INSTRUCTIONS

GEK-1271

Ground Directional Overcurrent Relays

TYPES

IBCG51K IBCG53K IBCG77K

IBCG52K IBCG54K IBCG78K

POWER SYSTEMS MANAGEMENT DEPARTMENT

GENERAL ELECTRIC

PHILADELPHIA, PA.

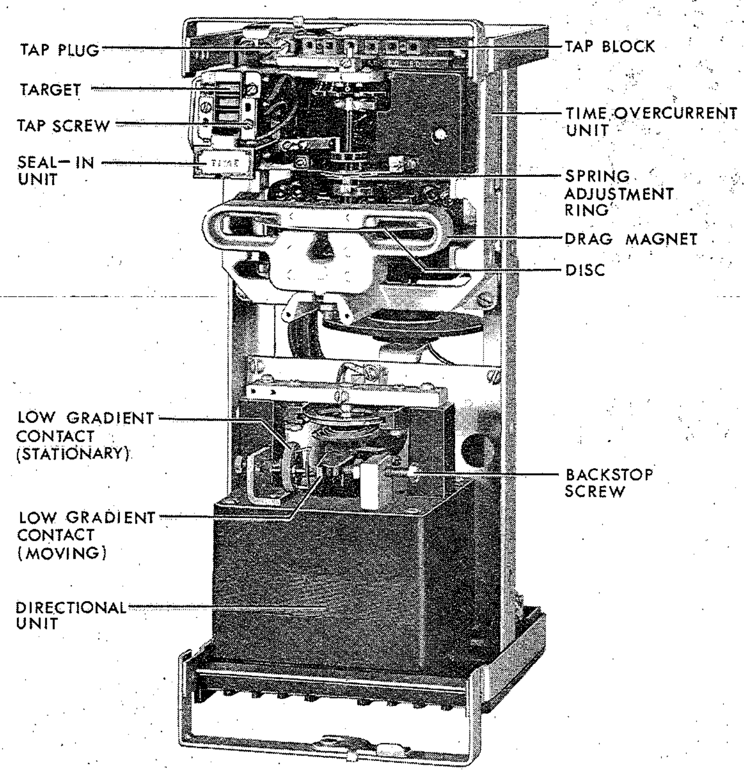


Fig. 1A (8036986)
Front View

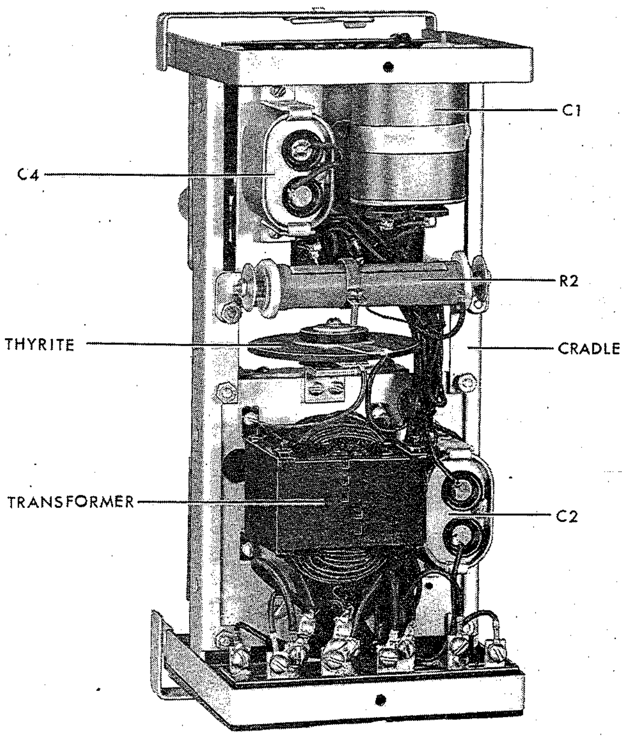


Fig. 1B (8036985)
Back View

Fig. 1 Type IBCG77K Relay, Removed From Case

GROUND DIRECTIONAL OVERCURRENT RELAYS
TYPE IBCG

DESCRIPTION

Type IBCG relays are ground directional overcurrent relays used primarily for the protection of feeders and transmission lines. They are available with either inverse, very inverse or extremely inverse time characteristics.

They consist of two units, a time overcurrent unit (top) of the induction disk type, and an instantaneous power directional unit (bottom) of the induction cup type. The directional unit is either potential or current polarized or both and, by means of its closing contacts, directionally controls the operation of the time overcurrent unit.

APPLICATION

Type IBCG relays are used for ground fault protection of a single line. They have a low-range time overcurrent unit which may be rated 0.5/2 or 1.5/6 amperes, although the 4/16 ampere rating is also available.

Under normal conditions, no current flows in either the operating or current polarizing coils, nor is there any voltage across the potential polarizing coils.

Figure 2 shows the external connections for the single circuit type IBCG relays.

Figure 3 shows the external connections for the double circuit type IBCG relays.

On some applications, system conditions may at one time be such that potential polarization is desirable, and at other times be such that current polarization would be preferred. The type IBCG relay, with its dual polarization feature, is well suited for such applications. The curves in Fig. 4 compare the performance of the relay when dual polarized with its performance when either potential or current polarized alone. The simultaneous use of both sets of polarizing coils is advantageous on applications where current and potential polarizing sources are available and there is a possibility that one or the other source may be temporarily lost.

The differences between the various models covered by this instruction book are shown in Table I. Inverse time relays should be used on systems where the fault current flowing through a given relay is influenced largely by the system generating capacity at the time of the fault. Very inverse time and extremely inverse time relays should be used in cases where the fault current magnitude is dependent mainly upon the location of the fault in relation to the relay, and only slightly or not at all upon the system generating setup. The reason for this is that relays must be set to be selective with maximum fault current flowing. For fault currents below this value, the operating time becomes greater as the current is decreased. If there is a wide range in generating capacity, together with variation in short-circuit-current with fault position, the operating time with minimum fault current may be exceedingly long with very inverse time relays and even longer with extremely inverse time relay. For such cases, the inverse time relay is more applicable.

TABLE I

Relay Model IBCG	Time Characteristic	Circuit Closing Contacts	Internal Connections
51K	Inverse	One	Fig. 9
52K	Inverse	Two	Fig. 10
53K	Very Inverse	One	Fig. 9
54K	Very Inverse	Two	Fig. 10
77K	Ex. Inverse	One	Fig. 11
78K	Ex. Inverse	Two	Fig. 12

CURRENT CIRCUITS

The continuous & short time ratings of the time overcurrent unit operating coil circuit are shown in Table II. The directional unit current polarizing & operating coils have a continuous rating of 5 amperes and a one second rating of 150 amperes.

Since all operating current circuits are normally connected in series, the operating coil ratings of both units should be considered in determining the rating of the entire operating circuit.

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.

POTENTIAL COILS

The potential polarizing coils will withstand 120 volts continuously and 360 volts for 60 seconds.

TABLE II

RATINGS OF TIME OVERCURRENT UNIT OPERATING COILS

Tap Range (Amps)	Tap Ratings (Amps)	*Cont. Rating (Amps)	One Sec. Ratings (Amps)
0.5/2.0	0.5,0.6,0.8,1.0, 1.2,1.5,2.0	1.5	100**
1.5/6.0	1.5,2,2.5,3,4,5,6	5	200
4/16	4,5,6,7,8,10, 12,16	10	220

*Applies to all taps up to & including this value. The continuous rating of higher current taps is the same as the tap value.

**Applies to the very inverse & extremely inverse time relays only. The one second rating of inverse time relays is 65 amperes.

SEAL-IN UNIT

The rating and impedance of the seal-in unit for the 0.2 and 2 ampere taps are given in Table III. The tap setting used will depend on the current drawn by the trip coil.

TABLE III

	2 AMP TAP	0.2 AMP TAP
Carry Tripping Duty	30 Amps	3 Amps
Carry Continuously	3 Amps	0.3 Amps
D-C Resistance	0.13 Ohms	7 Ohms
Impedance (60 cycles)	0.53 Ohms	52 Ohms

The 0.2 ampere tap is for use with trip coils which operate on currents ranging from 0.2 up to 2.0 ampere at the minimum control voltage. If this tap is used with trip coils requiring more than 2 amperes, there is a possibility that the resistance of 7 ohms will reduce the current to so low a value that the breaker will not be tripped.

The 2 ampere tap should be used with trip coils that take two amperes or more at minimum control voltage, provided the current does not exceed 30 amperes at the maximum control voltage. If the tripping current exceeds 30 amperes, the connections should be arranged so that the induction unit contacts will operate an auxiliary relay which in turn energized the trip coil or coils. On such an application, it may be necessary to connect a loading resistor in parallel with the auxiliary relay coil to allow enough current to operate the target seal-in units.

CHARACTERISTICS

PICKUP

When potential polarized, the directional unit will pickup at 3.6 volt-amperes at the maximum torque angle of 60 degrees lag (current lags voltage). When current polarized, it will pickup approximately 0.5 ampere with the operating and polarizing coils connected in series. The performance of the unit with simultaneous current and potential polarization is typified in Figure 4.

The current required to close the time overcurrent unit contacts, will be within five percent of the tap screw setting.

RESET (TIME OVERCURRENT UNIT)

The minimum percentage of minimum closing current at which the time overcurrent unit will reset is 90% for inverse-time relays and 85% for very inverse and extremely inverse time relays. When the relay is de-energized, the time required for the disk to completely reset to the number 10 time dial position is approximately 6 seconds for inverse time relays and 60 seconds for very inverse and extremely inverse time relays.

OPERATING TIME

The time curve for the directional unit is shown in Figure 5.

The time curves of the time overcurrent unit are shown in Figures 6, 7, and 8 respectively for inverse, very inverse and extremely inverse time relays. For the same operating conditions, the relay will operate repeatedly within one or two percent of the same time.

BURDEN

The capacitive burden of the potential polarizing circuit of the directional unit at 60 cycles & 120 volts is 10 volt amperes at 0.86 power factor. Table IV gives the current circuit burdens of the directional unit.

