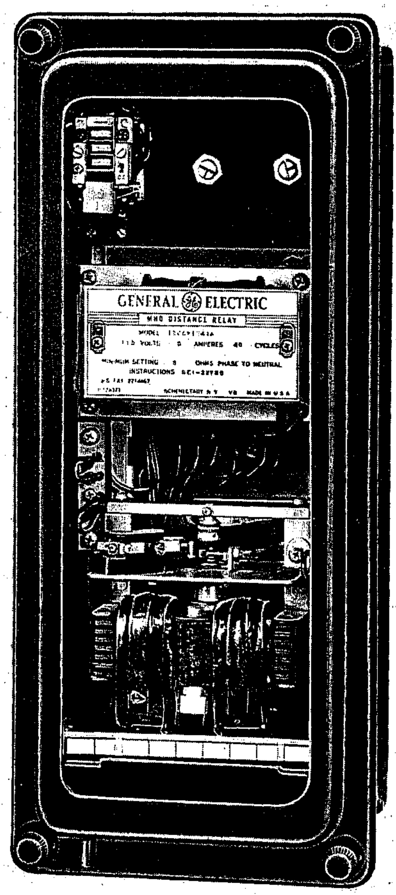
INSTRUCTIONS

GEI-22785D

SUPERSEDES GEI-22785C

MHO DISTANCE RELAY

HANDBOOK REFERENCE 7244



Type CEY12A

LOW VOLTAGE SWITCHGEAR DEPARTMENT

A GENERAL ELECTRIC

PHILADELPHIA, PA.

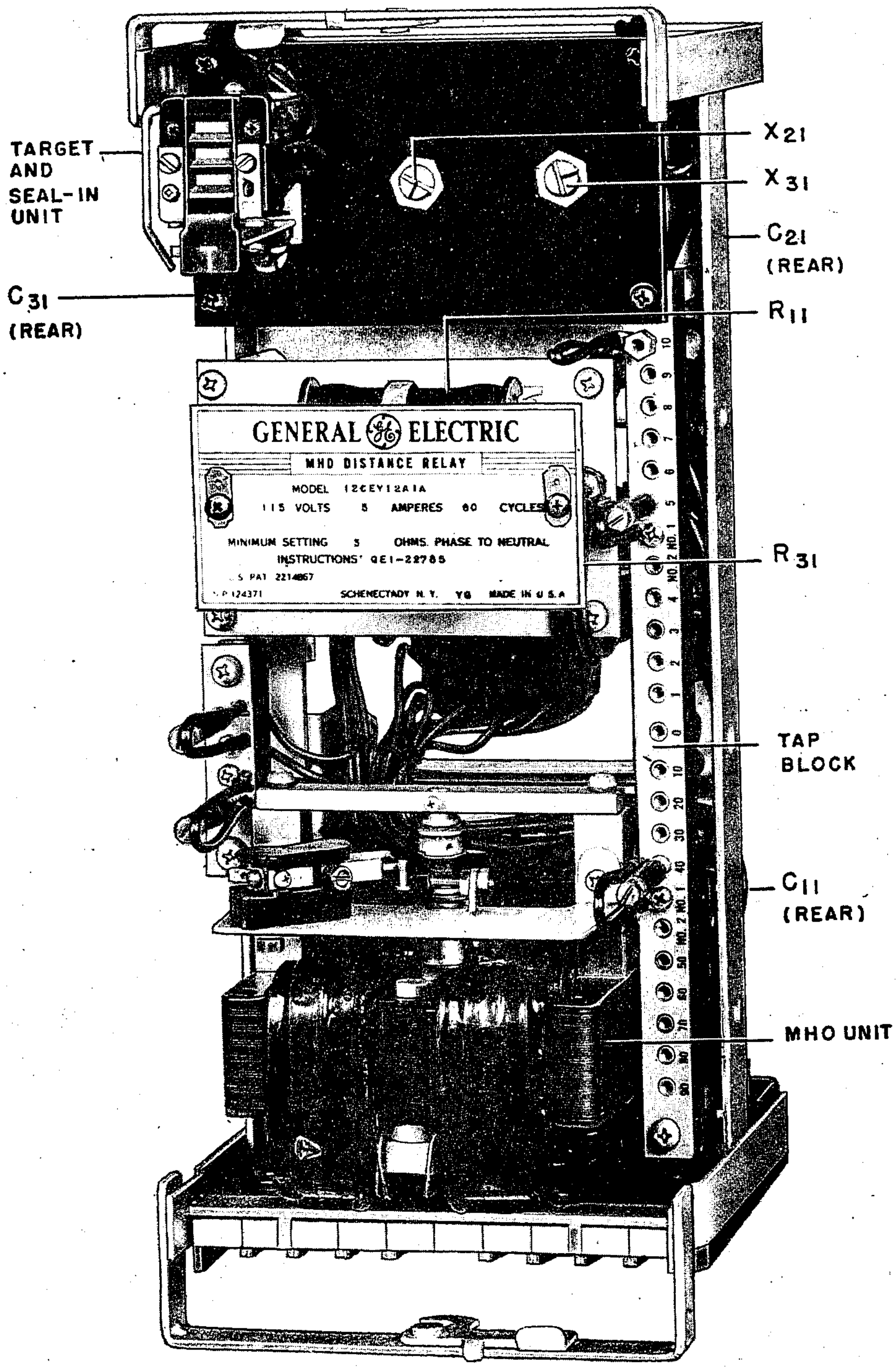


Fig. 1 Type CEY12A Relay Removed From Case (Front View)

Fig. 1 (8012887)

Cover (8012889)

MHO DISTANCE RELAY
TYPE CEY12A

INTRODUCTION

The Type CEY12A relay is a high-speed directional distance relay with a mho type operating characteristic. This means that the relay will operate whenever the admittance represented by the relay current and voltage has a component in the direction of maximum torque greater than some predetermined value. Since line characteristics are usually expressed in ohms, it is more convenient to translate the above characteristic into an impedance function. On an impedance diagram this characteristic appears as a circle passing through the origin and having its diameter in the direction of maximum relay torque as shown in Fig. 2.

