GEK-34117G

INSTRUCTIONS

POLYPHASE POWER DIRECTIONAL RELAY
FOR ANTI-MOTORING PROTECTION

TYPE GGP53C

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POWER DIRECTIONAL RELAY

TYPE GGP53C

DESCRIPTION

The Type GGP53C is an extremely sensitive three phase, time delay, power directional relay designed to provide anti-motoring protection for steam turbine generators upon the loss of its prime mover power. The relay consists of an instantaneous power directional element which operates on the in-phase component of current plus a separate AC operated adjustable time delay element all included with a target seal-in unit in a standard M2 drawout case. The internal connections for this relay are illustrated in Fig. 1. The outline and drilling dimensions are indicated in Fig. 2. One GGP53C is required per generating unit.

APPLICATION

The GGP53C relay was designed specifically to provide anti-motoring protection for steam turbine generators where extreme sensitivity is required. However, it may be applied wherever a sensitive three phase power directional function with time delay is required.

Under balanced three phase conditions and with rated voltage applied, the relay has an adjustable range of pickup from 0.01 to 0.04 amperes of unity power factor current. With generator CT's sized so that full KVA rating of the generator produces five secondary amperes, the GGP53C will operate for motoring power in excess of the adjustable range of 0.2-0.8 percent of this KVA rating. Since generator CT's are generally oversized, the actual sensitivity of the system will be reduced. This is illustrated in the section under **CALCULATIONS OF SETTINGS.**

Because of its extreme sensitivity, the GGP53C is almost universally applicable for anti-motoring protection. However, in many instances, the motoring power taken by the generator is so large that the sensitivity of the GGP53C relay is not required. The actual sensitivity required will depend on the CT ratio used and the motoring power taken by generator unit. While the following table lists some general ranges of motoring power as a function of the different kinds of prime movers, for any specific application the minimum motoring power taken by the generator should be obtained from the supplier of the unit.

If the extreme sensitivity of the GGP53C relay is neither required nor desired, information on less sensitive power directional relays may be obtained from the local General Electric Company Sales Office.

TYPE OF PRIME MOVER	MOTORING POWER IN PERCENT OF UNIT RATING
Gas Turbine:	
Single Shaft	100
Double Shaft	10-15
Four Cycle Diesel	15
Two Cycle Diesel	25
Hydraulic Turbine	2-100**
Steam Turbine (Conventional)	1-4
Steam Turbine (Cond. Cooled)	0.5-1.0

** The larger powers are taken by turbines having submerged impellers.

The power directional unit in the GGP53C relay operates instantaneously to energize a separate AC operated time delay unit in the relay. This time delay unit is adjustable in the range of from about one to 30 seconds. See time curves in Fig. 3. A suitable setting should be made so that,

1) The relay will not time out on power swings during synchronizing

2) The relay will not time out if the directional unit operates on a transient basis during nearby external faults.

A minimum setting of about five seconds should be considered unless there is good reason for shorter settings.

Fig. 4 illustrates the external connections to the relay. It is important that the associated circuit breaker's auxiliary switch is used in the timer circuit to prevent operation when the main circuit breaker is open. This will eliminate any possibility of nuisance operations due to vibration while the generator unit is being brought up to speed.

It also should be recognized that the GGP53C is a true power directional relay only under balanced voltage and current conditions. Its sensitivity is based on balanced conditions with rated voltages applied. At applied balanced voltages different from the rated value, the current required to operate the relay is given by the following equation.

$$I = I_R \times \frac{\text{Rated Voltage}}{\text{Applied Voltage}}$$

where: I_R is the current required to operate the relay with rated voltage applied.

When selecting a GGP53C relay, select a voltage rating that matches the voltage supply. For example, if the generator PT's will be connected to supply a nominal
* 120 volts phase-to-phase, then a relay with a 120 volt rating should be used.

RATINGS

Type GGP53C relays are available with potential coils rated at 120 volts or 208 volts and current coils rated at five amperes. The one-second rating of the current circuit is 260 amperes.

The current-closing rating of the contacts is 30 amperes for voltages not exceeding 250 volts. The current-carrying ratings are affected by the selection of the tap on the seal-in coil as indicated in the following table:

		Target and Seal-in Coil Tap	
		2-Amp	0.2-Amp
Coil DC Resistance	(ohms)	0.24	8.3
Tripping Duty (AC or DC)	(amps)	30	5
Carry Continuously (AC or DC)	(amps)	2.3	0.35

The tap setting used on the seal-in unit is determined by the current drawn by the trip coil. The 0.2 ampere tap is for use with trip coils that operate on currents ranging from 0.2 up to two amperes at the minimum control voltage. If this tap is used with trip coils requiring more than two amperes, there is a possibility that the 8.3 ohms resistance will reduce the current to so low a value that the breaker will not be tripped.

