INSTRUCTIONS

TYPE CN-33P PRIMARY NETWORK RELAY

CAUTION: Before putting relays into service, remove all blocking which may have been inserted for the purpose of securing the parts during shipment, make sure that all moving parts operate freely, inspect the contacts to see that they are clean and close properly, and operate the relay to check the settings and electrical connections.

APPLICATION

The type CN33P relay supplies the tripping and closing requirements of a primary distribution network relay. These requirements are:

1. Close its TRIP contacts for primary supply line or network transformer faults.

2. Close its TRIP contacts, when the primary supply line breaker is open, and the network is energizing the transformer. The current which flows can be either the transformer magnetizing current or a combination of the magnetizing current and the primary line charging current.

3. Not close its TRIP contacts for faults within the network.

4. Close its CLOSE contacts when the relation between the primary supply voltage and the network voltage is such as to cause power to flow from the primary supply line to the network.

5. Not close its CLOSE contacts when the relation between the feeder voltage and the network voltage is such as to cause power to flow from the network to the feeder. A CNJ relay is also needed to completely fulfill this requirement.

6. Not to close its CLOSE contacts for reverse phase conditions; that is, when the conductor phase sequence is not the same on each side of the breaker.

CONSTRUCTION

The type CN-33P primary network relay, shown in Figs. 1 & 2, is a three phase relay which operates on the induction principle. Its moving element is a drum carried on a horizontal shaft which rotates on knife edge bearings. Since this type of bearing is placed at the center of the shaft, friction is reduced to a minimum. Phosphor bronze retaining rings encircle the ends of the drum shaft. End thrust is taken care of by means of flat polished steel surfaces in the stationary bearing assembly screws. The ends of the drum shaft are conical, and one end or the other makes point contact with its associated flat steel surface depending upon the direction of thrust.

The relay has single pole, double throw contacts made of pure silver. The moving contact arm carries two spring mounted silver contacts which are electrically one, and one flat steel spring which extends down from the shaft. This spring determines the amount of phasing voltage necessary to close the CLOSE contacts of the relay. Counter weights are also carried on the moving arm so that the moving element is substantially balanced in all positions.

The block which carries the stationary CLOSE contacts is mounted to the left (Front View) of the moving contact on the insulation plate through which the drum shaft passes, and is stamped with the letter "C". The block which carries the stationary TRIP contact is mounted to the right of the moving contact and is stamped with the letter "T".

On the lower part of the insulation plate is mounted another brass block with three tapped holes in it. This block carries a small thumb screw which acts as a stop to deflect the phasing voltage spring. This phasing voltage spring adjuster is used to vary the amount of phasing voltage necessary to close the CLOSE contacts.

When the relay is completely deenergized the moving contact is held against the TRIP stationary contact by means of the spiral spring. The inner end of this spring is fastened to the moving contact arm and the outer end is fastened to a spring adjuster which is on the front of the insulation plate.

Fig. 1 Type CN33P Relay, Front View.