The operating unit of this relay is the same as the first zone unit of the three-step GCY mho distance relay. A number of precautions have been taken with this unit to insure accuracy of operation.

APPLICATION

There are two principle applications where this relay is useful. These are:

1. With overcurrent relays to reduce the tripping time without loss of selectivity.

2. As back-up protection with other high-speed relays such as pilot wire differential relays.

In the first application the advantage is derived from the fact that the relay can be used to trip instantaneously for faults up to 90 per cent of the line section. This decreases directly the tripping time for these faults. There is a further advantage, indirectly obtained, in that the overcurrent relays usually can be set for greater sensitivity and shorter times without losing selectivity with relays at the next station.

In the second application a Type RPM timing relay would normally be used for each set of three CEY relays. This relay will provide control of the back-up tripping time to obtain selectivity.

It must be emphasized that when the relay is used for time delay tripping, faults producing less than 1.5 volts phase-to-phase and 2 amperes at the relay will not be tripped since the memory action of the unit will expire before tripping can be completed. If further protection is desired, the application of the Type CEB13B offset mho relay and Type RPM timer is suggested. Refer to GEI-31086.

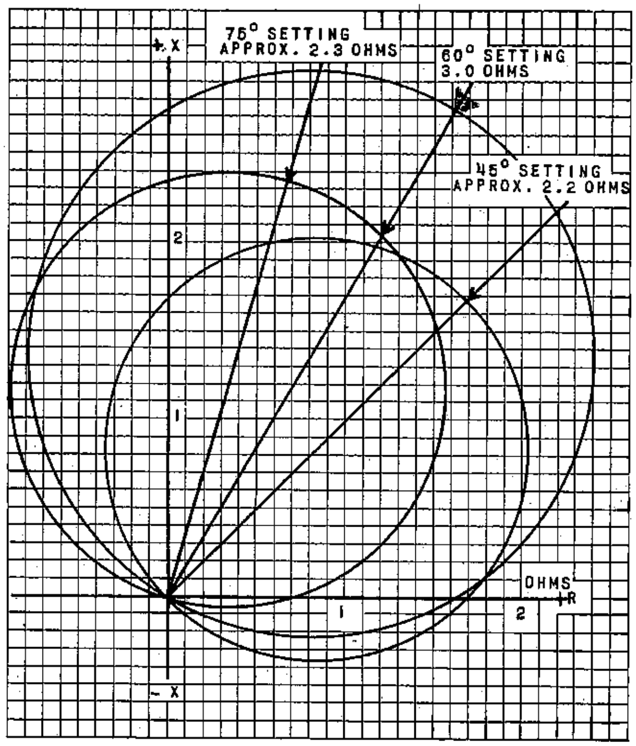


Fig. 2 Minimum Static Operating Characteristics of the MHO Unit

Fig. 2 (K-6556578)

OPERATING CHARACTERISTICS

Fig. 2 is an impedance diagram showing the relationship of the relay characteristics for the three available maximum torque angles. These are the minimum ohmic characteristics. The size of any of these circles can be increased by reducing the restraint tap setting of the tapped transformer in the relay. The following formula gives the ohmic reach at other tap settings with the relay set for maximum torque at 60 degrees lag.

$$\text{Ohmic reach (Phase-to-Neutral)} = \frac{300}{\%\ \text{settings}}$$

Two other settings of the angle of maximum torque can be obtained by different connections of

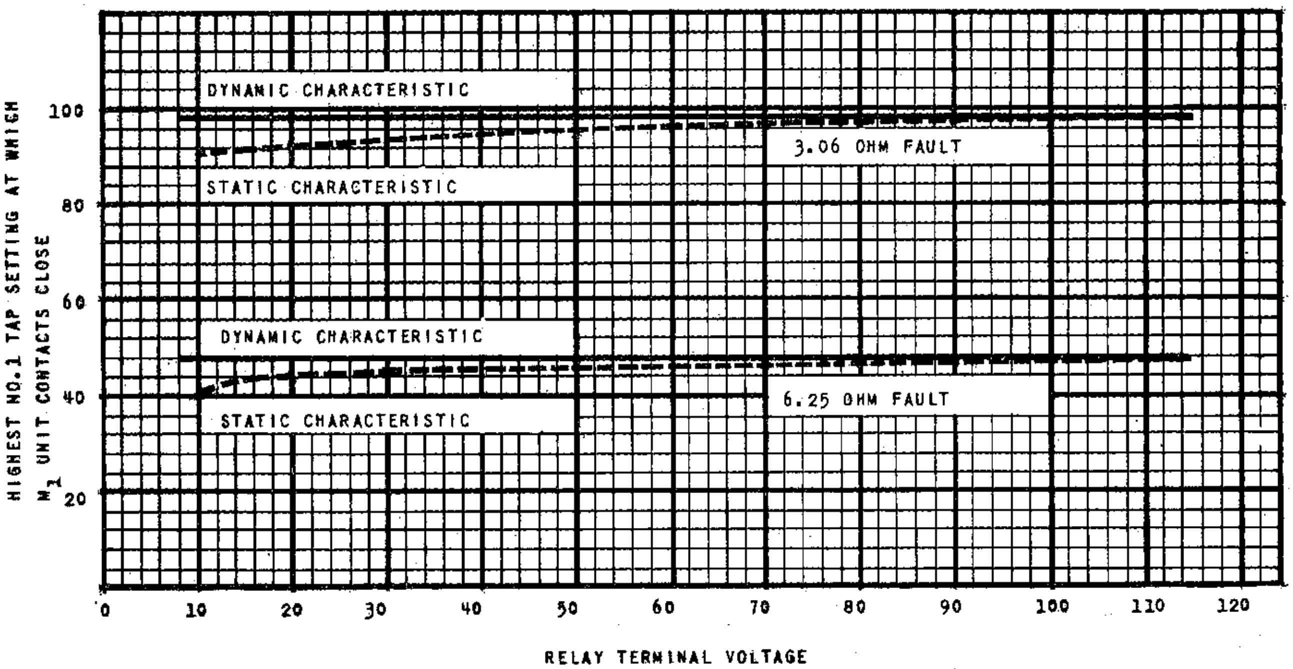


Fig. 3 Accuracy of the MHO Unit Under Static and Dynamic Conditions (Phase-to-phase Faults, 60 Degree Phase Angle)

