



INSTRUCTIONS

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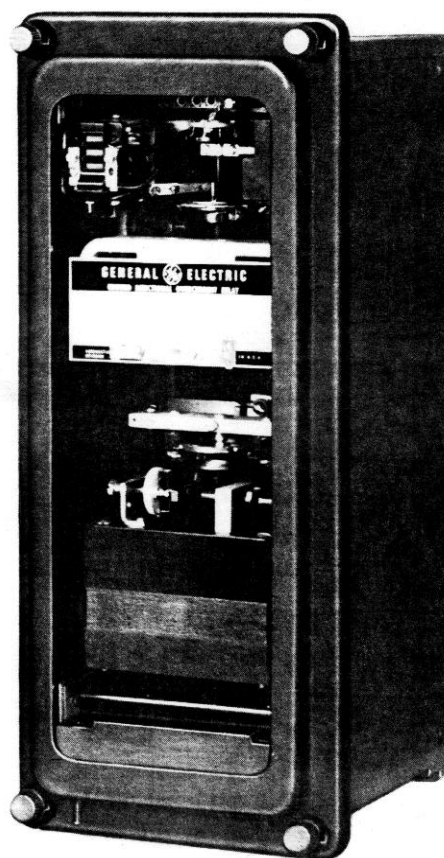
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NORTHEAST ELECTRICAL TESTING

GROUND DIRECTIONAL OVERCURRENT RELAYS



Types

IBCG51 E IBCG52E
IBCG53E IBCG54E

LOW VOLTAGE SWITCHGEAR DEPARTMENT

GENERAL  ELECTRIC

PHILADELPHIA, PA.

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GROUND DIRECTIONAL OVERCURRENT RELAY TYPE IBCG

INTRODUCTION

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

Fig. 6 shows the external connections when the Type IBCG relay is used in conjunction with phase relays polarized from wye-wye potential transformers. The polarizing voltage for the ground relay is obtained by means of an auxiliary wye-broken-delta potential transformer.

Fig. 9 shows the external connections for the Type IBCG ground relay when current polarized from a local source of ground current.

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. 1 compare the performance of the relay when dual polarized with its performance when either potential or current polarized alone.

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 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. For such cases, the inverse time relay is more applicable.

TABLE I

Relay Model	Time Characteristic	Circuit Closing Contacts	Internal Connections
IBCG51E	Inverse	One	Fig. 2
IBCG52E	Inverse	Two	Fig. 3
IBCG53E	Very Inverse	One	Fig. 4
IBCG54E	Very Inverse	Two	Fig. 5

OPERATING CHARACTERISTICS

PICKUP

When potential polarized, the directional unit will operate at 3.6 volt-amperes at the maximum torque angle of 60 degrees lag (current lags voltage). When current polarized, it will operate at approximately 0.5 ampere with the operating and polarizing

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.*

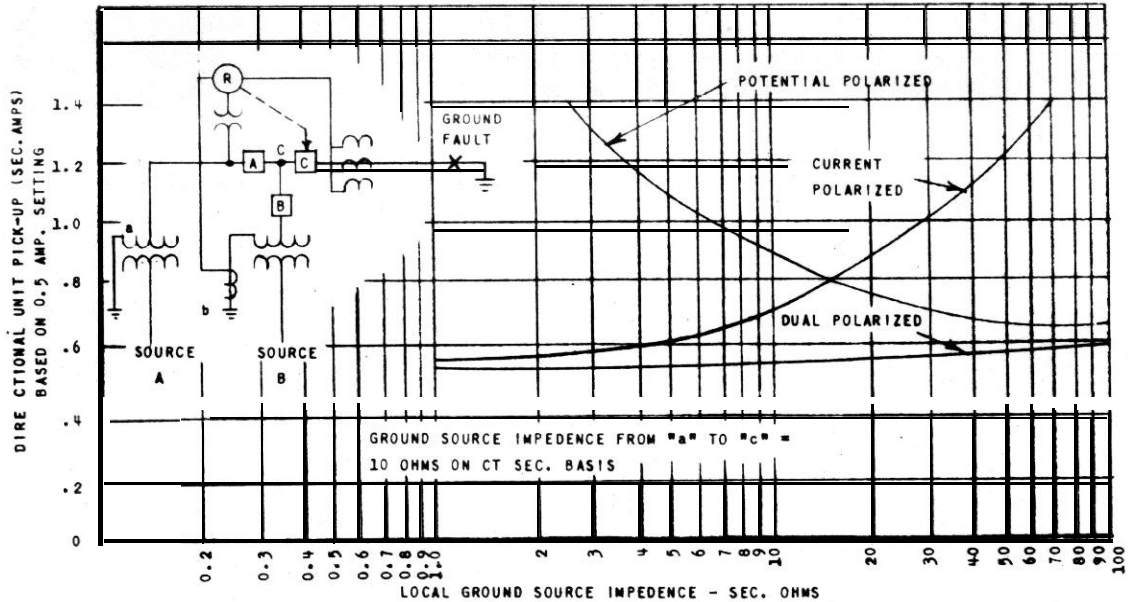


Fig. 1 Type IBCG Directional Unit Pickup For Various Values Of Ground-Fault Impedance With Current, Potential Or Dual Polarization

coils connected in series. The performance of the unit with simultaneous current and potential polarization is typified in Fig. 1.

The maximum operating current required to close the time overcurrent unit contacts, at any time-dial position, will be within five per cent of the tap plug setting.

RESET

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-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 time relays.

OPERATING TIME

The time curves of the time overcurrent unit are shown in Fig. 14 and Fig. 15 respectively for inverse-time and very inverse-time relays. For the same operating conditions, the relay will operate repeatedly within one or two per cent of the same time.

RATINGS

CURRENT COILS

The continuous and short time ratings of the operating coil circuits are shown in Table II. The current polarizing coils have a continuous rating of 5 amperes and a one (1) second rating of 150 amperes.

TABLE II

RATINGS OF OPERATING COIL CIRCUITS

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

* The continuous rating of the operating circuit is limited by the directional unit operating coil.

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

POTENTIAL COILS

The potential polarizing coils will withstand 120 volts for 20 minutes and 360 volts for 10 seconds.

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. The current ratings are either a-c or d-c.

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 2 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 energizes the trip coil or coils. On such

TABLE III
SEAL-IN UNIT RATINGS

	2 AMP TAP	0.2 AMP TAP
Carry-Tripping Duty carry continuously	30 Amps	5 Amps
D-C Resistance	3 Amps	0.3 Amps
Impedance (60 cycles)	0.13 Ohms	7 Ohms
	0.53 Ohms	52 Ohms

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 unit.

CONTACTS

The current-closing rating of the induction unit contacts is 30 amperes for voltages not exceeding 250 volts. Their current-carrying rating is limited by the tap rating of the seal-in unit.

BURDENS

The capacitive burden of the potential polarizing circuit of the directional unit at 60 cycles and 120 volts is 19.6 volt-amperes at 0.78 power factor. The burden of the current polarizing circuit of the directional unit at 60 cycles and 5 amperes is 8.6 volt-amperes at 0.95 power factor. Table IV gives the current circuit burdens of the directional and overcurrent unit operating coils (studs 5-6).

