GEK-26420B

INSTRUCTIONS

OFFSET MHO DISTANCE RELAY

TYPE CEB51B

GE Protection and Control
205 Great Valley Parkway
Malvern, PA 19355-1337

CONTENTS

OFFSET MHO DISTANCE RELAY
TYPE CEB51B

DESCRIPTION

The CEB51B is a single phase, single zone, mho distance relay with provisions for offsetting the characteristic. The relay was designed primarily for use where one zone of back-up protection is required.

The relay contains a target seal-in unit in addition to the mho unit. The relay is mounted in an M1 case; the outline and panel drilling dimensions for which are given in Figure 9. The internal connections for the relay are illustrated in Figure 8.

Three CEB51B relays plus a suitable timing relay are required per terminal to provide one zone of time delay distance protection for three phase, phase-to-phase and double-phase-to-ground faults.

APPLICATION

The CEB51B relays may be applied wherever one zone of back-up protection is required. These relays are not suitable for first zone applications because the transient response has not been controlled to minimize overreach.

Probably the most common application of the CEB51B relays is in generator back-up protection schemes where the relays are used to protect the generator from faults on the adjacent system which are not cleared by the first line relays. Fig. 1 illustrates the external a-c and d-c connections to the CEB51B relays for this type of protection. In this scheme a separate auxiliary tripping relay, device 94, is used to isolate the d-c supply to the back-up relaying from the d-c supply to the generator main breaker. This will make it possible for the relay to shut the generator down in the event that a high voltage bus fault occurs during a loss of d-c supply to the main breaker trip circuit.

The a-c connections to the CEB51B relays will depend on the location of the CT's and PT's in relation to the main delta-wave power transformer. All the different possibilities are shown in Fig. 1.

The impedance seen by the CEB51B relays will depend on the location of the PT's and CT's that supply them and these relations are given in Table A.

This table indicates that when there is no power bank between the fault and the relay supply, the relay sees the normal expected impedance.

TABLE A

CT CONNECTION FIG. 3	PT CONNECTION FIG. 3	SECONDARY IMPEDANCE SEEN BY RELAY OHMS
(A)	(1)	$KZ_L \left(\frac{CT_A \text{ Ratio}}{PT_1 \text{ Ratio}}\right)$
(B)	(2)	$0.866\ (Z_T + KZ_L) \left(\frac{V_L}{V_H}\right)^2 \left(\frac{CT_B \text{ Ratio}}{PT_2 \text{ Ratio}}\right)$
(A)	(2)	$(Z_T + KZ_L) \left(\frac{V_L}{V_H}\right) \left(\frac{CT_A \text{ Ratio}}{PT_2 \text{ Ratio}}\right)$
(B)	(1)	$0.866\ KZ_L \left(\frac{V_L}{V_H}\right) \left(\frac{CT_B \text{ Ratio}}{PT_1 \text{ Ratio}}\right)$

Where:

Z_L = Primary Ohms of Line Impedance

K = Ratio of current in Line (Z_L) to current in Line Side of Power Transformer. This Constant Corrects for Infeed. See Fig. 3.

V_L/V_H = Low Side to High Side Voltage Ratio of Power Bank on Taps Used.

Z_T = Power Transformer Impedance in Ohms Referred to the High Side Winding.

CALCULATION OF SETTINGS

Assume a system such as that illustrated in Fig. 3.

Assume that the following parameters describe the system

$V_L/V_H = 13.8/132$

$Z_L = 0.81 \angle 80^\circ$ ohms per mile

Z_T = 10% on 100,000 KVA base at 86 deg. lagging

Since the CT's and PT's supplying the CEB relays are both on the generator side of the power transformer, PT connections 2 and CT connections B would be used as shown in Figure 1. Referring to Table A we find that

$$Z_{relay} = 0.866\ (Z_T + KZ_L) \left(\frac{V_L}{V_H}\right)^2 \left(\frac{CT_B \text{ Ratio}}{PT_2 \text{ Ratio}}\right) \quad \text{(B-2)}$$

It will be noted that three auxiliary PT's will be required. These should have a winding ratio of 120/69 volts so that when they are connected in delta-wye, the line-to-line ratio is 1.0.

On the system described above, the PT ratio would be

$PT_2 = 14{,}400/120 = 120$

Assume that the generator CT ratio is 5000/5 which is a reasonable rating for CT's used on a 100,000 KVA, 13.8 KV unit.

$CT_B = 5000/5 = 1{,}000$

The primary ohms of the transformer (Z_T) referred to the 132 KV side may be obtained from the following equation

$$Z_T = \text{Per Unit Impedance } \frac{(KV)^2}{\text{MVA Base}}$$

$$Z_T = 0.10\ \frac{(132)^2}{100} = 17.4 \text{ ohms}$$

Assume now that it is desired for the CEB to reach no further than 30 miles out from the high voltage bus on any of the three circuits under any condition of infeed from the other two. Thus

$Z_L = 30 \times 0.81 \angle 80^\circ = 24.3$ primary ohms

Assume that a fault study indicates that the minimum value of infeed under any reasonable system conditions will result in K being no smaller than 1.2. Thus

$K = 1.2$

(It should be noted that on a radial system, K will be equal to 1.0. In order to be absolutely certain that the relay does not reach beyond the desired distance under any conditions on any system, K should be assumed equal to 1.0).

From equation B-2, the relay should be set with a forward reach of

$$Z_{relay} = \frac{0.866 \quad 17.4 \ \underline{/86^{o}} + 1.2\ (24.3\ \underline{/80^{o}})}{\left(\frac{13.8}{132}\right)^{2} \quad \left(\frac{1000}{120}\right)}$$

$$Z_{relay} = (\ 40.2\ \underline{/82.1^{o}})\ (0.01093)\ (8.34)$$

$$Z_{relay} = 3.67\ \underline{/82.1^{o}}\ )\ \text{secondary ohms}$$

Thus, the relays should be set with a forward reach of about 3.7 ohms at 82 degrees. However, in applications of this kind some people prefer to set the relay with offset in order to obtain some additional back-up protection for faults in the leads between the generator and the transformer. If this is the case, it is suggested that the relay be set with 2 ohms offset. It is now necessary to determine the restraint tap setting required with a 2 ohm offset setting to obtain a forward reach of 3.7 ohms at 82 degrees. This is most easily done by graphical construction.

Refer to Figure 4, draw the R-X diagram and perform the following construction to scale. Through the origin (O) draw line AB at the angle of maximum torque of the CEB51B relay. Now draw the line $\overline{OL}$ equal in length to the desired forward reach of the relay and at the desired impedance angle (θ). Locate point P on line AB so that $\overline{OP}$ is equal to the offset. Now, by trial draw a circle with its center (C) on line AB and its circumference passing through points P and L. Measure the line $\overline{PR}$ and set the restraint tap to

$$T = \frac{Z_{min}}{PR} \times 100$$

where Z_{min} is the minimum reach of the relay as stamped on the nameplate.

In the case of the above example

θ = 82 degrees

∅ = 75 degrees

$\overline{OP}$ = 2 ohms

$\overline{OL}$ = 3.7 ohms

From measurement RP = 5.7 ohms. Thus, the desired tap setting is

$$T = \frac{3}{5.7} \times 100 = 52.7\% \text{ Use } 55\% \text{ tap}$$

The SAM timing unit TU2 should be set to trip the breaker in the desired backup clearing time. Timing unit TU3 os the SAM relay should be set somewhat longer to shut down the unit in the event the normal backup function does not operate.

RATINGS

The relays are available within ratings of 120 volts, 5 amps, 50 or 60 cycles and are designed to operate continuously energized in an ambient temperature not to exceed 40°C.

The angle of maximum torque is continuously adjustable over the range of 60 degrees to 75 degrees. When the angle of maximum torque is factory set to be 60 degrees (model 12CEB51B1A), the reach will be 3-30 OHMS at 60 degrees. If this relay is readjusted to have maximum torque at 75 degrees then the reach will be 115 to 125 percent higher. If the relay is factory set to have maximum torque at 75 degrees (models 12CEB51B2A and 12CEB51B3A), then the reach will be 3-30 OHMS at 75 degrees, and the reach will be lower (80 to 88 percent) if the maximum torque angle is adjusted to be 60 degrees.

The ohmic reach of the relay is 3-30 phms phase to neutral at the factory set angle of maximum torque. The adjustment of reach is made in five percent steps by means of the autotransformer taps.

The offset is 0-4 ohms in one ohm steps measured at 240 degree lag. The offset will be tap value ±15 percent. The offset taps are located on the tap block on the right hand side of the relay.