Fig. 3 (362A525)

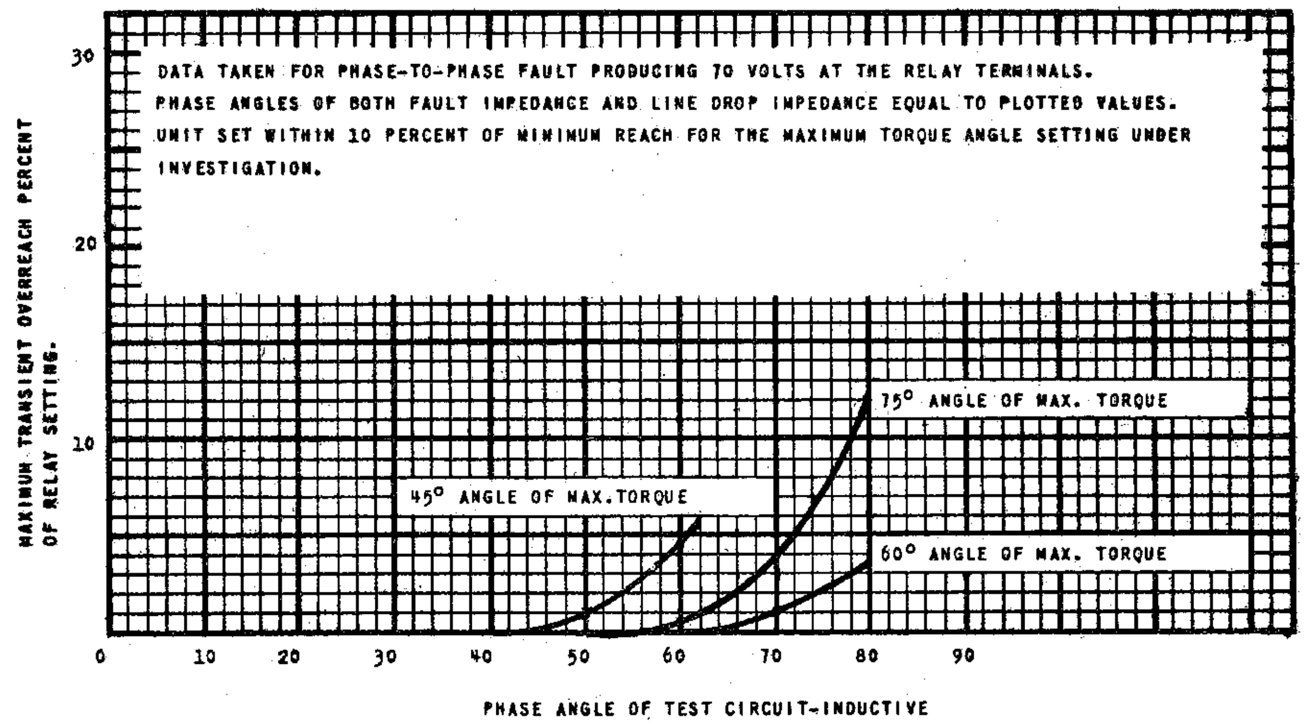


Fig. 4 Maximum Transient Overreach of MHO Unit

Fig. 4 (362A526)