TABLE IV

DIRECTIONAL UNIT CURRENT CIRCUIT BURDEN AT 60 CYCLES & 5 AMPERES

Circuit	Z (Ohms)	VA	P.F.	Watts
Operating	.46	12.0	.52	6.24
Polarizing	.24	6.0	.95	5.27

Table V gives the current circuit burdens of time overcurrent units.

Ordinarily the potential circuit is in the open corner of broken delta potential transformers & the current circuits are in the residual circuits of current transformers. The burden is, therefore, only imposed for the duration of the ground fault and need be considered only for this brief period.

TABLE V

Time Characteristic	Tap Range (Amps)	Burdens At Minimum Pickup					Ohms Impedance At		‡ VA At Five Amperes
		Eff. Res. (Ohms)	React. (Ohms)	*Imped. (Ohms)	+Volt Amps	P.F.	3 Times Min. P.U.	10 Times Min. P.U.	
Inverse	0.5/2	5.6	21	22	5.5	.26	10.8	5.0	530
Inverse	1.5/6	.62	2.3	2.4	5.4	.26	1.2	.55	60
Inverse	4/16	.10	.34	.35	5.6	.29	.18	.09	8.8
Very Inverse	0.5/2	1.4	3.9	4.15	1.0	.35	4.2	2.9	104
Very Inverse	1.5/6	.24	.53	.58	1.3	.42	.58	.4	14.5
Very Inverse	4/16	.04	.07	.08	1.3	.50	.08	.06	2.0
Extr. Inverse	0.5/2	.8	1.38	1.6	.4	.5	1.6	1.6	40
Extr. Inverse	1.5/6	.1	.17	.2	.45	.5	.2	.2	5
Extr. Inverse	4/16	.025	.043	.05	.8	.5	.05	.05	1.25

* The impedance values given are those for the minimum tap of each relay. The impedance for other taps, at pick-up current (tap rating), varies inversely approximately as the square of the current rating. Example: for the Type IBCG51K relay, 0.5/2 amperes the impedance of the 0.5 ampere tap is 22.5 ohms. The impedance of the 1 ampere tap, at 1 ampere, is approximately $(0.5/1)^2 \times 22.5 =$ 5.63 ohms.

\+ Some companies list relay burdens only as the volt-ampere input to operate at minimum pickup. This column is included so a direct comparison can be made. It should not be used in calculating volt-ampere burdens in a CT secondary circuit, since the burden at 5 amperes is used for this purpose.

‡ Calculated from burden at minimum pickup.

CALCULATION OF SETTING

TIME SETTING

The operating time of the time overcurrent unit for any given value of current and tap setting is determined by the time dial setting. The operating time is inversely proportional to the current magnigude as illustrated by the time curves in Figs. 6, 7, and 8. Note that the current values on these curves are given as multiples of the tap setting. That is, for a given time dial setting, the time will be the same for 80 amperes on the 8 ampere tap as for 50 amperes on the 5 amp tap, since in both cases, the current is 10 times tap setting.

If selective action of two or more relays is required, determine the maximum possible short-circuit current of the line and then choose a time value for each relay that differs sufficiently to insure the proper sequence in the operation of the several circuit breakers. Allowance must be made for the time involved in opening each breaker after the relay contacts close. For this reason, unless the circuit time of operation is known with accuracy, there should be a difference of about 0.5 second (at the maximum current) between relays whose operation is to be selective.

EXAMPLE OF SETTING

Assume that the relay is being used in a circuit where the circuit breaker should trip on a minimum fault of 450 amperes, and that the breaker should trip in one second on a short circuit current of 2,250 amperes. Assume further that current transformers of 60/1 ratio are used.

The current tap setting is found by dividing minimum primary tripping current by the current transformer ratio, and then allowing a 50% margin of safety. In this case, 450 amperes divided by 60 equals 7.5 amperes, and 7.5 amperes divided by 1.50 equals 5 amperes. Thus, the 5 ampere tap is used. To find the proper time dial setting to give one second time delay at 2,250 amperes, divide 2,250 by the transformer ratio. This gives 37.5 amperes secondary current which is 7.5 times the 5 ampere tap setting. By referring to the time-current curves Figs. 6, 7, and 8 it will be seen that 7.5 times the minimum operating current gives a one second delay for a no. 3.6 time dial setting on an inverse time relay, a no. 5.5 time dial setting on a very inverse time relay, and a no. 10 time dial setting on an extremely inverse time relay. The above results should be checked by means of an accurate timing device. Slight readjustment of the dial can be made until the desired time is obtained.

The time overcurrent unit is controlled by the directional unit. It is desireable to determine that, at the pickup of the time overcurrent unit, the directional unit will operate. This can be readily done by calculating, from system fault data, the zero sequency voltage and zero sequency currents at the relay for a fault restricted to the pickup value of the time over-current unit. With potential polarization only, 3.6 va at the maximum torque angle of 60 degrees lag (current times voltage) is required. With current polarization only, 0.25 ($I_0 \times I_{polar.}$ in phase) is required.

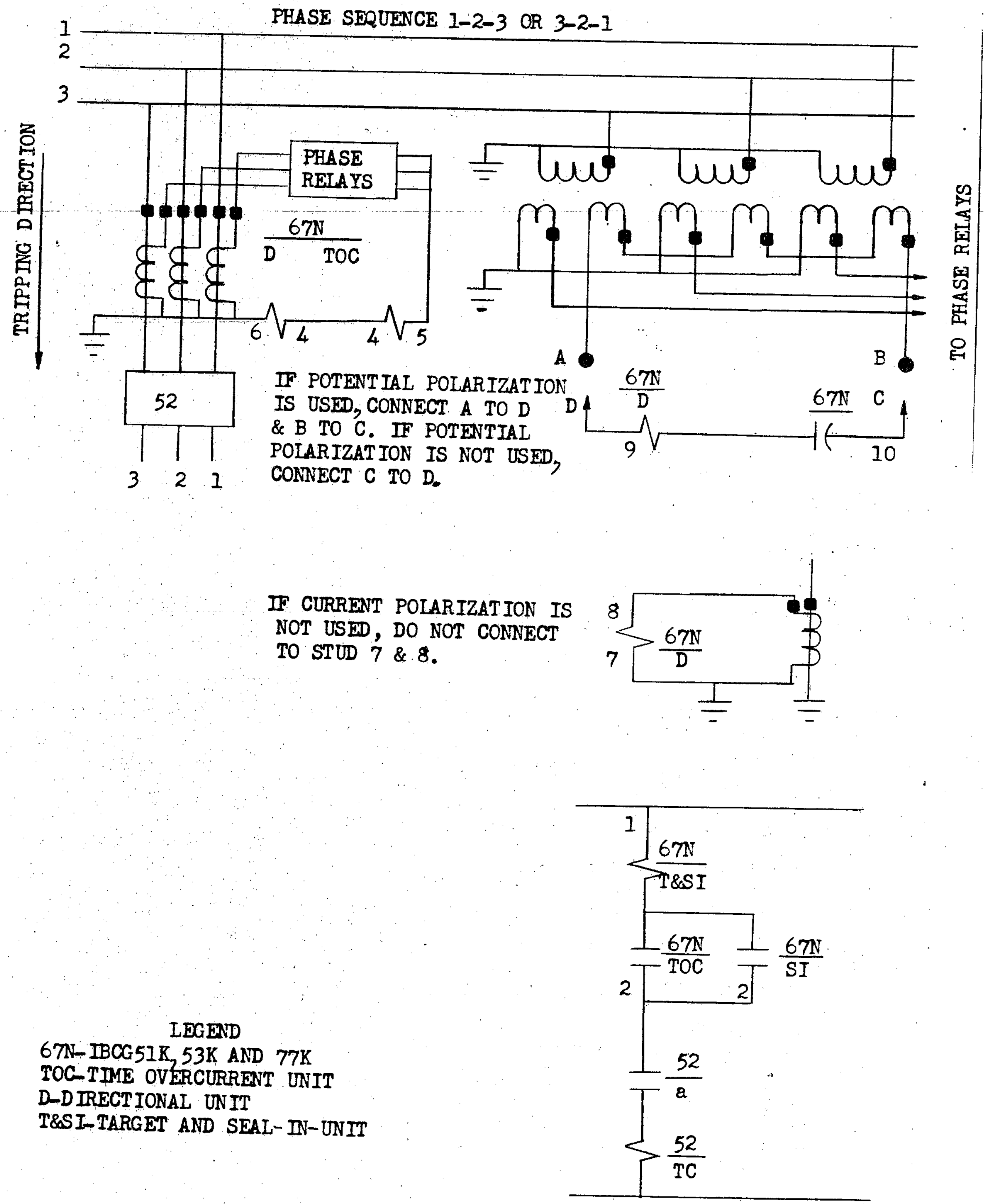


Fig. 2 (0178A9183-0) External Connection Diagram For Relay Type IBCG51K, 53K, or 77K