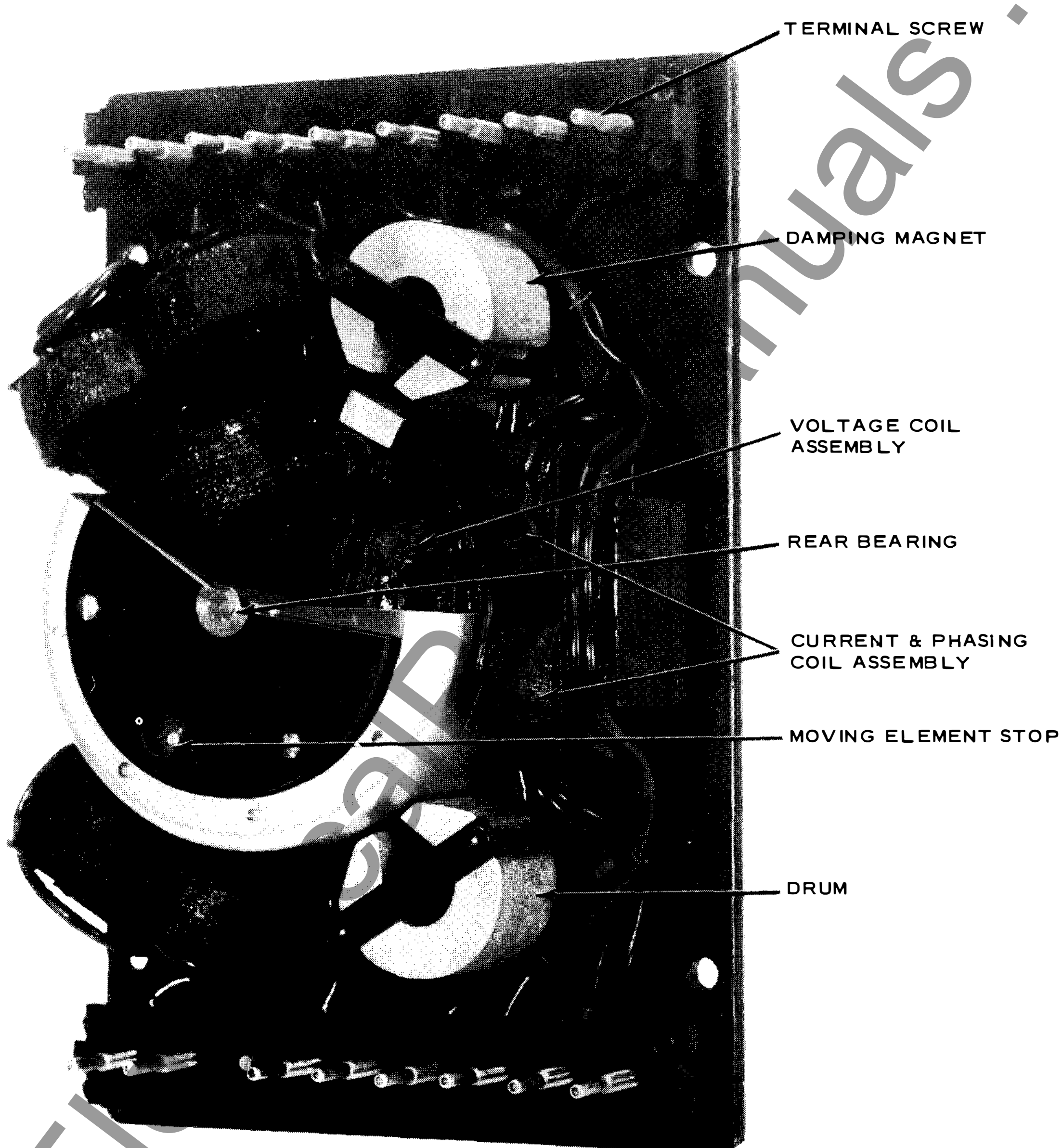


Fig. 2 Type CN33P Relay, Rear Cutaway View.

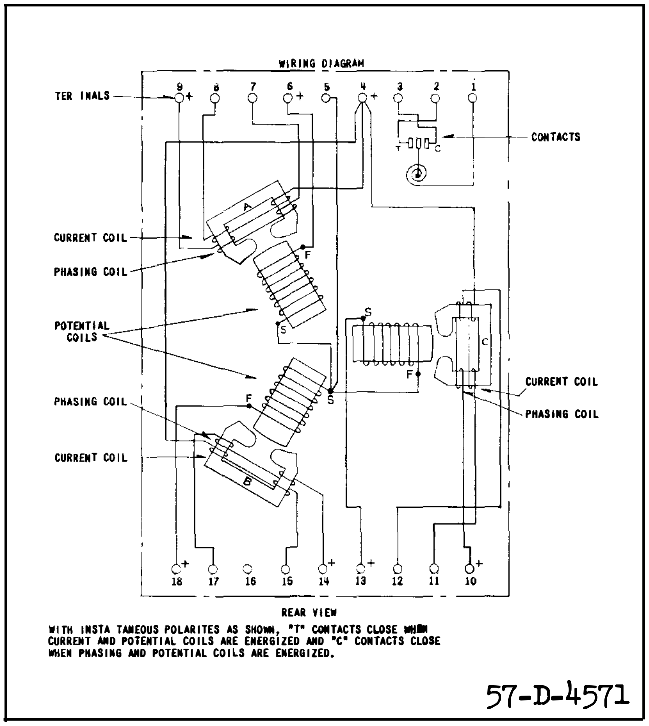


Fig. 3 Internal Schematic of Type CN33P Relay, S#1731270.

Gear teeth on the adjuster engage the pinion, the insulation shaft of which extends through a hole in the front bearing plate. The spring tension is easily adjusted by rotating the pinion with a screw driver without danger of grounding the assembly. This adjustment is located under the glass cover to prevent unauthorized changing of the adjustments.

The moving element stop, which is a pin in the drum, operates in a large clearance hole in the rear bearing plate and limits the movement of the drum in both directions by striking the opposite sides of this hole.

The three electromagnets which are carried on the back of the steel mounting plate are mounted radially and equally spaced about the drum. Each electromagnet consists of a conventional potential coil and iron assembly mounted inside the drum and a current and phasing coil and iron assembly mounted on the same radial centerlines outside the drum.

Each current and phasing coil and iron assembly is securely fastened to the back of the mounting plate by two screws.