Ordinarily, the potential circuit is in the open corner of broken delta potential transformers and 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 IV
CURRENT CIRCUIT BURDENS OF DIRECTIONAL AND OVERCURRENT
UNIT OPERATING COILS AT 60 CYCLES

Time Character- istic	Tap Range (Amps)	BURDENS AT MINIMUM PICKUP					OHMS IMPEDANCE AT		* VA At Five Amperes
		Eff. Res. (Ohms)	React. (Ohms)	*Imped. (Ohms)	+ Volt- Amperes	Power Factor	3 Times Min. P.U.	10 Times Min. P.U.	
Inverse	0.5/2	8.00	20.0	22.5	5.60	0.36	13.4	7.80	560
Inverse	1.5/6	1.00	2.65	2.90	6.50	0.35	1.70	1.09	73.0
Inverse	4/16	0.32	0.16	0.83	13.3	0.38	0.65	0.49	20.7
Very Inverse	0.5/2	2.20	5.10	5.60	1.40	0.40	5.30	4.50	140
Very Inverse	1.5/6	0.36	0.77	0.85	0.96	0.43	0.81	0.68	22.0
Very Inverse	4/16	0.26	0.44	0.51	8.15	0.51	0.51	0.46	12.1

* 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 IBCG51E 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.

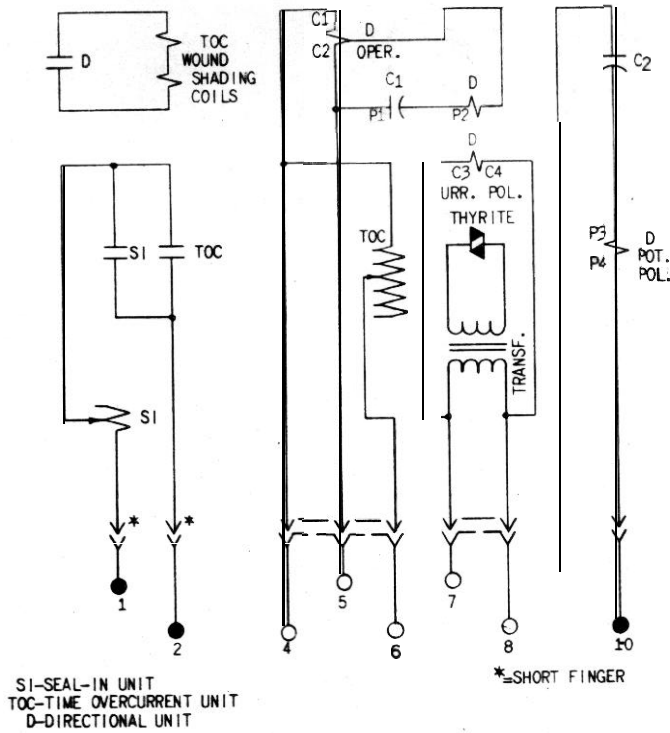


Fig. 2 Internal Connections - Type IBCG51E Relay (Front View)

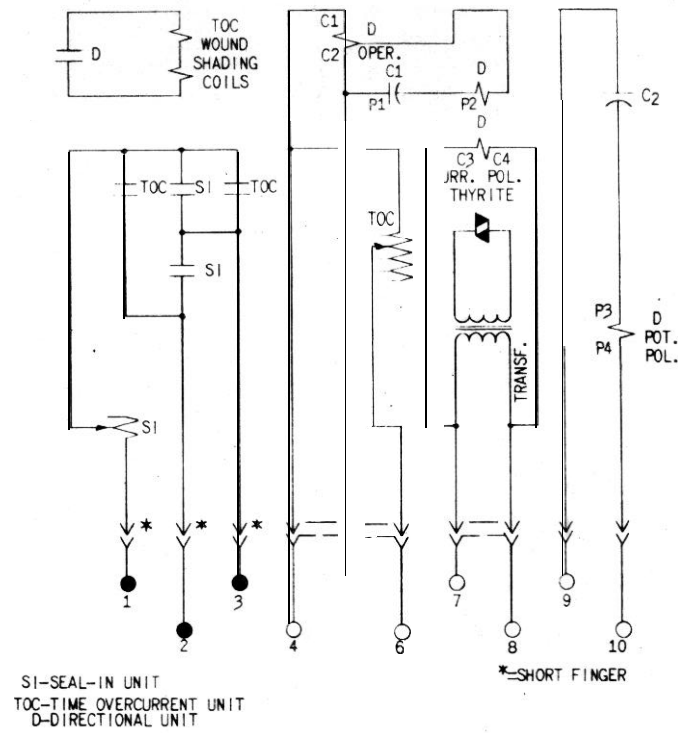


Fig. 3 Internal Connections - Type IBCG52E Relay (Front View)

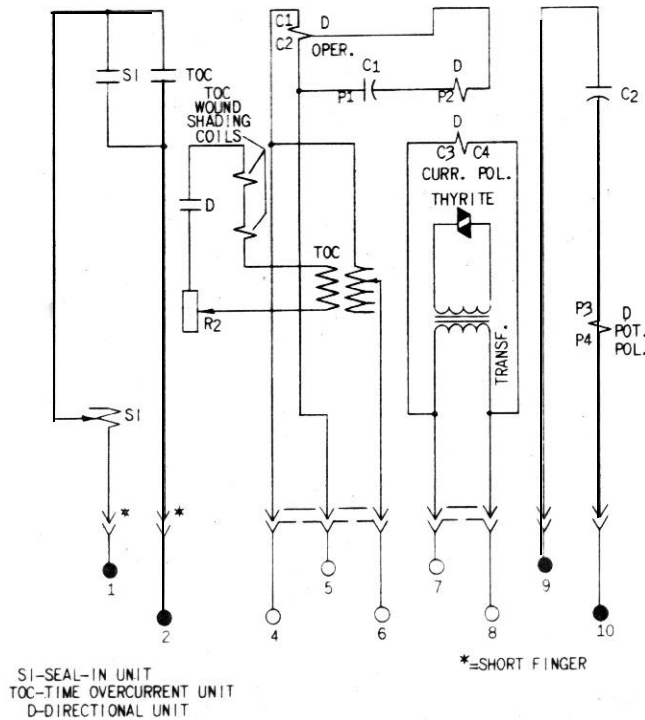


Fig. 4 Internal Connections - Type IBCG53E Relay (Front View)