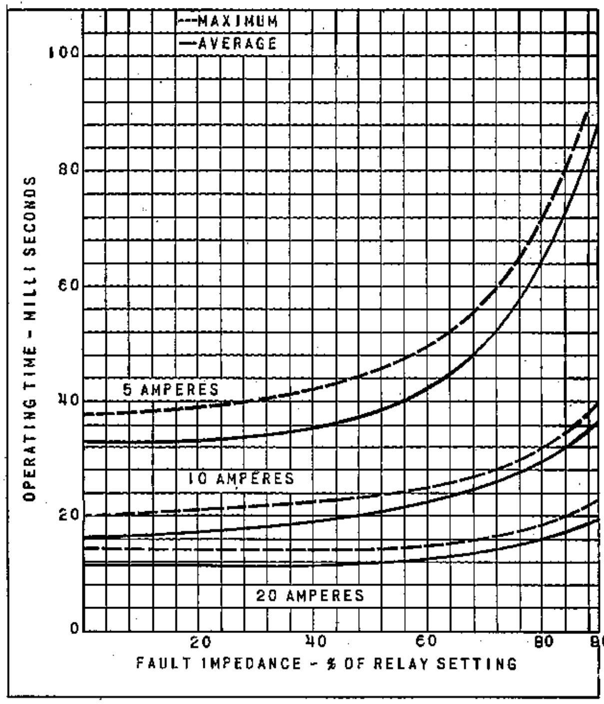


Fig. 5 Operating Times of MHO Unit Set for 3 Ohms at 60 Degrees

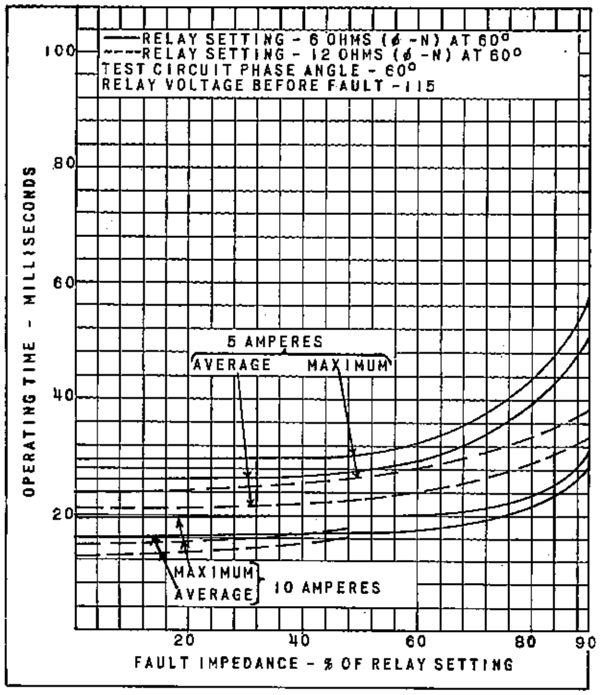


Fig. 6 Operating Times of MHO Unit Set for 6 and 12 Ohms at 60 Degrees

Fig. 5 (K-6556587) Sht. 1

Fig. 6 (K-6556587) Sht. 2

the A, B, C, and D taps on the small tap block. These connections are indicated at the top of the internal connection diagram, Fig. 8. These settings are adjusted at the factory for the correct angle but there is a small variation from relay to relay in the ohmic reach at these angles. The variations which may be expected between relays are shown below:

Angle of Max. Torque	MINIMUM OHMIC REACH		
	60 cy.	50 cy.	25 cy.
75	2.23-2.44	-	-
70	-	2.35-2.50	-
60	2.94-3.06	2.94-3.06	2.94-3.06
45	2.10-2.20	2.35-2.50	3.50-3.70

For a given setting of the relay the ohmic value at which the unit will operate may be somewhat lower than the calculated value as is indicated in Fig. 3. This figure shows the change in the restraint autotransformer tap setting at which the relay will just operate for a constant fault impedance as a function of voltage. These data are most easily checked by test, and are indicative of the change in ohmic value at which the relay will just operate for a constant restraint setting as a function of voltage, which is the actual operating condition. It will be noted that the percentage change for a given voltage is practically independent of whether a high or low value of restraint tap setting is being used.

The operation of the unit under transient conditions at the inception of a fault is important because the relay may be connected so that the contacts will trip a breaker independently of any other contacts. The curves shown in Figs. 2 and 3 represent steady-state conditions. Fig. 5 indicates the extent to which the unit may overreach, i.e., close its contacts momentarily when the impedance being measured is greater than that for which the contacts close under steady-state conditions. Maximum transient overreach occurs when a fault occurs at the one instant in either half of a cycle which produces the maximum amount of d-c offset to the current wave. If the fault occurs midway between these two instants, there is no transient overreach.

The unit is carefully adjusted to have correct action with respect to the direction of the fault under low voltage conditions for currents between 5 and 60 amperes.

The speed of operation of the M_1 unit is also dependent upon the phase angle of the current circuit and the instant at which a fault occurs. The curves of operating times shown in Figs. 5 and 6 indicate the average operating times, and the maximum times.

RATINGS

One 60 cycle, one 50 cycle, and one 25 cycle rating is available. The ohmic ranges are 3 to 30 ohms, phase-to-neutral, when set to the factory angular adjustment of 60 degrees lag.

Additional ranges of 1.5 to 15 ohms and 1.0 to 10 ohms can be obtained by the use of one ohmic

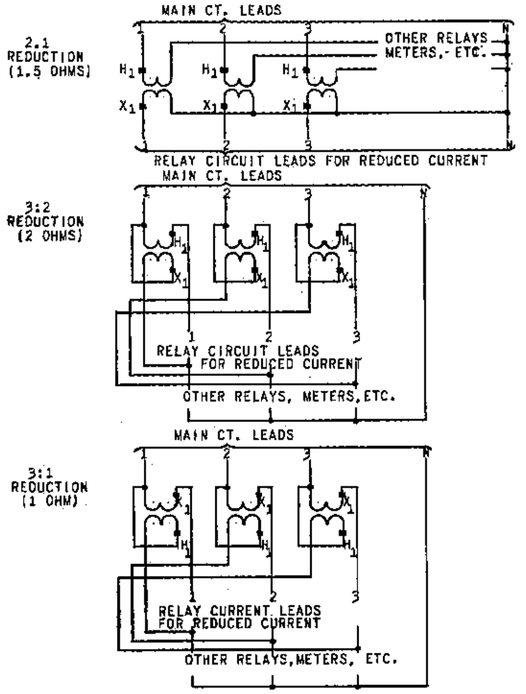
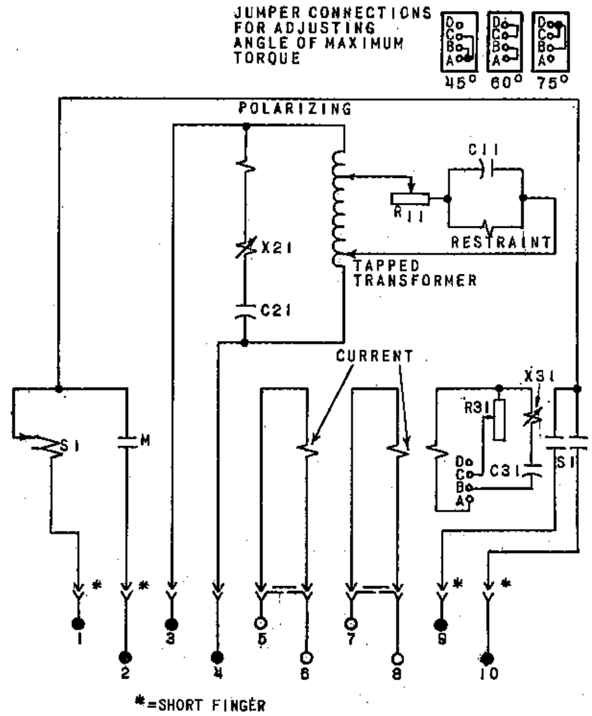
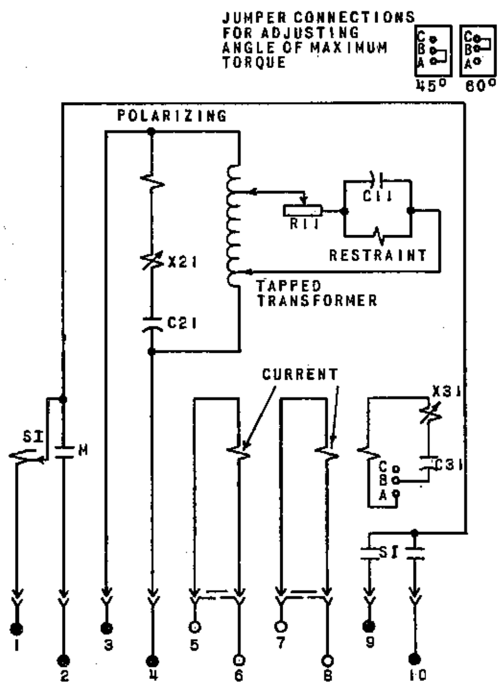