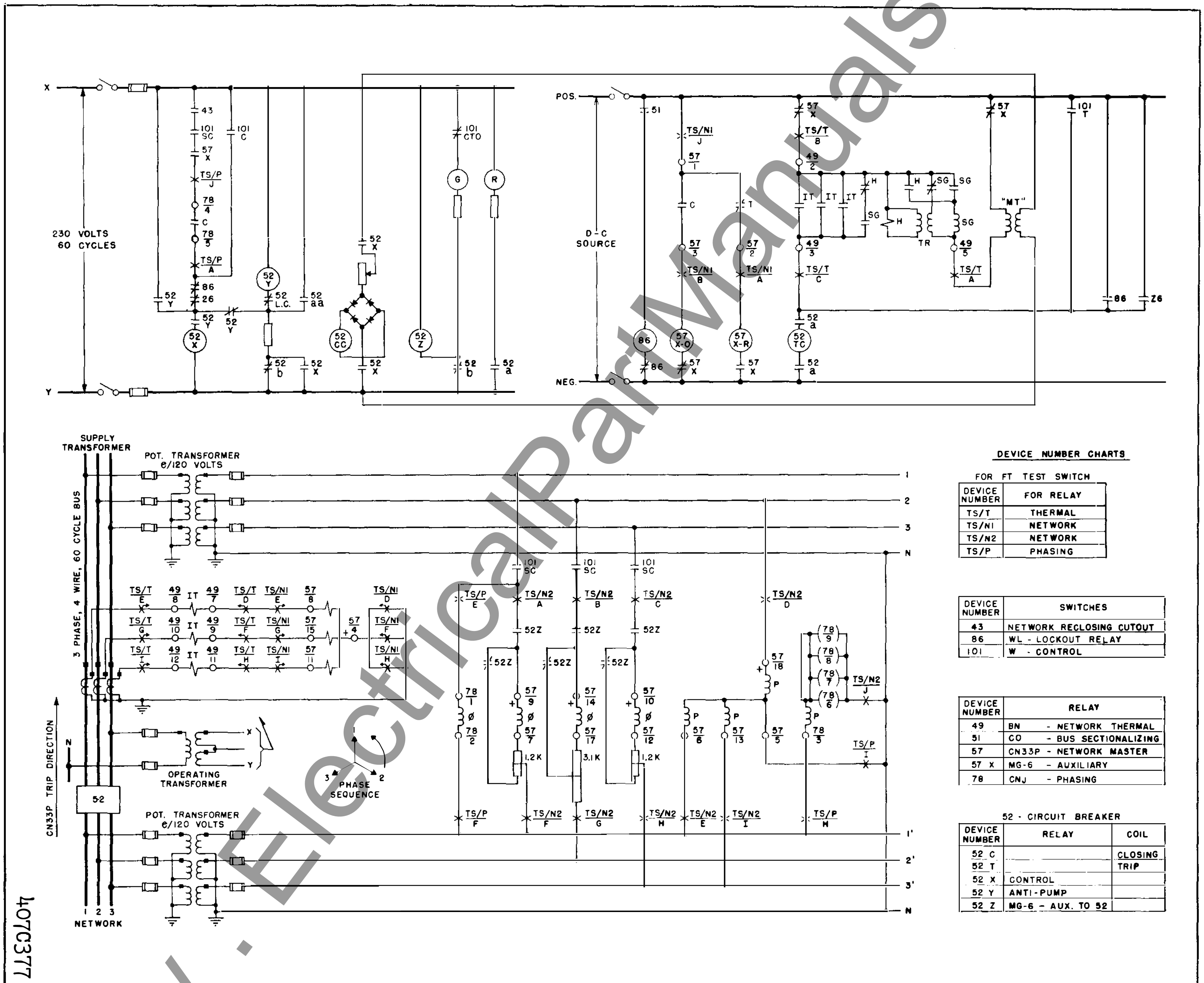
Molded insulation terminal blocks are mounted on the two ends of the mounting plate. Silver tip screws pass through the terminal blocks in the relay base and engage the stationary terminals in the external blocks. These stationary terminal blocks have silver plated copper jaws which are backed up by steel springs assembled in the molded insulation blocks.

The relay is mounted on two studs and held securely in place by two nuts, which when tightened, force the terminal screws firmly into engagement with their associated jaws. These jaw assemblies are free to move in their molded insulation blocks so as to be self aligning. The heads of all terminal screws are accessible from the front of the relay, and when they are screwed down in their normal position the heads are completely surrounded by the molded terminal blocks through which the screws pass. This prevents accidental contact with personnel, or shorting to ground or between screws. By partially removing the proper terminal screw or screws any circuit or circuits between the relay and the external wiring can be opened. Before the head of the screw becomes flush with the surface of the terminal block the circuit is opened. The screw remains connected to its associated relay circuit even after it is backed out until its head extends above the surface of the molded block, so that a test clip can be connected to it.

OPERATION

The operation of the type CN33P relay can best be described by referring to Fig. 4. Fig. 4 shows a typical external schematic diagram of the type CN33P, the type CNJ (I.L. 41-893), and the type BN (I.L. 41-894) relays, when used on a three phase, 4-wire, primary network with wye-wye potential transformers and wye connected current transformers. Assume the system to be deenergized. When the CN33P is deenergized its TRIP contacts will be held closed by the spiral spring. The CN-J CLOSE contact will be held open. The BN contacts will be opened. If the primary supply breaker is closed energizing the transformer, the phase 2 potential coil of the CN33P will be energized. The supply voltage will also be applied to the phasing circuits. The phasing resistor of phase 2 has been proportioned to give sufficient torque to close the CLOSE contacts when the relay is energized from the supply side only. Therefore, the breaker will close and connect the transformer to the network since the CLOSE contacts of both the CN33P and the CNJ are closed.

Again, refer to Fig. 4 and the original conditions:



DEVICE NUMBER CHARTS

FOR FT TEST SWITCH

DEVICE NUMBER	FOR RELAY
TS/T	THERMAL
TS/N1	NETWORK
TS/N2	NETWORK
TS/P	PHASING

DEVICE NUMBER	SWITCHES
43	NETWORK RECLOSING CUTOUT
86	WL - LOCKOUT RELAY
101	W - CONTROL

DEVICE NUMBER	RELAY
49	BN - NETWORK THERMAL
51	CO - BUS SECTIONALIZING
57	CN33P - NETWORK MASTER
57 X	MG-6 - AUXILIARY
78	CNJ - PHASING

52 - CIRCUIT BREAKER

DEVICE NUMBER	RELAY	COIL
52 C		CLOSING
52 T		TRIP
52 X	CONTROL	
52 Y	ANTI-PUMP	
52 Z	MG-6 - AUX. TO 52	

Fig. 4 Typical External Schematic of the Type CN33P Relay, with Type CNJ & BN Relays.