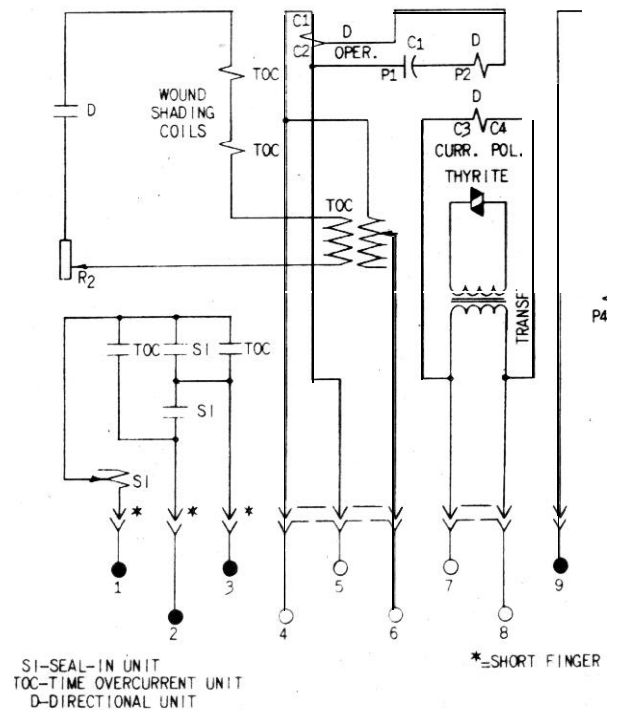
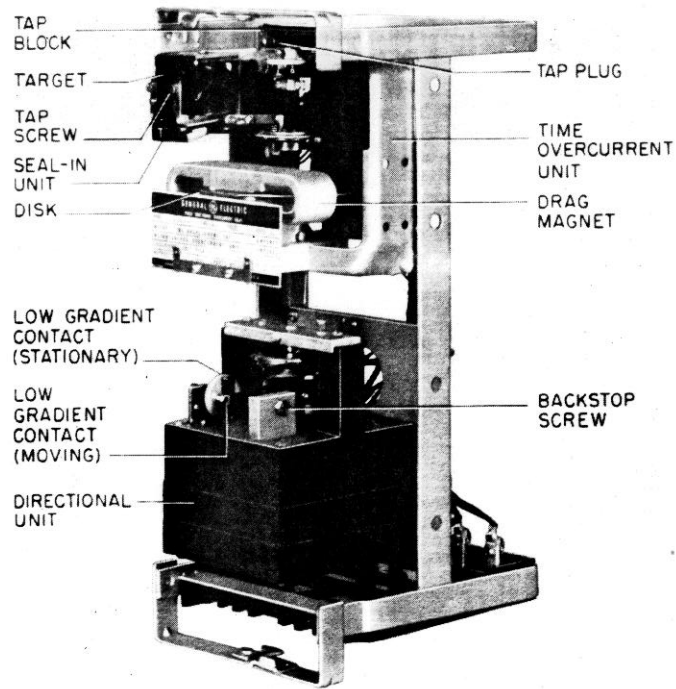
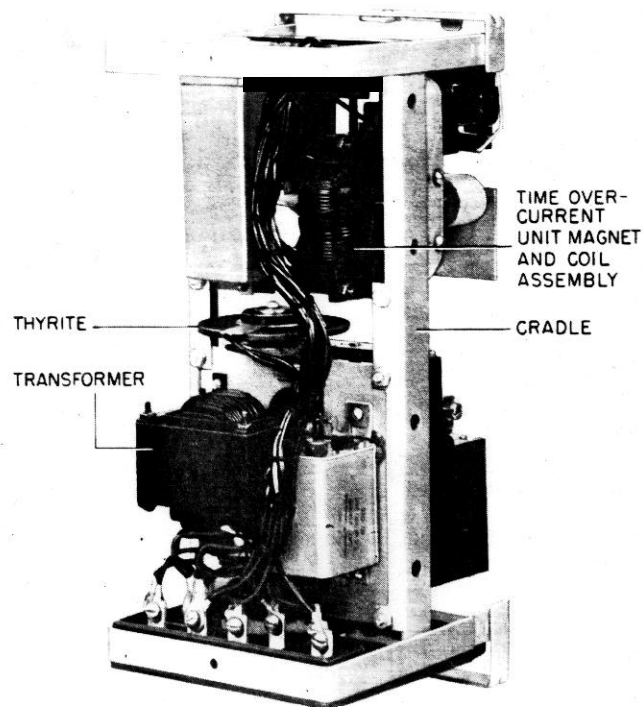


Fig. 5 Internal Connections - Type IBCG54E Relay (Front View)

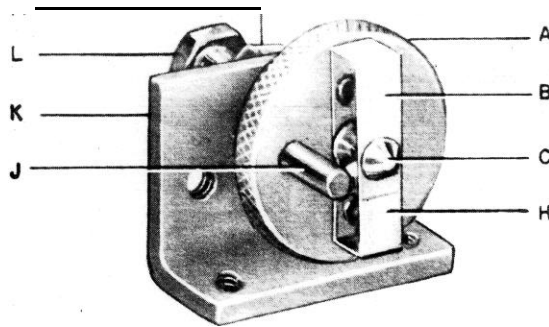


Front View

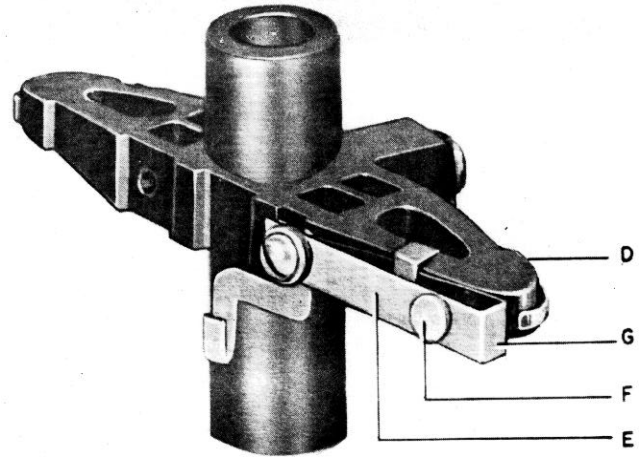


Rear View

Fig. 6 Type IBCG51E Relay Unit In Cradle



Stationary Contact Assembly



Moving Contact Assembly

A - Contact Dial
B - Contact Brush
C - Contact Tip
H - Contact Brush Retainer
K - Contact Support
L - Mounting Screw
M - Locknut

D - Contact Arm
E - Contact Brush
F - Contact Tip
G - Contact Brush Retainer

Fig. 7 Low Gradient Contact Assembly For The Directional Unit

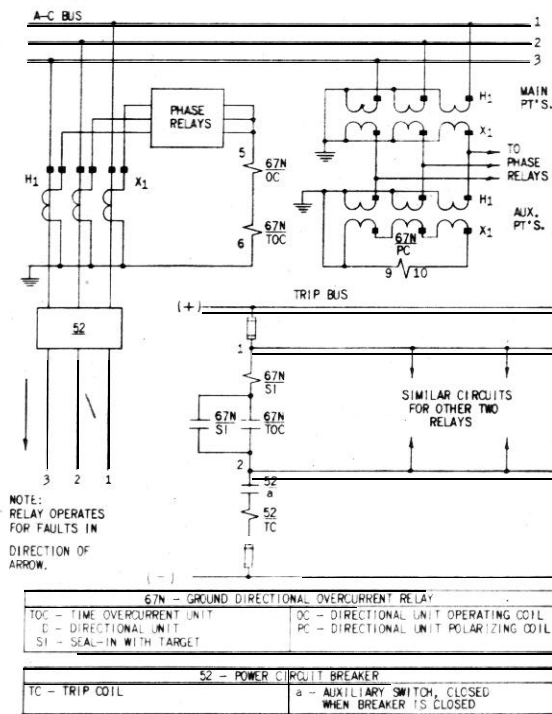


Fig. 8 External Connections For Type IBCG5IE Relays For Directional Ground Fault Protection Of A Single Line Using Potential Polarization

