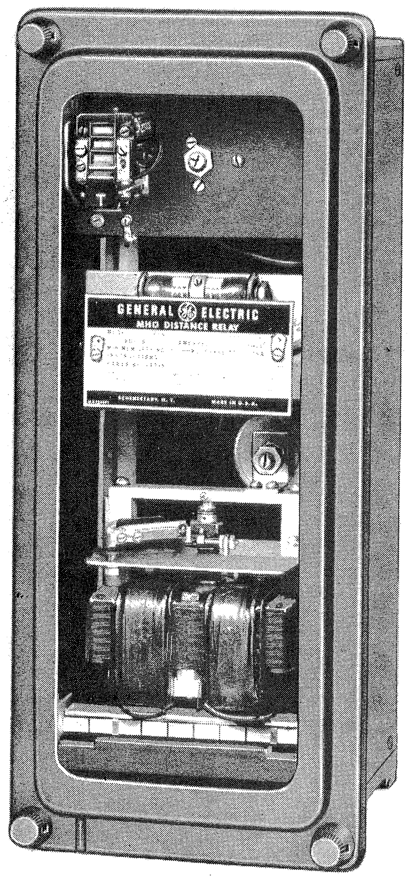
INSTRUCTIONS

GEI-44087

MHO DISTANCE RELAY

Type CEY13A



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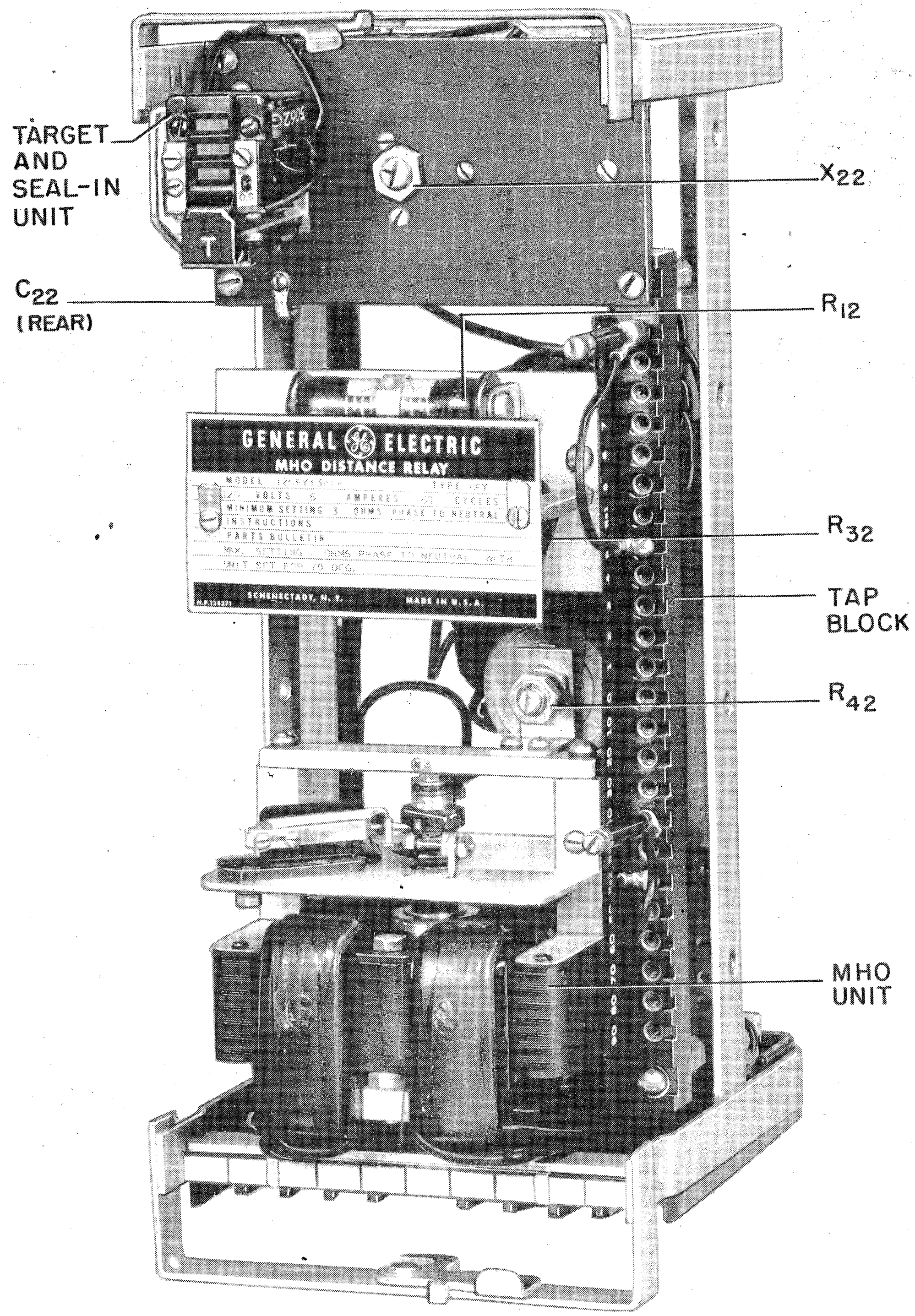