CURRENT CIRCUIT

The current circuit will withstand 5 amperes continuously. The one second rating is 260 amperes. Higher currents may be applied for shorter periods of time in accordance with the following equation:

$I^2t = 67,600$
where, I = current in amperes
t = time / 1 second

POTENTIAL CIRCUIT

The potential circuit will withstand 120 volts continuously.

CONTACT CIRCUIT

The contacts of the MB unit will make and carry 30 amperes for tripping duty. The continuous current rating of the contact circuit is limited by the target seal-in unit as shown in Table I for the various taps.

TABLE I

CHARACTERISTICS OF SEAL-IN UNIT

	0.2	0.6	1	2	4
D.C. RESISTANCE ± 10% (OHMS)	7	0.6	0.21	0.13	0.06
MIN. OPERATING (AMPERES)	0.2	0.6	1.0	2.0	4.0
CARRY CONT. (AMPERES)	0.3	0.9	1.5	3	6
CARRY 30 AMPS FOR (SEC.)	0.03	0.5	1.4	4	7
CARRY 10 AMPS FOR (SEC.)	0.25	4	12	30	60
60 HZ IMPEDANCE (OHMS)	52	6	2.1	0.53	0.13

CHARACTERISTICS

OPERATING PRINCIPLES

The mho unit of the CEB51B relay is one of the four pole induction cylinder construction in which torque is produced by the interaction between a polarizing flux and the fluxes proportional to the restraining and/or operating quantities.

The torque at the balance point of the unit can be expressed by the following equation:

$$\text{Torque} = 0 = EI \cos(\phi - \theta) - KE^2$$

where:

E = phase-to-phase voltage
I = Delta current (I1 - I2)
θ = angle of maximum torque of the unit
ϕ = power factor angle of fault impedance
K = design constant

To prove that the equation defines a mho characteristic divide both sides by E^2 and transpose. The equation reduces to:

$$\frac{1}{Z} \cos(\phi - \theta) = K$$

or

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

Thus, the unit will pickup at a constant component of admittance at a fixed angle depending on the angle of maximum torque. Hence, the name mho unit.

When offset is used the transactor is energized with line current and introduces a voltage (proportional to the current) added to the line to line voltage received by the unit. This voltage offsets the circular characteristic of the MB unit in the R-X diagram.

SENSITIVITY

The sensitivity of the MB unit without offset is shown in Fig. 5. Figure 6 shows the effect of offset.

DIRECTIONAL ACTION

The MB unit has been carefully adjusted to have correct directional action under steady state, low voltage, and low current conditions. For faults in the non-tripping direction (zero offset) the range of 0-30 amperes. For faults in the tripping direction, the unit will close its contacts with as little as 2% voltage applied over the range of 6-60 amperes.

BURDENS

CURRENT CIRCUIT

The burden of the current circuit is little affected by the offset tap used and the value imposed on each current transformer is as shown in table II.

TABLE II

AMPS	FREQUENCY (HZ)	R	+jx	P.F.	WATTS	VOLT AMPS
5	60	.14	.14	.7	3.5	5

POTENTIAL CIRCUIT

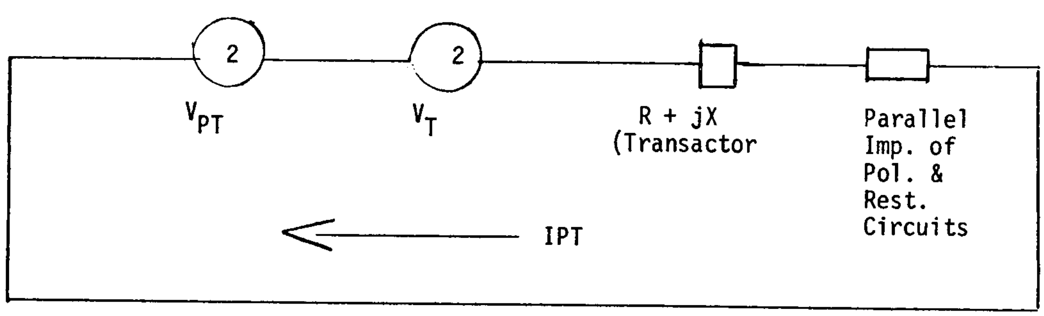
The potential burdens imposed on each potential transformer at 120 volts with the restraint taps at 100%, and the offset at zero is as shown in Table III.

TABLE III

CIRCUIT	R	X	P.F.	WATTS	VARS	VA
Polarizing	1400	-j50	.99	10.3	----	10.3
Restraint	740	+j1750	.39	3.0	7.0	7.7

When offset is used, the potential circuit burden may be calculated as follows:

When offset is used, the potential circuit may be represented as:



Where VT is the output voltage of the transactor and VPT is the input voltage to the relay potential circuit.

Thus the burden on the PT would be:

VPT X IPT

and

$$IPT = \frac{VPT \pm VT}{Zs}$$ (Positive if load or fault current is opposite of Offset)

where:

IPT = current in Potential Circuit
VPT = input voltage to relay
VT = output voltage of transactor
Zs = impedance of Potential Circuit

and:

$$VT = \sqrt{3}\ I_L' \times Z_T' \angle \theta - 75$$

where:

I_L = load current
Z_T = ohmic offset
θ = P.F. angle of I_L

and:

$$Zs = \frac{Zp \cdot Zr \left(\frac{100}{T}\right)^2}{Zp + Zr \left(\frac{100}{T}\right)^2} + Zt^2\,(4.5 + j14.5)$$

$$Zs = (a + jb) + (c + jd)$$

To aid in the calculation of burden, the following values have been calculated:

Restraint Tap (T)	a + jb	
100	845	452
50	1260	160
25	1370	0

ZT	c + jd	
0	0	
1	4.5	14.5
2	18	58
3	41	131
4	72	232

Thus, for 0.86 power factor load of 5 amperes into the protected line, the potential burden has been calculated for the following conditions:

Restraint Tap (T)	Offset Ohms	Watts	VARS
100	0	13.3	7.0
100	1	13.3	8.2
50	2	11.9	3.3
25	3	11.6	2.7
25	4	11.3	3.9

MECHANICAL INSPECTION

1. It is recommended that the mechanical adjustments in Table IV be checked.
2. There should be no noticable friction in the rotating structure of the units.
3. Make sure control spring is not deformed and spring convolutions do not touch each other.
4. With the relay well leveled in its upright position the contacts of the MB unit must be open. The moving contact should rest against the backstop.
5. The armature and contacts of the seal-in unit should move freely when operated by hand. There should be at least 1/32" wipe on the seal-in contacts.
6. Check the location of the contact brushes on the cradle and case blocks against the internal connection diagram for the relay.

TABLE IV

MECHANICAL ADJUSTMENTS

MB UNIT	
Rotating shaft end play	0.010 to 0.015"
Contact Gap	0.040 to 0.060"
Contact Wipe	0.003 to 0.005"
Clutch Slip	40 to 60 Grams

ELECTRICAL CHECKS

DRAWOUT RELAYS GENERAL

Since all drawout relays in service operate in their case, it is recommended that they be tested in their case or an equivalent steel case. In this way any magnetic effects of the enclosure will be accurately duplicated during testing. A relay may be tested without removing it from the panel by using a 12XLA13A test plug. This plug makes connections only with the relay and does not disturb any shorting bars in the case. Of course, the 12XLA12A test plug may also be used. Although this test plug allows greater testing flexibility, it also requires C.T. shorting jumpers and the exercise of greater care since connections are made to both the relay and the external circuitry.

POWER REQUIREMENTS GENERAL

All alternating current operated devices are affected by frequency. Since non-sinusoidal waveforms can be analyzed as a fundamental frequency plus harmonics of the fundamental frequency, it follows that alternating current devices (relays) will be affected by the applied waveform.

Therefore, in order to properly test alternating current relays it is essential to use a sine wave of current and/or voltage. The purity of the sine wave (i.e. its freedom from harmonics) cannot be expressed as a finite number for any particular relay, however, any relay using tuned circuits, R-L or RC networks, or saturating electromagnets (such as time overcurrent relays) would be essentially affected by non-sinusoidal wave forms.

Similarly, relays requiring dc control power should be tested using dc and not full wave rectified power. Unless the rectified supply is well filtered, many relays will not operate properly due to the dips in the rectified power. Zener diodes, for example, can turn off during these dips. As a general rule the dc source should not contain more than 5% ripple.

MB UNIT

Before any electrical tests are made on the MB unit, the relay should be connected as shown in Fig. 10 and allowed to warm up for approximately 15 minutes with rated voltage applied and the restraint taps set at 100%.