The 2.0 ampere tap should be used with trip coils that take 2.0 amperes or more at minimum control voltage, providing the tripping current does not exceed 30 amperes at the maximum voltage. If the tripping current exceeds 30 amperes, an auxiliary relay should be used, the connections being such that the tripping current does not pass through the contacts or the target seal-in coil of the protective relay.

CHARACTERISTICS

The units in the GGP53C operate on the induction principle.

The top overvoltage unit operates from a single quantity, voltage. The flux from the operating magnet induces eddy currents in the disk, which react with the flux from the operating magnet to produce contact closing torque. The closing torque is restrained by a damping magnet to produce a time-voltage characteristic as shown in Fig. 3.

The lower polyphase power directional unit operates from two quantities, voltage and current. Both these quantities induce eddy currents in a cup-type assembly to produce torque, which is a function of the magnitudes of these quantities and the phase angle between them. The circuitry is arranged so that the unit produces maximum torque when the currents are at their unity power factor position and zero torque when ± 90 degrees from the unity power factor position.

The general expression of the torque for this unit under balanced three phase conditions is as follows:

T = K E I Cos $(\theta - 30)$
K = The design constant
E = The L-L voltage
I = The phase current
θ = The angle by which I leads E

The circuitry is arranged so that:

E12 works with I_2
E23 works with I_3
E31 works with I_1

BURDENS

The burdens of the currents at five amperes are as follows:

TERMINALS	60 HERTZ			50 HERTZ		
	VA	WATTS	P.F.	VA	WATTS	P.F.
3 - 4	22.0	6.4	0.29	18.2	5.4	0.29
5 - 6	11.0	3.2	0.29	9.1	2.7	0.29
7 - 8	11.0	3.2	0.29	9.1	2.7	0.29

The burdens of the potential circuits at 120 volts are as follows:

TERMINALS	60 HERTZ			50 HERTZ		
	VA	WATTS	P.F.	VA	WATTS	P.F.
2 - 12	20.3	7.8	0.38	24.0	9.9	0.41
13 - 14	21.4	10.7	0.50	18.0	9.0	0.50
15 - 16	21.4	10.7	0.50	18.0	9.0	0.50

CALCULATIONS OF SETTINGS

Consider a large steam driven turbine generator unit under the following conditions:

Full Load MVA	-	832 MVA
Rated Voltage	-	24 kV
Full Load Current	-	20,000 Amperes
PT Ratio	-	25,000/120
CT Ratio	-	30,000/5

Assume that the minimum motoring power taken by the unit with full vacuum in the condenser is given as 4.0 mW. Then the unity power factor component of the motoring current at rated voltage will be:

$$\frac{4000}{24\sqrt{3}} = 96 \text{ Primary Amperes}$$

or

$$\frac{96 \times 5}{30,000} = 0.016 \text{ Secondary Amperes}$$

The secondary voltage applied to the relay at rated primary voltage is

$$\frac{24,000}{25,000} \times 120 = 115 \text{ Secondary Volts}$$

For a relay rated for 120 volts and calibrated to pick up at 0.010 ampere at rated volts , approximately 0.0104 ampere would be required at 115 volts applied.

Because the relay operates on real power, if its setting is based on the motoring power taken by the machine at rated machine voltage and the actual CT and PT ratios, it will provide essentially the same protection when the machine is operated either above or below rated voltage.

For the example given above a pickup setting of 0.010 ampere is suggested. The time delay should be set long enough to eliminate the possibilities of undesired operation from the causes noted in the section under **APPLICATION.**

CONSTRUCTION

Refer to photographs, Fig. 5 and 6, which identify the components of the relay.

The type GGP53C relay consists of a time-delay overvoltage unit (upper), a three phase directional unit (lower) and a target and seal-in unit.

TIME OVERVOLTAGE UNIT

The time-delay overvoltage unit is of the induction-disk construction. A potential operating coil on a laminated U-magnet actuates the disk. The disk shaft carries the moving contact which completes the trip or alarm circuit when it touches the stationary contact. To give the proper contact closing voltage, the disk shaft is restrained by a spiral spring, and its motion is retarded by a permanent magnet acting on the disk to give the correct time delay.

TARGET AND SEAL-IN UNIT

A seal-in unit is mounted to the left of the disk shaft. This unit has its coil in series and its contacts in parallel with the main contacts of the time overvoltage unit such that when the main contacts close, the seal-in unit picks up and seals in. When the seal-in unit picks up, it raises a target into view ehich latches up and remains exposed until released by pressing a button beneath the lower-left corner of the relay case.

DIRECTIONAL UNIT

The three phase directional unit is of induction-cylinder construction. The principle by which torque is developed is the same as that employed in an induction-disk relay with a watthour meter element, although the assembly is more like a split-phase induction motor.