Fig. 1 The Type CEY13A Relay Withdrawn From Case (Front View)

Fig. 1 (8017840)

Cover (8017841)

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MHO DISTANCE RELAY
TYPE CEY13A

INTRODUCTION

The Type CEY13A 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.

APPLICATION

This relay is intended for application as a high-speed directional distance relay for carrier stopping.

OPERATING CHARACTERISTICS

The minimum operating characteristics of the CEY13A ohm unit as shown in Fig. 2. The relay is adjusted for the 75 degree setting of 3 ohms as shown. The size of the circle can be increased by reducing the restraint tap setting of the tapped transformers in the relay. The following formula gives the ohmic reach at other tap settings, with the relay still set for maximum torque at 75 degrees lag.

$$\text{Ohmic Reach (Phase-to-neutral)} = \frac{300}{\text{Tap Setting (\%)}}$$

The relay reach should not be increased beyond the nameplate rating of 9 ohms phase-to-neutral.

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. Data most easily checked by test, and 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 operating times of the relay for various current levels and percent reach are shown in Figs. 4 and 5. The speed of operation will depend upon the instant in the cycle at which the fault occurs. Maximum operating times are shown in the Figs. 4 and 5. The fast operating times indicated by these time curves have been gained at the expense of transient overreach. Consequently on carrier applications, for which this relay is intended, care must be taken the CEY13A carrier stopping relay does not outreach the carrier start relay at the remote terminal of the line.

The relay is carefully adjusted to have correct directional action under steady-state low voltage and current conditions. For faults in the tripping direction the relay has been checked for correct contact action at 1.5 volts and between 2 and 90 amperes. It should be remembered that this is a steady state test. Under transient conditions the memory action feature will insure correct operation with 0 volts and higher currents. For faults in the non-trip direction the contacts will remain open at 0 volts and between 0 and 90 amperes.

RATINGS

The relay is available with a rating of 120 volts, 5 amperes at 60 cycles, with an ohmic range, phase-to-neutral of 3 to 9 ohms and 75 degrees angle of maximum torque. The ohmic setting of the relay between these limits can be made in one percent steps. The restraint tap setting should not be set below 33 percent, i.e. above 9 ohms reach.

CONTACTS

The contacts of the relay will close and carry momentarily currents up to 30 amperes, d-c. The breaker trip circuit, however, should always be opened by an auxiliary switch or other suitable means.

