OD's 5, 9, and 500, the long-time armature (wide armature) should be blocked or the instantaneous should be set at the maximum calibration point. The current through the breaker should be set at 1½ times the pickup point for the OD-4 through 82 and 1½ times the pickup point times the calibration multiplier for the OD-400 and 500. In order to set the current through the breaker at 150% pickup, it is necessary to keep the OD armatures from moving since this movement may result in the breaker tripping and also as the long-time moves toward the magnet, the current through the breaker will decrease. On OD-3 through OD-82, this movement can be stopped by holding down the armatures at Point "A" (Figure 2) by using a wire looped around the screw. OD-300 through OD-800 armatures can be stopped from moving by pushing up at Point "B" (Figure 5) with an appropriate stick. Once the current is established, the control handle should not be moved. The short-time delay is measured from the inception of current until the breaker trips. The delay time limits are listed in Table II. See Figures 4 and 6 to determine at which short-time delay band the overcurrent device is set.

TABLE II

Test Current	OD 4,5,9,10 - 6 X Coil Rating	
	OD400 & 500 - 6 X Coil Rating X Calibration Multiplier	
Time Delay	Minimum Band	.14 to .33 Sec.
	Intermediate Band	.29 to .47 Sec.
	Maximum Band	.47 to .8 Sec.

B. Example for Testing

Type OD-5

OD Rating - 400 Amp.

Long-Time Pickup Set at - 400 Amp.

Long-Time Delay Band Set at - Intermediate

Instantaneous Pickup Set at - 4000 Amp.

Short-Time Pickup Set at - 2800 Amp.

Information from Overcurrent Device Nameplate. See Figure 1.

Short-Time Delay Band Set at - Intermediate - By observing location of pin. See Figure 4.

1. Long-Time Delay

Per Section "A", Paragraph 1., the current through the breaker should be 1200 Amp. = 3 x 400 Amp. (coil rating). Time to trip the breaker should be 30-52 seconds for intermediate band per Table I.

2. Instantaneous Pickup

Per Section "A", Paragraph 2, reset the instantaneous element to the minimum point of 2000 Amp. Reset the short-time element to the maximum point of 4000 Amp. Test per Section "A", Paragraph 2. The instantaneous element should pick up instantaneously and trip the breaker at 2000 ±20% Amp.

3. Short-Time Pickup

Per Section "A", Paragraph 3., reset the short-time element to the mimimum point of 1600 Amp. Reset the instantaneous element to the maximum point of 6000 Amp. Test per Section "A", Paragraph 3. The short-time element should pick up and trip the breaker at 1600 ±15% Amp.

4. Short-Time Delay

Per Section "A", Paragraph 4., the current through the breaker should be 1½ x 1600 = 2400 Amp. Time delay should be .29 to .47 seconds per Table II.

5. Long-Time Pickup

There is not a recommended test; however, if required, then test per Section "C". The minimum current that will pickup the long-time armature and trip the breaker should be 400 ±10% Amp.

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6. Examole for OD-500

Assuming the example of Paragraph III.B., page 9, to be an OD-500, center pole, the following values would prevail.

a.	L. T. Delay - 3 x 400 x 1.25	Applied
b.	Inst. Pickup - 2000 x 1.25 ±10%	Required
c.	S. T. Pickup - 1600 x 1.25 ±15%	Required
d.	S. T. Delay - 2400 x 1.25	Applied
e.	L. T. Pickup - 400 x 1.25 ±10%	Required

C. Long-Time Pickup Test (See "Introduction I" - not recommended)

This method checks the long-time pickup by first removing the intentional time delay and visually checking to see when the long-time armature (wide armature) begins to move toward the magnet.

This is done as follows:

1. OD's 3, 4, 5, 6, 20, 32, 61 (See Figures 2 and 3)

Turn the long-time delay adjusting screw so that the delay indicator moves up. After the indicator begins to move past the minimum time band, it is necessary, after each quarter turn of the adjustment, to check if time delay has been removed. Time delay is removed when a sudden light push of the long-time armature at Point "A" results in the armature moving toward the magnet, the only resistance being that due to mechanical friction and the long-time calibration spring.

NOTE: On OD-5 and OD-500, a sudden upward push on the armature with time delay still engaged can result in the armature moving. This is due to the instantaneous spring compressing; therefore, on OD-5 and OD-500, do not push at Point "A" hard enough to compress this spring.

