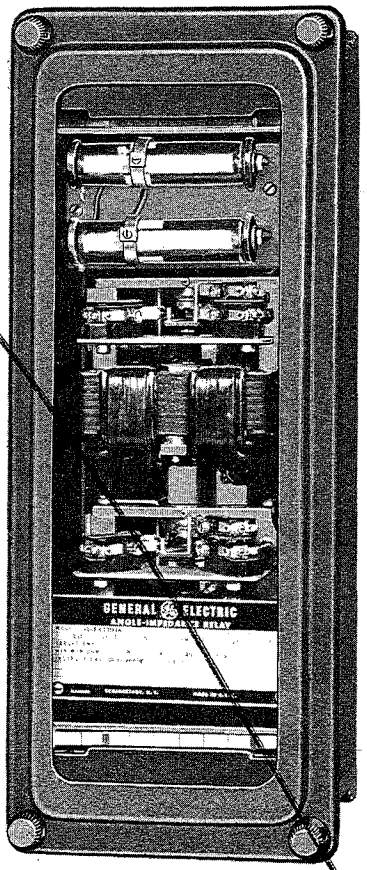
INSTRUCTIONS

GEI-38858B

SUPERSEDES GEI-38858A

ANGLE-IMPEDANCE RELAY



TYPE CEX17D

POWER SYSTEMS MANAGEMENT DEPARTMENT

GENERAL ELECTRIC

PHILADELPHIA, PA.