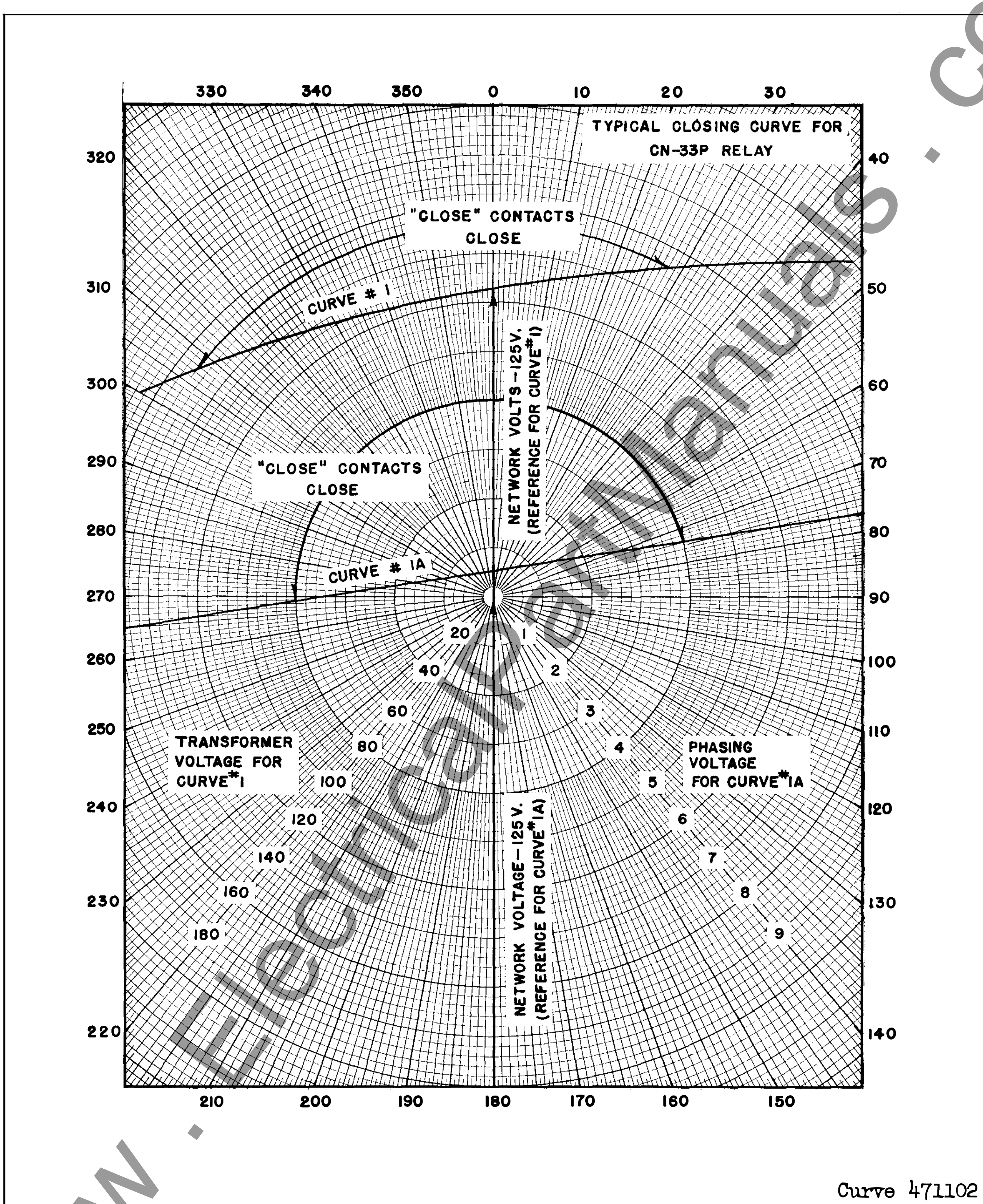


Fig. 5 Typical Closing Phase Angle Curve for the CN33P Relay.