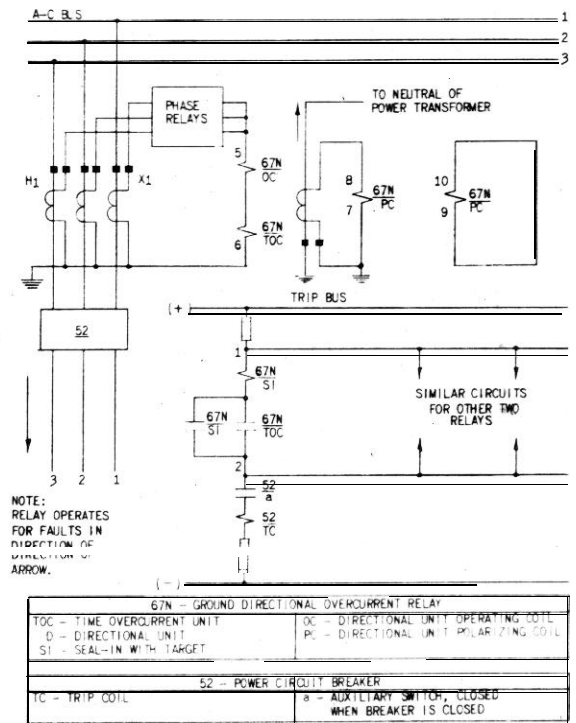


Fig. 9 External Connections For Type IBCG5IE Relays For Directional Ground Fault Protection Of A Single Line Using Current Polarization

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 un-

packing 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 relay.

DESCRIPTION

TIME OVERCURRENT UNIT

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

The very inverse time overcurrent "nit is of the wattmetric type similar to that used in watt-hour 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, and the two coils on the lower legs of the magnetic circuit. When power flow is in such a direction as to close the directional "nit 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 contact or 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 "nit is of the induction-cylinder construction with a laminated stator having eight poles projecting inward and arranged symmetrically around a stationary central core. The cup-like 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 "nit 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 relay.

SEAL-IN UNIT

A seal-in "nit is mounted on the left side of the overcurrent "nit as indicated in Fig. 6. This "nit has its coil in series and its contacts in parallel with the main contacts of the overcurrent "nit, arranged in such a manner that when the main contacts close, the seal-in "nit picks up and seals-in around the main contacts. When the seal-in "nit operates, it raises a target into view which latches up and remains exposed until manually released by pressing the button located at the lower-left corner of the cover.

CONTACTS

The directional unit contacts which control the time overcurrent "nit, are shown in Fig. 7. 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 brush (E) on which is mounted a button contact up (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 (Ii). The stop (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 two locknuts (M).

CASE

The case is suitable for either surface or semiflush panel mounting and an assortment of hardware is provided for either mounting. The cover attaches to the case and also carries the reset mechanism when one is required. Each cover screw has provision for a sealing wire.

The case has studs or screw connections at both ends or at the bottom only for the external connections. The electrical connections between the relay "nits and the case studs are made through spring backed contact fingers mounted in stationary molded inner and outer blocks between which nests a removable connecting plug which completes the circuits. The outer blocks, attached to the case, have the studs for the external connections, and the inner blocks have the terminals for the internal connections.

The relay mechanism is mounted in a steel framework called the cradle and is a complete "nit with all leads being terminated at the inner block. This cradle is held firmly in the case with a latch at the top and the bottom and by a guide pin at the back of the case. The cases and cradles are so constructed that the relay cannot be inserted in the case upside down. The connecting plug, besides making the electrical connections between the respective blocks of the cradle and case, also locks the latch in place. The cover, which is fastened to the case by thumbscrews, holds the connecting plug in place.

To draw out the relay "nit the cover is first removed and the plug drawn out. Shorting bars are provided in the case to short the current transformer circuits. The latches are then released, and the relay "nit can be easily drawn out. To replace the relay "nit, the reverse order is followed.

A separate testing plug can be inserted in place of the connecting plug to test the relay in place on the panel either from its own source of current and voltage, or from other sources. Or, the relay "nit can be drawn out and replaced by another which has been tested in the laboratory.

INSTALLATION

LOCATION

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

MOUNTING

The relay should be mounted on a vertical surface. The outline and panel drilling diagram is shown in Fig. 16.

CONNECTIONS

The internal connection diagrams for the various relays are shown in Figs. 2 to 5. Typical wiring diagrams are shown in Figs. 8 and 9.

One of the mounting studs or screws should be permanently grounded by a conductor not less than No. 12 B&S gage copper wire or its equivalent.

INSPECTION

At the time of installation, the relay should be inspected for tarnished contacts, loose screws, or other imperfections. If any trouble is found, it should be corrected in the manner described under MAINTENANCE.

OPERATION

Before the relay is put into service, it should be given a check to determine that factory adjustments have not been disturbed. The time dial will be set at zero before the relay leaves the factory. It is necessary to change this setting in order to open the time overcurrent "nit contacts.

ADJUSTMENTS

TIME OVERCURRENT UNIT

TARGET AND SEAL-IN UNIT

When used with trip coils operating on currents ranging from 0.2 to 2.0 amperes at the minimum control voltage, the target and seal-in tap screw should be set in the 0.2-ampere tap. When the trip coil current ranges from 2 to 30 amperes

at the minimum control voltage, the tap screw should be placed in the 2.0 ampere tap.

The seal-in "nit tap screw is the screw holding the right-hand stationary contact of the seal-in "nit. To change the tap setting, first remove the connecting plug. Then take a screw from the left-hand stationary contact and place it in the desired tap. Next, remove the screw from the other tap and

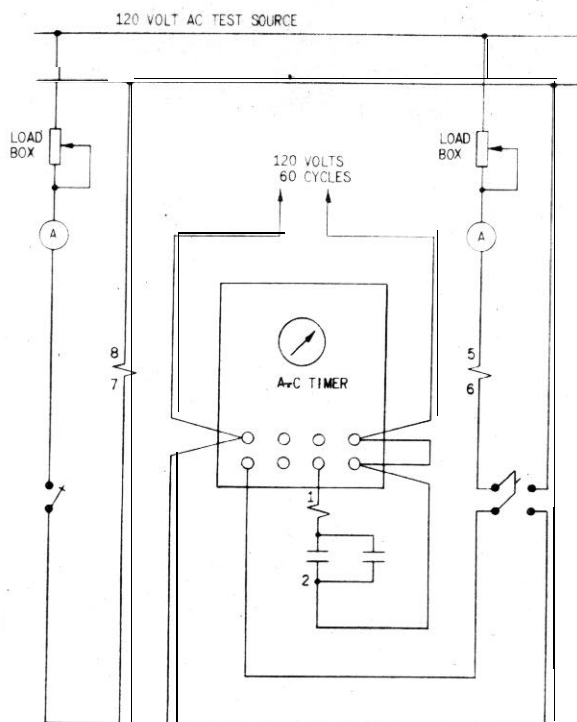


Fig. 10 Test Connections For Checking Pickup And Operating Time Of The Time Overcurrent Unit Using Current Polarization

place it back in the left-hand contact. This procedure is necessary to prevent the right-hand stationary contact from getting out of adjustment. If tap screws are left in both taps, the pickup will be less than 2.0 amperes d-c, but the seal-in unit will take longer to close its contacts.