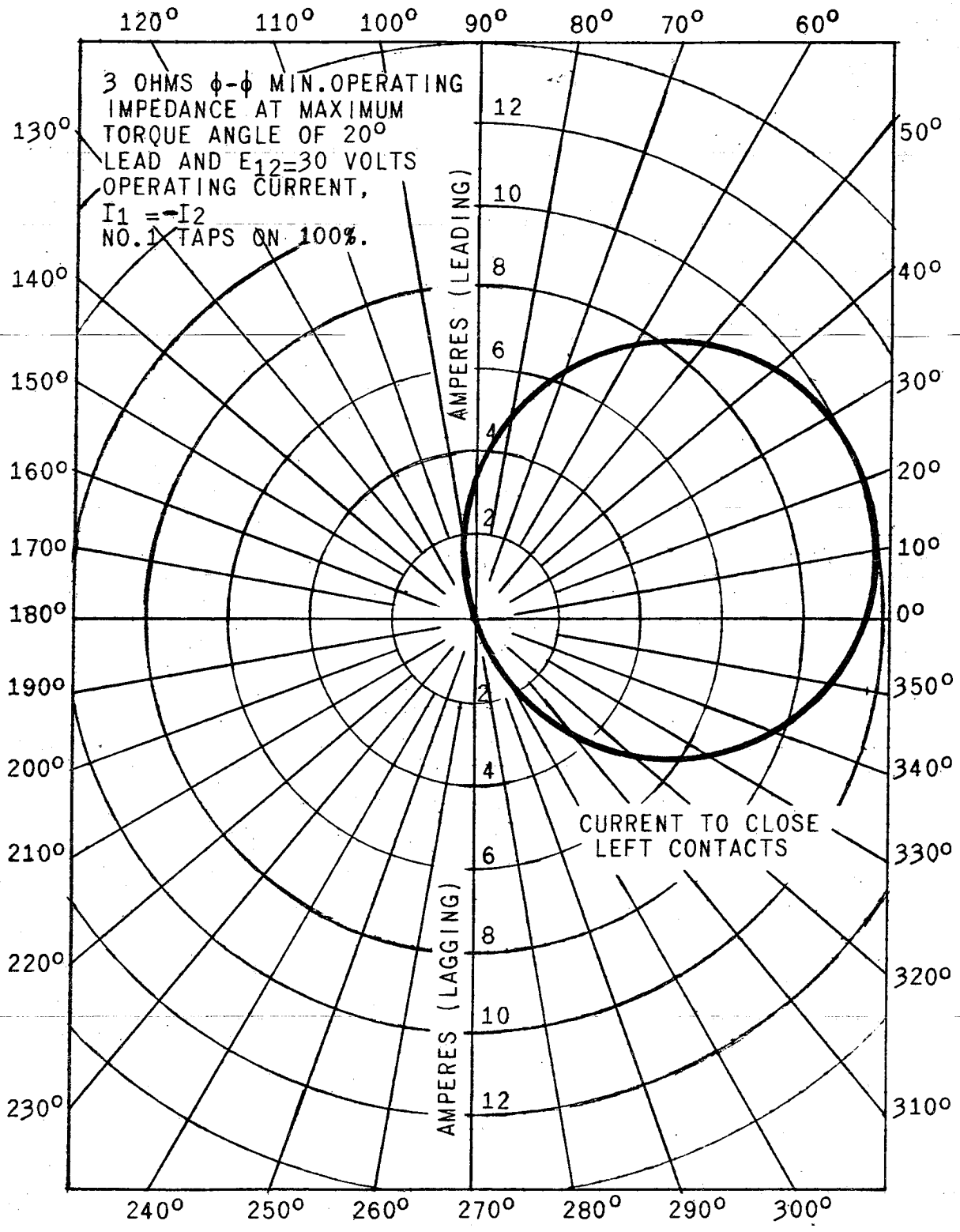


Fig. 1 Typical Current Operating Characteristics of Type CEX17D Relay

Fig. 1 (378A570) Cover (8013828)

ANGLE-IMPEDANCE RELAY TYPE CEX17D

INTRODUCTION

APPLICATION

Type CEX17D relay is a high speed induction cylinder type, having an ohm unit characteristic whose angle of maximum torque can be varied from 5 to 35 degree lead. Therefore, its straight line characteristic can be arranged parallel with the line impedance vector and be used as a blinder.

The relay is used in the protection of very long transmission lines using carrier current. The tripping zone of the Type GCY distance relay in this case is necessarily large and the Type CEX is used to confine the tripping zone to a strip wide enough to permit tripping on arc resistance. Three relays per terminal are required.

The relay is also designed to provide tripping on out of step conditions, in which case it is used *with a Type NAA19B auxiliary relay. Two blinders are arranged to operate the auxiliary relay on power swings in either direction. One relay per terminal is required for out-of-step tripping.

* The two units should be adjusted so that the out-of-step condition crosses the relay characteristics (See Fig. 2) when the two ends of the system are approximately 90° out of phase. This can be done by adjusting each unit so that the minimum ohms from the origin to the relay characteristic is equal to one half the total ohms of the system.

Each relay contains two ohm units (not operating at a constant value of reactance, however). Each unit has single circuit-closing contacts and single circuit-opening contacts. All contact circuits are brought out to individual studs.

RATINGS

The current-closing rating of the contacts is 30 amperes for voltages not exceeding 250 volts, hence, it will trip any circuit breaker with trip-coil current within this rating. After tripping occurs, the tripping circuit must be opened by an auxiliary switch on the circuit breaker or by other automatic means as the relay contacts are sealed closed when tripping current is flowing.

BURDENS

CURRENT BURDENS

Burdens imposed by the current circuits of the Type CEX17D relay (3 ohms minimum phase-to-phase) are as follows:

Circuit (Studs)	Amps	Cyc.	Watts	Vars	VA
5-8 (6 & 7 jumpered)	5.0	60	22.5	29.5	37.0

Burdens of the Type CEX17D (0.5 ohms minimum) are:

Circuit (Studs)	Amps	Cyc.	Watts	Vars	VA
5-8 (6 & 7 jumpered)	5.0	60	5.5	7.5	9.5

POTENTIAL BURDENS

The burdens imposed by each coil of a Type CEX17D relay (minimum ohms, 3, phase-to-phase) under the conditions stated are as follows:

Volts	Cyc.	Winding	Watts	Vars	VA
120	60	Trans., 100%	0.69	1.15	1.32
120	60	One Unit †	9.7	19.1	21.5
120	60	Total ††	20	39	44

† Maximum burden

†† For input to autotransformer on 100 percent and No. 1 and No. 2 taps on 100 percent.

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 the relay, an examination should be made for any damage sustained during shipment. If injury or damage resulting from rough handling is evident, a claim should be filed at once with the transportation company and the nearest Sales Office of the General Electric Company notified promptly.

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.

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.

* Denotes change from superseded issue.