Fig. 7 Connections for Use of Ohmic Range Selectors



* Fig. 8 Internal Connection for the Type CEY12A Relay(60 And 50 Cycles)



* Fig. 9 Internal Connections for the Type CEY12A Relay (25 Cycles)

range selector per phase, furnished for mounting externally to the relay. The ohmic setting of the unit can be made in one per cent steps. Connections for using the selectors are shown in Fig. 7.

The current closing rating of the normally open contact is 30 amperes for voltages not exceeding 250 volts. However, their current rating is usually determined by selection of the tap on the target and seal-in element as indicated in the following table.

*

Current Rating of Target and Seal-in Coil		
	Amperes a-c or d-c	
Function	2 Amp Tap (0.13 Ohm) Target and Seal-in Coil	0.2 Amp Tap (7 Ohms) Target and Seal-in Coil
Tripping Duty	30	5
Carry Continuously	3	0.3

The tap setting used on the target and seal-in element is determined by the current drawn by the trip coil. The 0.2 ampere tap is for use with trip coils that operate on currents ranging from 0.2 to 2.0 amperes at the minimum control voltage. If this tap is used with trip coils requiring more than 2 amperes there is a possibility that the 7 ohms resistance will reduce the current to so low a value that the breaker will not operate. The 2-ampere tap should be used with trip coils that take 2 amperes or more at the minimum control voltage, provided that the tripping current does not exteed 30 amperes at the maximum control voltage.

If the tripping current exceeds 30 amperes an auxiliary relay should be used, the connections being

Fig. 7 (K-6400554)

Fig. 8 (K-6400412)

Fig. 9 (K-6400754)

* Denotes change from superseded book

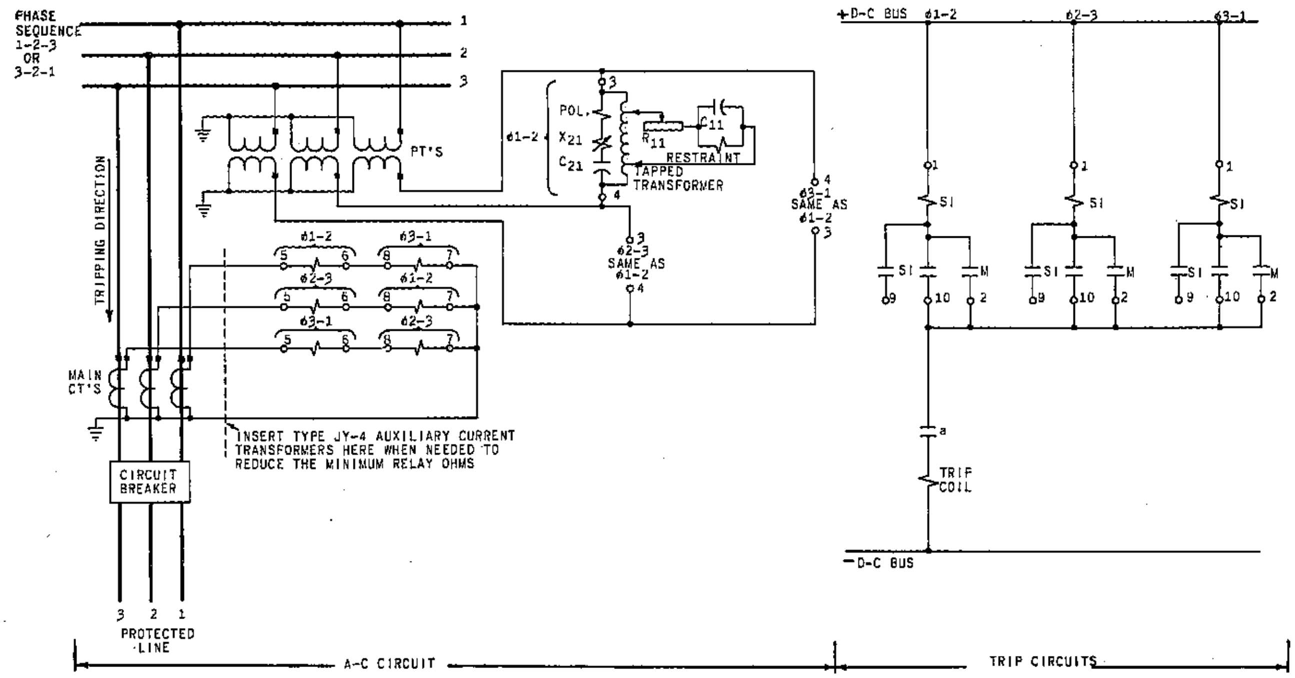


Fig. 10 External Connections for the Type CEY12A Relay

Fig. 10 (264B404)

such that the tripping current does not pass through the contacts or the target and seal-in coils of the protective relay.