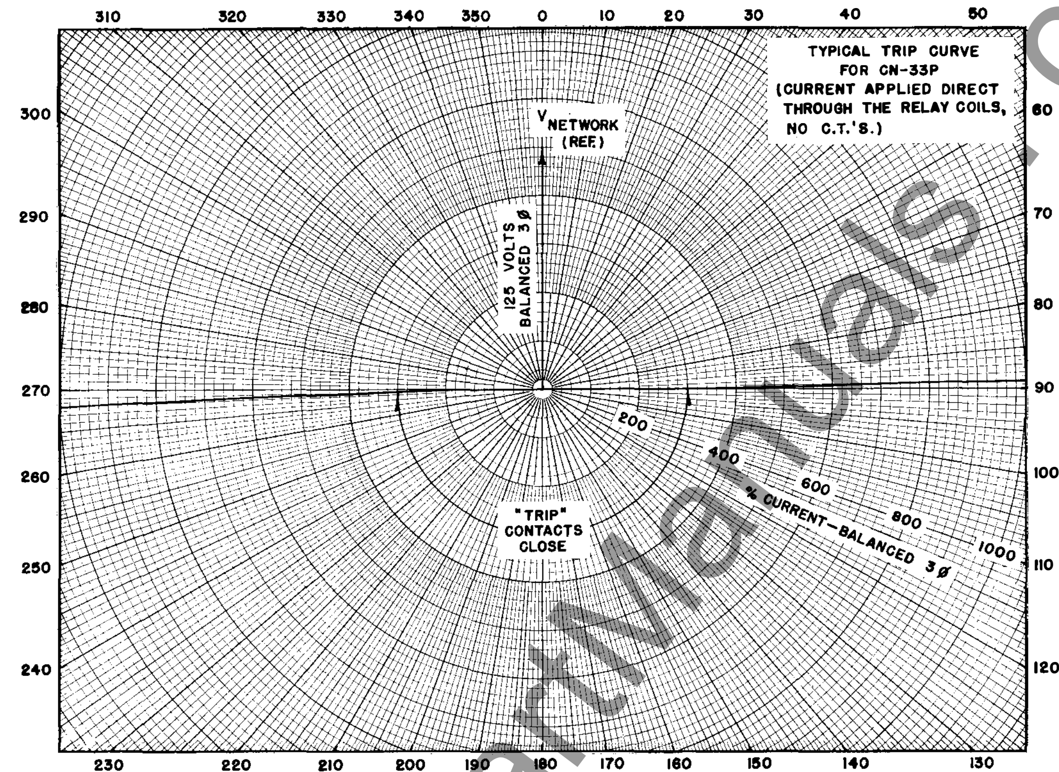


Fig. 6 Typical Tripping Phase Angle Curve for the CN33P Relay — High Current Values.

that is, that all feeders associated with the network are open. Now suppose that some network supply line, other than the one to which the transformer bank of Fig. 4 is connected is energized by closing its breaker at the supply station. The breaker on that feeder will close and energize the network as has been explained. This energizes the network, and the phase 1 and 3 potential coils and all phasing circuits of the CN33P become energized. The phasing circuits of all phases have essentially full voltage on them but since the voltage on the network side of the breaker is the higher, a strong torque is produced which keeps the TRIP contacts closed.

With the network energized, assume that the primary supply breaker closes to energize the network transformer in question. If the supply and network voltages are in phase, the phasing voltage will be zero. In this case there will be no electrical torque produced, except the "voltage only" torque produced by the potential coils. This torque is sufficient to overcome the tension of the spiral spring. Thus, the voltage only torque opens the TRIP contact. However, there is not enough torque to close the CLOSE contact, so the CN33P does not close the breaker.

With the network energized, assume that the network transformer in question is energized, such that the transformer secondary voltage is higher than the network voltage, and substantially in phase with it. In this case, the phasing coils in conjunction with the potential coils will produce a torque which will cause the moving contact of the CN33P relay to make with the stationary CLOSE contact and close the network breaker, thus connecting the transformer bank to the network, provided the CNJ contacts are closed.

The instant the breaker closes, power starts to flow from the transformer into the network. This causes current to flow in the current coils of the relay, and produces a stronger torque in the closing direction. The network breaker will remain closed even if conditions change so that there is no current flowing through it. As the current decreases to