CURRENT SETTING

The minimum current at which the time overcurrent unit will close its contacts is determined by the position of the plug in the tap block. The tap plate on this block is marked in amperes, as shown in Table II.

When the tap setting is changed with the relay in its case, the following procedure must be followed: (1) remove the connecting plug; this de-energizes the relay and shorts the current transformer secondary winding. (2) remove the tap plug and place it in the tap marked for the desired pick-up current. (3) replace the connecting plug.

The minimum current required to rotate the disk slowly and to close the contacts should be within five per cent of the value marked on the tap Plate for any tap setting and time dial position. If this adjustment has been disturbed, it can be restored by means of the spring adjusting ring. The ring can be turned by inserting a screw driver

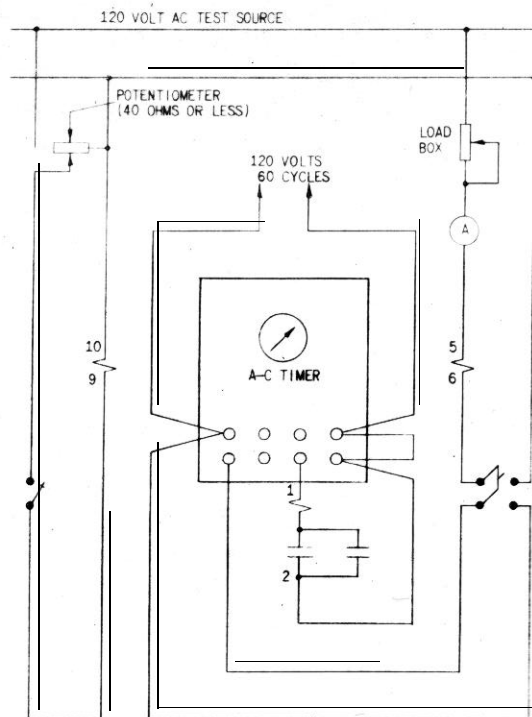


Fig. 11 Test Connections For Checking Pickup And Operating Time Of The Time Overcurrent Unit Using Potential Polarization

blade in the notches around the edge. By turning the ring, the operating current of the unit can be brought into agreement with the tap setting employed. This adjustment also permits any desired setting to be obtained intermediate between the available tap settings.

Test connections for making pickup and time checks on the time overcurrent unit are shown in Fig. 10 and Fig. 11. Use a source of 120 volt.5 or greater with good wave form and constant frequency. Stepdown transformers or phantom loads should not be employed in testing induction relays since their use may cause a distorted wave form.

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. This operating time is inversely proportional to the current magnitude as illustrated by the time curves in Fig. 14 and Fig. 15. 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 ampere 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

The time and current settings of the time overcurrent unit can be made easily and quickly. Each time value shown in Fig. 14 and Fig. 15 indicates the time required for the contacts to close with a particular time-dial setting when the current is a prescribed number of times the current-tap setting. In order to obtain any particular time-current setting, insert the removable plug in the proper tap receptacle and adjust the time dial to the proper position. The following example illustrates the procedure in making a relay setting.

Assume that the relay is being used in a circuit where the circuit breaker should trip on a sustained current of approximately 450 amperes, and that the breaker should trip in one second on a short-circuit current of 3750 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. In this case, 450 divided by 60 equals 7.5 amperes. Since there is no 7.5 ampere tap, the B-ampere tap is used. To find the proper time-dial setting to give one second time delay at 3750 amperes, divide 3750 by the transformer ratio. This gives 62.5 amperes secondary current which is 7.8 times the B-ampere setting. By referring to the time-current curves Fig. 14 and Fig. 15, it will be seen that 7.8 times the minimum operating current gives a one second time delay for a No. 3.4 time dial setting on an inverse time relay or a No. 5.8 time dial setting on a very 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.

Aid in making the proper selection of relay settings may be obtained on application to the nearest Sales Office of the General Electric Company.

DIRECTIONAL UNIT

POLARITY CHECK

The polarity of the external connections to the directional unit, when it is potential polarized, may be checked using load currents. The idea is to obtain current from one current transformer and

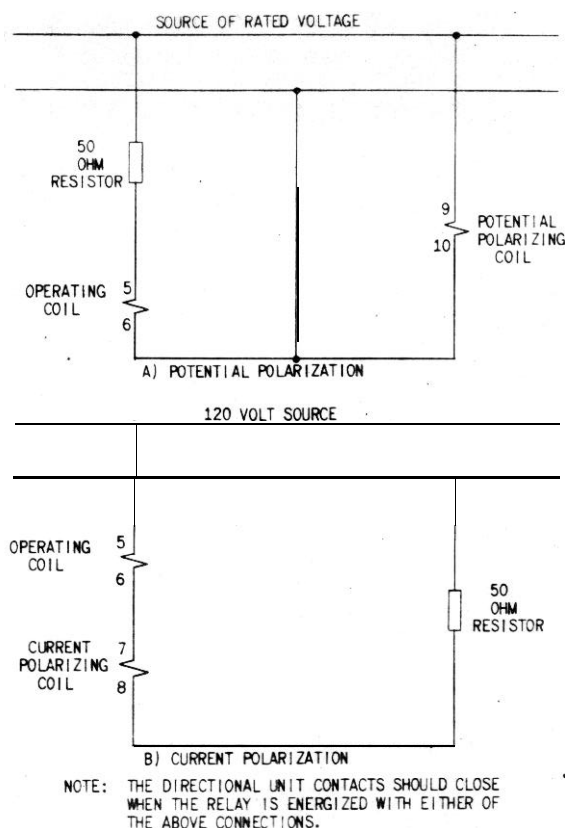


Fig. 12 Test Connections For Checking Polarity Of The Directional Unit Internal Connections

voltage from the same phase. The voltage is obtained by removing phase 1 from the primary of the wye-broken-delta transformer and shorting the phase-one primary winding. Current is obtained by shorting the current transformers in phases two and three and opening their circuits to the relay. This permits the current transformer in phase one to supply the operating current.

Connect a phase angle meter to read the angle between the current and voltage supplied to the relay. The relay has maximum torque at 60 degrees lag. With power flowing in the proper direction for operation, the relay should operate for phase angles within plus or minus 60 degrees of the maximum torque angle.