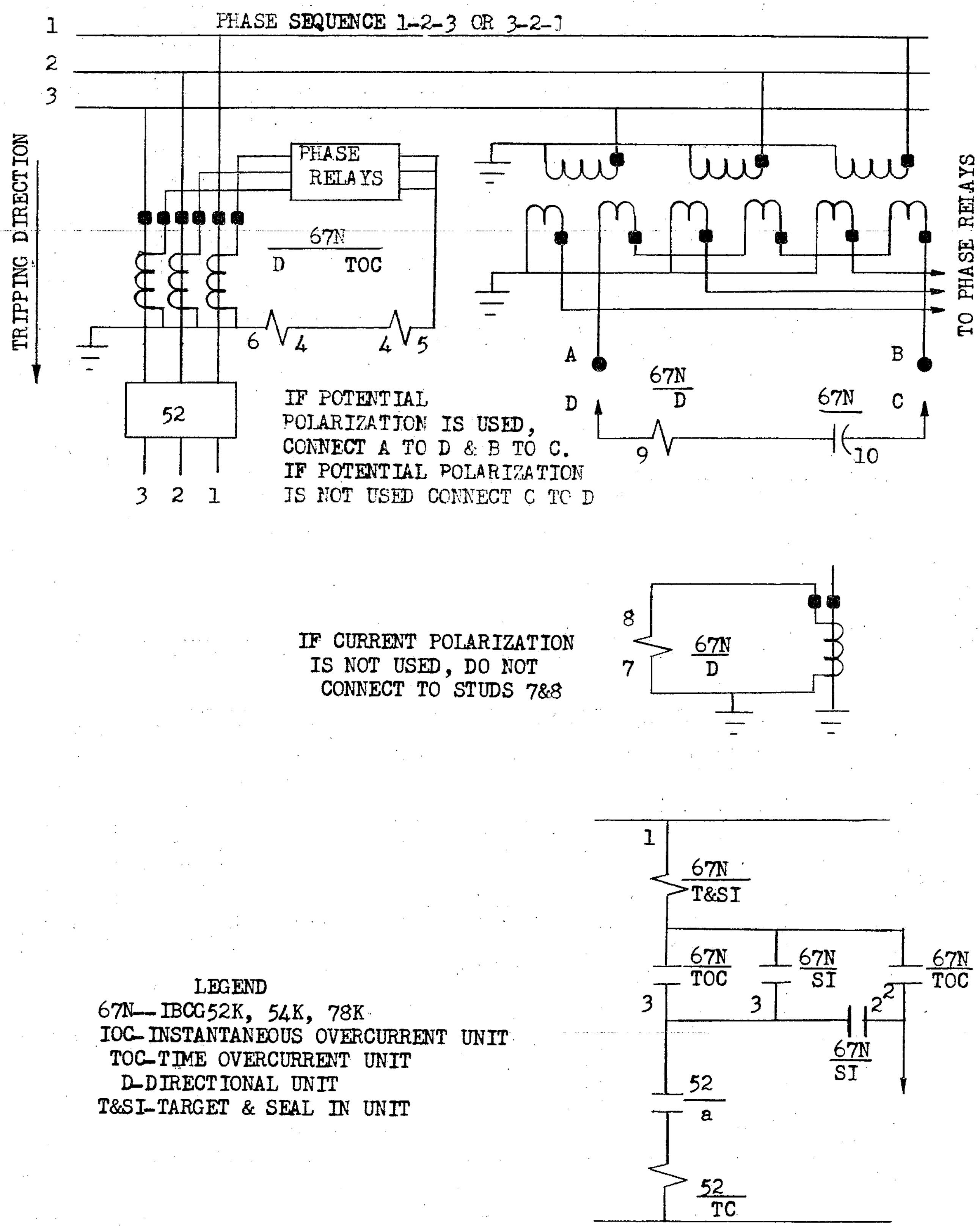


Fig. 3 (0178A9184-0) External Connection Diagram For Relay Type IBCG52K, 54K, or 78K

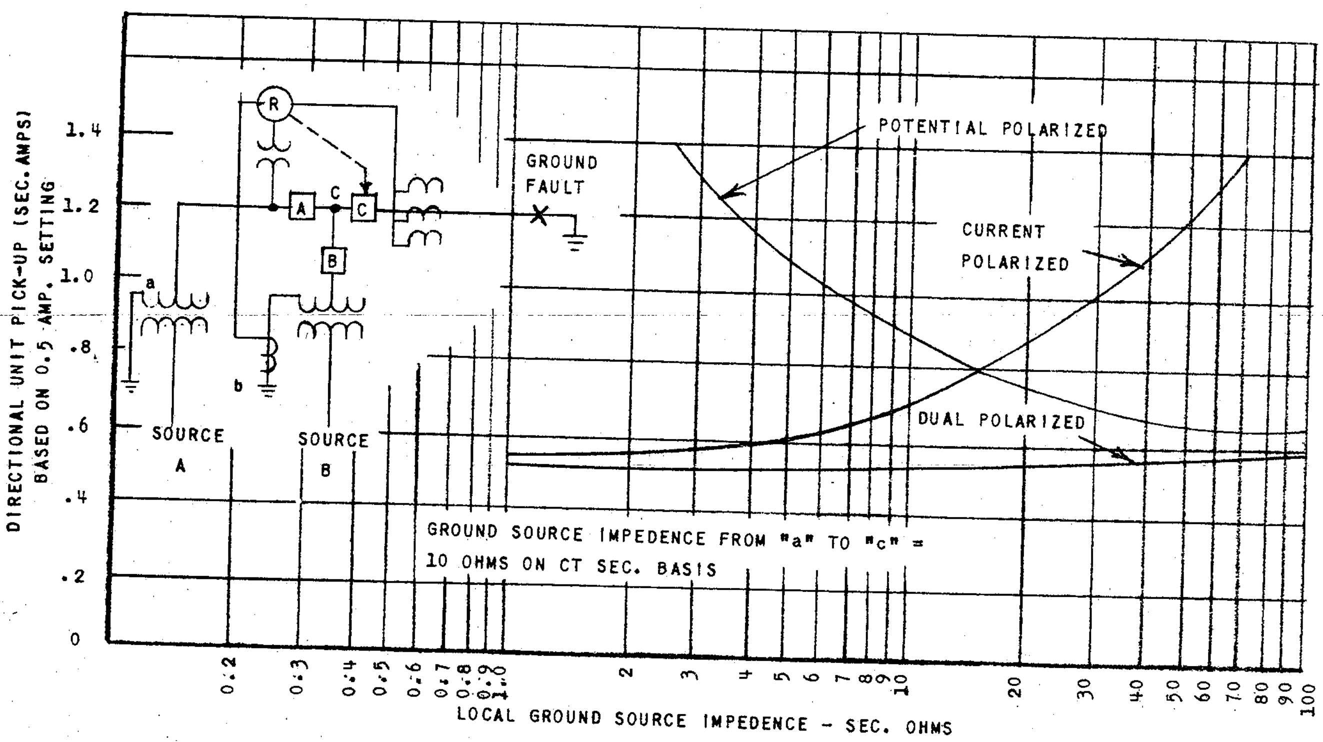


Fig. 4 (0362A684-1) A Typical Comparison Of Current, Potential or Dual Polarization Showing Effect Of Local Ground Impedance On Directional Unit Of Type IBCG Relay

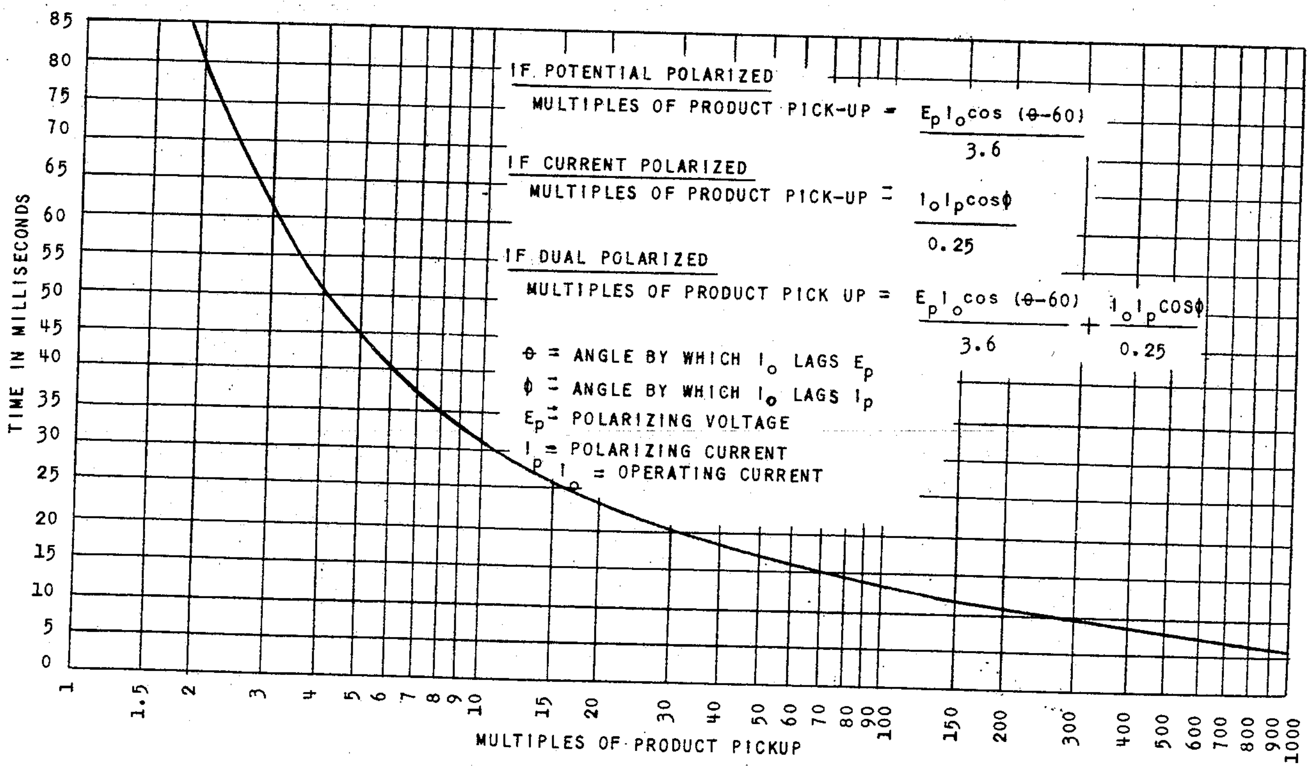


Fig. 5 (0376A934-0) Time Characteristic Of Dual Polarized Directional Unit In Type IBCG Relay