2. OD's 300, 400, 500, 600 (See Figure 5)

Loosen the long-time delay lock screw approximately one turn. Turn the long-time delay adjustment to the right until the minimum band lines up with the indicator. Continue to turn the adjustment to the right, but after each 1/6 turn of the adjustment, check to determine if time has been removed. It may be necessary to bend the indicator to permit movement past the minimum band. Time delay is removed when a sudden light push of the long-time armature at Point "A" results in the armature moving toward the magnet, the only resistance being that due to mechanical friction and the long-time calibration spring. See above note for OD-500.

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The current through the breaker should be gradually increased. The pickup current is the lowest current that will cause the armature to move toward the magnet. This pickup current should be within ±10% of the pickup point adjacent to the indicator times the calibration multiplier. After completion of test, move delay indicator to desired setting and retighten the lock screw. Recheck time delay (See Section "A", Paragraph 1.)

NOTE: All delay times are applicable for 50/60Hz systems and based on a normal calibration temperature range of 10^0 - 40°C with no previous load being applied to the trip device.

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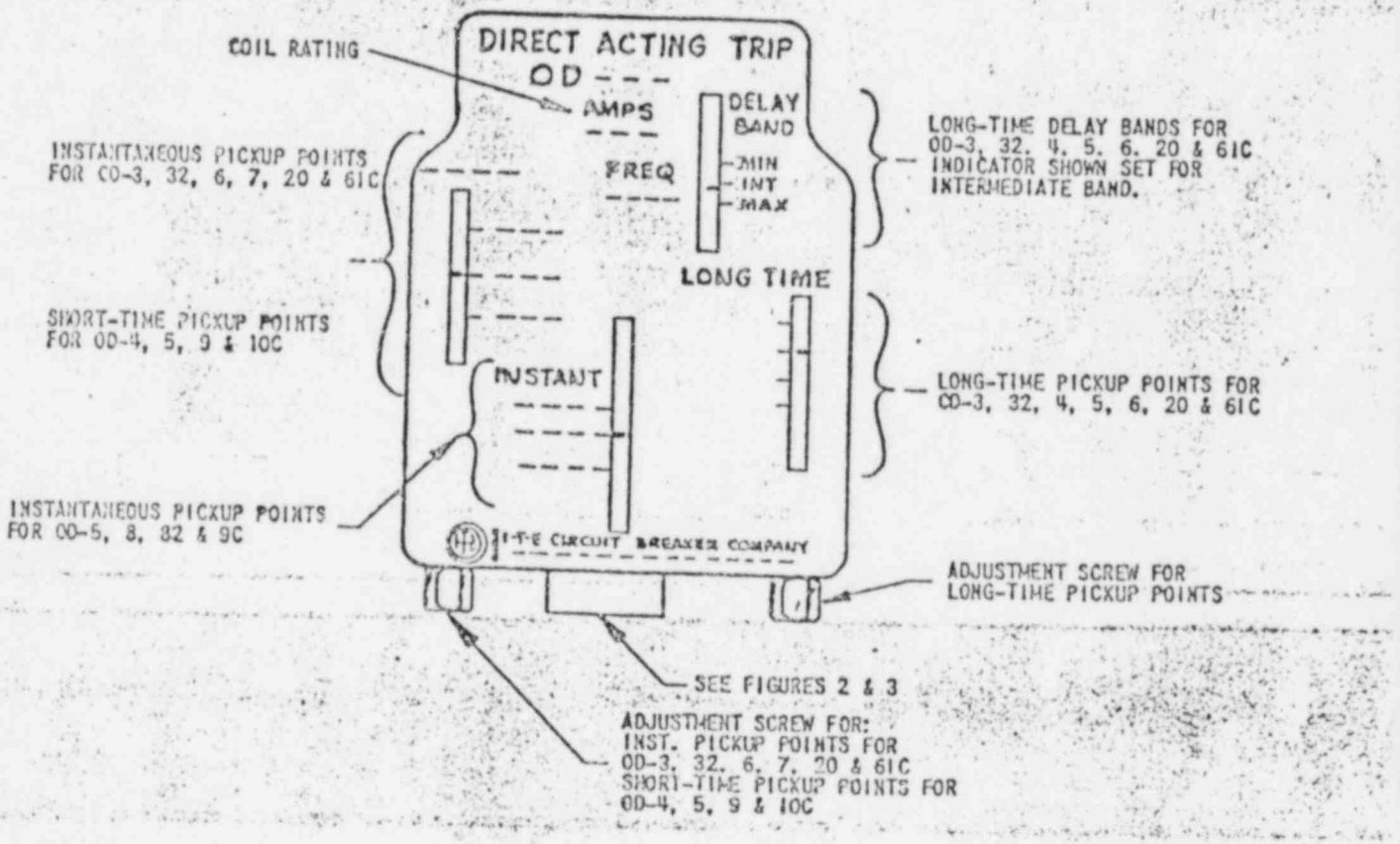