If the unit is current polarized from a current transformer in the power transformer neutral, such a check is not easily made. It is sometimes practical to introduce a single phase current in one phase of the primary circuits in such a way that current flows through both the transformer neutral current transformer and one of the line current transformers. If this cannot be done, a careful wiring check must suffice.

Fig. 12 shows the test connections for checking the polarity of the directional unit itself.

MAINTENANCE

These relays are adjusted at the factory and it is advisable not to disturb the adjustments. If, for any reason, they have been disturbed, the following points should be observed in restoring them:

TIME OVERCURRENT UNIT

DISK AND BEARINGS

The lower jewel may be tested for cracks by exploring its surface with the point of a fine needle. The jewel should be turned up until the disk is centered in the air gaps, after which it should be locked in this position by the set screw provided for this purpose. The upper bearing pin should next be adjusted so that the disk shaft has about 1/64 inch end play.

CONTACT ADJUSTMENT

The contacts should have about 1/32 inch wipe. That is, the stationary contact tip should be deflected about 1/32 inch when the disk completes its travel. Wipe is adjusted by turning the wipe adjustment screw thereby adjusting the position of the brush relative to the brush stop. On two-circuit closing relays, the two stationary contact tips should be in the same vertical plane.

When the time dial is moved to the position where it holds the contacts just closed, it should indicate zero on the time-dial scale. If it does not and the brushes are correctly adjusted, shift the dial by changing the position of the arm attached to the shaft just below the time dial. Loosen the screw clamping the arm to the shaft and turn the arm relative to the shaft until the contacts just make for zero time-dial setting.

DIRECTIONAL UNIT

BEARINGS

The lower jewel bearing should be screwed all the way in until its head engages the end of the threaded core support. The upper bearing should be adjusted to allow about 1/64 inch end play to the shaft.

To check the clearance between the iron core and the inside of the rotor cup, press down on the contact arm near the shaft, thus depressing the spring-mounted jewel until the cup strikes the iron. The shaft should move about 1/16 inch.

The lower jewel can be tested for fractures by exploring its surface with a fine needle.

CUP AND STATOR

Should it be necessary to remove the cup-type rotor from the directional "nit, the following procedure should be followed:

All leads to the "nit should first be disconnected and tagged for identification in reconnecting. The "nit can then be removed from the cradle with its mounting plate still attached.

The upper of the three flat-head screws holding the "nit to the plate should now be removed. On some models, it may be necessary to remove a resistor or capacitor to expose this screw. The four corner screws clamping the "nit together, should next be removed, and the entire top structure lifted off. This gives access to the cup assembly and exposes the stator assembly, which should be protected to keep it free from dust and metallic particles until the "nit is reassembled.

To remove the shaft and rotor from the contact head assembly, the spring clip at the top of the shaft must be pulled out and the clutch adjusting screw taken out of the side of the molded contact arm. The shaft and cup can now be pulled out of the molding. The rotor must be handled very carefully while it is out of the "nit.

CONTACT ADJUSTMENTS

To make contact adjustments, refer to Fig. 7 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 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. Note that, after the moving and stationary contact members first begin to touch, an additional 3/4-1 turn of the backstop screw is required to cause the moving contact brush retainer to strike the stationary contact stop. If not, back off the backstop screw and either wind or unwind the mounting screw the number of full turns necessary to cause this condition to be satisfied. After this condition has been satisfied, tighten the locknut which secures the mounting screw to the stationary contact support. Manipulate the backstop screw until the moving and stationary contact members begin to touch. 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.

TORQUE ADJUSTMENT

Connect the current operating and current polarizing coils in series by connecting a jumper across terminals 6 and 7. Apply current to terminals 5 and 8 and adjust the directional unit spiral spring so that the unit picks up at 0.5 ampere.

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 circuit terminals 9 and 10 and connect the circuit show" in Fig. 13A. Set I_O for 0.25 ampere and I_P for 30 amperes and check that the unit does not operate. Higher values of I_P may be used if such values of polarizing current can be expected from the system. Open the current polarizing circuit, adjust I_O for 7 amperes, and check that the unit does not operate.

Unshort terminals 9 and 10 and connect the circuit show" in Fig. 13B. Set I_O for 0.25 ampere and V_P for 120 volts and check that the unit does not operate. Higher values of V_P may be used if such values of polarizing voltage can be expected from the system.

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 polarizing coils and thyrite resistor 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 and thyrite to cool.

CLUTCH ADJUSTMENT

The connections shown in Fig. 12 for the polarity check can also be used in making the clutch adjustment. The clutch should be adjusted using either potential or current polarization, not both. The 50 ohm resistor should be replaced with an adjustable resistor capable of providing the current range listed in Table V for the relay rating in question. A screw, projecting from the side of the moving contact arm, controls the clutch pressure, and consequently the current value at which the clutch will slip. With rated frequency (and at rated volts for potential

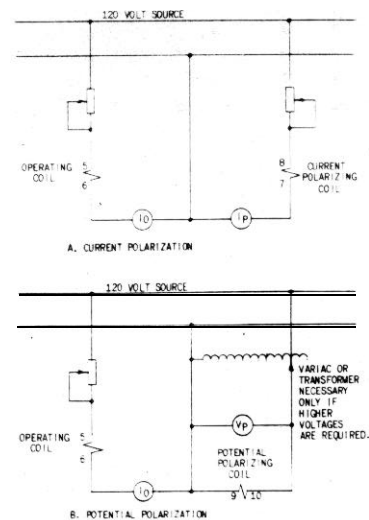


Fig. 13 Test Connections For Checking Proper Directional Unit Core Position

polarization), the clutch should be set to slip at the current values listed in Table V.

TABLE V
CLUTCH ADJUSTMENTS

Method Of Polarization	Tap Rang (Amps)	Amperes For Clutch To Slip
Current	0.5/2	10-15
Current	1.5/6	10-15
Current	4/16	20-25
Potential	0.5/2	7-10
Potential	1.5/6	7-10
Potential	4/16	12-15

CONTACT CLEANING

For cleaning fine silver contacts, a flexible burnishing tool should be used. This consists of a flexible strip of metal with a "etched roughened surface, resembling in effect a superfine file. The polishing action is so delicate that no scratches are left, yet corroded material will be removed rapidly and thoroughly. The flexibility of the tool insures the cleaning of the actual points of contact.

Fine silver contacts should not be cleaned with knives, files or abrasive paper or cloth. Knives or files may leave scratches which increase arcing and deterioration of the contacts. Abrasive paper or cloth may leave minute particles of insulating abrasive material in the contacts thus preventing contact closing.

The burnishing tool described above can be obtained from the factory.

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 part wanted, and give complete nameplate data. If possible, give the General Electric Company requisition number on which the relay was furnished.