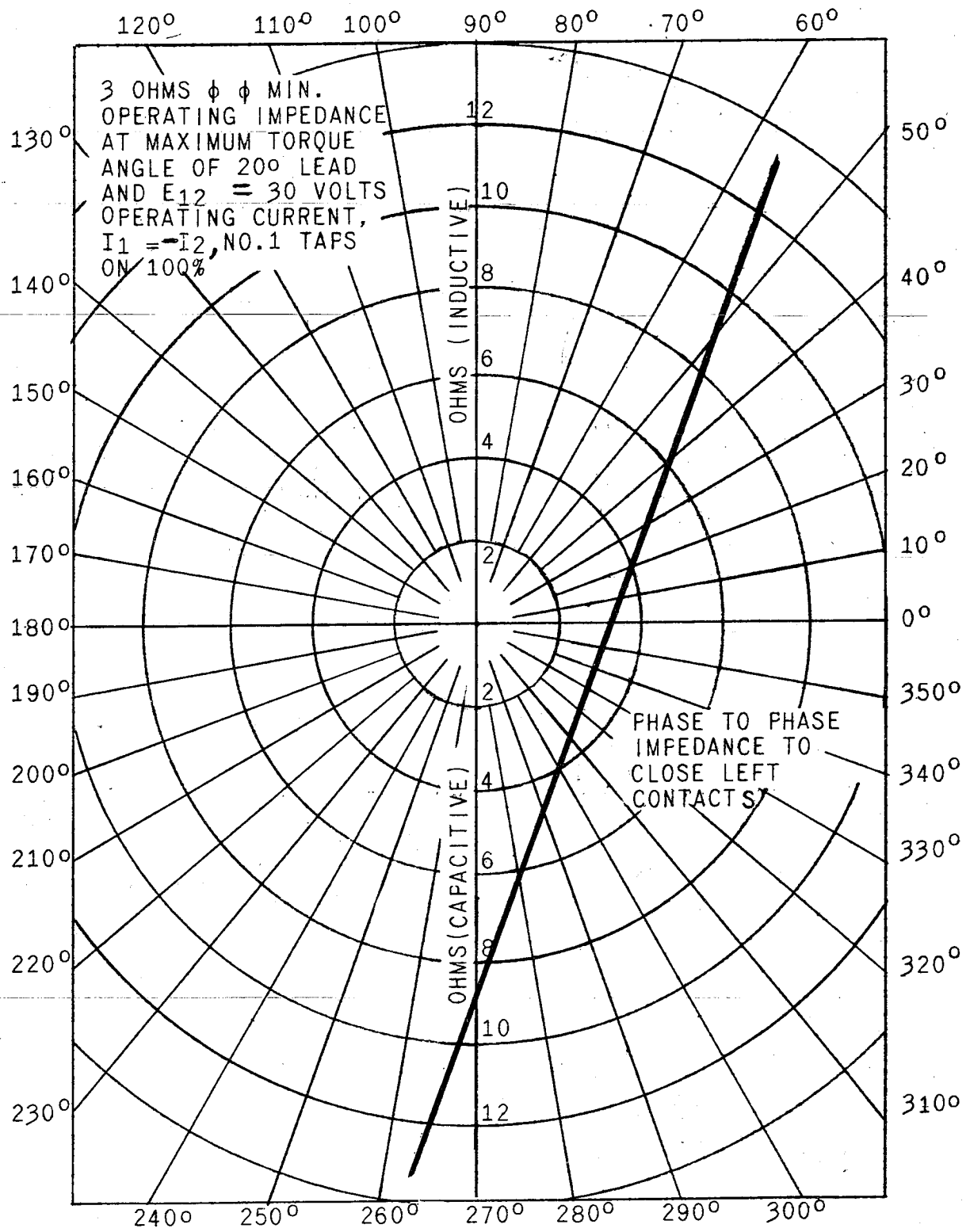


Fig. 2 (378A569)

Fig. 2 Typical Impedance Operating Characteristics of Type CEX17D 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 both ends or 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 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. 7.

CONNECTIONS

The internal connection diagram for the Type CEX17D relay is shown in Fig. 3. A typical external diagram is given in Fig. 4.

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.

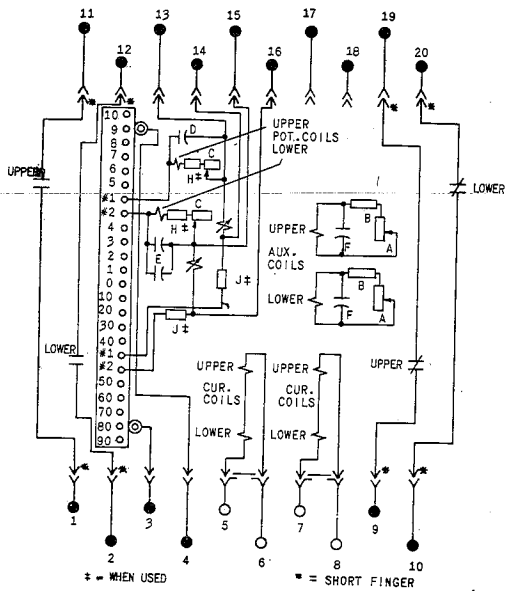


Fig. 3 (362A627)