ANGLE OF MAXIMUM TORQUE

With the offset taps set at zero and restraint taps set at 100%, set V for 55 volts and I for 15 amperes (Fig. 10). The angle of maximum torque should be as shown below:

MODEL	12CEB51B1A	12CEB51B2A	12CEB51B3A
Angle of max. torque	$60^{o} \pm 1^{o}$	$75^{o} \pm 1^{o}$	$75^{o} \pm 1^{o}$
Phase angle meter reading If phase angle meter reads angle I leads V	$300^{o} \pm 1^{o}$	$285^{o} \pm 1^{o}$	$285^{o} \pm 1^{o}$

R2 may be adjusted to change the angle of maximum torque.

OHMIC REACH (3 OHM MINIMUM RELAY)

Using the same connection and tap setting as used for "Angle of Maximum Torque". Set angle shifter to angle of maximun torque, set V = 55 volts and unit should pickup between 8.9 and 9.4 amperes.

R1 may be adjusted to change the ohmic reach.

INSTALLATION PROCEDURE

LOCATION

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

MOUNTING

The relay should be mounted on a vertical surface. The outline and panel drilling dimensions are shown in Fig. 9.

CONNECTIONS

The internal connection of the CEB51A relay is shown in Fig. 8.

Unless mounted on a steel panel which adequately grounds the relay case, it is recommended that the case be grounded through a mounting stud or screw with a conductor not less than #12 B&S gage copper wire or its equivalent.

Settings on the target seal-in unit are made using the tap selection screw. The tap screw is the screw holding the right-hand stationary contact of the seal-in unit. 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 place it in the left-hand contact. This procedure is necessary to prevent the right-hand stationary contact from getting of of adjustment. Screws should not be in both taps at the same time.

PERIODIC CHECKS AND ROUTINE MAINTENANCE

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

CONTACT CLEANING

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

SERVICING

If it is found during the installation or periodic tests that the mho unit calibrations are out limits they should be recalibrated as outlined in the following paragraphs. It is suggested that these calibrations be made in the laboratory. The circuit components listed below, which are normally considered as factory adjustments, are used in recalibrating the units. Their locations in the relay circuit are shown in the internal connection diagram of Fig. 8.

CONSTRUCTION

The Type CEB51B relays are assembled in the medium size single ended (M1) drawout case having studs at one end in the rear for external connections. The electrical connections between the relay and case studs and through stationary molded inner and outer blocks between which nests a removable connecting plug. The outer blocks have the terminals for the internal connections.

Every circuit in the drawout case has an auxiliary brush, as shown in Fig. 7, to provide adequate overlap when the connecting plug is withdrawn or inserted. Some circuits are equipped with shorting bars (see internal connections in Fig. 8), and on those circuits, it is especially important that the auxiliary brush make contacts as indicated in Fig. 7 with adequate pressure to prevent the opening of important interlocking circuits.

The relay mechanism is mounted in a steel framework called the cradle and is a complete unit with all leads terminated at the inner blocks. This cradle is held firmly in the case with a latch at both top and bottom and by a guide pin at the back of the case. 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 drawn to the case by thumbscrews, holds the connecting plugs in place. The target reset mechanism is a part of the cover assembly.

The relay case is suitable for either semiflush or surface mounting on all panels up to 2 inches thick and appropriate hardware is available. However, panel thickness must be indicated on the relay order to insure that proper hardware will be included. Outline and panel drilling is shown in Fig. 9

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 can be drawn out and replaced by another which has been tested in the laboratory.

The rheostat for adjusting the angle of maximum torque, the rheostat for making fine adjustment of the reach setting, the rheostat for setting the transactor angle, the autotransformer and offset tap block are all front mounted and can be adjusted from the front of the relay. Thus, all adjustments can be made from the front of the relay without removing the relay from its case.

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 substained 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 immedaitely, 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.

ACCEPTANCE TESTS

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

VISUAL INSPECTION

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

Remove the relay from its case and check that there are no broken or cracked molded parts or other signs of physical damage, and that all screws are tight.

R1 - Reacn Adjusting Rheostat
R2 - Angle of Maximum Torque Rheostat

a. Control Spring Adjustments:

With the contact gap set per Table IV adjust the control spring adjusting ring so that the moving contact just touches the backstop with the relay de-energized and level.

b. Directional Check

With the relay connected per Fig. 10, restraint taps in 100%, and zero offset, allow the relay to preheat for approximately 15 minutes at rated voltage.

Set the phase angle meter at the angle of maximum torque and reduce the voltage to 2 volts. The relay contact must close over the range of 6-60 amperes.

With the potential circuit short circuited on itself, the contacts must remain open over the range of 0-30 amperes.

Should the MB unit fail to pass either test, the core must be adjusted (see Fig. 11).

By use of a special wrench (0178A9455 Pt. 1) the core may be rotated in either direction 360° without holding nut "F" or retightening after the final position of the core has been determined.

The final position of the core is that position where the unit passes both the above tests. The core and coil assembly is shown in Fig. 11.

c. Pickup & Angle of Maximum Torque (75° Relays)

1. Set offset taps to zero.
2. Set restraint taps to 100%.
3. Connect as shown in Figure 10.
4. Apply 55 volts and 15 amperes and adjust R2 to obtain an angle of maximum torque of 285° ±1°.
5. Set the phase angle meter to the angle of maximum torque (285° on phase angle meter).
6. Set the voltage at 55 volts.
7. Adjust R1 to get relay closure at 8.9 to 9.4 amperes.

RENEWAL PARTS

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

When ordering renewal parts, address the nearest Sales Office of the General Electric Company, specify quantity required, name of the part wanted, and the complete model number of the relay for which the part is required.

Since the last edition, the photographs, and paragraph c. under ACCEPTANCE TESTS, have been added, and a change has been made in Figure 9.