FIG. 1

OVERLOAD DEVICE (OD-3 THROUGH OD-82) USED ON K-225 - K-2000

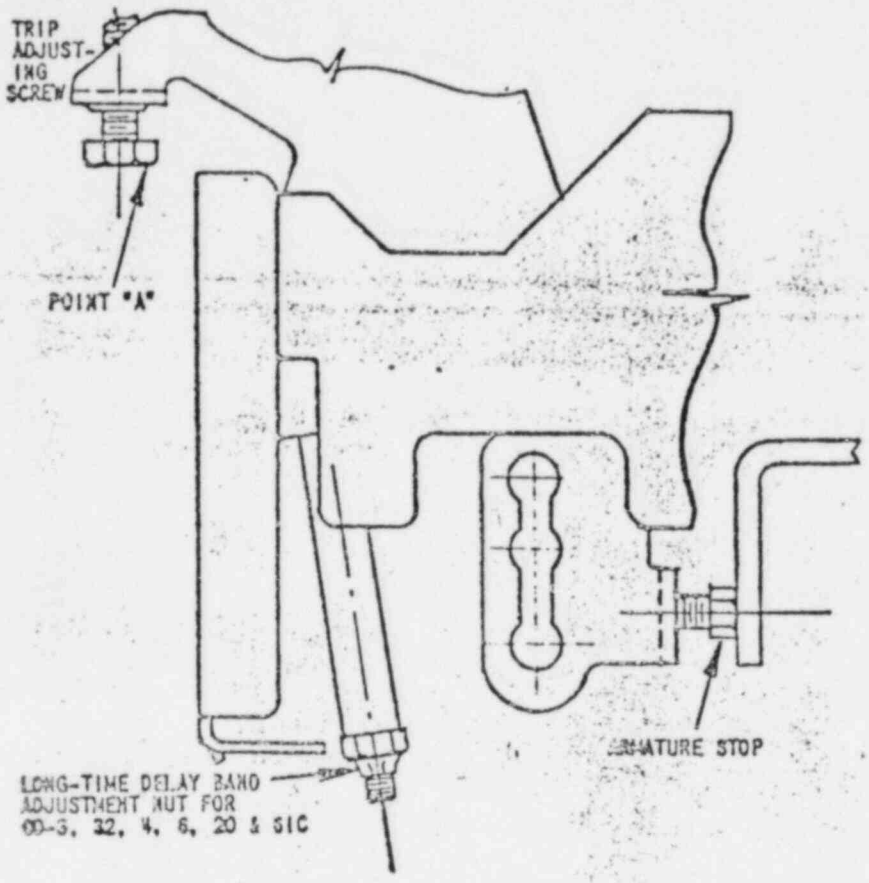


FIG. 2

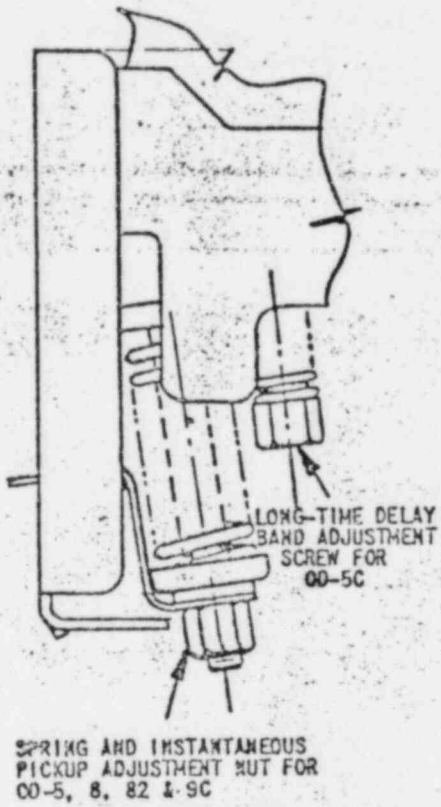


FIG. 3

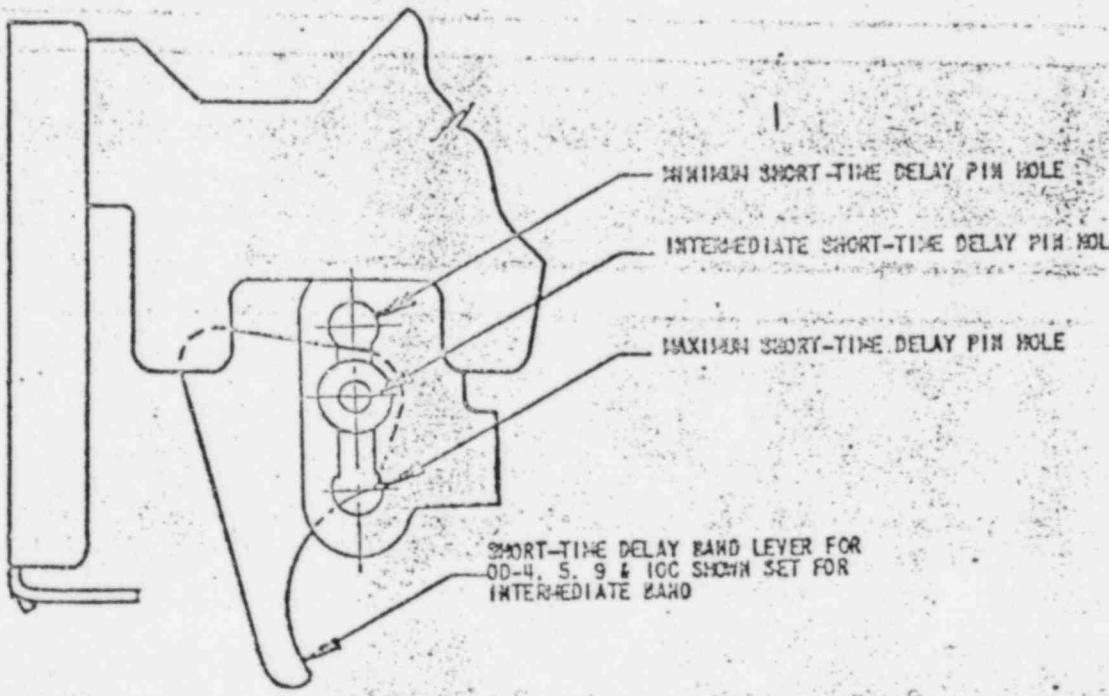


FIG. 4

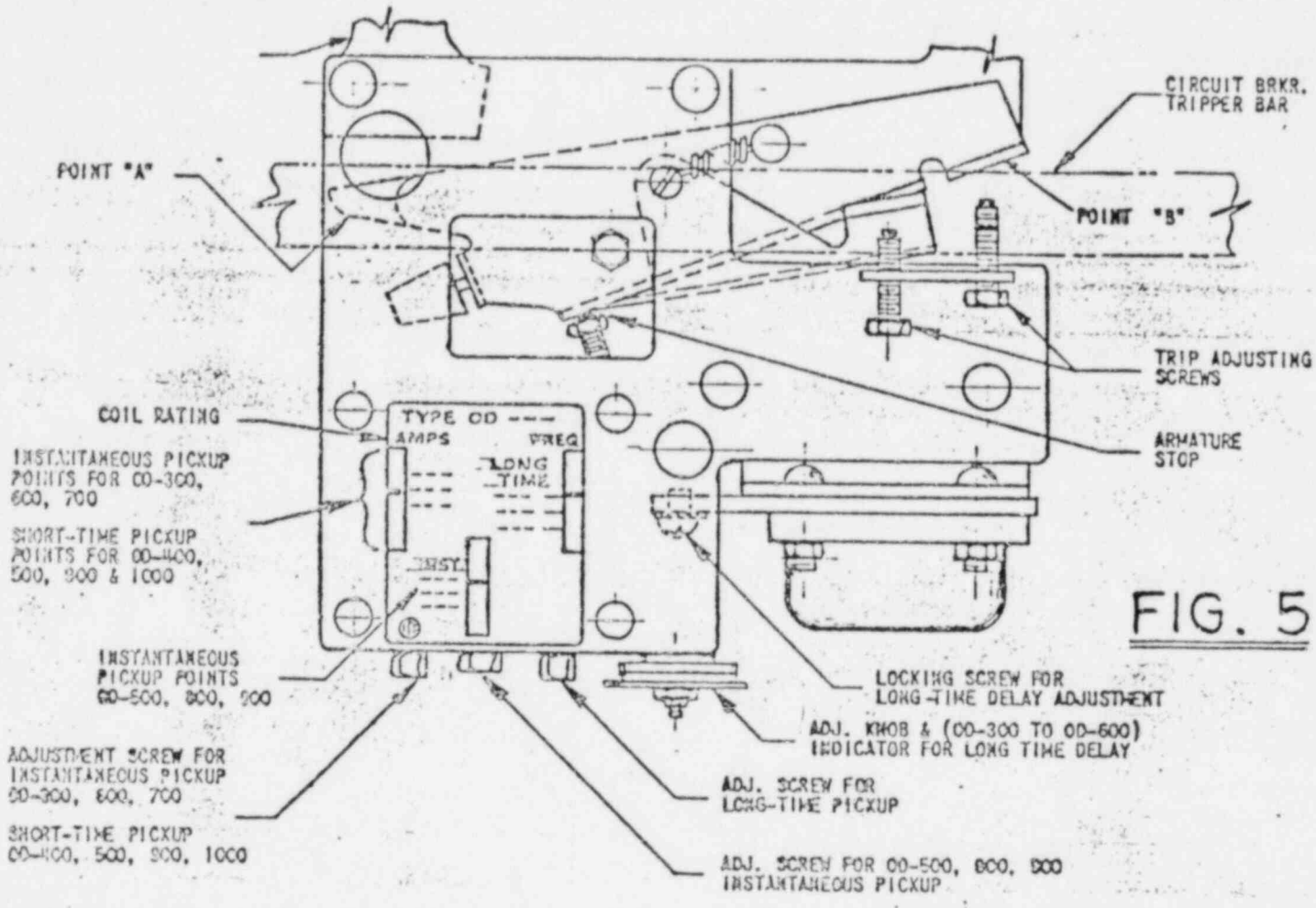


FIG. 5

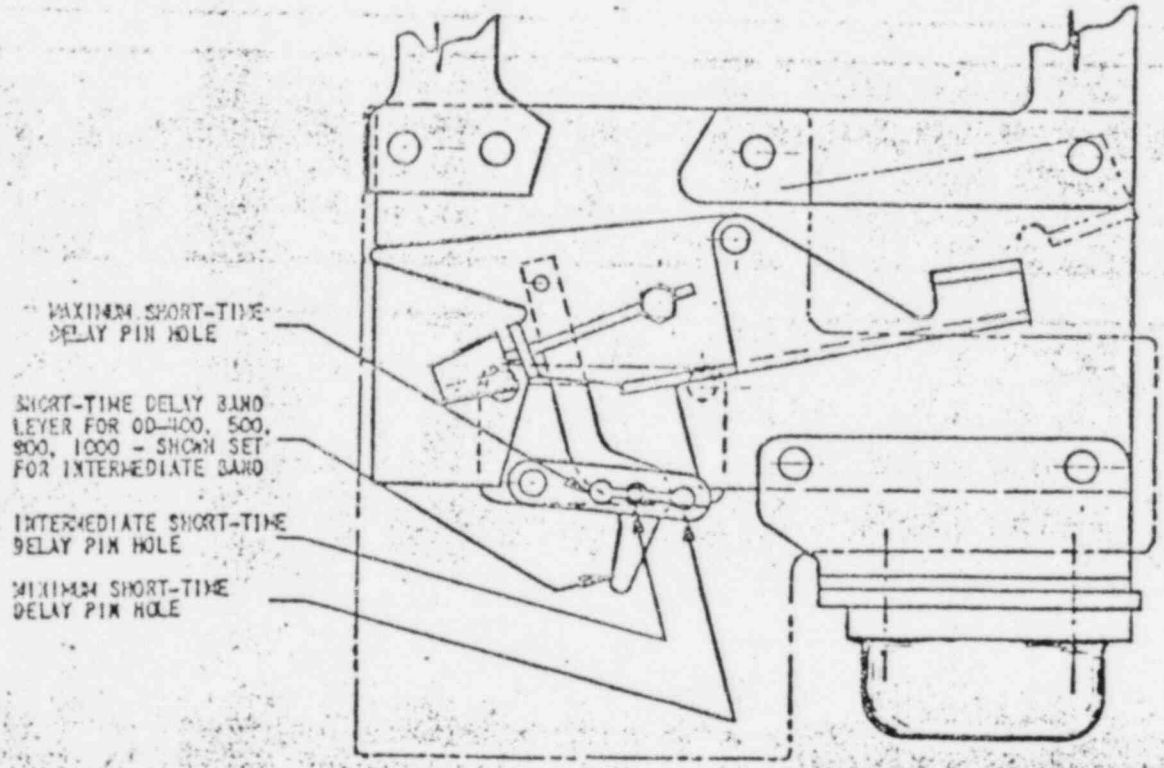


FIG. 6

OVERLOAD DEVICE (OD-300 - 1000) USED ON K-3000/4000

ADJUSTMENT OF OVERCURRENT TRIP DEVICES FOR TYPE K-225, K-600, K-1600, AND K-2000 CIRCUIT BREAKERS