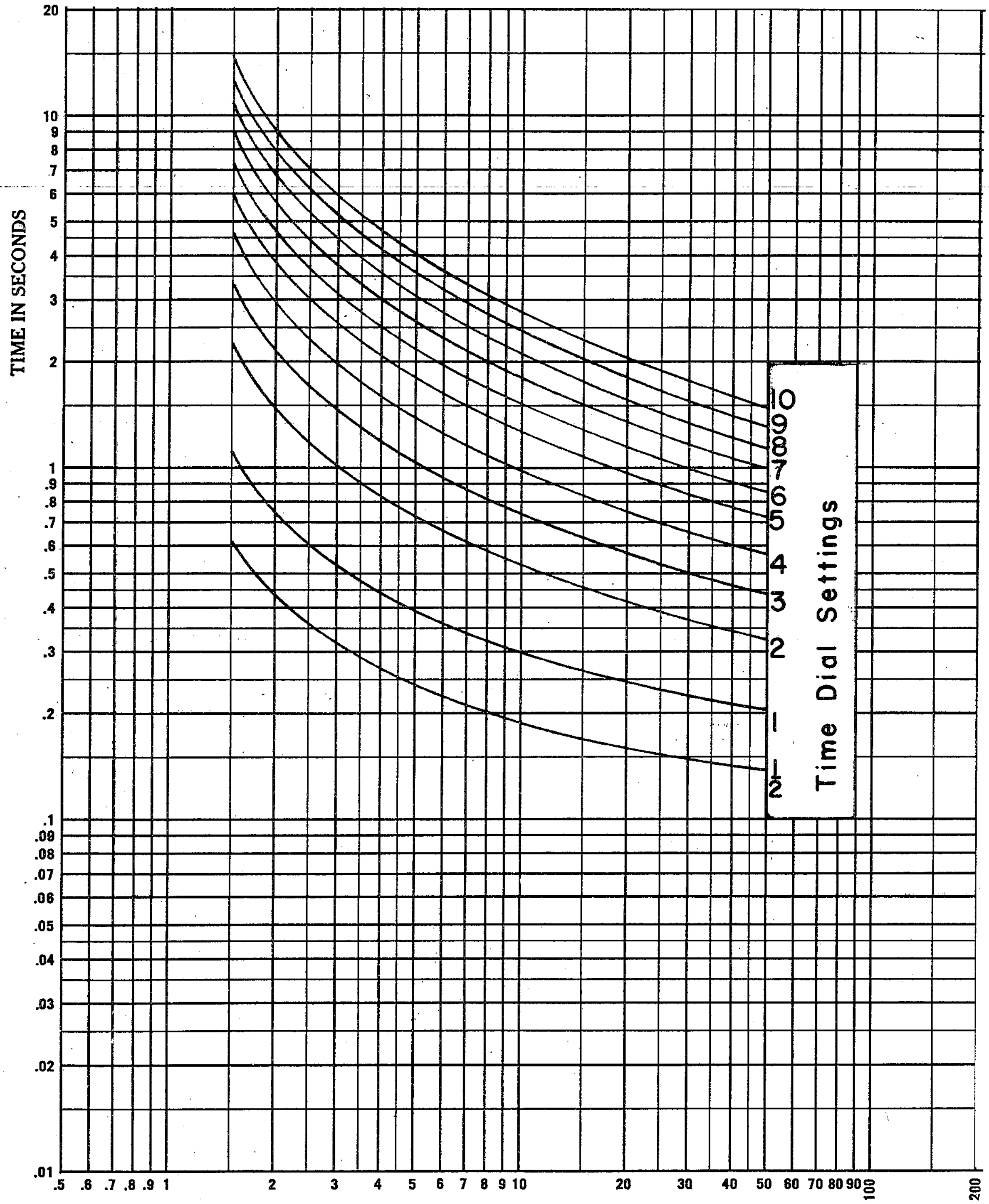


Fig. 6 (0888B0269-0) Time-Current Curves For Inverse Time Overcurrent Unit. (IBCG51 & IBCG52)

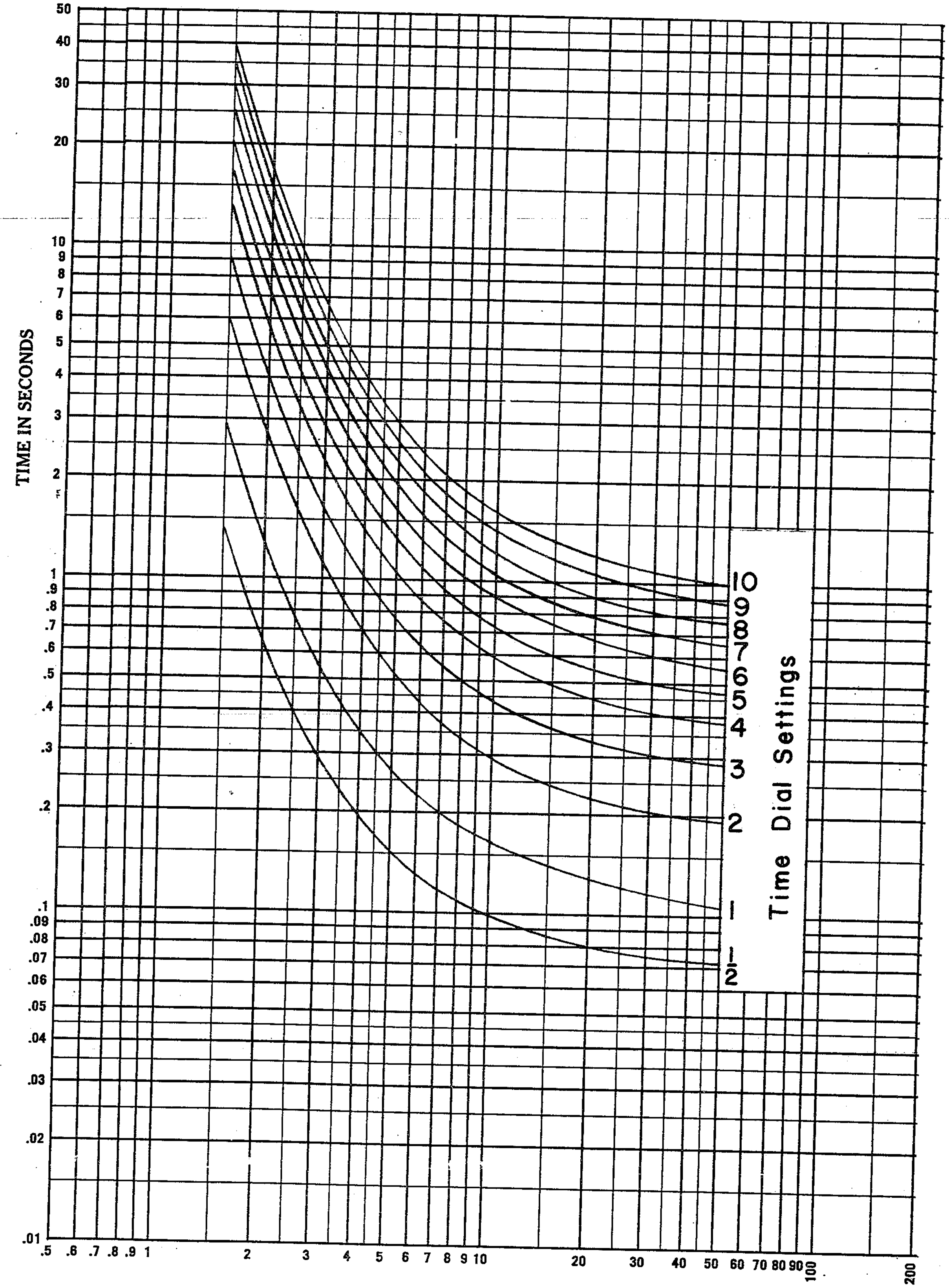


Fig. 7 (0888B0270-0) Time-Current Curves For Very Inverse Time Overcurrent Unit. (IBCG53 & IBCG54)

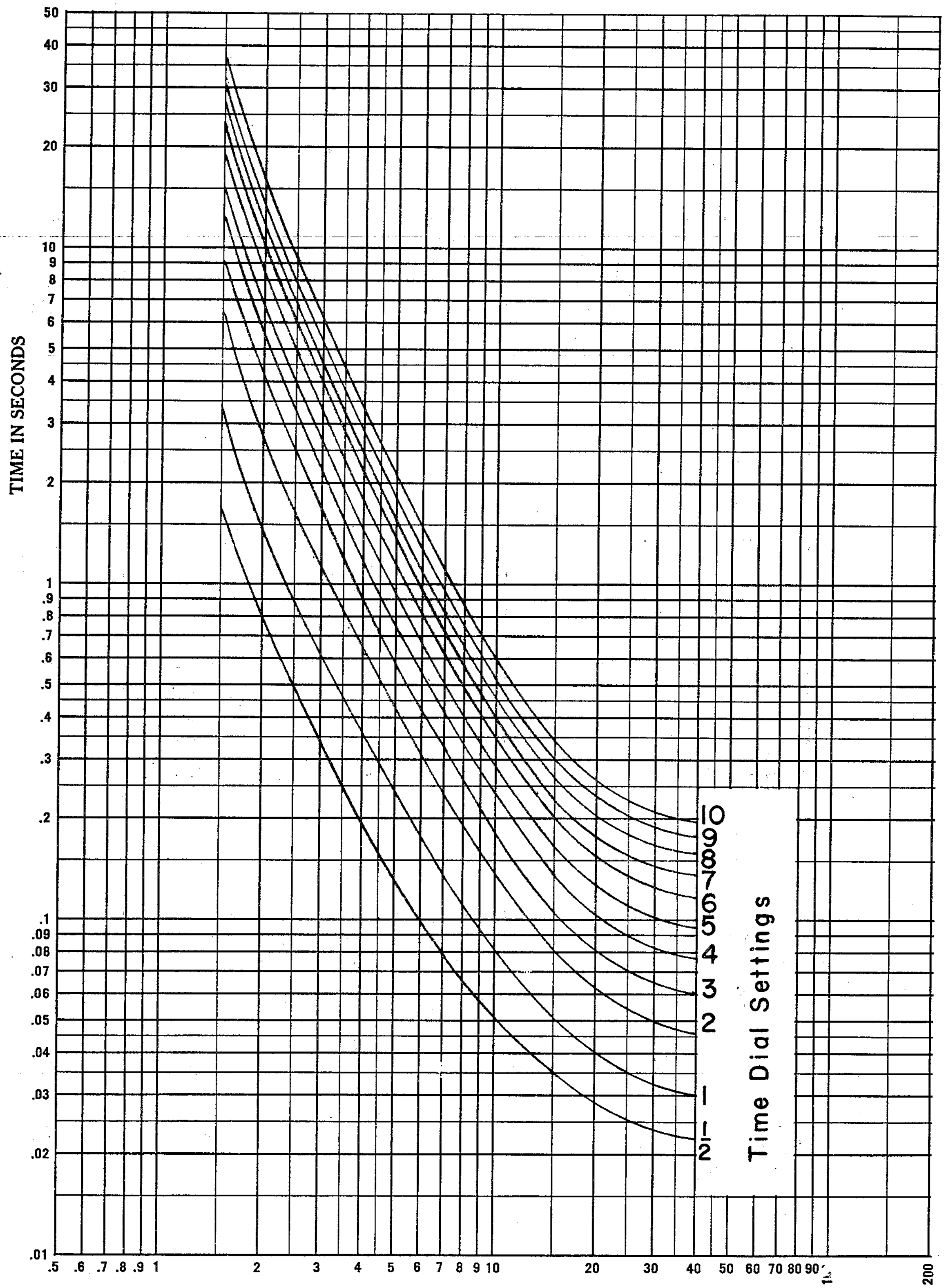


Fig. 8 (0888B0274-1) Time-Current Curves For Extremely Inverse Time Overcurrent Unit (IBCG77 & IBCG78)