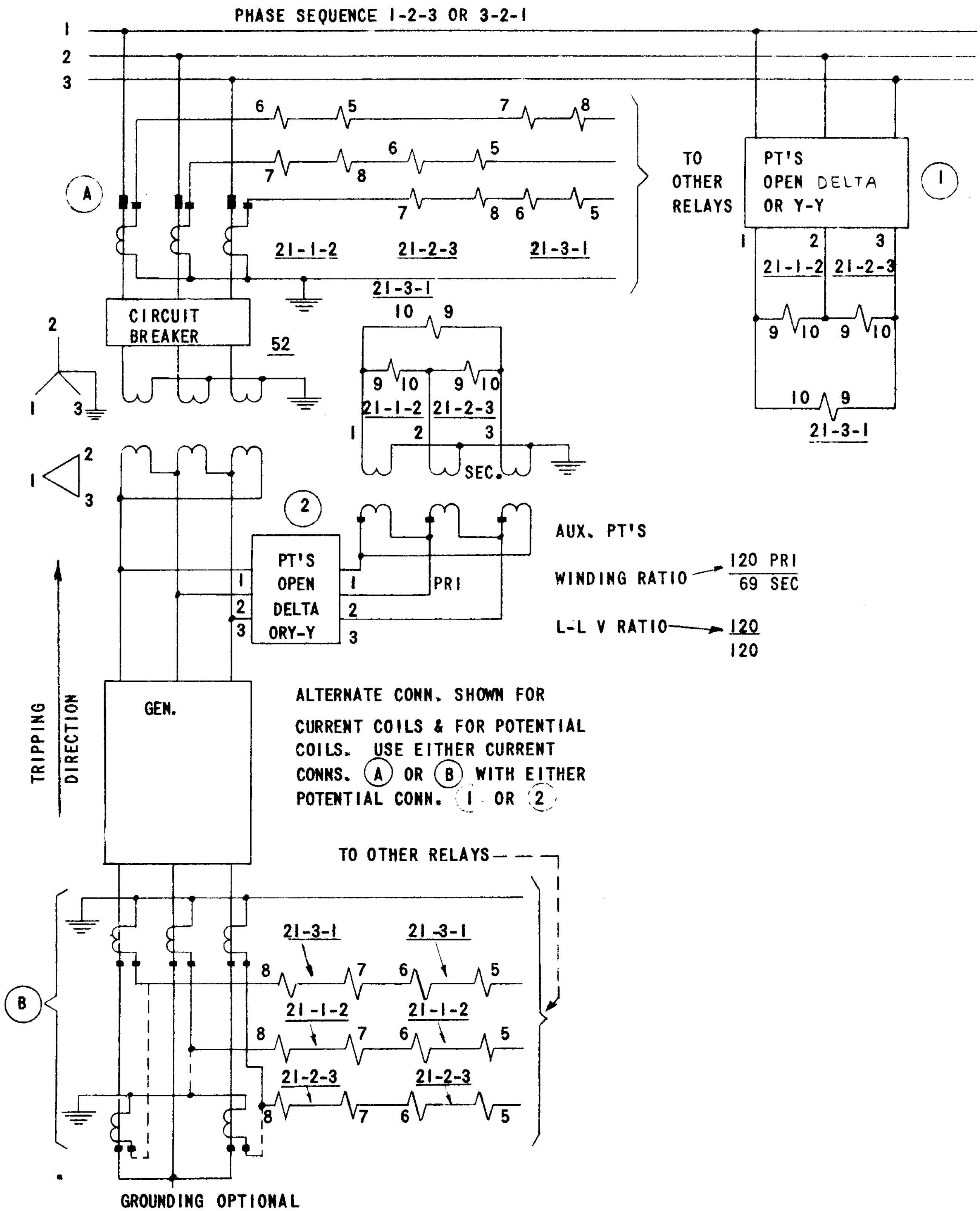
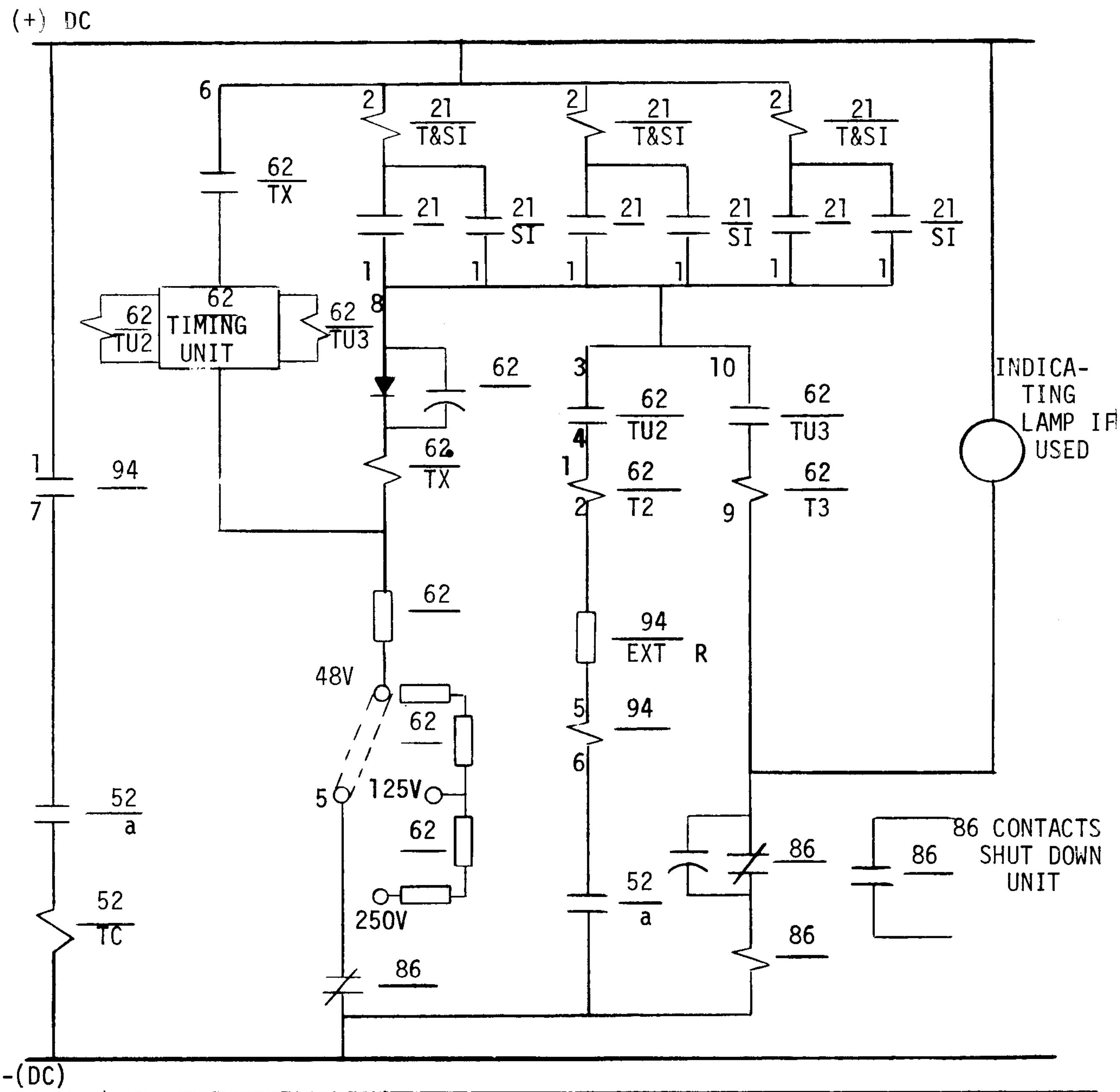
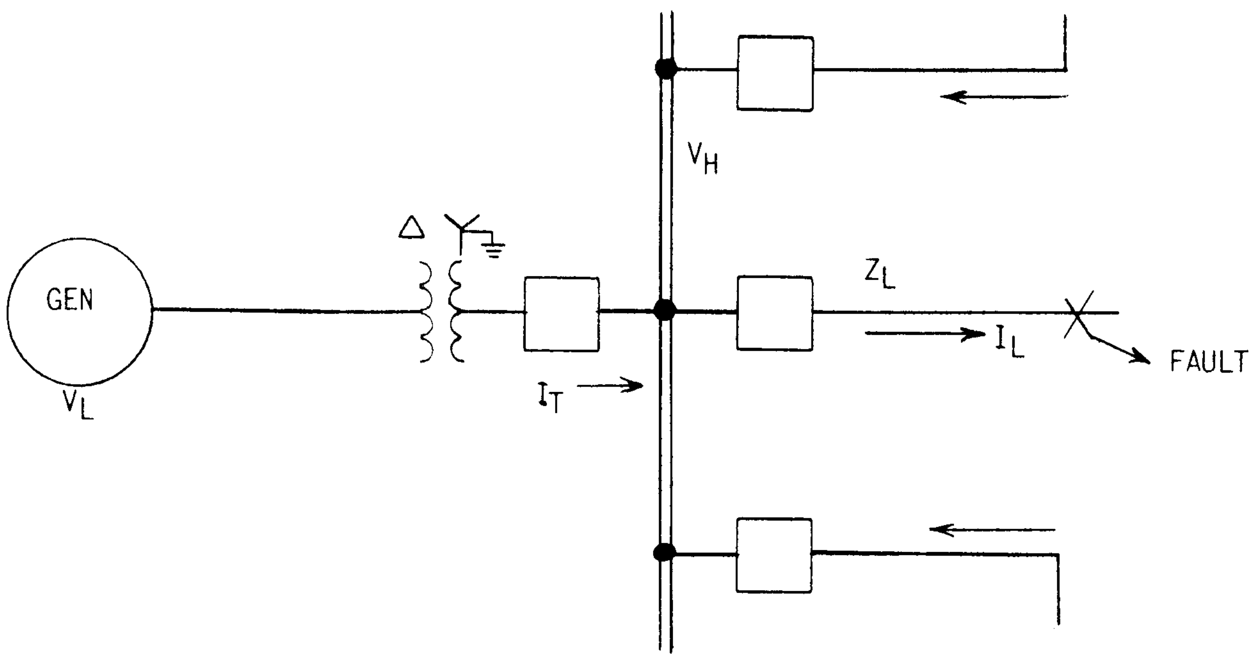


FIG. 1 (403A118-5 SH. 1) External A-C Connections For Type CEB51B Relay For Back-Up Protection Of A Generator Against Prolonged Faults



DEV. NO.	RELAY MOD.	INC.UNITS	DESCRIPTION	INTERNAL
21	CEB51B	T & SI	BACK-UP DISTANCE RELAY TARGET AND SEAL-IN UNIT	0226A6947
62	SAM14A12	 TU2 T2 TU3 T3	TIMING RELAY TIMING UNIT NO. 2 TARGET FOR TU2 TIMING UNIT NO. 3 TARGET FOR TU3	0208A2426 Sh1.0
94	HGA14AM		AUXILIARY TRIPPING RELAY	6400533-2
86	HEA		LOCKOUT RELAY	

FIG. 2 (0246A3381-0) External D-C Connections For Type CEB51B And SAM14A Relays For Back-Up Protection Of A Generator Against Prolonged Faults



$$K = \frac{I_L}{I_T}$$

FIG. 3 0165A7772-1) Typical High Voltage Bus In A Generating Station Showing Ratio Of Current In Line (Z_L) To Current In Line Side Of Power Transformer