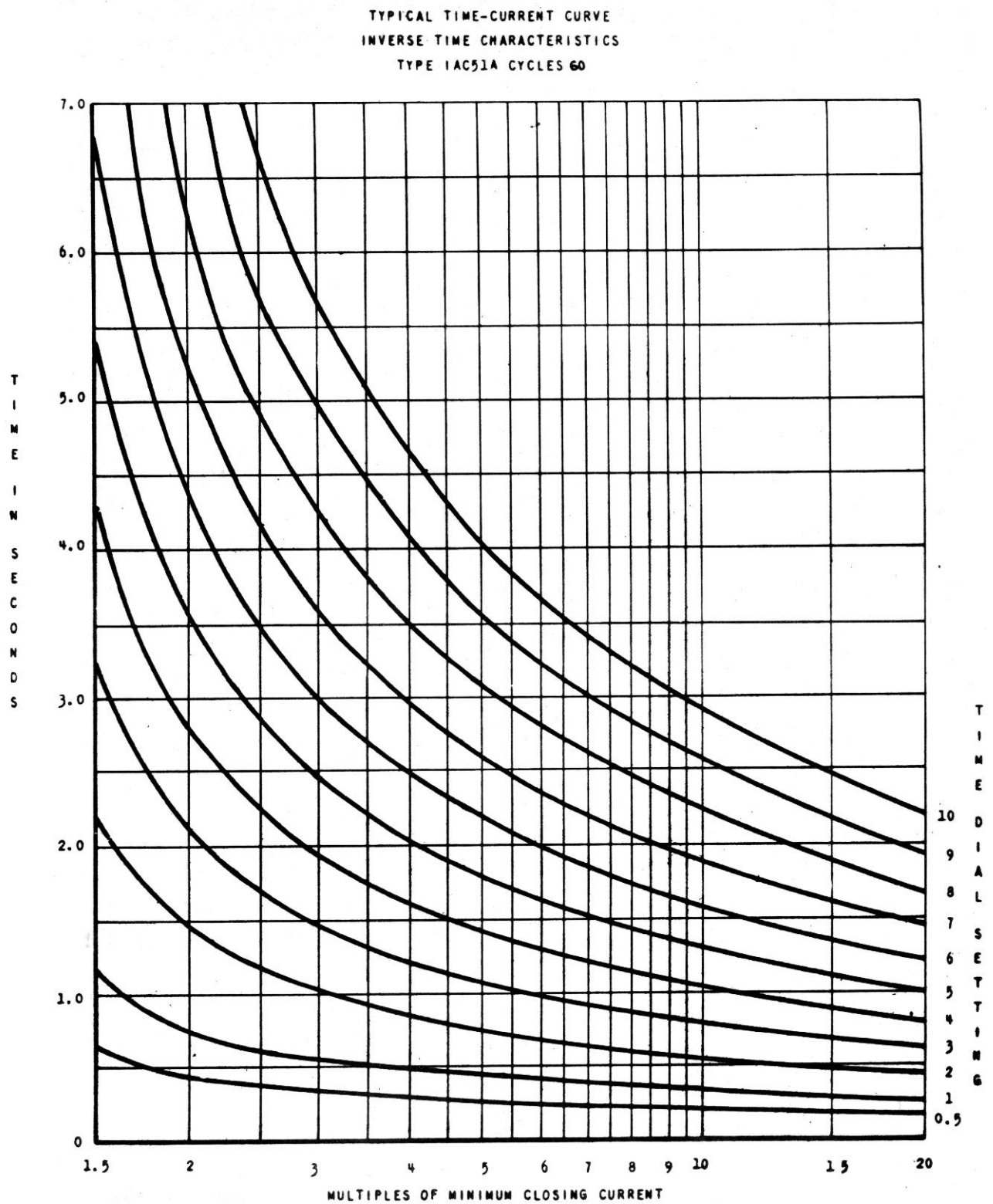


Fig. 14 Time-Current Curves For The Inverse Time Overcurrent Unit

Fig. 15 (K-6400220)