TARGET SEAL-IN UNIT

The combination target and seal-in unit has a dual rating of 0.6/2.0 amperes. The tap setting used is determined by the current drawn by the breaker trip coil. The 0.6 ampere tap is for use with trip coils which operate on currents ranging from 0.6 to 2.0 amperes at minimum control voltage, while the 2.0 ampere tap should be used when trip currents

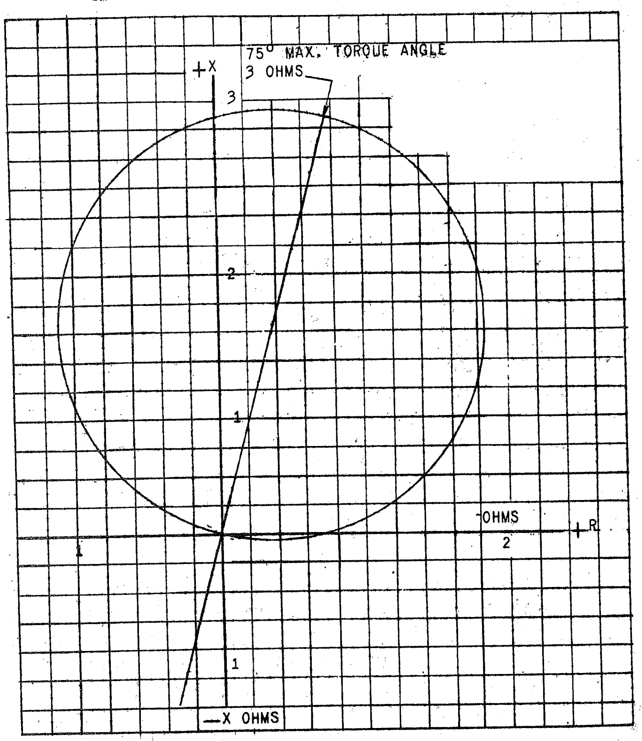

Fig. 2 Minimum Static Operating Characteristics Of MHO Unit In Type CEY13A Relay

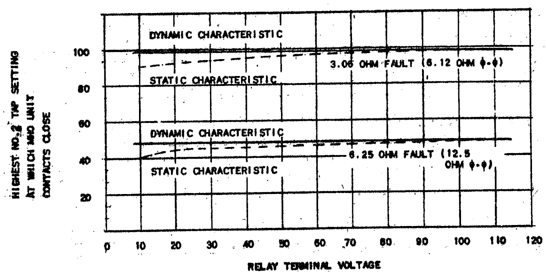

Fig. 3 Accuracy Of MHO Unit Under Static And Dynamic Conditions (Phase-to-Phase Faults Of 60° Phase Angle)

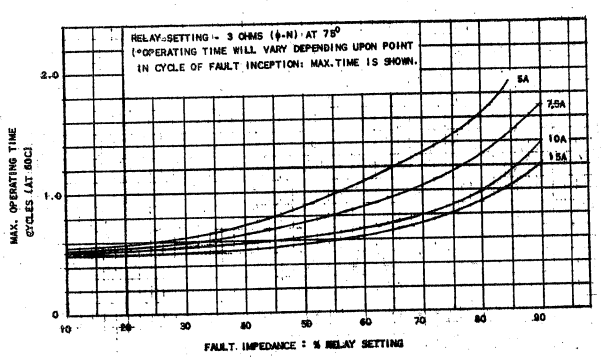

Fig. 4 Operating Times Of The Type CEY13A Relay Set For 3 Ohms At 75°

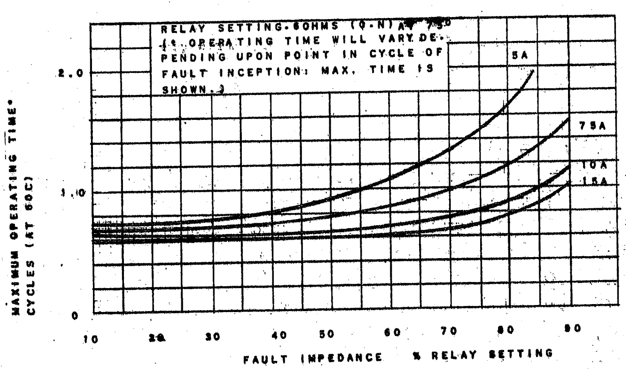

Fig. 5 Operating Times Of The Type CEY13A Relay Set For 6 Ohms At 75°

Fig. 2 (389A778)

Fig. 3 (389A773)

Fig. 4 (389A774)

Fig. 5 (389A775)

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are greater than 2.0 amperes. It is not good practice to use the 0.6 ampere tap when the trip current is greater than 2.0 amperes since the 0.6 ohm resistance of this tap will cause an unnecessarily high voltage drop which will reduce the voltage at the circuit-breaker trip coil. If the tripping current should exceed 30 amperes it is recommended that an auxiliary tripping relay be used.