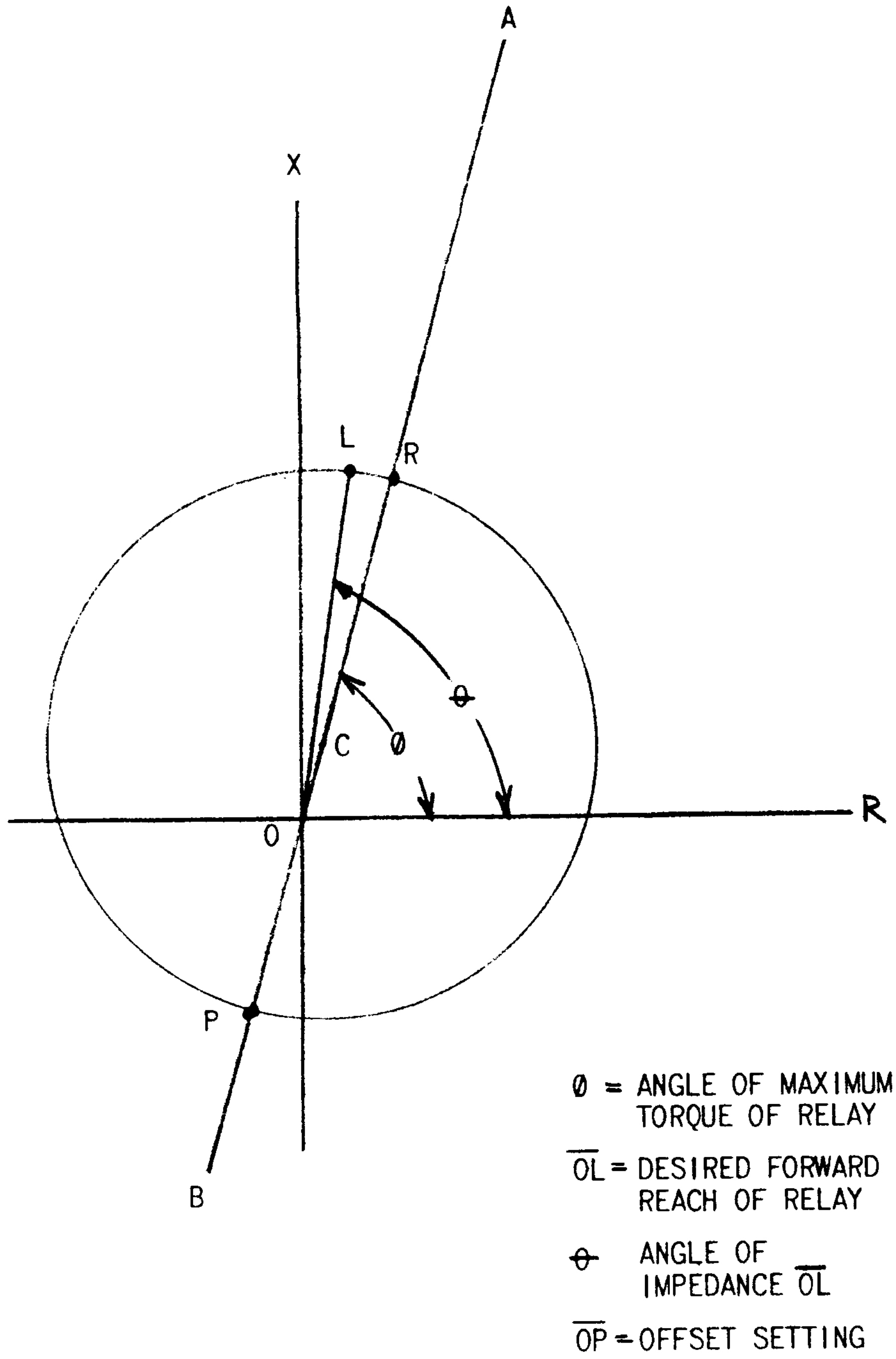


FIG. 4 (0165A7770-0) Offset Characteristic Of Type CEB51B Relay

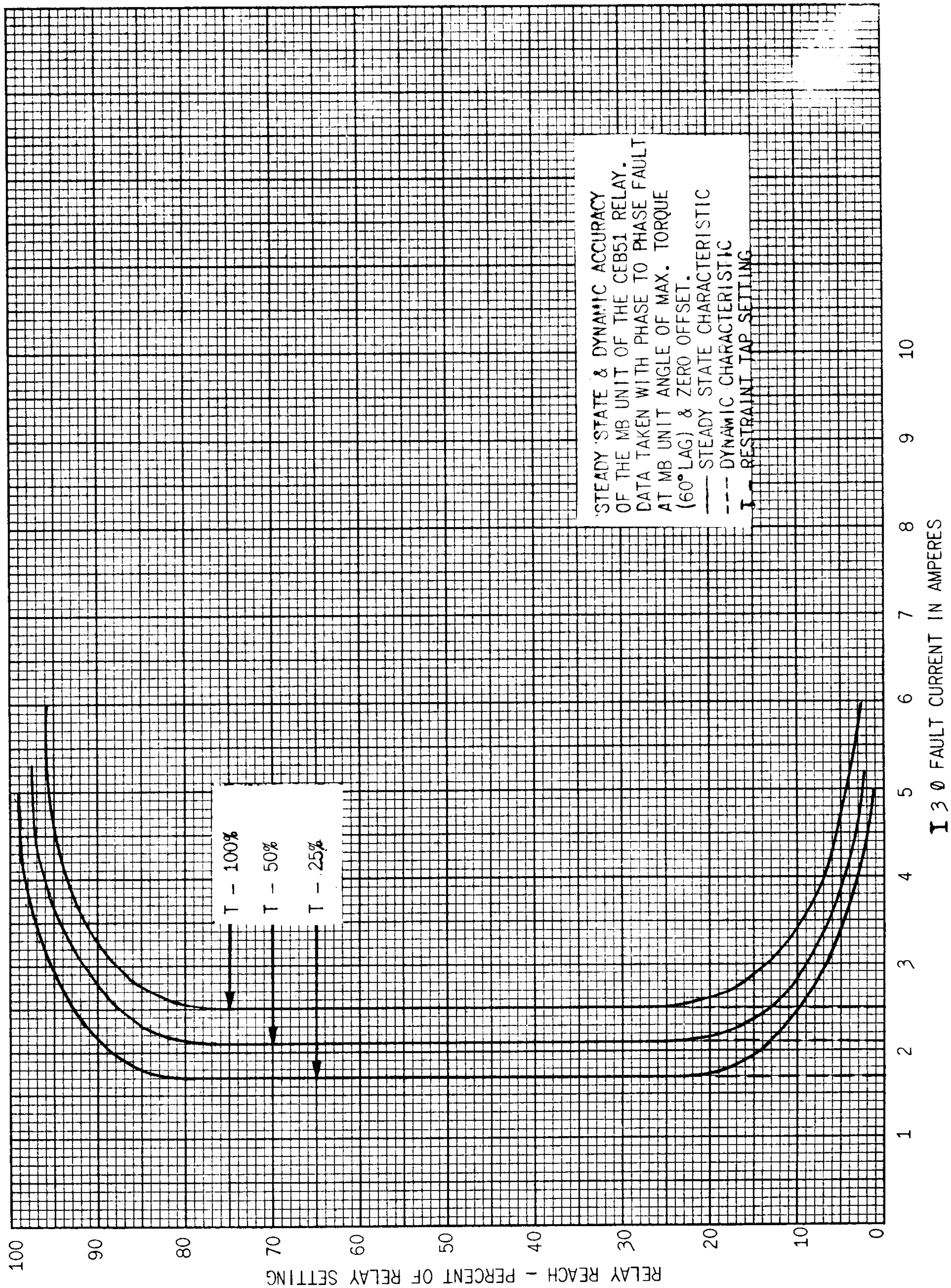


FIG. 5 (0208A3908-0) Steady State And Dynamic Accuracy Of The CEB51B Relay

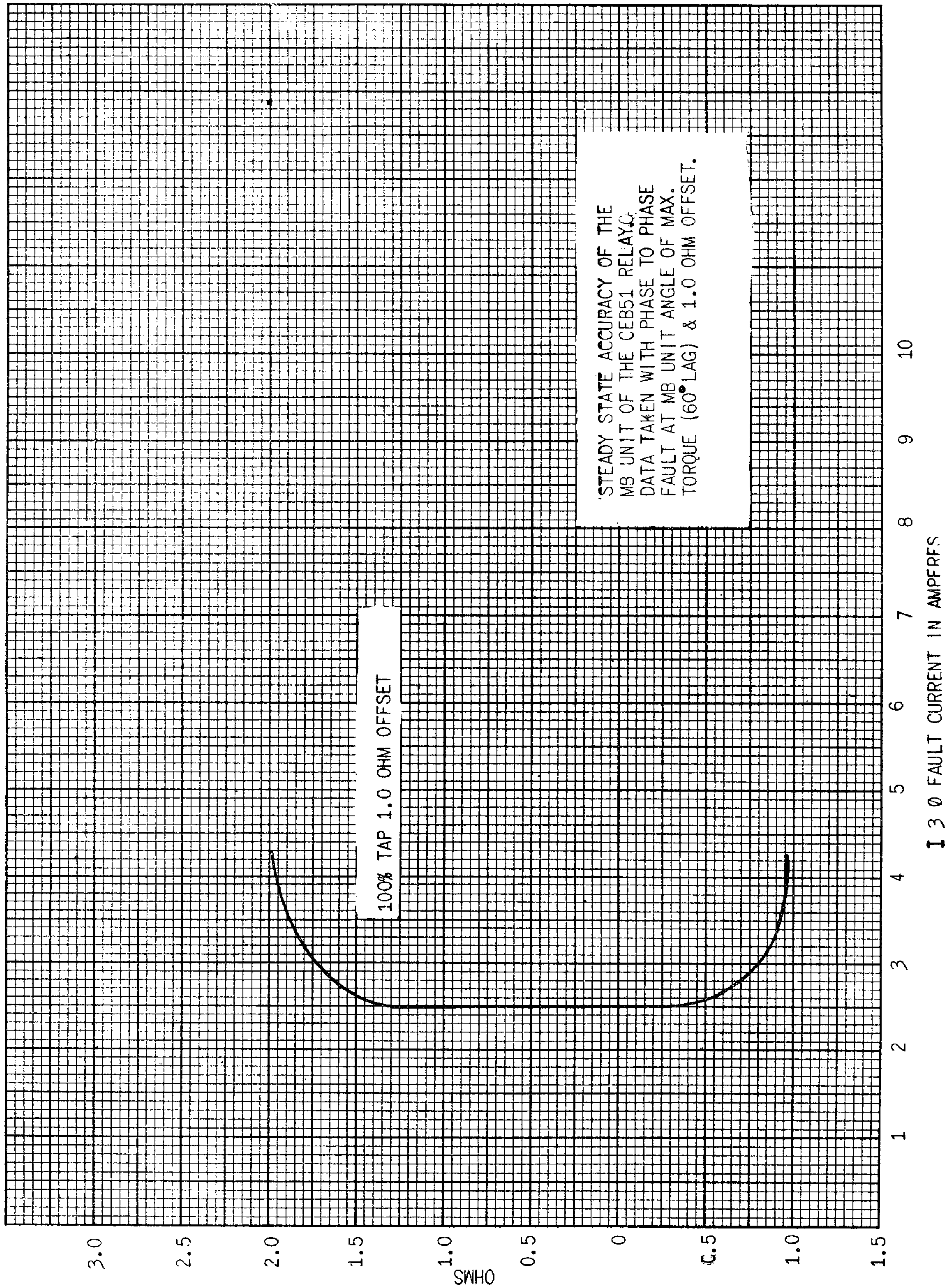
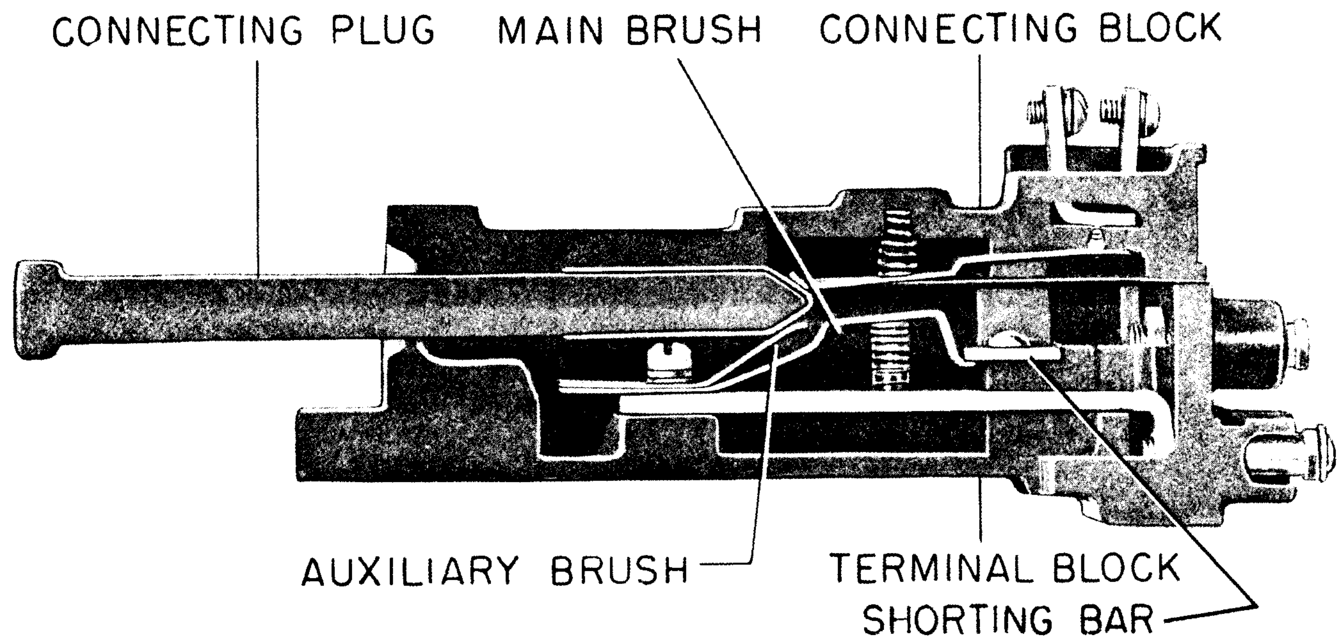


FIG. 6 (0208A3909-0) Steady State Accuracy Of The CEB51B
With Offset



NOTE: AFTER ENGAGING AUXILIARY BRUSH, CONNECTING PLUG TRAVELS 1/4 INCH BEFORE ENGAGING THE MAIN BRUSH ON THE TERMINAL BLOCK

FIG. 7 (8025039) Cross Section Of A Drawout Case Showing The Position Of Auxiliary Brush And Shorting Bar