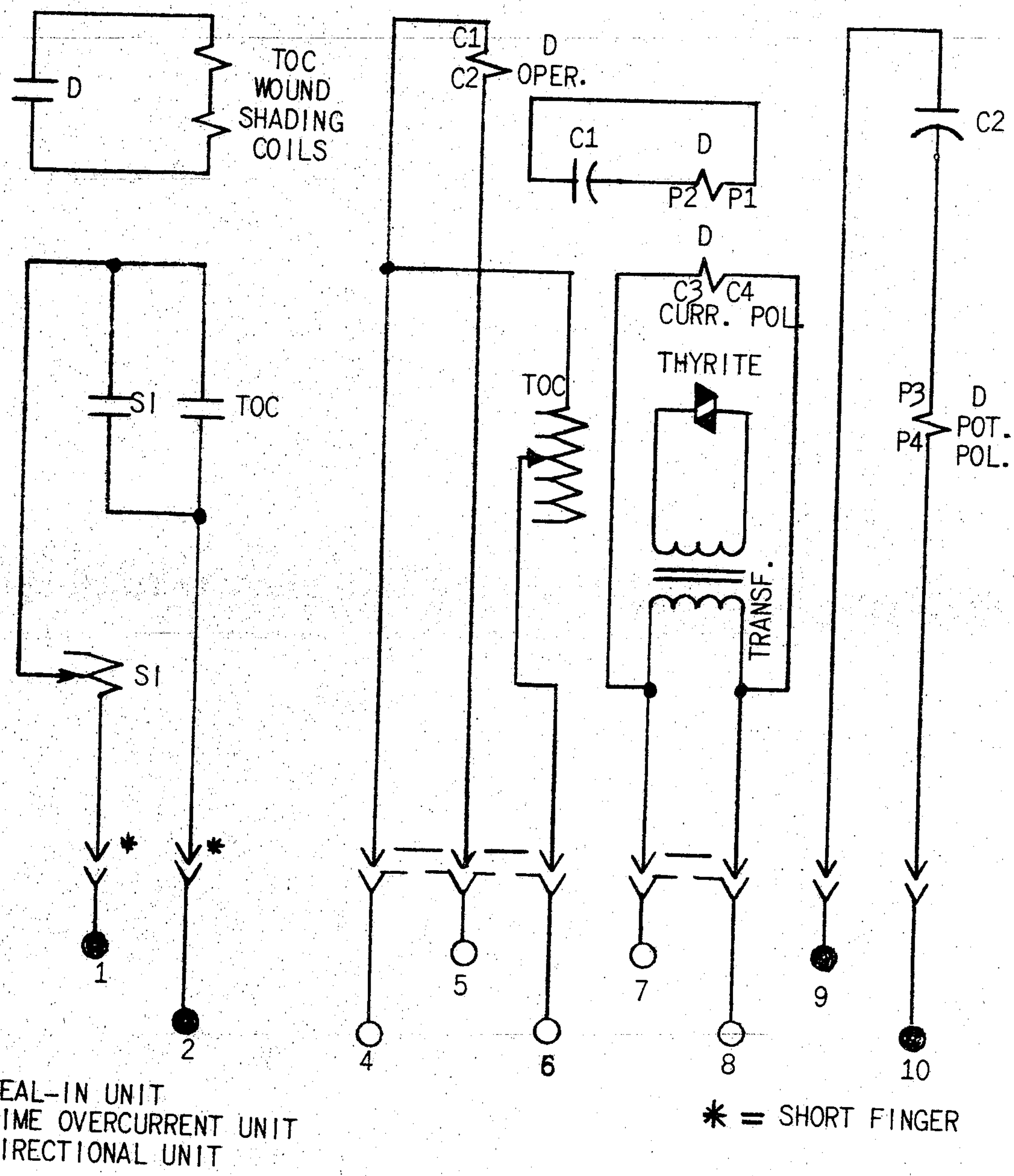


Fig. 9 (0104A8970-0) Internal Connections For The Type IBCG51K And 53K Relay (Front View)

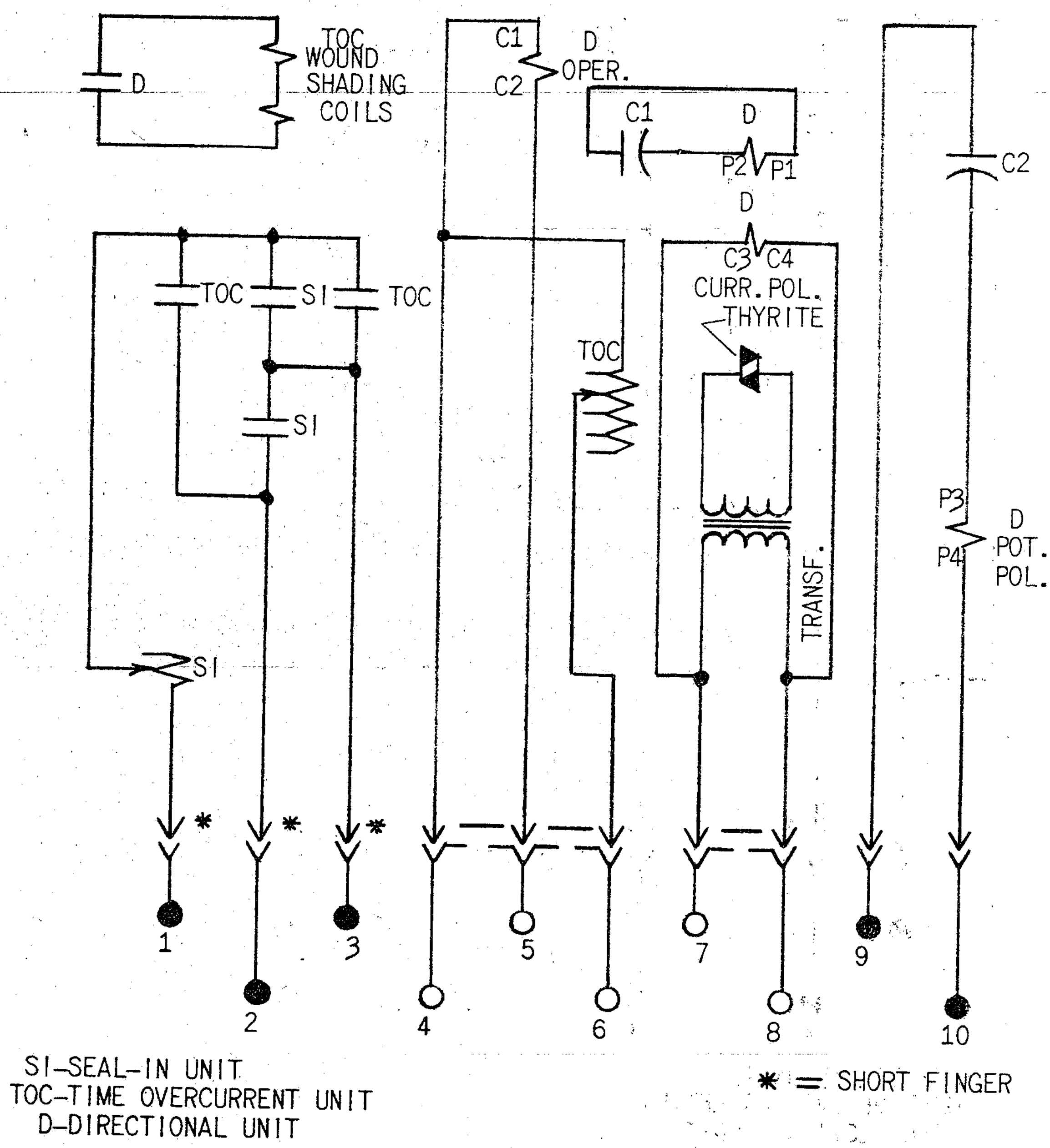


Fig. 10 (0104A8972-0) Internal Connections For The Type IBCG52K And 54K Relay (Front View)