TARGET SEAL-IN UNIT

Function	Amperes, a-c or d-c	
	2.0A tap (0.13 ohms)	0.6A tap (0.6 ohms)
Carry for tripping duty	30	6
Carry continuously	4	0.8
Min. target operating current	2	0.6

BURDENS

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

Frequency	Impedance Ohms	P.F.	Volt-Amperes
60	0.05	0.65	1.2

The burden imposed on each potential transformer at 120 volts and rated frequency is:

Frequency	Circuit	P.F.	Volt-Amperes
60	Polarizing Restraint*	0.99 0.55	8.0 12.1

The burden of the restraint circuit is reduced when the setting of the tapped transformer is reduced. The volt-ampere burden will be approximately proportional to the square of this setting. The burden of the polarizing circuit is not affected by the tap setting.

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 relay.

DESCRIPTION

GENERAL CONSTRUCTION

The mho unit of the Type CEY13A relay is of the four pole induction cylinder construction, with schematic connections as shown in Fig. 6. The two side poles, energized with phase-to-phase voltage, produce the polarizing flux which interacts with the flux produced in the back poles, energized with a percentage of the same voltage to produce the restraint torque in the relay. The flux produced in the front pole, energized with the two line currents associated with the phase-to-phase voltage used, interacts with the polarizing flux to produce the operating torque. The torque equation at pickup is therefore:

$$T = O = EI \cos(\phi - \theta) - KE^2$$

where E is the phase-to-phase voltage

I is the delta current $(I_1 - I_2)$

θ is the angle of maximum torque of the relay

ϕ is the power factor angle

K is a design constant

Dividing through by E^2 and transposing reduces the equation to:

$$Y \cos(\phi - \theta) = K$$

Thus, the relay will pick up at a constant component of admittance at a fixed angle depending upon the maximum torque angle of the unit, hence the name mho unit.

The mho unit contacts are of fine silver for low contact resistance and are of the ideal design of two cylinders at right angles, which provides a point contact without using an actually pointed contact. To protect the contacts from damage caused by high operating torques under short circuit conditions, a felt clutch is provided between the shaft and the contact arm.