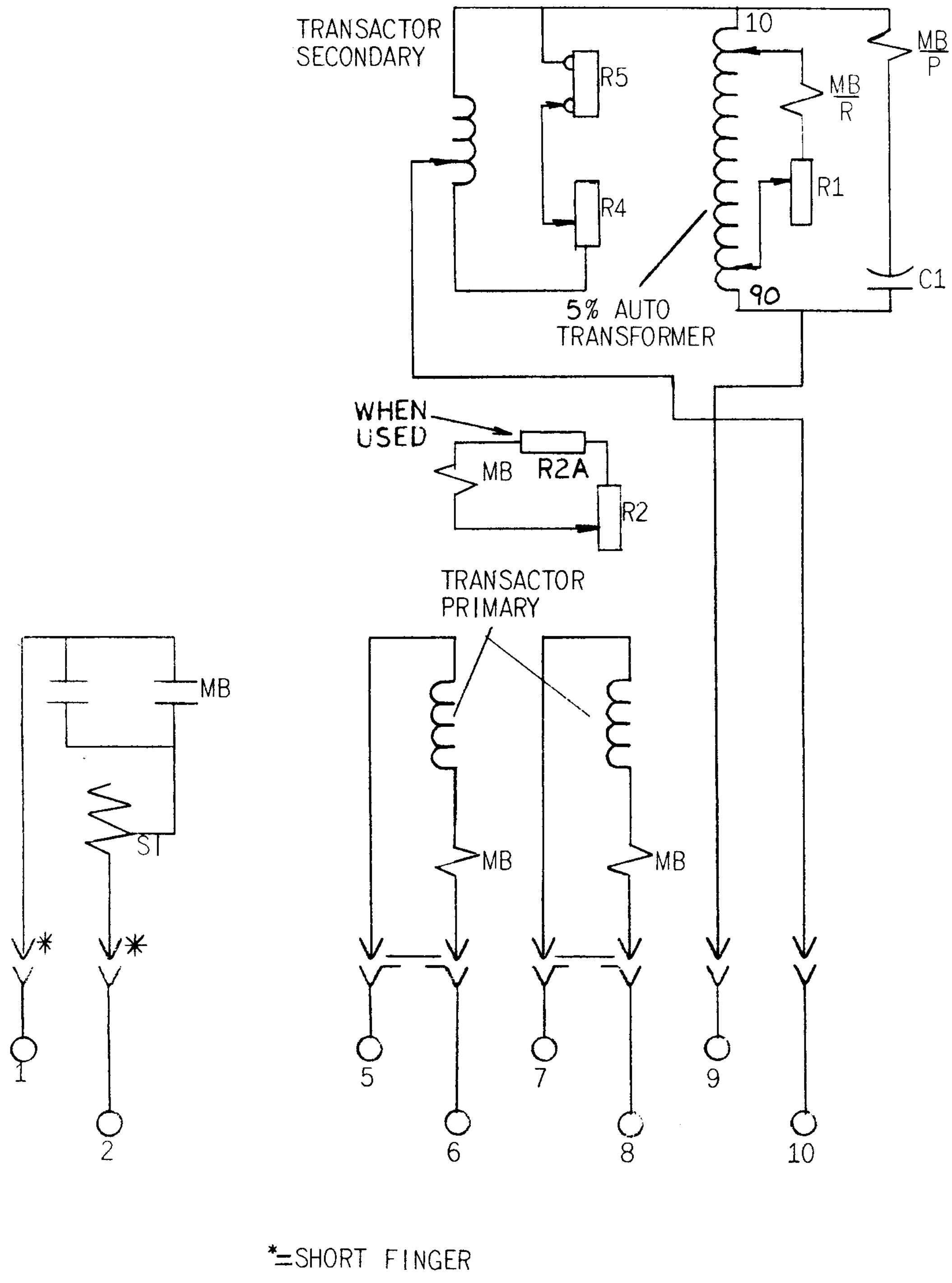


FIG. 8 (0226A6947-2) Internal Connections Of The CEB51B Relay

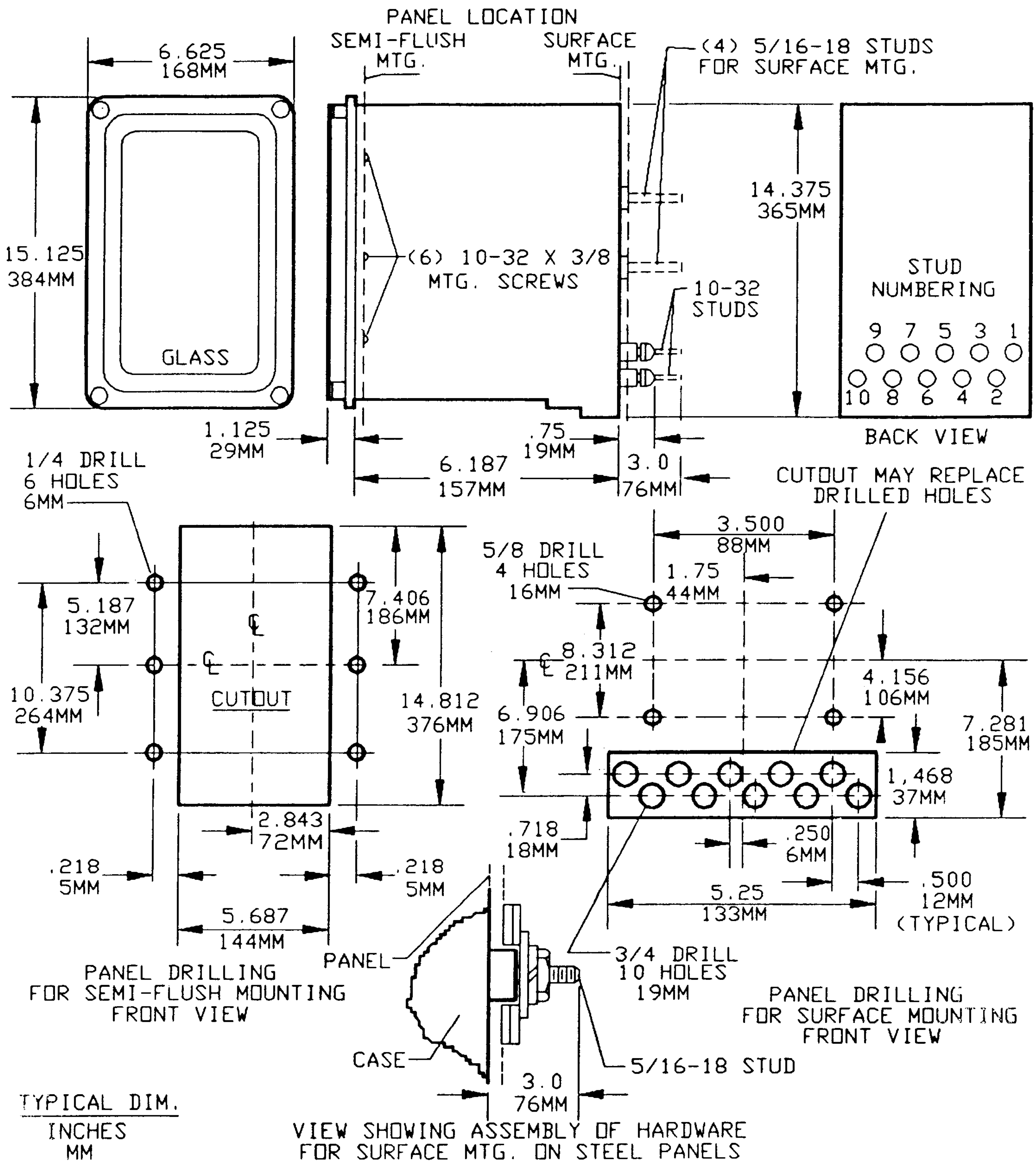


FIG. 9 (K-6209273-5) Outline and Panel Drilling Dimensions for the CEB51B

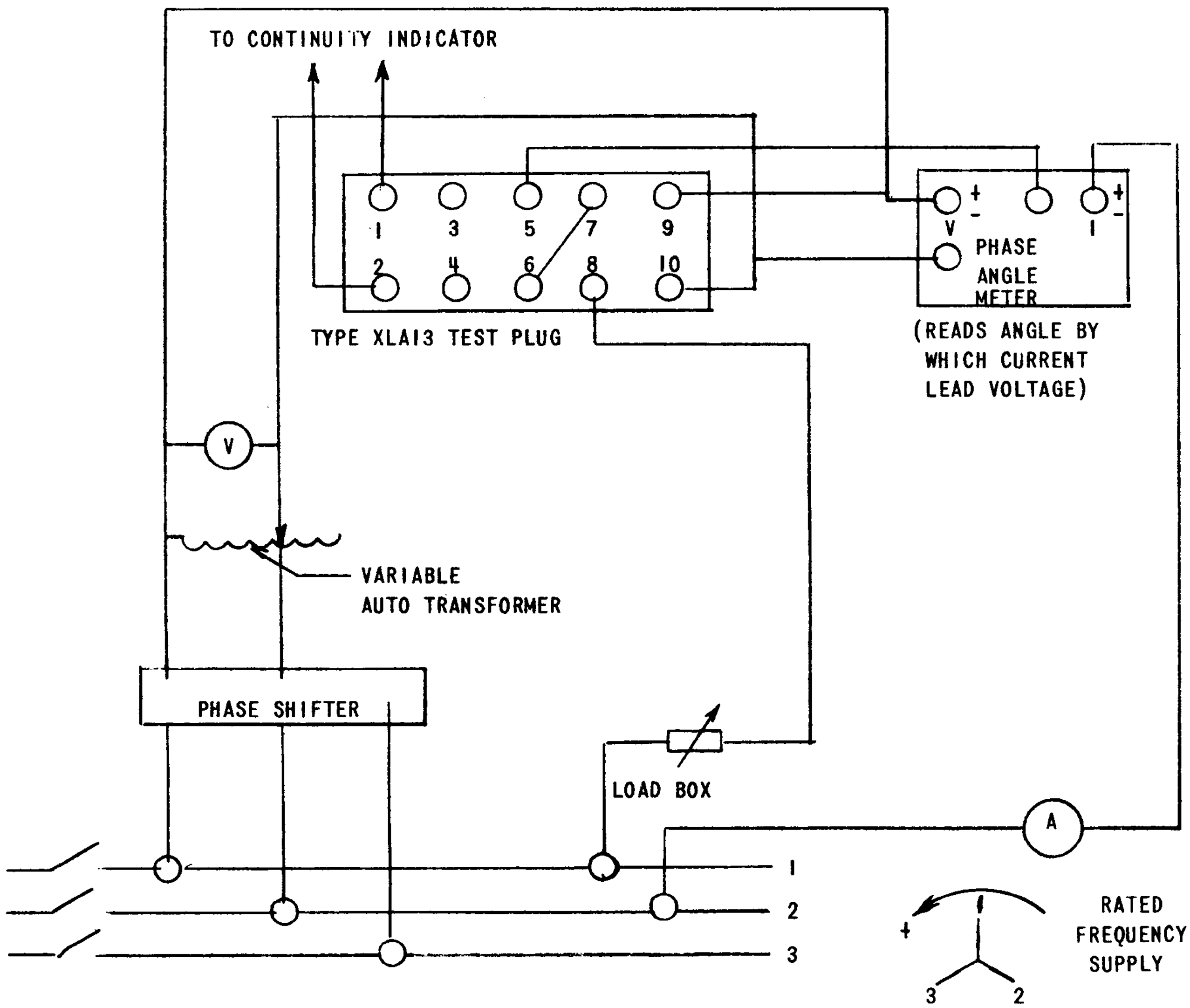


FIG. 10 (246A3365-0) Test Connection Diagram For Checking Reach And Angle Of Maximum Torque