BURDENS

The maximum burden imposed on each current transformer by a set of three relays at 5 amperes and rated frequency is:

Freq. Cps.	Impedance Ohms	Power Factor	Volt-Amperes
60	0.046	0.64	1.15
50	0.044	0.70	1.1
25	0.040	0.75	1.00

The burden imposed on each potential transformer at 115 volts rated frequency is:

Freq. Cps.	Circuit	Watts	Power Factor	Volt-Amperes
60	Pol.	8.1	0.99	8.2
	Rest. ‡	5.2	0.95	5.5
50	Pol.	9.4	0.99	9.5
	Rest. ‡	4.8	0.95	5.0
25	Pol.	7.5	0.87	8.6
	Res. ‡	5.5	0.98	5.6

‡ The burden of the restraint circuit is reduced when the tapped transformer setting is reduced. The volt-ampere burden is proportional to the square of this setting. The burden of the polarizing

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 than 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

CASE

The case is suitable for either surface or semi-flush 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 the bottom only for the external connections. The electrical connections between the relay units 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 unit 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 unit 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 unit can be easily drawn out. To replace the relay unit, 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 unit 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, excessive heat, and vibration, and well lighted to facilitate inspection and testing.

MOUNTING

The relays should be mounted on a vertical surface. The outline and panel drilling dimensions are shown in Fig. 13.

CONNECTIONS

The internal connection diagram for the 50 and 60 cycle relay is shown in Fig. 8. The internal connection diagram for the 25 cycle relay is shown in Fig. 9. Typical external connections are shown in Fig. 10.

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.

ADJUSTMENTS

At the time the relay is put in service it is necessary to make the appropriate settings on the two tap blocks in order to adapt the relay to the particular application.

In general, the maximum torque angle of the relays should be set as nearly as possible at the angle of the circuit being protected. The taps on the small tap block at the left side of the relay are used for selecting the desired maximum torque angle. The necessary settings are:

For a 75-degree angle, (70 degrees on 50 cycle relays) jumper B and C to D.

For a 60-degree angle, jumper B to A and C to D.

For a 45-degree angle, jumper B and C to A.

After the angle has been set the reach of the unit should be set to cover the required length of the line section. The secondary line impedance may be calculated from the formula.

$$Z \text{ sec} = Z \text{ pri} \times \frac{\text{CT ratio}}{\text{PT ratio}}$$

The relay tap settings are then made according to the relation.

$$\% \text{ tap} = \frac{\text{Min. Ohmic Reach}}{\text{Desired Ohmic Reach}} \times 100$$

In making these settings and calculations, the following points should be remembered.

1. The minimum ohmic reach is dependent upon the angle of maximum torque selected above. It is 2.3 for 75 degrees, 3.0 for 60 degrees, and 2.2 for 45 degrees on 60 cycle relays. On 50 cycle relays it is 2.4 for 45 and 75 degrees. On 25 cycle relays it is 3.6 for 45 degrees.

2. These ohmic values are phase-to-neutral as noted on the nameplate.

3. The ohmic reach is inversely proportional to the tap setting on the right-hand tap block.

For example, 100 per cent will give a 3 ohm reach with the 60-degree angular setting, then 75 percent would give a 4-ohm reach.

4. The reach at some angle different from maximum torque is less by the cosine of the angle between the line and the relay maximum torque. For example, the reach along a 70-degree line with a 75-degree relay setting would be the cosine of 5-degrees times the reach at maximum torque as determined from the preceeding paragraphs.

The operating characteristics of the relay will be within 10 percent of the values calculated above. If greater accuracy is required the test procedure described under MAINTENANCE should be used.

INSPECTION

Before placing a relay into service, the following mechanical adjustments and polarity should be checked, and faulty conditions corrected according to instructions for the preceding adjustments or under MAINTENANCE which follows.

The armature and contacts of the target and seal-in attachment should operate freely by hand.

There should be a screw in only one of the taps on the right-hand contacts of the target and seal-in attachment.

The target should reset promptly when the reset button at the bottom of the cover is operated with the cover on the relay.

There should be no noticeable mechanical friction in the rotating structure of the mho unit and the moving contacts should barely return to the right when the relay is de-energized.

There should be approximately 1/64 inch end play in the shaft of the rotating structure. The lower jewel screw bearing should be screwed firmly into place, and the top pivot locked in place by its set screw.

If there is reason to believe the jewel is cracked or dirty, the screw assembly can be removed from the bottom of the unit and examined under a microscope, or the surface of the jewel explored with a fine needle. When replacing a jewel, have the top pivot engaged in the shaft while screwing the jewel screw.

All nuts and screws should be tight, with particular attention paid to the tap plugs.

The felt gasket on the cover should be securely cemented into place in order to keep out dust.

The contact surfaces should be clean.

* With connections as in Fig. 11A, the number 1 taps are placed in the 100% tap setting and the phase angle jumpers are placed in the A taps. The polarity of the energized relay should be such as to produce contact opening torque when the lead is removed from stud 5. When this lead is replaced and one of the number 1 tap leads removed, the unit should produce contact closing torque.

The clutch should slip at a torque corresponding to approximately 50 grams applied at the contact normal to the contact arm.

MAINTENANCE

PERIODIC INSPECTION

The relay should be inspected as described under INSTALLATION at least once every six months. It should also be checked electrically to be sure that the mho unit and the target and seal-in unit will operate properly.

PERIODIC TESTING

The relay may be tested for pickup and maximum torque angle calibration in place on the panel through the use of the portable test box, test reactor, test resistor, and the relay test plug. The calibrated test resistor and test reactor are used together to provide fixed impedances at angles of 30 degrees and 60 degrees lag. The resistor used alone provides an impedance at zero degrees and the reactor used along provides an impedance at an angle nearly 90 degrees lag. The relay pick up can be determined at one of these angles and translated into the relay reach at the maximum torque angle through the cosine of the angle relation previously explained. A maximum torque angle can be checked by measuring equal impedances at two angles equidistant from the expected angle of maximum torque. The connections for using the test box, test reactor and resistor are shown in Fig. 12.