*Fig. 3 Internal Connections for Type CEX17D Relay

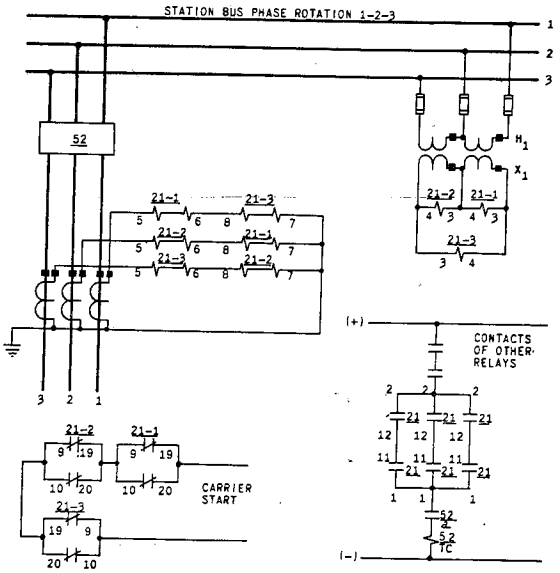


Fig. 4 (K-6400503)

Fig. 4 External Connections for Type CEX17D Relay

* Denotes change from superseded issue.

OPERATION

* TABLE I

Angle of Max. Torque	Resistor C	Studs 13 & 14, 15 & 16	1.5 ohm Ø - N Pick-up Current at 30 Volts	.5 ohm Ø - N Pick-up Current at 10 Volts	Adjustment
5^{o}	0 ohms	unshorted	11.3	12.2	reactor
10^{o}	max. ohms	unshorted	9.3	9.2	reactor
15^{o}	max. ohms	unshorted	9.7	9.8	reactor
20^{o}	max. ohms	unshorted	10.0	10.0	reactor
25^{o}	max. ohms	unshorted	10.1	10.1	reactor
30^{o}	adjust as nec.	shorted	14.3	14.1	resistor C
35^{o}	adjust as nec.	shorted	12.7	13.4	resistor C

The two units of the Type CEX17D relays are identical in construction and differ in their characteristics only because of their connections to the currents and potentials of the protected system.

Figs. 1 and 2 show typical operating characteristics for the upper unit of relay which used I_1, I_2 and E_{12} to obtain its operation. (The top relay in Fig. 4). In Fig. 1, when the current vector $(I_1 - I_2)$ ends anywhere outside the circle, the left contacts close. In Fig. 2, this corresponds to any value of impedance lying to the left of the impedance characteristic.

If I_1 is not equal to I_2, the operation is proportional to their vector difference, so that the current for pick-up of the left contacts can be written:

$$I_1 - I_2 = \frac{1}{100X} T_1 E_{12} \cos(\theta - \phi)$$

where T_1 = No. 1 tap setting in percent

θ = Angle between $I_1 - I_2$ and E_{12}

ϕ = Relay angle of maximum torque

X = Minimum ϕ / N pickup ohms of unit

The pickup of the unit is adjusted by means of the variable resistor and the reactor which are in the potential coil circuit. By means of the variable resistor in the potential circuit, with studs 13 and 14, 15 and 16 shorted, the angle of maximum torque can be varied from 35 to 30 degrees. With the variable resistor set on maximum ohms and studs 13 and 14, 15 and 16 unshorted, the angle of maximum torque can be varied from 30 to 10 degrees by rotating the reactor. With the variable resistor set on zero ohms and studs 13 and 14, 15 and 16 still unshorted, the angle of maximum torque can be varied from 10 to 5 degrees by rotating the reactor. The process of setting the desired angle of maximum torque is simplified in Table I.

The lower unit is similar to the upper unit except that it is connected with the opposite polarity, so that if the characteristics of Fig. 1 are both rotated 180 degrees they will apply to the lower unit. In this case the current for pickup can be written:

$$I_1 - I_2 = \frac{1}{100X} T_2 E_{12} \cos\left[\theta - (\phi + 180)\right]$$

where T_2 is the No. 2 tap setting in percent.

MAINTENANCE

The 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.