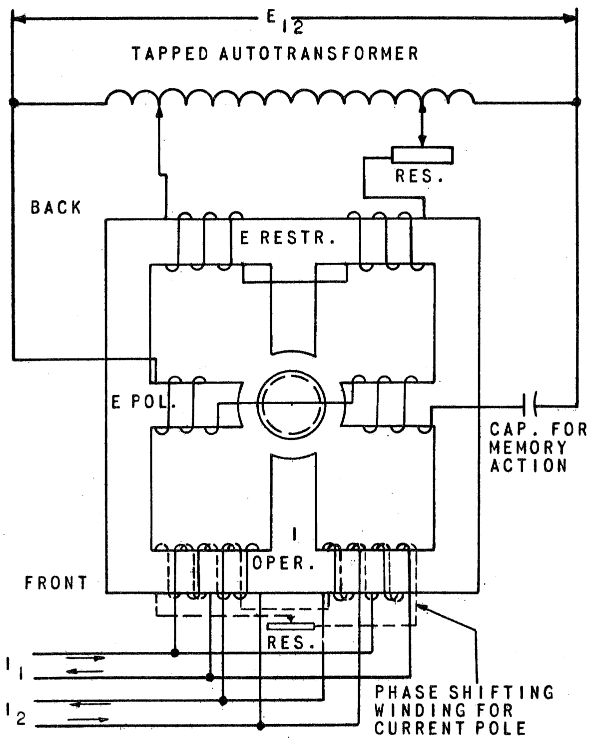

Fig. 6 Schematic Connections For MHO Units Of Type CEY13A Relay

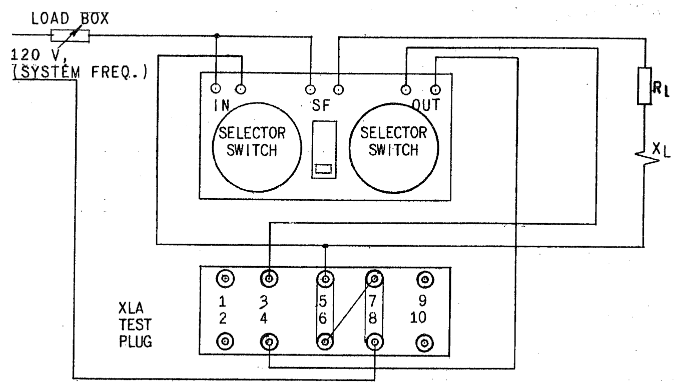

Fig. 7 Test Connections For Type CEY13A Relay Using Test Box

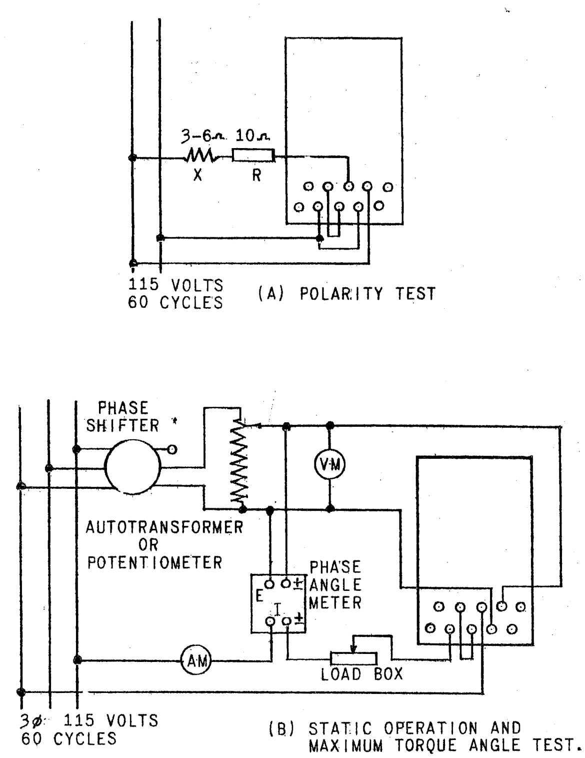

Fig. 8 Test Connections For The Type CEY13A Relay

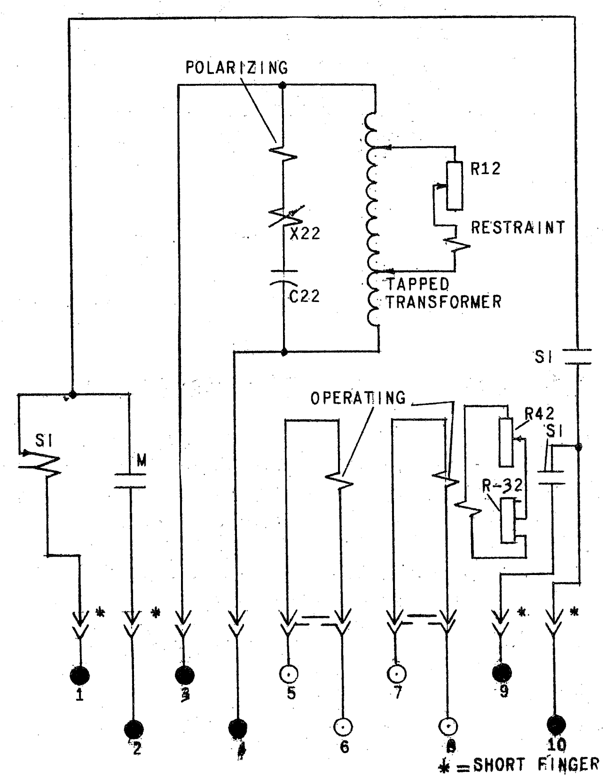

Fig. 9 Internal Connections For Type CEY13A Relay

Fig. 6 (K-6556581)

Fig. 7 (402A931)

Fig. 8 (389A777)

Fig. 9 (389A750)

A combination target and seal-in element is mounted at the top of the relay and is connected in series with the tripping circuits.