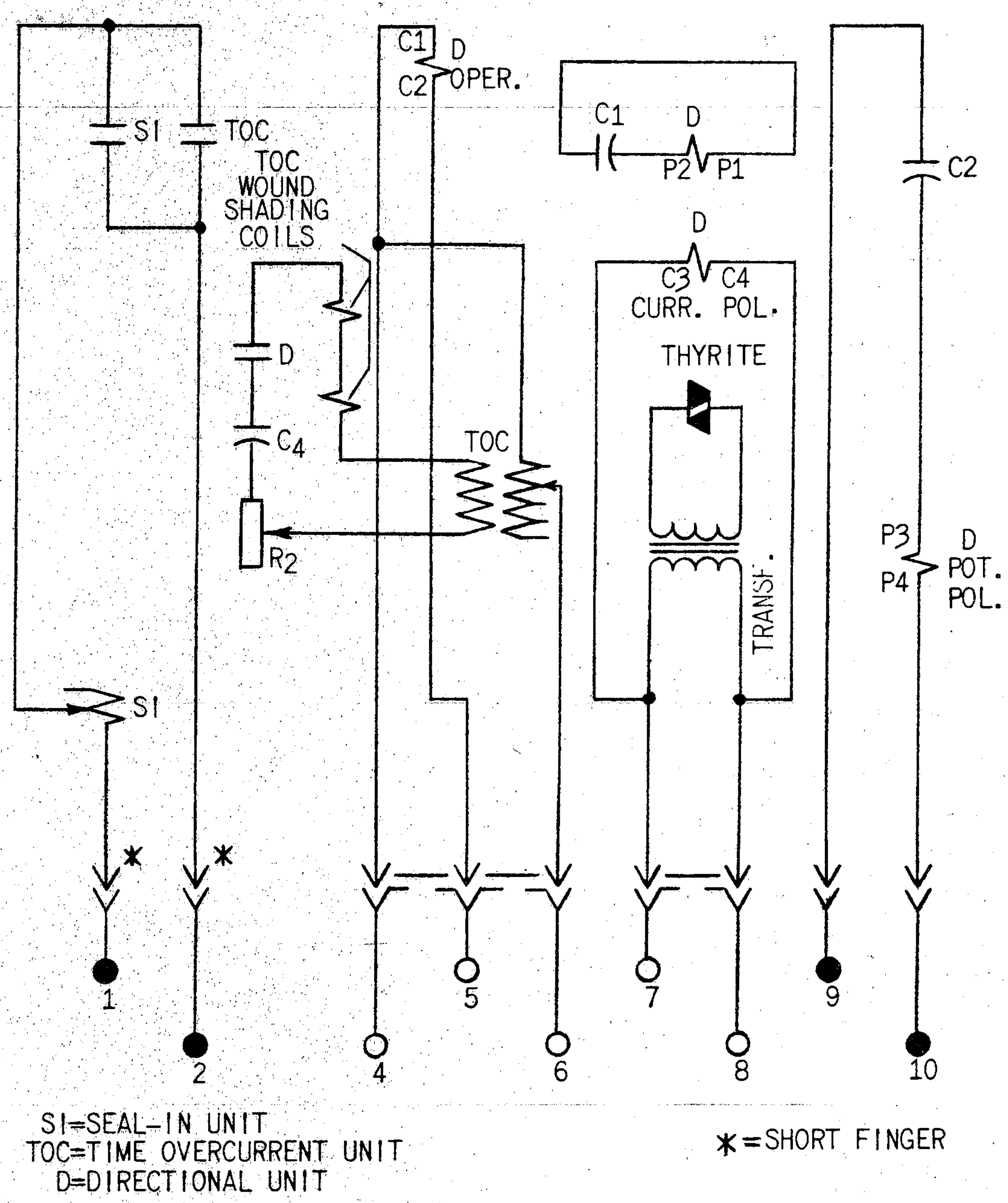
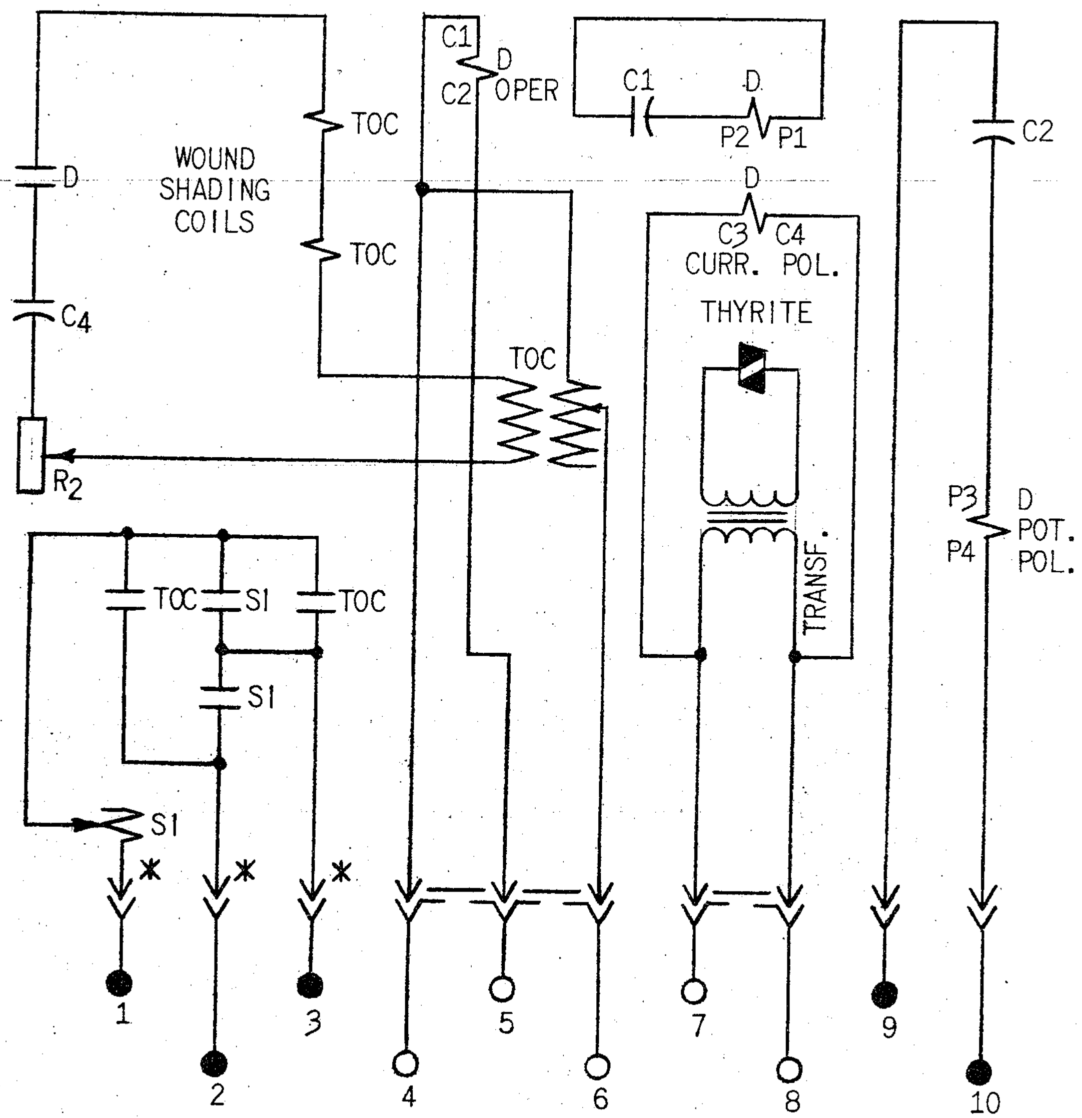


Fig. 11 (0127A9423-0) Internal Connections For The Type IBCG77K Relay (Front View)



SI=SEAL-IN UNIT
TOC=TIME OVERCURRENT UNIT
D=DIRECTIONAL UNIT

* =SHORT FINGER

Fig. 12 (0127A9424-0) Internal Connections For The Type IBCG78K Relay (Front View)

CONSTRUCTION

TIME OVERCURRENT UNIT

The inverse and very inverse time overcurrent units consist of a tapped current operating coil wound on a U-magnet iron structure. The tapped operating coil is connected to taps on the tap block. The U-magnet contains wound shading coils which are connected in series with a directional unit contact. When power flow is in such a direction as to close the directional unit contacts, the shading coils act to produce a split-phase field which, in turn develops torque on the operating disk.

The extremely inverse time overcurrent unit is of the wattmetric type similar to that used in watthour meters except as follows: the upper portion of the iron structure has two concentric windings on the middle leg of the magnetic circuit. One of these is a tapped current winding connected to taps on the tap block; the other is a floating winding which is connected in series with the directional unit contacts, a resistor, a capacitor and the two coils on the lower legs of the magnetic circuit. When power flow is in such a direction as to close a directional unit contacts, the unit develops torque on the operating disk.

The disk shaft carries the moving contact which completes the trip circuit when it touches the stationary contactor contacts. The shaft is restrained by a spiral spring to give the proper contact-closing current, and its motion is retarded by a permanent magnet acting on the disk to produce the desired time characteristic. The variable retarding force resulting from the gradient of the spiral spring is compensated by the spiral shape of the induction disk, which results in an increased driving force as the spring winds up.

DIRECTIONAL UNIT

The directional unit is of the induction-cylinder construction with a laminated stator having eight poles projecting inward and arranged symmetrically around a stationary central core. The cuplike aluminum induction rotor is free to operate in the annular air gap between the poles and the core. The poles are fitted with current operating, current polarizing, and potential polarizing coils.

The principle by which torque is developed is the same as that of an induction disk relay with a wattmetric element, although, in arrangement of parts, the unit is more like a split-phase induction motor. The induction-cylinder construction provides higher torque and lower rotor inertia than the induction-disk construction resulting in a faster and more sensitive unit.

SEAL-IN UNIT

The seal-in unit is mounted in the upper left hand corner of the relay as shown in Figure 1. The unit operates in conjunction with the time overcurrent unit contacts. Its coil is in series, and its contacts in parallel with the time overcurrent unit contacts, so that when the T.O.C. unit contacts close, the seal-in unit will pick up and seal in around these contacts.

The seal-in unit is equipped with a target which is raised into view when the unit operates. The target latches & remains exposed until manually released by means of the button projecting below the lower left corner of the cover.

CONTACTS

The directional unit contacts which control the time overcurrent unit, are shown in Fig. 13. They are of the low gradient type specially constructed to minimize the effects of vibration. Both the stationary and moving contact brushes are made of low gradient material which, when subjected to vibration, tend to follow one another, hence, they resist contact separation.

The contact dial (A) supports the stationary contact brush (B) on which is mounted a conical contact tip (C). The moving contact arm (D) supports the moving contact bursh (E) on which is mounted a button contact tip (F). The end of the moving contact brush bears against the inner face of the moving contact brush retainer (G). Similarly, the end of the stationary contact brush bears against the inner face of the stationary contact brush retainer (H). The stop screw (J), mounted on the contact dial, functions to stop the motion of the contact arm by striking the moving contact brush retainer after the moving and stationary contact members have made contact. The stationary contact support (K) and the contact dial are assembled together by means of a mounting screw (L) and the two locknuts (M).

RECEIVING, HANDLING AND STORAGE

These relays, when not included as a part of a control panel will be shipped in cartons designed to protect them against damage. Immediately upon receipt of a relay, examine it for any damage sustained in transit. If injury or damage resulting from rough handling is evident, file a damage claim at once with the transportation company and promptly notify the nearest General Electric Apparatus Sales Office.