ADJUSTMENT AND CARE

The relay was properly adjusted at the factory, and the only adjustments that should be necessary are the settings of the No. 1 and No. 2 taps on the autotransformer and the resistors in the potential circuits. The resistor for the upper unit is mounted near the back of the relay on the left side (front view) in the lower part of the relay, and the resistor for the lower unit is mounted on the right side (front view).

The proper tap settings for the desired operation can be determined approximately by using the two formulae stated under OPERATION, making allowances for any change in the operating current required by the upper unit because of its phase-angle setting proportional to the values listed in table under OPERATION.

For setting the angle of minimum operating impedance, follow the procedure as outlined under TESTING.

In order to set the taps, by test, the unit should be energized with the values of current and voltage for which operation of the unit is desired. Then the highest transformer tap should be selected so that the unit will just operate to close its contacts. The portable test box, Cat. 102L201, can be used for this purpose.

If for any reason, it becomes necessary to remove the rotor from either unit, proceed as follows:

* Denotes change from superseded issue.

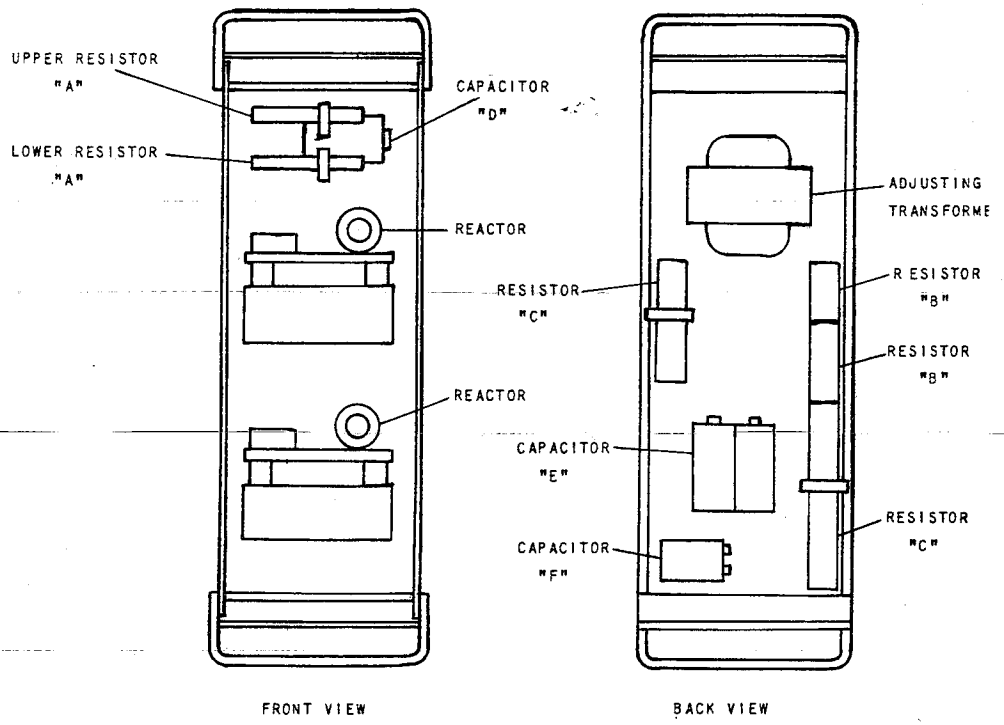


Fig. 5 (362A660)

Fig. 5 Illustration of Type CEX17D Relay Removed from Case

1. Unsolder the control spring from its supporting post.
2. If desired, the right contact block can be backed off to provide more clearance.
3. Remove the upper bearing plate and upper bearing by removing the two screws which hold it to its supporting post.
4. This allows the rotor assembly to be drawn from the stator structure.
5. Resolder the control spring to its supporting post.
6. In reassembly, make sure that the guide marks on the back of the upper bearing plate and on back of the left-hand supporting post (front view) are together. The dowel pins cause all parts to be properly aligned.

Use care in handling the rotor while it is out of the relay, and see that the air gap and rotor are kept clean. In reassembly, the rotor will go into the air gap easily without forcing if the parts are held in line properly.

CUP AND BEARINGS

The lower jewel may be tested for cracks by exploring its surface with the point of a fine needle. If it is necessary to replace the jewel a new pivot should be screwed into the bottom of the shaft at the same time.

CONTACT CLEANING

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 corroded material will be removed rapidly and thoroughly. The flexibility of the tool insures the cleaning of the actual points of contact. Sometimes an ordinary file cannot reach the actual points of contact because of some obstruction from other part of the relay.