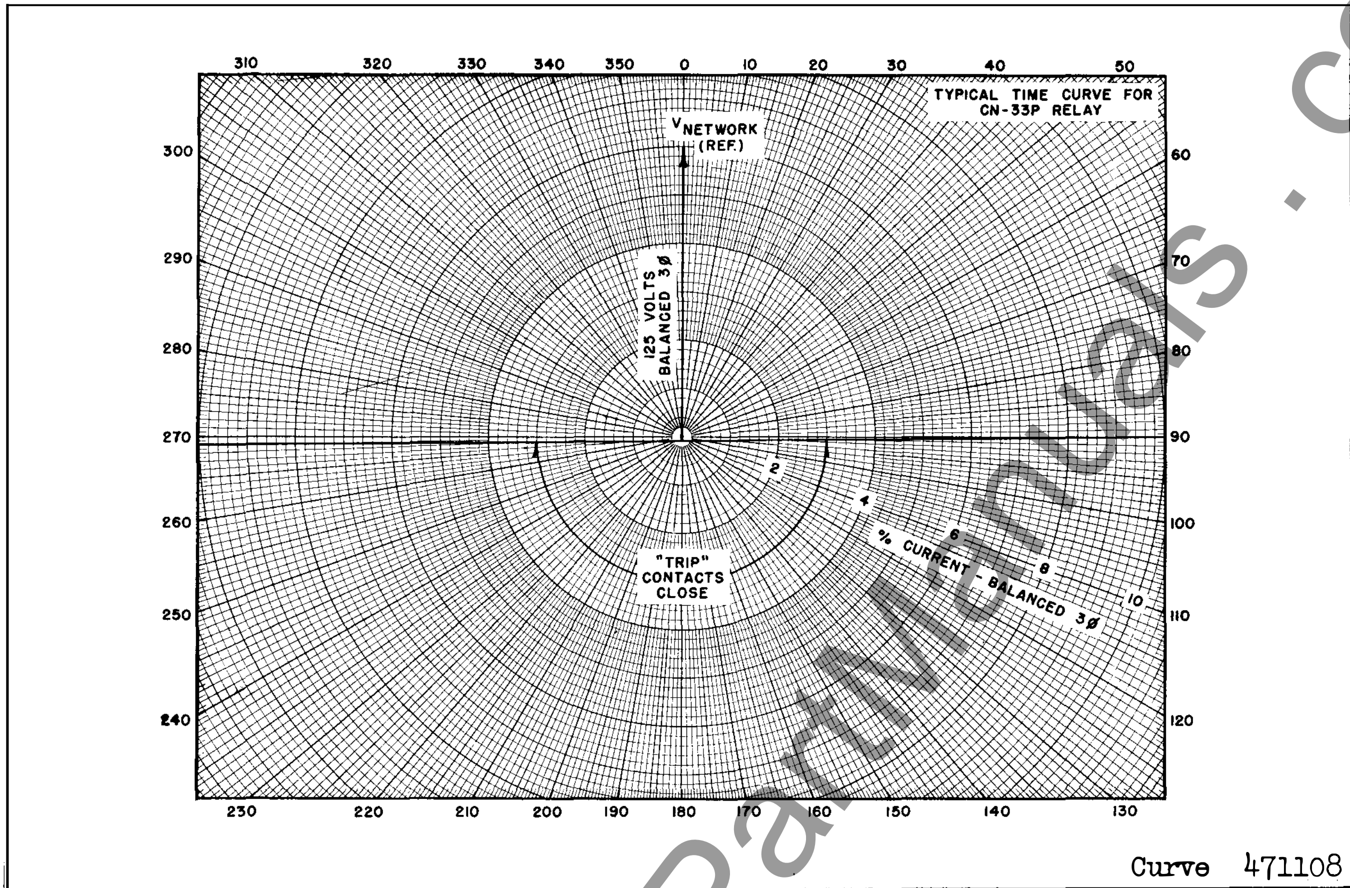


Fig. 7 Typical Trip Phase Angle Curve for the CN33P Relay — Low Current Values.

zero, the moving contact will move away from the stationary CLOSE contact and take up a position somewhere between it and the stationary TRIP contact.

When the feeder breaker opens, the transformer will be magnetized from the network. This flow of exciting current from the network to the transformer bank will cause enough current to flow in the current coils in the type CN33P relay to produce a tripping torque sufficient to close the TRIP contacts. This energizes the BN relay which will trip the breaker when its timer contacts have closed. The timer contacts are shunted by the instantaneous trip contacts which close when the reverse current exceeds their setting.

Fig. 4 shows the phasing coils short circuited through a resistance by 52Z contacts when the breaker is closed. This circuit is used to obtain the desired tripping phase angle characteristic.

CHARACTERISTICS

Figures 5, 6 & 7 show the operating characteristics of the type CN33P primary network relay for balanced 3 phase conditions. Fig. 5 shows the closing characteristics of the relay. For curve #1A, lines drawn from the origin at various angles with respect to the network voltage represent both in magnitude and phase position the transformer voltage which will produce a torque in the relay just sufficient to cause its CLOSE contacts to make. Any transformer voltage which does not terminate on or above the closing curve will produce a relay torque in the tripping direction. Curve #1A in fig. 5 shows a small section of the closing curve plotted to a much larger scale so as to show the characteristics of the relay for the values of phasing voltage at which it normally operates. Lines drawn from the origin to this curve represent in magnitude and phase position the phasing voltage (the voltage across the open breaker) necessary to produce a torque in the relay just sufficient to make its CLOSE contacts.

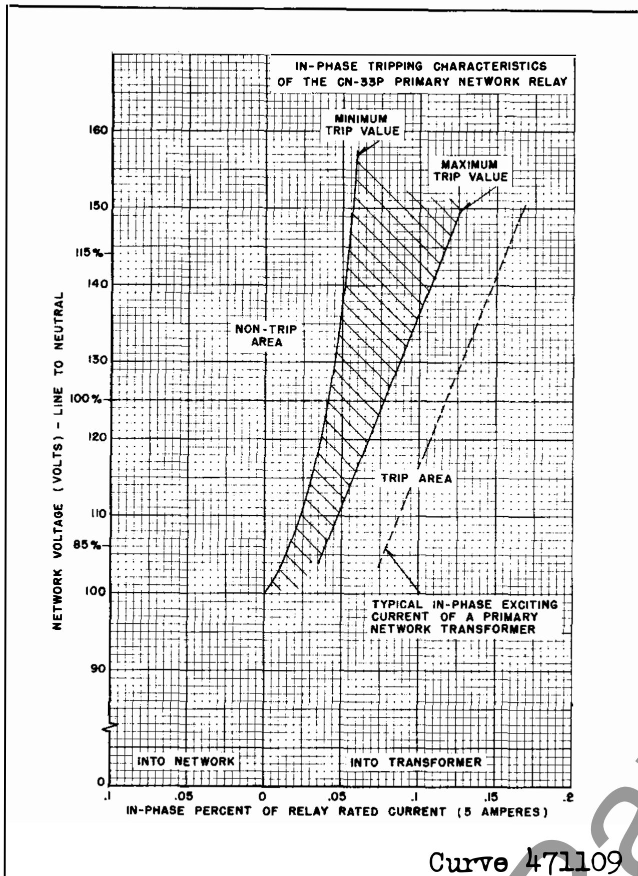


Fig. 8 Trip Sensitivity Characteristic of the Type CN33P Relay — Voltage & Current In Phase.

The upper end or line potential end of the voltage vector is at the origin in this case. It will be noted by referring to curve #1A of Fig. 5 that the relay will just close its CLOSE contacts with approximately 0.5 volts across the phasing circuit, in phase with the network voltage.

The closing voltage adjusting screw, located on the front panel, allows a range of adjustment of the in-phase phasing voltage pickup from 0.5 to 2 volts.