Reasonable care should be exercised in unpacking the relay in order that none of the parts are injured or the adjustments disturbed.

If the relays are not to be installed immediately, they should be stored in their original cartons in a place that is free from moisture, dust and metallic chips. Foreign matter collected on the outside of the case may find its way inside when the cover is removed and cause trouble in the operation of the realy.

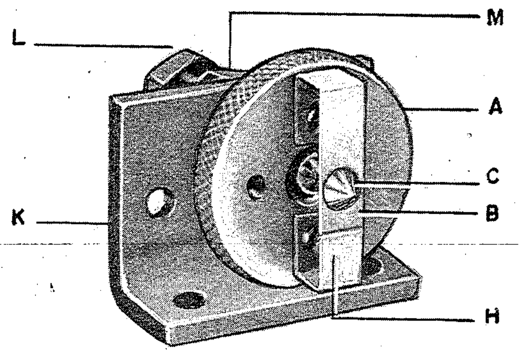


Fig. A

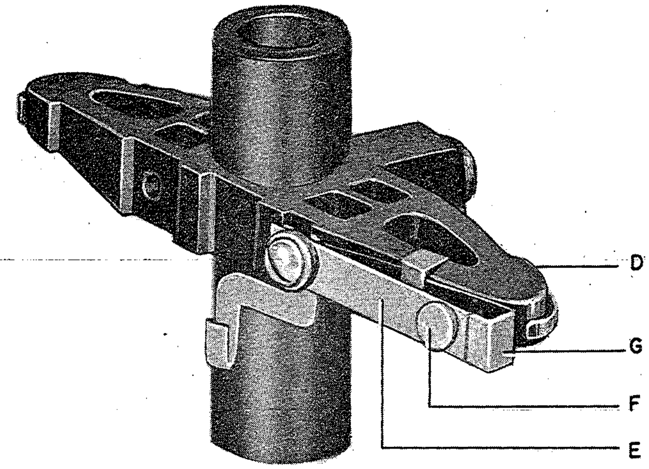


Fig. B

Fig. 13 Low Gradient Contact Assembly For The Directional Unit. Fig. A (8023401), Fig. B (8023399)

ACCEPTANCE TESTS

Immediately upon receipt of the relay an INSPECTION AND ACCEPTANCE TEST should be made to insure that no damage has been sustained in shipment and that the relay calibrations have not been disturbed. If the examination or test indicates that readjustment is necessary, refer to the section on SERVICING.

VISUAL INSPECTION

Check the nameplate stamping to insure that the model number and rating of the relay agree with the requisition.

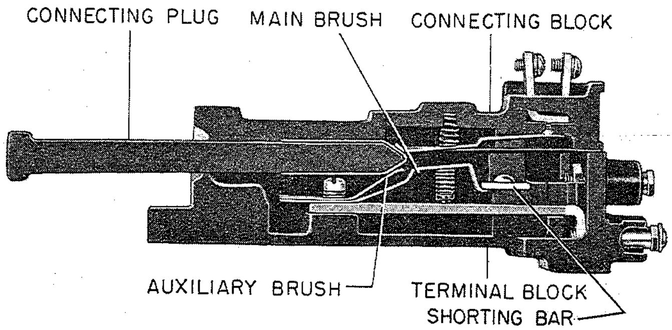


Fig. 14 (8025039) Cross Section Of Drawout Case Showing Position Of Auxiliary Brush And Shorting Bar.

Remove the relay from its case and check that there are no broken or cracked molded parts or other signs of physical damage and that all screws are tight. Check that the shorting bars are in the proper location (s) and that they are properly formed (see Figure 14).

MECHANICAL INSPECTION

A. Top Unit (TOC)

1. The disk shaft end play should be 0.005-0.015 inches.
2. The disk should be centered in the air gaps of both the electro magnet and drag magnet.
3. Both gaps should be free of foreign matter.
4. The disk should rotate freely.
5. The moving contact should just touch the stationary contact when the time dial is at the zero time dial position.

B. Target Seal-In Unit

1. The rotating shaft end play should be 0.015-0.020 inches.
2. The contact gap should be 0.015 - 0.025 inches on the low gradient front contact.

C. Target Seal-In Unit

1. Both contacts should make at approximately the same time.
2. The target should latch into view just as the contacts make.
3. The contacts should have approximately .030 inch wipe.

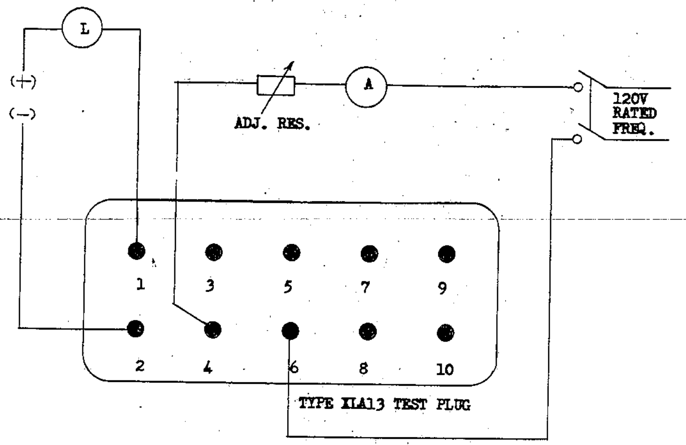


Fig. 15A (0195A9179-0) Test Connections For Checking Pick-up of TOC Unit

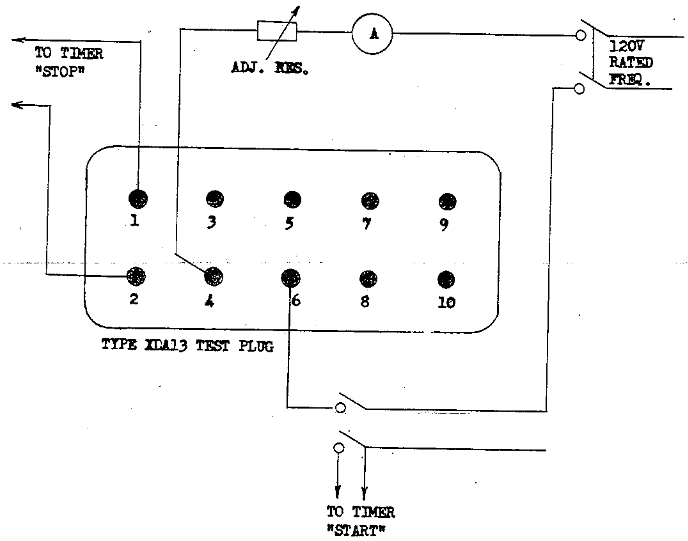


Fig. 15B (0195A9180-0) Text Connections For Checking Operating Time Of TOC Unit

D. Electrical Tests

(To properly duplicate operating conditions all electrical tests should be conducted with the relay reasonably level and in its case.)

1. Top Unit (TOC)
   a. Connect relay per Figure 15 of Test Connections.
   b. Block directional unit contacts closed.
   c. Set tap screw in lowest tap and the time dial at the 0.5 time dial position. The unit should close its contacts within plus or minus 5% of the tap value.
   d. In a like manner, each of the other taps may be checked.
   e. To check the time curve, set the tap screw in the minimum tap and the time dial at the 5 time dial position. Apply 5 times pickup current, the operating time should be:

Relay Type	Oper. Time (secs. ±5%)
Inverse	1.78
Very Inverse	1.31
Extremely Inverse	0.93

   f. Open the directional unit contacts. At 20 times pickup current the time-overcurrent unit (TOC) should not operate.

3A Bottom Unit (Current Polarization)
   a. Connect per Figure 16 of Test Connections.
   b. The unit should close its contacts within 5% of 0.5 ampere. The clutch should slip between 8-18 amperes.

3B Bottom Unit (Potential Polarization)
   a. Connect per Figure 17 of Test Connections.
   b. With V wet for 5 volts the unit should close its contacts between 0.75-1.65 amps.

4. Target Seal-In Unit
   a. The unit should pickup between 85 and 100% of the tap value and drop out at 25% or more of tap value.

INSTALLATION PROCEDURE

LOCATION

The location of the relay should be clean and dry, free from dust, excessive heat and vibration, and should be well lighted to facilitate inspection and testing.

MOUNTING

The relay should be mounted on a vertical surface. The outline and panel drilling dimensions are shown in Figure 18.

CONNECTIONS

The internal connections are shown in Figures 9, 10, 11 & 12.

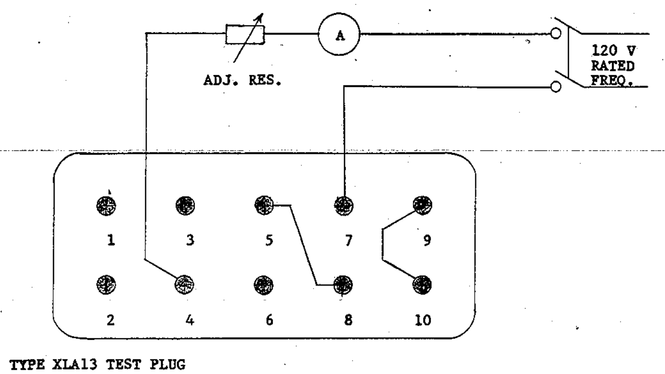


Fig. 16 (0195A9181-1) Test Connections For Checking Pickup of Directional Unit Using Current Polarization

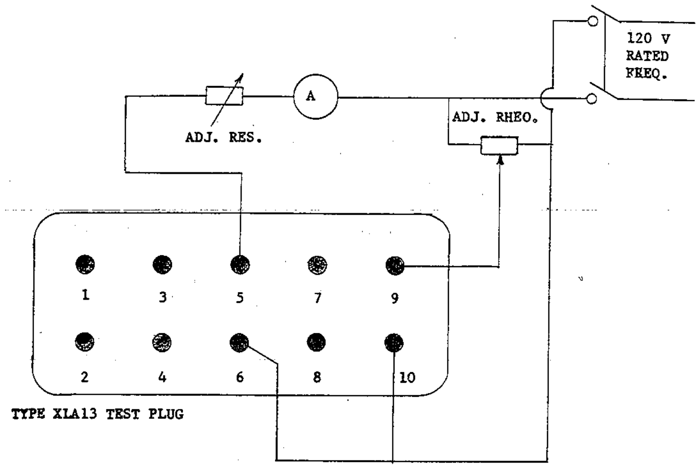


Fig. 17 (0195A9182-0) Test Connections For Checking Pickup of Directional Unit Using Potential Polarization

VISUAL INSPECTION

Remove the relay from its case and check that there are no broken or cracked component parts and that all screws are tight.