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 and thus prevent closing.

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

The moving contacts should clear the bottoms of the stationary contacts by at least 1/64 inch. This can be adjusted by moving the contact plate up or down.

The stationary contact brush should be under the influence of a slight bending movement due to the leaf spring on top of it and contacts with felt backstops should rest lightly against them. The heavy brush in front of the two lighter brushes should clear the contact brush by approximately 1/64 inch.

Pull the left brush block completely forward and then push the left-hand end back until the left front corner is 1/16 inch to 1/8 inch back from the front edge of the contact plate.

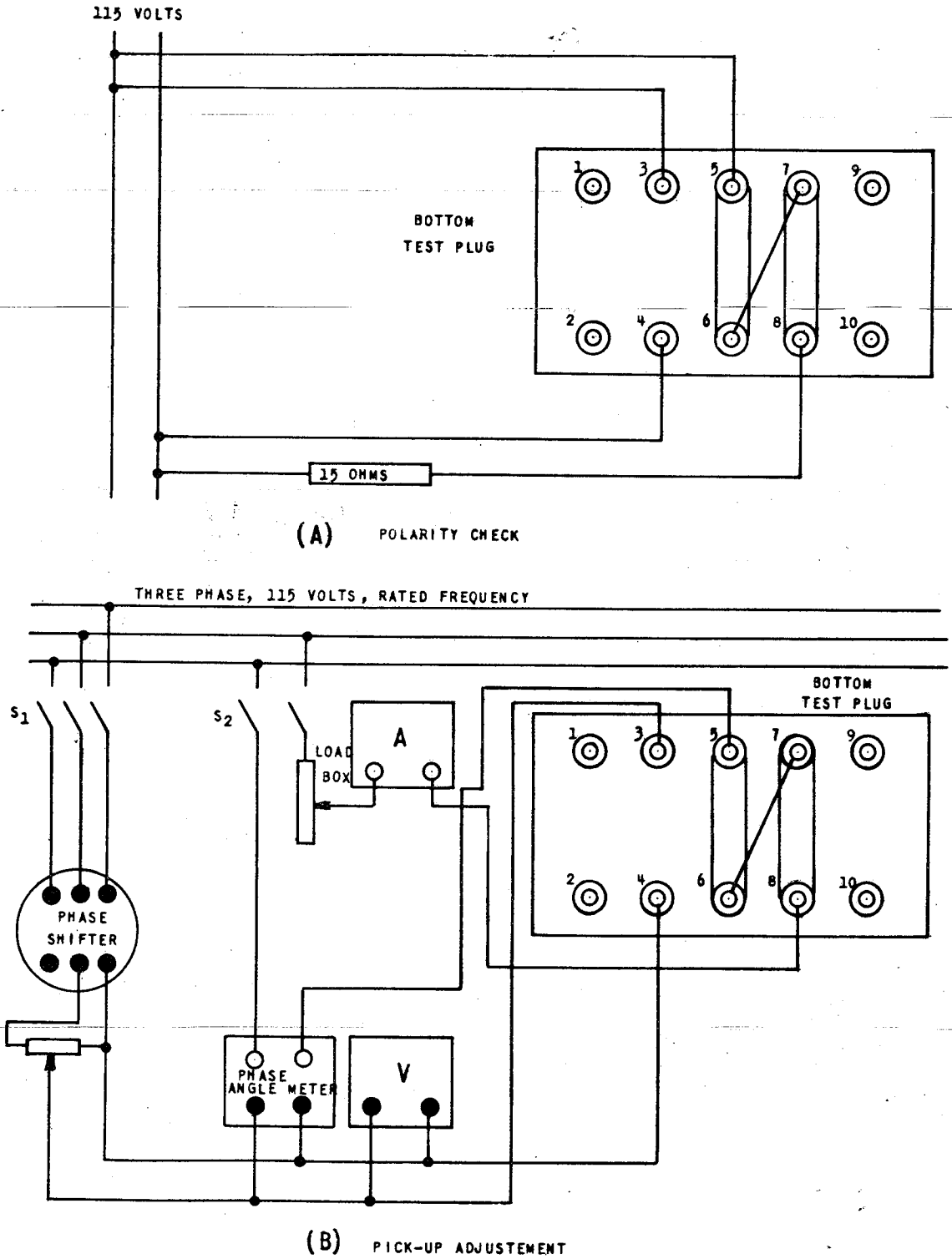


Fig. 6 (K-6556491)

Fig. 6 Test Connections for Type CEX17D Relay

Adjust the wipe of the left hand contacts to be 0.002 inch to 0.005 inch as the moving contact pushes the stationary contact into the felt stops.