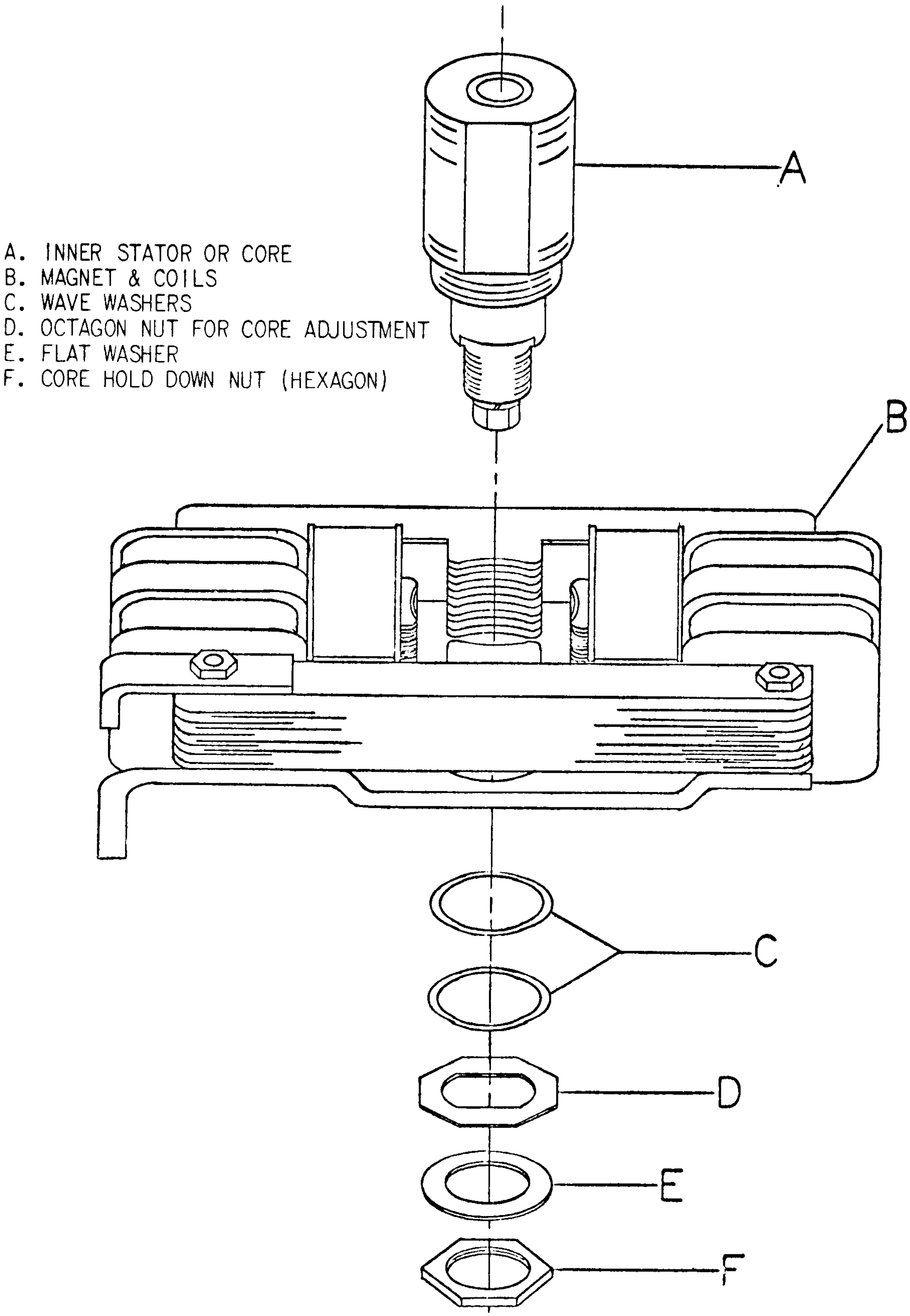


FIG. 11 (0208A3583-0) Exploded View Of The Four Pole Induction Cup Unit Showing The Core Retaining Hardware

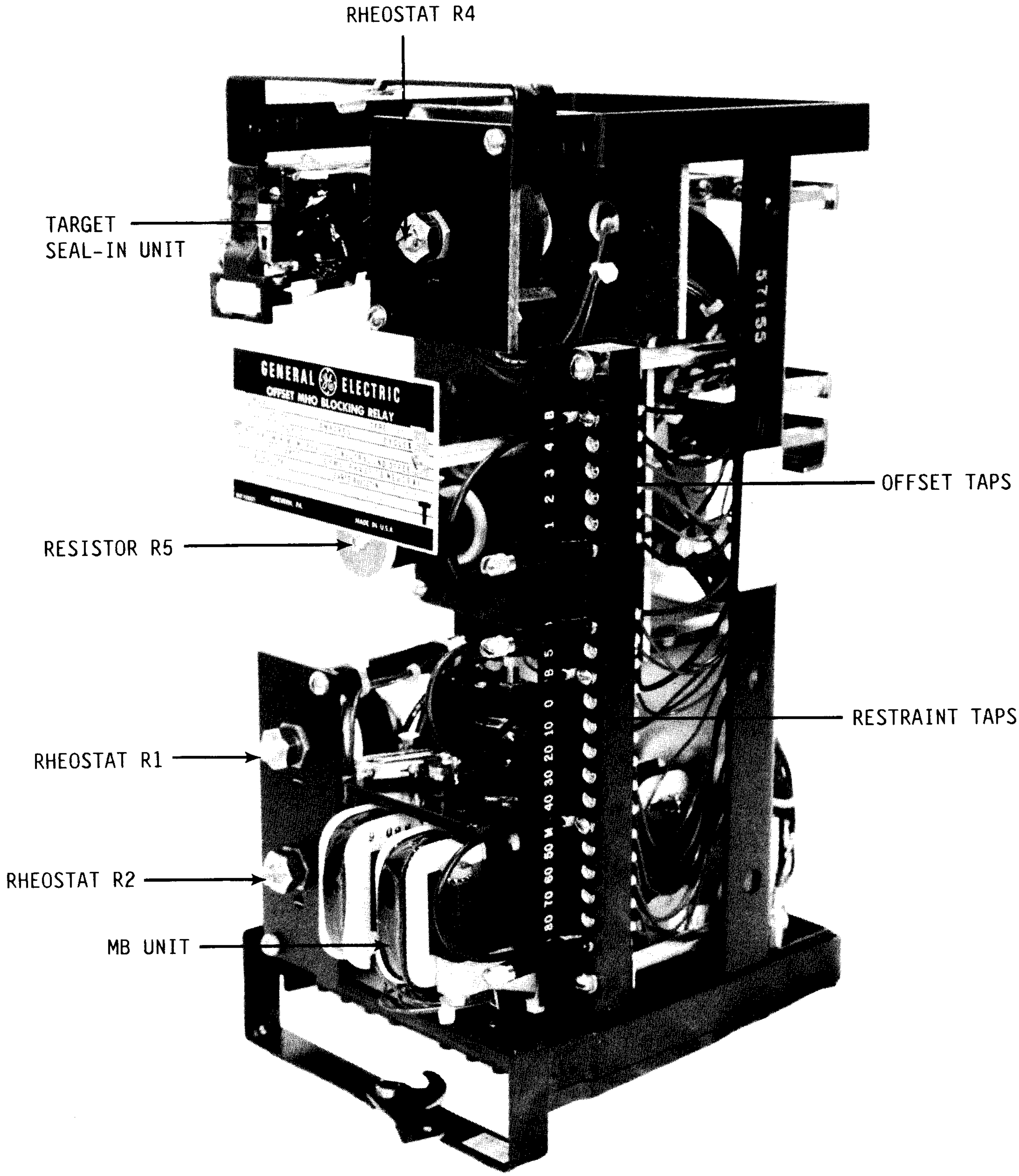


Fig. 12 (8919545) CEB 51B Removed from Case