MECHANICAL INSPECTION

Recheck the adjustments mentioned under Mechanical Inspection in the section on ACCEPTANCE TESTS.

ELECTRICAL TESTS

1. Top Unit (TOC)
   a. Connect per Figure 15 of Test Connections.
   b. Block the directional unit contacts closed.
   c. Set the tap screw in the desired tap and the time dial at the 0.5 time dial position. Check that pickup is within 5% of the selected tap. If it is desired to set pickup for some value other than tap value, the control spring may be adjusted for any value between taps.
   d. Apply the calculated multiples of pickup and set the time dial for the desired operating time. Fine adjustment of time may be obtained by moving the permanent magnet (drag magnet) in or out along the supporting shelf.
2. Bottom Unit (Directional Unit)
   a. Connect per Figure 16 of Test Connections.
   b. Adjust the control spring for 0.5 ampere pickup is current polarized or dual polarized.
   c. If potential polarized connect per Figure 17 of Test Connections.
   d. Adjust the control spring for 3.6 Volt amperes (±10%). Ten volts and 0.36 amperes are recommended values for this test.
3. Target Seal-In Unit
   a. The unit should pickup between 85 and 100% of the tap value and drop out at 25% or more of tap value.

PERIODIC CHECKS & ROUTINE MAINTENANCE

In view of the vital role of protective relays in the operation of a power system it is important that a periodic test program be followed. It is recognized that the interval between periodic checks will vary depending upon environment, type of relay, and the user's experience with periodic testing. Until the user has accumulated enough experience to select the test interval best suited to his individual requirements it is suggested that the points listed INSTALLATION PROCEDURE be checked at an interval of from one to two years.

CONTACT CLEANING

Check that the contacts are clean and burnish where necessary.

For cleaning fine silver contacts, a flexible burnishing tool should be used. This consists of a flexible strip of metal with an etched roughened surface resembling in effect a superfine file. The polishing action is so delicate that no scratches are left, yet it will clean off any corrosion thoroughly and rapidly. Its flexibility insures the cleaning of the actual points of contact. Do not use knives, files, abrasive paper or cloth of any kind to clean relay contacts.

SERVICING

If it is found during the installation or periodic tests that the unit calibrations are out of limits, they should be recalibrated as outlined in the following paragraphs. It is suggested that these calibrations be made in the laboratory. The circuit components listed below, which are normally considered as factory adjustments, are used in recalibrating the units. These parts may be located from Fig. 1.

TOP UNIT (TOC)

Extremely inverse relays only.

In addition to the control spring setting for setting pickup, there is a resistor (R_2) for adjusting the torque level.

If the control spring has been replaced, the resistor must be readjusted as follows:

1. Unwind the control spring until the moving contact just "floats" at the 1 time dial position.
2. Wind the control spring two full turns (720°).
3. Set the resistor in its mid range.
4. Connect per Figure 15.
5. Check pickup per acceptance tests.
6. Make adjustments in resistor setting to obtain proper pickup.

BOTTOM UNIT (Directional)

The contact construction has been previously described in the "Construction" section.

CONTACT ADJUSTMENTS

To make contact adjustments, refer to Fig. 13 for identification of low gradient contact parts and proceed as follows:

Loosen the locknut which secures the backstop screw (located at the right hand corner of the unit) to its support. Unwind the backstop screw so that the moving contact arm is permitted to swing freely. Adjust the tension of each low gradient contact brush so that 1-2 grams of pressure are required at the contact tip in order to cause the end of the brush to separate from the inner face of its respective brush retainer. Adjust the spiral spring until the moving contact arm is in a neutral position, i.e. with the arm pointing directly forward. Loosen the locknut which secures the stationary contact mounting screw to the stationary contact support. Wind the mounting screw inward until the stationary and moving contact members just begin to touch. Unwind the mounting screw until the stationary contact stop screw lines up with the moving contact brush retainer. Wind the backstop screw inward until the moving and stationary contact members again just begin to touch. Loosen the locknut of the stationary contact stop screw, and advance this screw until it just touches the moving contact brush retainer. Unwind the screw 1-1/2 turns to provide contact wipe. Tighten the locknut. Unwind the backstop screw 2/3 turn and tighten the locknut which secures the backstop screw to its support. Finally, adjust the tension on the stationary contact brush such that, when the contacts are made and fully wiped in, there is approximately an equal deflection on each brush.

BIAS ADJUSTMENT

Connect the current operating and current polarizing coils in series by connecting a jumper across terminals 5 and 7. Apply current to terminals 4 and 8 and adjust the directional unit spiral spring so that the unit picks up at 0.5 ampere with terminals 9 & 10 jumpered.

The core of the directional unit has a small flat portion, the purpose of which is to minimize the effect of bias torques produced on the rotor. Such torques can be produced by any one of the operating or polarizing quantities acting alone with the other two circuits de-energized. The adjustment of the core is made at the factory, but may be checked by observing that the unit responds as outlined below:

Short out the potential polarizing coil (terminals 9 and 10), leaving the current polarizing coil (terminals 7 and 8) unshorted. Supply 30 amperes through the operating coil (terminals 4 and 5) and check that the unit does not operate.

If the unit does not satisfy the above conditions, rotate the core to a position which causes it to do so. The core can be turned by loosening the large hexagonal nut at the bottom of the unit and turning the core by means of the slotted bearing screw. This screw should be held securely in position when the nut is retightened.

Keep in mind that thirty amperes will cause the current coils to overheat if left on too long. Therefore, leave the test current on only for short intervals and allow sufficient time between tests for the coils to cool.

RENEWAL PARTS

It is recommended that sufficient quantities of renewal parts be carried in stock to enable the prompt replacement of any that are worn, broken, or damaged.

When ordering renewal parts, address the nearest Sales Office of the General Electric Company, specify quantity required, name of the part wanted, and give complete nameplate data. If possible, give the General Electric requisition number on which the relay was furnished.

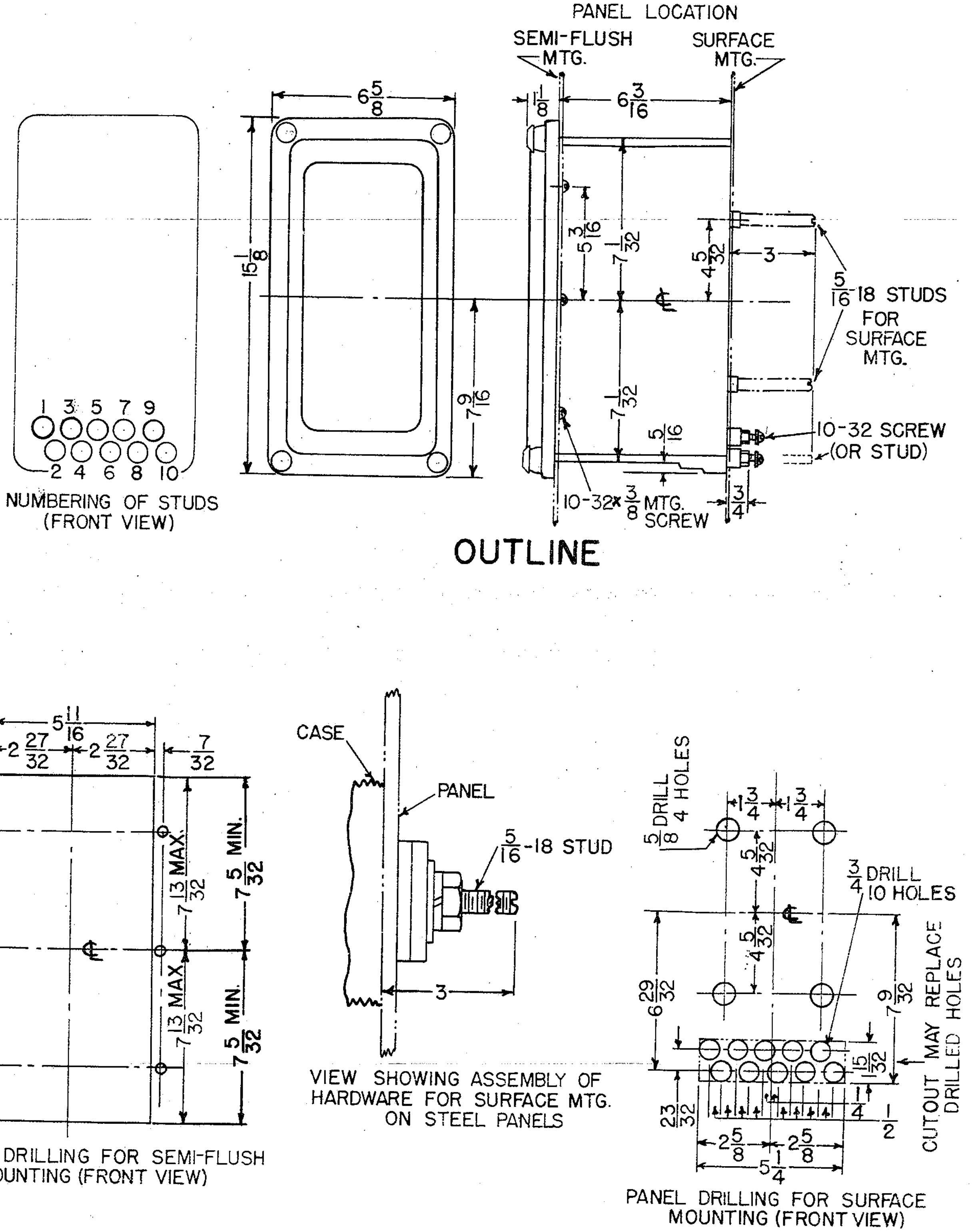


Fig. 18 (6209273-2) Outline And Panel Drilling Dimensions For Type IBCG Relays.

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