Figure 6 and 7 show typical tripping phase angle characteristic of the CN33P with 125 volts applied to the potential coils. Lines drawn from the origin to the curve are the currents which will produce a torque in the relay just sufficient to cause its TRIP contacts to make. The curve shown in Fig. 7 represents a small section of the trip curve just discussed plotted to a much larger scale in order to show the operation of the relay on small current values, such as the transformer magnetizing currents.

Fig. 8 shows the trip sensitivity characteristic, which shows how it parallels the transformer exciting current variations. At zero voltage, the TRIP contacts are closed by spiral spring tension. Voltage-only torque oppose this spring tension. Accordingly, at zero current & some value of voltage, below 100 volts, the voltage-only torque opens the TRIP contacts. This voltage-only torque is overcome and the TRIP contacts close when 2-4 ma in-phase current flows toward the transformer.

SETTINGS

Set the voltage closing adjusting screw for the desired value. Adjustment range is 0.5-2.0 phasing volts, in phase with a network potential of 125 volts. Factory adjustment is a nominal 0.5 volts. Refer to Fig. 9 for the test circuit used to make this adjustment. (Close switches A, B C, A", B," & C". Energize potential coils with 125 volts. Place switches A', B' & C' in position 2. Phasing voltage is measured across the one ohm resistors.)

It is not intended that the factory adjustment of the trip sensitivity characteristic be changed. *Note that if the spiral spring setting is changed,* the phasing voltage adjustment is affected.

INSTALLATION

The relays should be mounted on switchboard panels or their equivalent in a location free from dirt, moisture, excessive vibration, and heat. Mount the relay vertically by means of the two mounting holes through the case. Either a mounting stud or mounting screw may be utilized for grounding the relay. Electrical connections are made to the stationary terminal blocks.

ADJUSTMENTS & MAINTENANCE

All characteristics described are based on normal three-phase energization of the relay, with the phase order being 1, 2, 3. Where in-phase relationships are described, they are with respect to the individual phase voltages and current. Nominal rated voltage is 125 volts 60 cycles.

Acceptance & Routine Maintenance checks

Connect the relay per Fig. 9 & perform the following checks:

A) Close switches A, B, C. Adjust for 125 volts, phase to neutral, on the potential coils. Preheat for one hour.

B) Close switches A", B", & C". Place switches A', B' & C' in position 1 & adjust the current