Fig. 1 shows the locations of the component parts of the relay visible when the relay is removed from its case.

CASE

The case is suitable for surface or semi-flush panel mounting and an assortment of hardware is provided for either method. The cover attaches to the case and 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 for external connections. The electrical connections between the relay units and the case studs are made through spring back 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 terminating 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 case and cradle are so constructed that the relay cannot be inserted in the case upside down. The connecting plug, besides making the electrical connections between the 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 removed and the plug is 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.

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 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. 10.

CONNECTIONS

The internal connection diagram for this relay is shown in Fig. 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.

ADJUSTMENTS

At the time the relay is put in service, it is necessary to make appropriate restraint tap settings to adapt the relay most advantageously to the particular application. The line impedance as viewed from the secondary can be calculated from the formula:

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

The restraint tap setting can then be determined from the relationship:

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

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

1. All values of ohmic reach are phase-to-neutral as noted on the nameplate.

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

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

3. 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 lines with a 75-degree relay setting would be the cosine of 5-degrees times the reach at maximum torque as determined from the preceding paragraphs.

4. The ohmic reach on the basis of 75-degree angle of maximum torque must not be increased beyond 12 ohms, otherwise the restraint voltage may not be sufficient to reset the clutch upon the clearing of a fault.

5. The total ohmic reach, including transient overreach, must not be great enough so that the relay will outreach the fault detector at the remote terminal.