The lower-right contact brush should be adjusted so that the moving contact makes contact with upper and lower stationary contacts simultaneously, or else closes in on the top contact just ahead of the bottom contact. Adjust the lower contact stop so that there is 0.002 inch to 0.008 inch wipe.

Place the right-brush block symmetrically opposite the left-brush block and adjust as little as * possible to set the contact gap to .020 inch.

CONTROL SPRING

The control spring should be adjusted to just hold the upper-right contact closed when the relay is de-energized.

CLUTCH

The clutch is adjusted by loosening the set screw in the collar just above the moving-contact arm on the shaft and screwing the collar up or down. Screwing the collar down increases the clutch pressure.

Set the clutch to slip at 30 grams contact pressure.

TESTING

An operation test and inspection of the relay at least once every six months is recommended. Testing can be done with the relay in place by means of special testing plugs which are inserted in place of the connector plugs, or the relay can be withdrawn from its case and tested in the laboratory. When test plugs are used, care must be taken that no current-transformer circuit is opened.

The mechanical adjustments have been described under ADJUSTMENT AND CARE. The rotors must turn absolutely freely.

There are four variable resistors in the relay. (See Fig. 5). There is one in the auxiliary circuit of each unit. They are adjusted to obtain operation at the proper magnitudes of current and potential. They are mounted on the front side of the cradle above the two units and will be referred to as the "upper" and "lower" resistors. There is one resistor in the potential circuit of each unit. These are located in the rear, the one on the left side (front view) of the relay being for the upper unit and that on the right for the lower unit. They will be referred to as the "left potential" and "right potential" resistors. There are two reactors, one mounted on the top cross bar of each unit. They are readily accessible for adjustment.

POLARITY TEST

Connect the relay as shown in Fig. 6 (a) with the No. 1 and No. 2 taps both set at 100 per cent.

The left contacts of the upper unit should remain open while the left contacts of the lower unit should close. As both tap settings are reduced from 100, the left contacts of the upper unit should close at some tap setting where 0.15 times the tap number is near the ohmic rating (line-to-line) of the relay, and remain closed as the tap settings are reduced to zero, the left contacts of the lower unit remaining closed.

Put the taps back in 100. Reverse the leads to studs 3 and 4. The left contacts of the upper unit should close and the left contacts of the lower unit remain open. As both tap settings are reduced from 100, the left contacts of the lower units should close at approximately the same setting used above, and remain closed as the tap settings are reduced to zero, the left contacts of the upper unit remaining closed.

PICK-UP ADJUSTMENT

1. Connect the relay as shown in Fig. 6 (b). Set the potential resistors for maximum ohms. With S1 closed and on a supply of rated voltage, allow the relay to warm up for about 5 minutes, taps or 100 per cent.

2. Set the voltage to 30 volts. With a current of about 9 amperes, the left contacts of the upper unit will open near 20 degrees on the phase-angle meter. (Current leads voltage by 20 degrees; if the phase-angle meter reads 200 degrees when contact opens, reverse either its potential or current connections).

3. Adjust the phase angle to 20 degrees and the current to 10 amperes. Adjust the upper resistor so that the left contacts of the upper unit just close.

4. If a minimum operating impedance is desired at an angle other than 20 degrees, set the resistor and short or unshort studs 13 and 14, 15 and 16 as given in the table under OPERATION. Adjust either the resistor or reactor until the proper angular adjustment is obtained. The pickup at 30 volts will be given in the table under OPERATION.