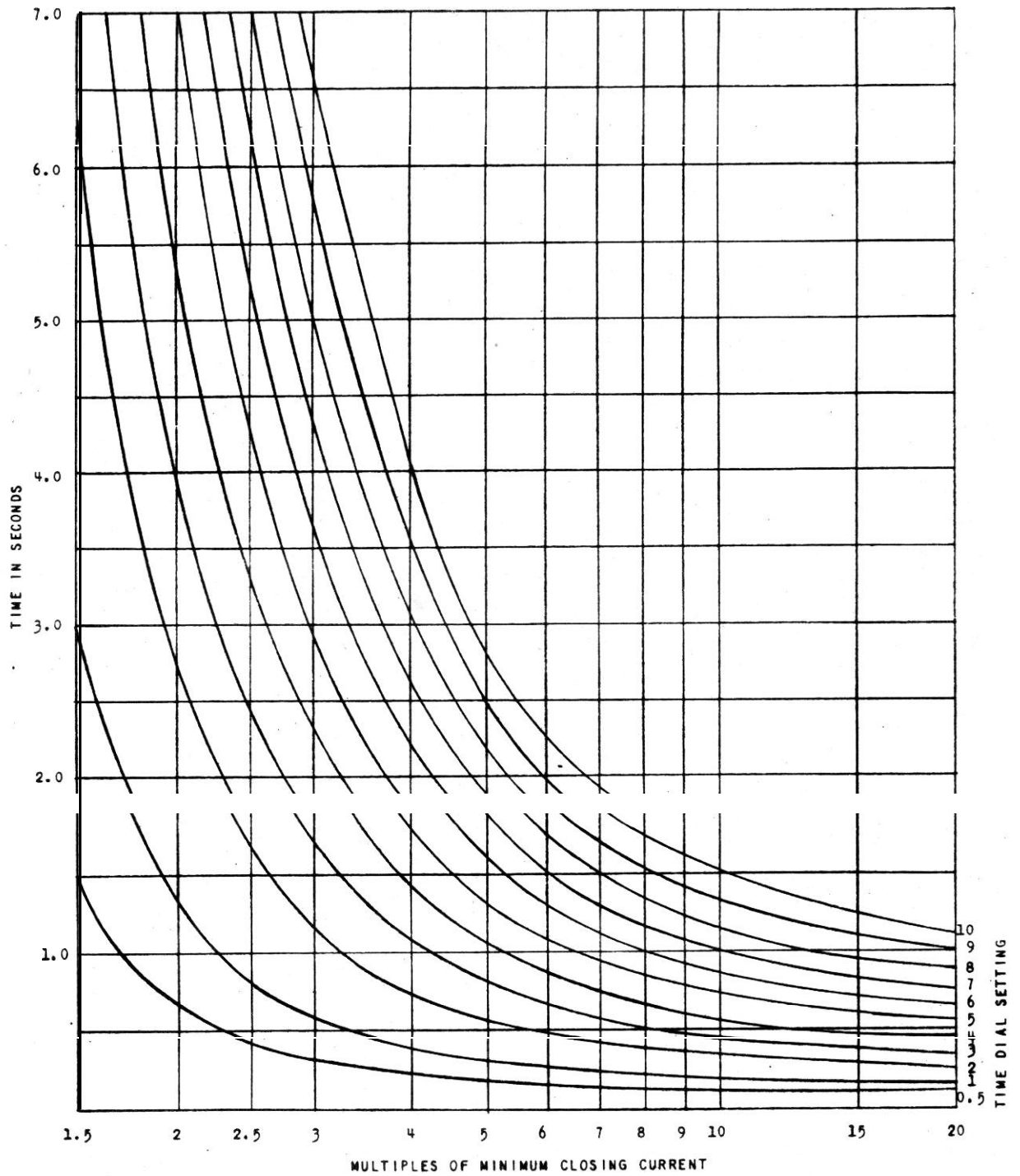


Fig. 15 Time-Current Curves For The Very Inverse Time Overcurrent Unit

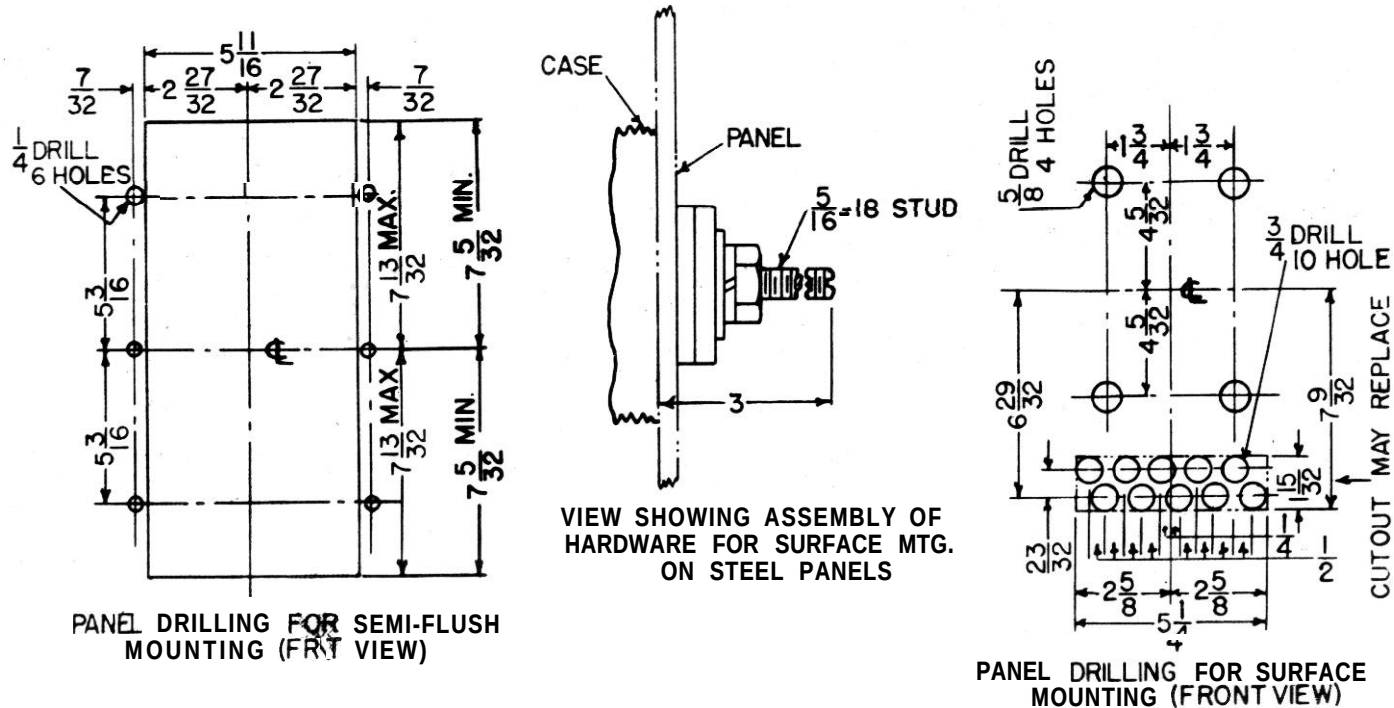
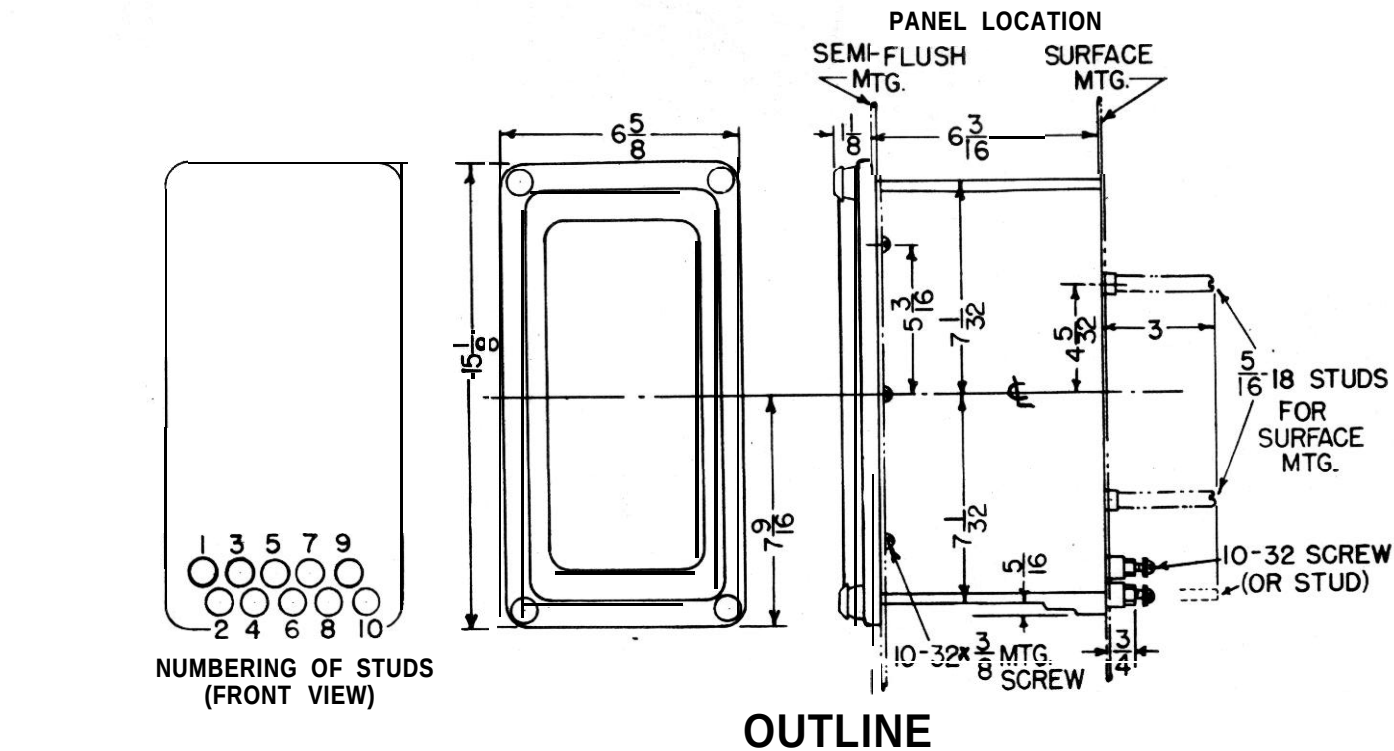


Fig. 16 Outline And Panel Drilling Dimensions