INSPECTION

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

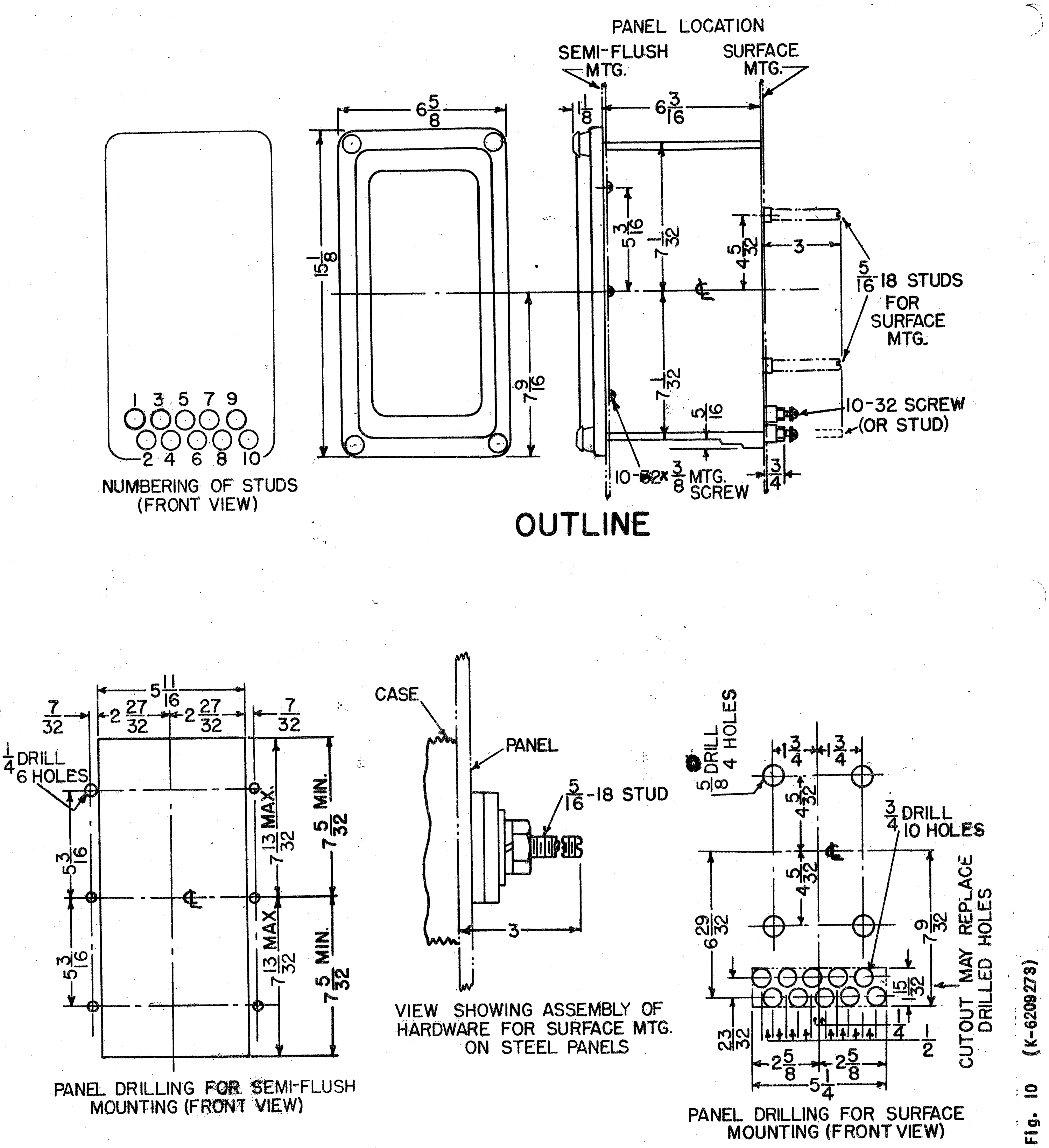

Fig. 10 Outline And Panel Drilling For Type CEY13A Relay

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

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

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 units 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 shafts of the rotating structures. 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 that 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 the point of a fine needle. When replacing a jewel, have the top pivot engaged in the shaft while screwing in 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 in place in order to keep out dust.

The contact surfaces should be clean.

The moving-contact backstops should be clean. The backstops should be wiped clean at regular intervals with a cloth moistened with carbon-tetrachloride solution.

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, (102L201), test reactor, test resistor, and the relay test plug. The calibrated test resistor and test reactor are used together to provide fixed impedance at angles of 30 degrees and 60 degrees lag. The resistor used alone provides an impedance at zero degrees and the reactor used alone provides an impedance at an angle nearly 90 degrees lag. The relay pickup 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. The 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. 7.

Tests of the operating characteristics of the relay can be made by means of the connections shown in Fig. 8B. 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. 7 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 polarity of the relay can be checked by means of the circuit in Fig. 8A. With these connections and with the restraint tap on 100 percent, the mho unit contacts should remain open. If one of the restraint taps is removed the contacts should close.

CLUTCH ADJUSTMENT

The clutch should slip at a torque corresponding to approximately 5-7 grams applied at the contact and normal to the contact arm. This is equivalent to a pickup of 3 to 3.5 amps. at maximum torque angle, rated voltage and zero restraint. If it is found that this adjustment has been disturbed, it can be restored by means of the steel collar at the upper end of the shaft. Loosen the set screw in the collar and rotate the collar through the number of half turns necessary to obtain the correct pressure. The set screw fits into a groove on the shaft which explains the need for half-turn steps.

Note that the clutch slip is limited by a pin on the moving contact arm. The restraint voltage supplied by the tapped transformer must be sufficient to reset the clutch against the 6 gram clutch pressure. Hence a 33 percent tap (9 ohm) setting as previously noted will be about the limit of reach which can be tolerated.

CONTACTS

The contact gap should be 0.020 inches. This should be measured between moving and stationary contact tips and should not include wipe of the stationary contact brush. There should be a 0.005 to 0.010 space between the stationary contact brush and the felt pad.

Silver contacts should never be handled or touched by bare hands, because a 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 so delicate yet it will clean off any corrosion thoroughly and rapidly. Its flexibility insures the cleaning of the actual points of contact. Sometimes an ordinary file cannot reach the points of contact because of the obstruction offered by some relay part, but 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, including serial number. If possible, give the General Electric Company requisition number on which the relay was furnished.

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