Tests of the operating characteristics of the relay can be made by means of the connections shown in Fig. 11 (C). In using this circuit, the relay ohmic pickup at any phase angle can be determined from the quotient of the voltage and pickup current at this angle. In using the circuit of Fig. 12 the ohmic characteristic is determined directly from the fault impedance, $R_F + jX_F$. In both cases the ohms of the circuit will be phase-to-phase and consequently twice the amount of impedance calculated as the relay setting under ADJUSTMENTS.

The transient characteristics of the relay are dependent upon the phase angle of the entire test circuit including that of the source of supply. The connections of Fig. 11 (B) are used to check the transient overreach of the relay in the laboratory. The values given are representative. With the fault switch open, the relay contacts should remain open. The value of fault reactance X_F is chosen for the tap setting at which the relay is to be tested. The tap setting is then increased above the

* Denotes change from superseded book

steady state balance point until a setting is reached where the relay will close its contacts momentarily as indicated by a test lamp on the contact circuit as the fault switch is closed perhaps once in five tries. The transient overreach, thus determined, should not exceed the values shown on the curves of Fig. 4.

If the relay is to be used with a timer to provide back-up protection the transient characteristics will be of no consequence and need not be checked.

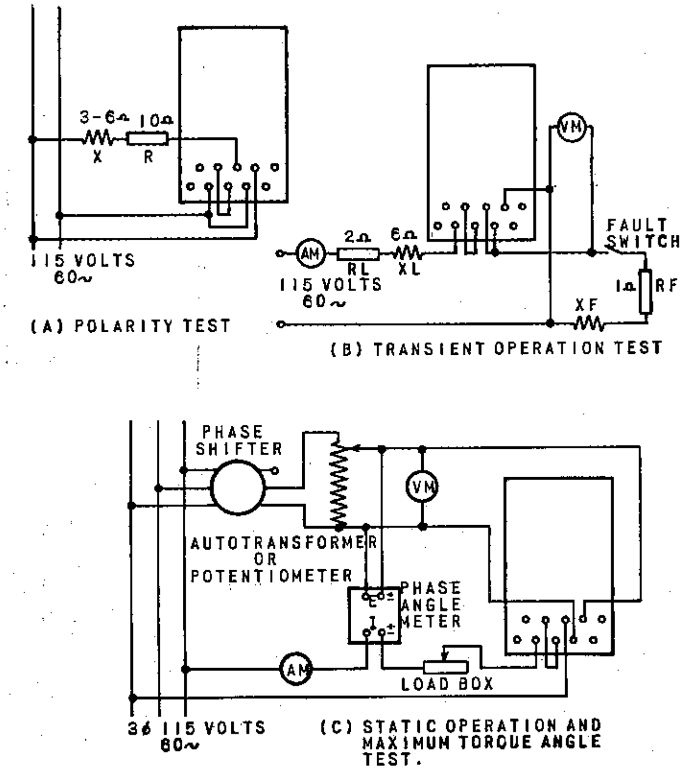


Fig. 11 Test Connections for the Type CEY12A Relay

Fig. 11 (K-6400553)

CONTACT CLEANING

Silver contacts should never be handled or touched by bare hands, because dampness on the hands may cause the formation, on the contacts, of silver salts which have high resistance.

For 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 delicate yet it will clean off any corrosion thoroughly and rapidly. Its flexibility insures the cleaning of the actual points of contact. The flexible burnisher can be drawn through the contacts while they are held together, thus cleaning both simultaneously and at the correct contact points.

The burnishing tools can be obtained from the factory but if none is available the best substitute is a sharp knife or a very fine file. The scratches produced by these tools will be deeper than those made by the burnishing tool and, therefore, the contacts may deteriorate more rapidly.

Under no circumstances should emery or crocus cloth be used to polish relay contacts. Particles of the abrasive may become imbedded in the silver and prevent the contacts from functioning.

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.