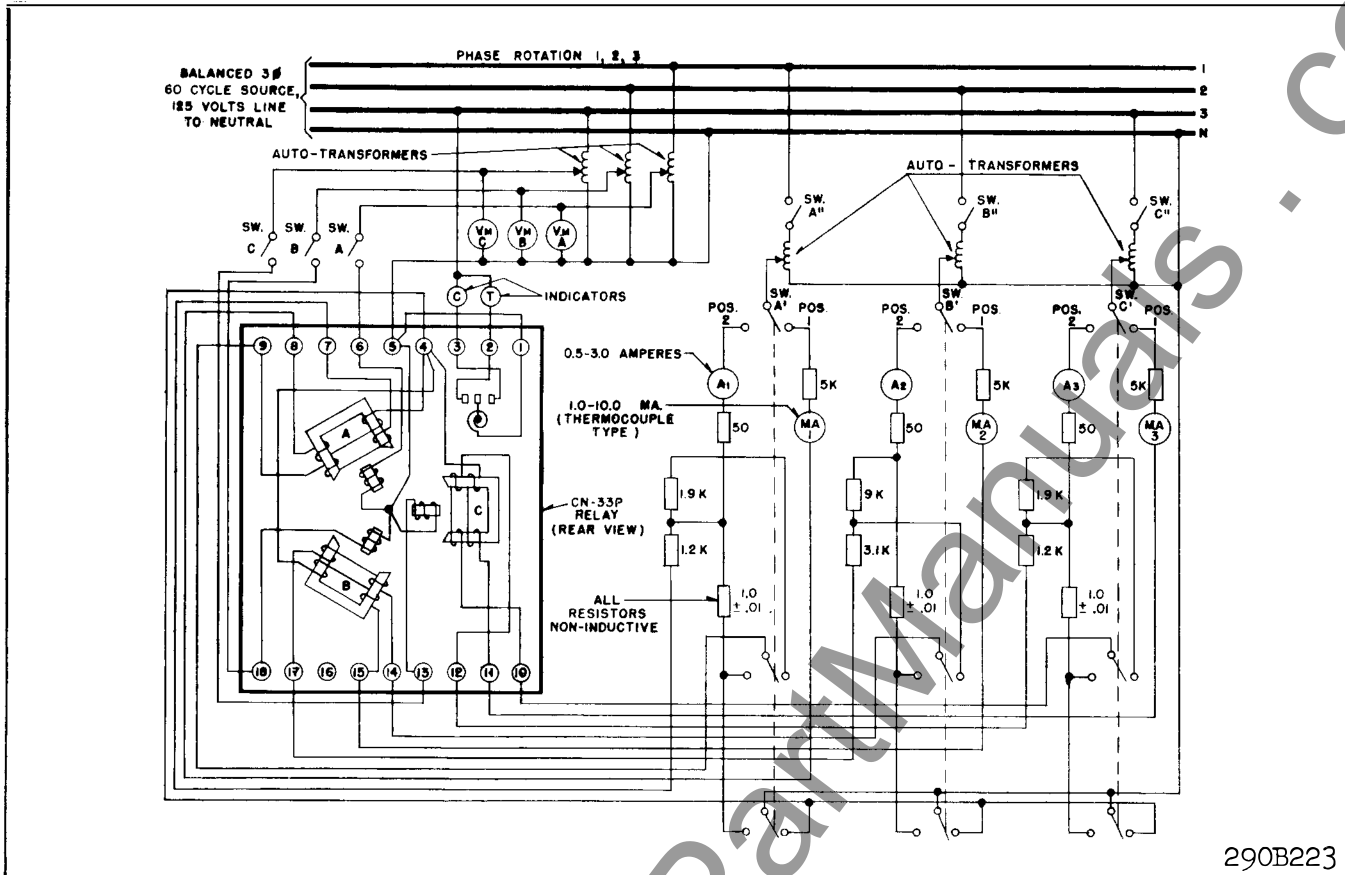


Fig. 9 Test Connections for Type CN33P Relay.

in MA1, MA2 & MA3 until the TRIP contacts just close. This current should be 2-4 ma. (All three currents should be the same). Potential coils should be energized at 125 volts.

C) Open switches A", B" & C" & reduce voltage on potential coils until TRIP contacts close. This potential should be 100 volts or less, line to neutral.

D) Close switches A", B" & C". Place switches A', B' & C' in position 2. Energize potential coils at 125 volts, phase to neutral. Adjust the phasing voltage (voltage across one ohm resistors) until CLOSE contacts just close. This value should be 0.5-0.8 volts.

Calibration

If the acceptance or routine maintenance check has shown further adjusting necessary, the following procedure may be used to recalibrate the relay.

Mechanical Adjustment

A. Set contacts (See Settings). The moving contacts are adjusted such that the contact springs are just touching their support. Just touching is determined as follows: With the relay vertical, as it would be mounted, the moving contact springs should be touching their respective supports. Turn the relay counter clockwise until the moving contact is horizontal. The weight of the moving TRIP contact should move the contact spring away from its support. Turn the relay horizontally in the opposite direction (clockwise) and the CLOSE moving contact spring should move away from its support.

B. Adjust the end play of the drum shaft to approximately .003 to .010 inches by setting the front bearing.

C. Check the position of the moving contact assembly in relation to the moving element stops. It should move about an equal distance on either side of the vertical center line with the stationary contacts moved back. If the position is not correct then loosen the two screws in the counter-weights and adjust. The inner spring support should not touch the spiral spring adjuster.

D. Adjust the stationary contact screws to deflect the moving contact when the drum is against its stop, to a point where they just fail to touch their supporting bracket. Set the spiral spring so that the TRIP contacts just make.

Electrical Adjustment

The relay should be preheated before calibration by applying rated volts, either single phase or three phase to the potential coils for a period of 1 hour. The relay can then be calibrated using the test circuit of Fig. 9.

Tripping Adjustment

With the TRIP contacts set to just make, the current and phasing (outer) electromagnets are adjusted, single phase to give the desired voltage only bias in the close direction by the following procedure.

1. Apply rated voltage to phase A potential coil (Switch A). Energize the current coils with 6 milliamp (Sw A" and Sw A', pos. 1). Adjust phase A phasing and current (outer) electromagnet by varying the air gap between it and potential (inner) electromagnet. The TRIP contacts should just make at 6 milliamps and break at 5 milliamps or above.

   Adjust phase B and C similar to phase A.

2. With all phases calibrated the three phase trip should be checked. Apply rated three phase voltage (Switches ABC) and adjust the current until the trip contacts just make and the three currents are equal. The TRIP contacts should make at 2.0 to 2.4 milliamp three phase. If the trip current is not within this range, the following readjustments should be made.

   a) If the *trip current is high* change the spiral spring setting by turning the pinion one to two teeth in a direction to open the trip contacts, then readjust the outer electromagnets. Recheck the three phase trip value.

   b) If the *trip current is low,* change the spiral spring setting by turning the pinion one to two teeth in a direction to close the trip contacts, then readjust the outer electromagnets. Recheck the three phase trip value.

3. With zero current applied to the relay, increase the voltage from zero. The TRIP contacts should open at 100 volts or less.

Closing Adjustment

With rated voltage applied to the potential coils and 0.5-2.0 volts on the phasing coils (Switches A'B'C'-Pos. 2; 2 amps through 1 ohm non-inductive resistors) adjust the CLOSE contact to make by using the phasing voltage adjusting screw. Normally the final setting will be made at 0.5 to 0.7 volts.

With the above calibration the relay should have the characteristics shown in Figures 5, 6, 7 and 8.

NOTE: Removerelay from case and check to see that minimum clearance between any outer electromagnet and the drum is not less than .015" when the relay is in its normal operating position.

The permanent magnet gap should be approximately .020 inches.

BURDEN

Potential Coils @ 125 volts, 60 cycles: 24.5VA phase @ 80° lag

Current Coils @ 5 amperes, 60 cycles: 9.4VA/phase @ 62° lag

Phasing coils @ 125 volts, 60 cycles:

	VA	phase angle-lag	ohms
Bkr. open, Phases A&C	6.5	22°	1200
Bkr. open, Phase B	0.91	4°	12000
Bkr. closed, Phases A,B&C	3.9	13°	3100

WESTINGHOUSE ELECTRIC CORPORATION

RELAY DEPARTMENT **NEWARK, N. J.**

Printed in U. S. A.