The type OD overcurrent trip devices are calibrated at the factory. The armature trip travel must be adjusted after the overcurrent trip devices are installed on the circuit breaker.

ARMATURE TRIP TRAVEL (Refer to Dwg. S-14783)

CAUTION: KEEP HANDS CLEAR OF ALL MOVING PARTS. THE CIRCUIT BREAKER WILL TRIP TO THE "OPEN" POSITION WHILE CHECKING OR ADJUSTING THE ARMATURE TRIP TRAVEL.

When checking the armature trip travel adjustment or making final armature trip travel adjustment, insert the feeler gauge at point "A" parallel to the magnet face. The circuit breaker should trip, when the armatures are operated by hand, with a 0.020 inch gauge inserted at "A". It should not trip when a 0.030 inch gauge is inserted.

If adjustments are not as stated above, turn the trip adjusting screw (4) in or out as may be required. Always recheck the trip travel adjustment after making any changes in the trip screw position.

Initial trip travel adjustment can be made as follows:

Refer to drawing S-14783 and,

1. Back-out adjusting screw (4) so that it will not strike the tripper bar (3) when the armature (2) is operated by hand.

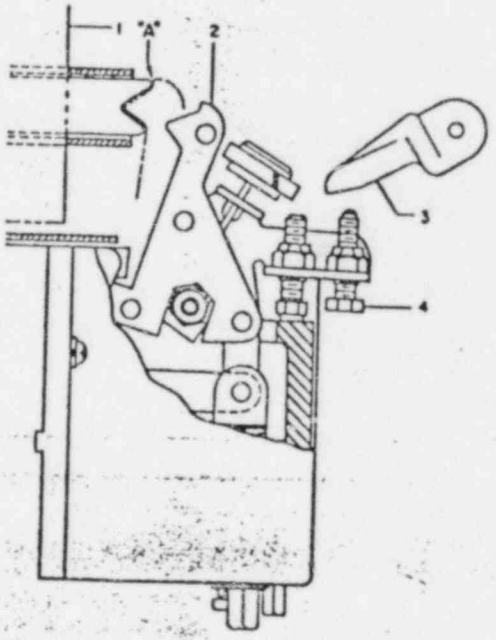
2. Close the circuit breaker.

3. Push up and hold the armature (2) in its tripping position (against the magnet face).

4. Slowly turn in the adjusting screw (4) until the circuit breaker trips.

5. Turn the adjusting screw (4) in (same direction as in step 4) one additional full turn.

NOTE: Final adjustment must be made by using the feeler gauges as described in the preceding paragraphs for checking the adjustment.



1 COIL
2 ARMATURE
3 TRIPPER BAR
4 ADJUSTING SCREW

DWG. S-14783