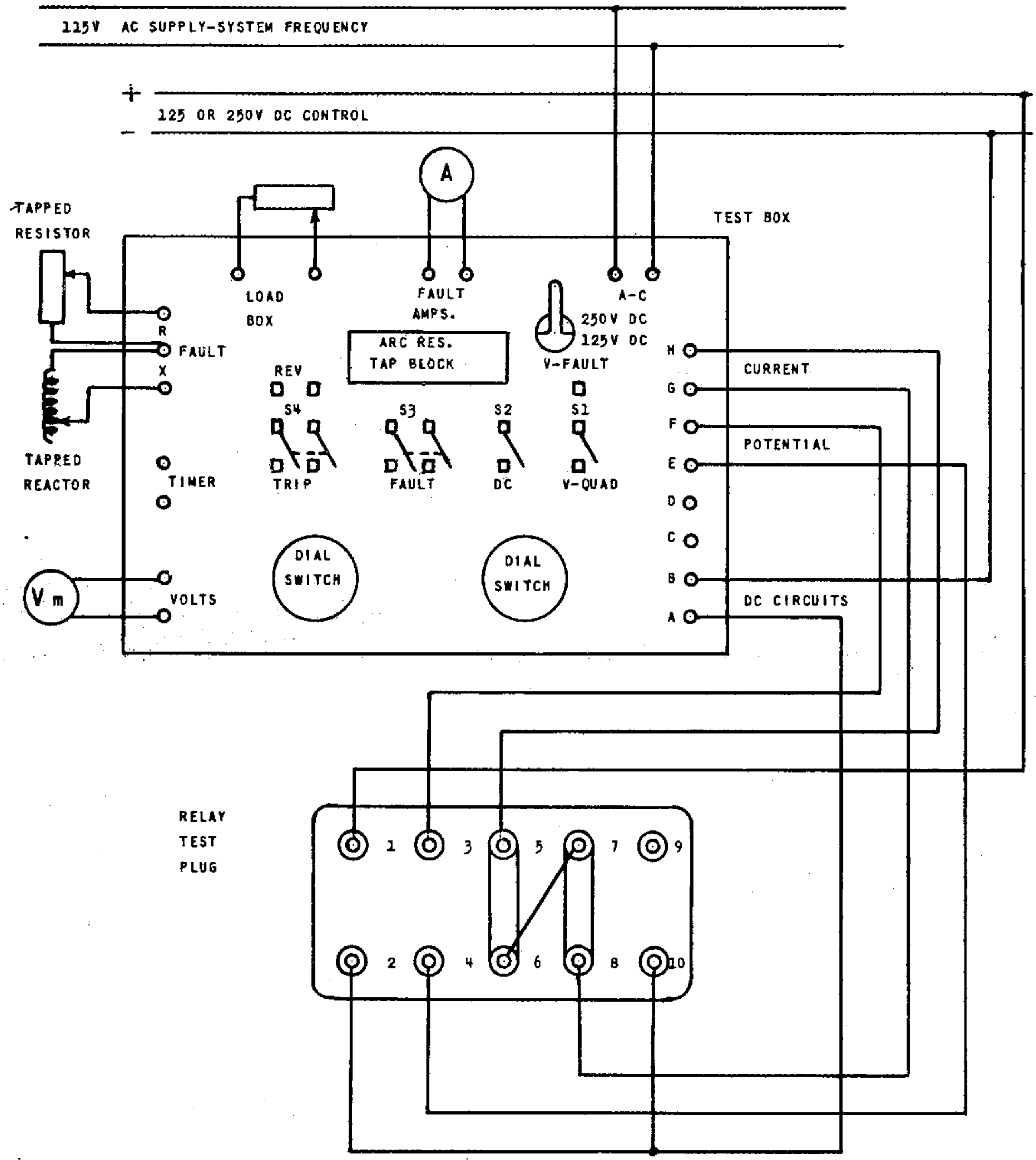


Fig. 12 (362A604)

Fig. 12 Test Connections for the Type CEY12A Relay Using the Test Box

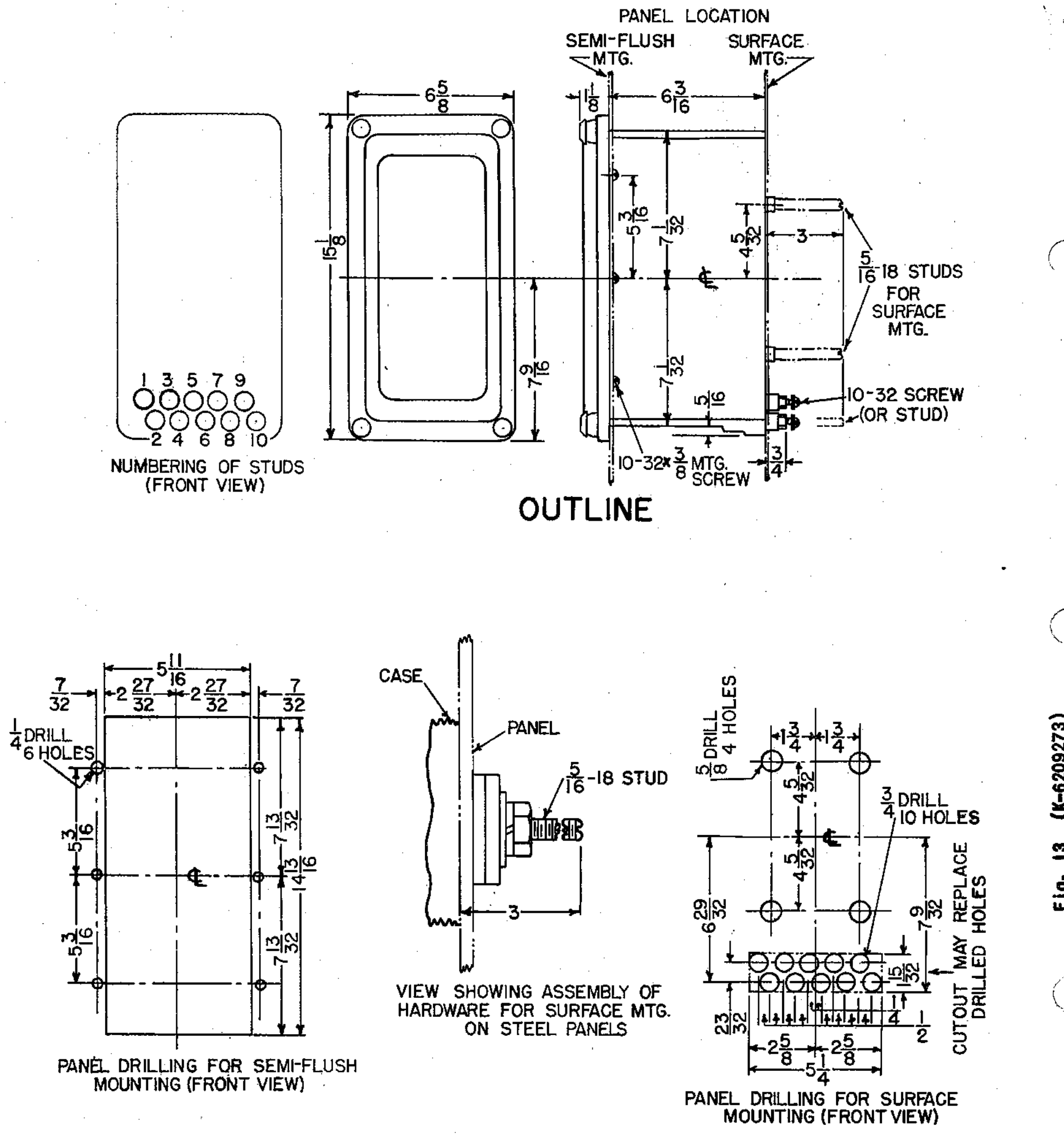


Fig. 13 Outline and Panel Drilling Dimensions for the Type CEY12A Relay