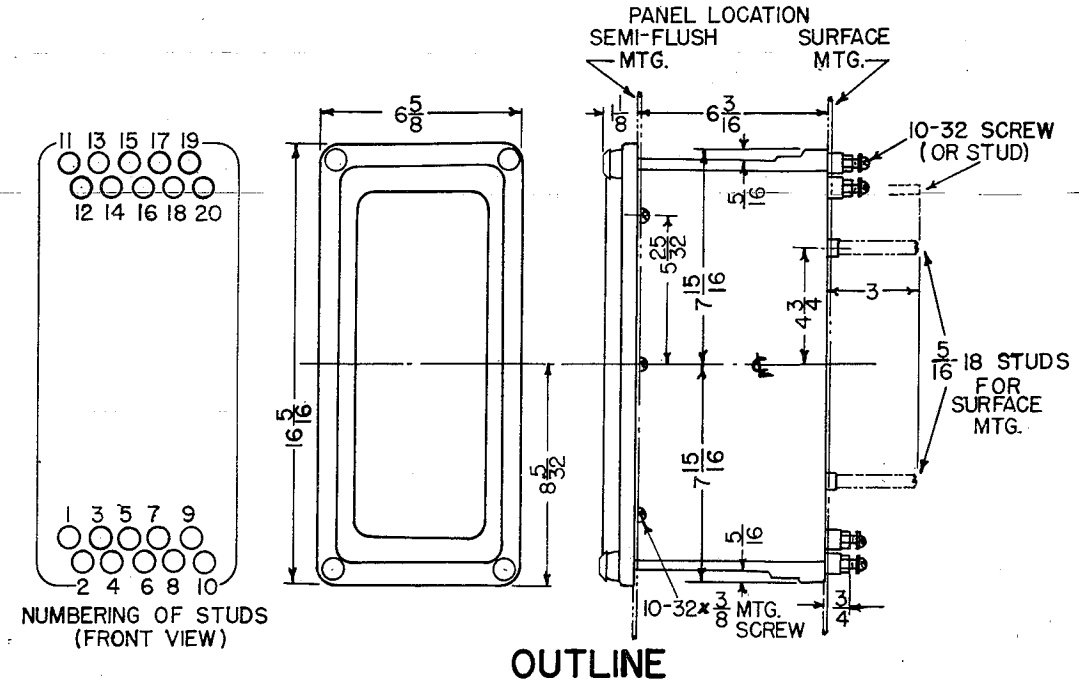
5. With the phase-angle meter reading 20 degrees reverse leads to studs 3 and 4 and set the current at 10 amperes. Adjust the lower resistor so that the left contacts on the lower unit just close. Repeat step 4 using the right potential resistor. The angle of minimum operating impedance must be the same for both units.

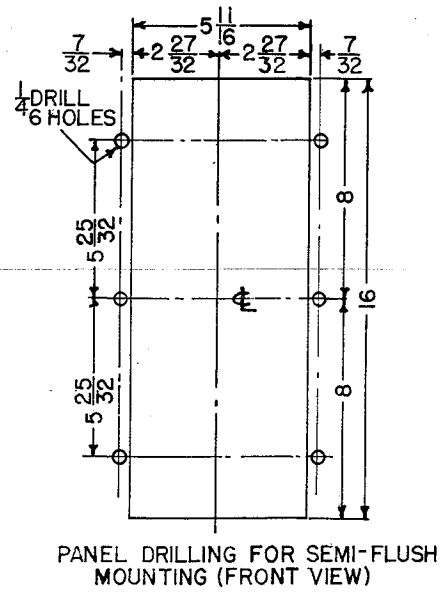
* Denotes change from superseded issue.

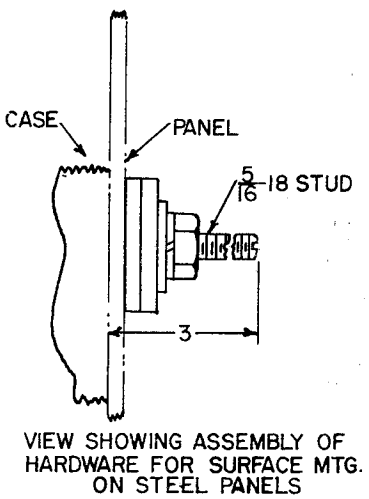
RENEWAL PARTS

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.







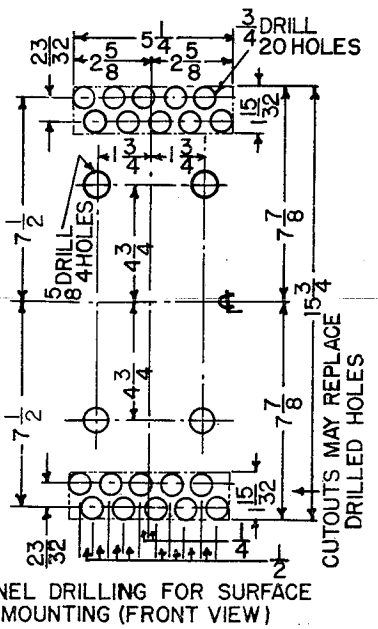


Fig. 7 (K-6209

Fig. 7 Outline and Panel Drilling Dimensions for Type CEX17D Relay

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