Included in the construction of the lower assembly is the stator, which has eight laminated magnetic poles projecting inward and arranged symmetrically around a central magnetic core. The poles are fitted with current and potential coils. The cylindrical cup-like aluminum rotor, which turns freely in the annular air gap, is in the gap between the poles and the central core. The central core is fixed to the stator frame.

This construction provides higher torque and lower rotor inertia than the induction-disk construction, making this relay faster and more sensitive.

The relay components are mounted in a cradle assembly, which is latched into a drawout case when the relay is in operation, but it can be removed easily when desired. To do this, first disconnect the relay by removing the connection plug that completes the electrical connections between the case block and the cradle block. This connection block can be replaced by a test plug to test the relay in its case. The cover, which is attached to the front of the relay case, contains the target reset mechanism and an interlock arm which prevents the cover from being replaced until the connection plugs have been inserted.

The relay case is suitable for either semi-flush or surface mounting on all panels up to two inches thick; appropriate hardware is available. However, panel thickness must be indicated on the relay order to insure that proper hardware will be included. For outline and drilling dimensions, see Fig. 2. 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, and it is especially important that the auxiliary brush on these circuits makes contact as indicated to assure the current coil is connected to the CT circuit before the shorting bar parts.

RECEIVING, HANDLING AND STORAGE

These relays, when not included as 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 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. 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.

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

ACCEPTANCE TESTS

MECHANICAL CHECKS

Inspect the relay for damage sustained in transit, such as loose screws in assemblies, or in the terminal and cradle block, and for foreign particles, cracked molded parts, etc.

TOP UNIT

The disk and shaft end play should be about 1/64 inch. The pivot on the shaft assembly is riding on a spring-mounted synthetic jewel bearing. Depress the disk near the shaft and note that the disk has some downward motion as the spring is compressed. The pivot riding on this spring-mounted jewel prevents damage to the jewel in the event of shock in transit. Set the time dial near zero, then manually close the contact, and note that the contact deflects about 1/32 inch before it hits its backstop. Move the time dial to the No. 10 position to see that the disk will reset to its fully open position with a steady motion.

Operate the armature of the target seal-in unit by hand and note that the bridging contacts make about the same time, and with some wiping action, before the armature resets against the pole piece. During operation, the target should come into view and latch up before the total travel is exhausted. The reset level should reset the target with some extra travel after the target resets.

BOTTOM UNIT

Check the cup and shaft end for a 1/64 inch end play. This assembly also rides on a spring-mounted jewel.

The stationary contact is mounted in a barrel-type assembly with a cone-shaped contact mounted on a flexible disk projecting from the barrel. The moving contact also has a flexible member resting against a "U" shaped assembly at the other end.

Close the contacts manually and note that the stationary and movable contacts both deflect.

The contact gap has been set at the factory by moving the barrel to the right until the contacts just make, then the barrel is backed away about 5/8 of a turn which results in a 0.020 inch gap. The barrel and the screw in the back stop assembly both have threads with 32 turns per inch, which permits a convenient means to set or check the contact gap.

The clutch adjusting screw located on the right-hand side of the moving contact arm near the shaft should be tightened until it bottoms against the shaft. It must be in this position to prevent the clutch from slipping.

ELECTRICAL TESTS

TOP UNIT

Connect relay as per test diagram Fig. 8. The disk should pick up to close its contacts at 50 percent ±3 percent of the rated voltage.

Spot check the time curve as shown in Fig. 3, testing the pickup time at the 2 and 7 time dial settings. Test values should be within ±10 percent.

The target and seal-in unit should pick up at rated tap value or less. Disconnect the test leads from studs 1 and 11, and in their place supply a controlled DC current source to these studs. Close the time unit contacts to complete the circuit.

BOTTOM UNIT

Make a polarity test as shown in Fig. 9. To test the relay for its operating chracteristic, set up a test as shown in Fig. 10. The relays are set at the minimum value of the adjustable range when they leave the factory.

NOTE: **Before** checking or setting the pickup, the relay should be **preheated** (energized with three-phase rated voltage as shown in Figure 10) for 30 minutes.

A typical minimum pickup value is 10 milliamperes. The pickup may be increased to its maximum value of 40 milliamperes by adjusting the control spring adjusting ring.

If three meters are not available for checking the minimum pickup values of the test circuit, one meter may be used in one of the phases. However, a resistance equal to that of the milliammeter, which will be mostly resistive, must be placed in the other two phases to keep all phase currents balanced. A voltage drop across these known resistance values, with a high ohm-per-volt meter, will give assurance that the currents are equal.

Test the holding action of the holding coil. This coil maintains the closing circuit when the relay is operating at its minimum pickup value, in an environment where the relay is subjected to vibration. If no holding action is present, the relay contacts might alternately close and open, resulting in an unstable supply of voltage to the timing unit. The holding action of the coil assists the operating current in maintaining the circuit; however, it should not hold the contacts closed when no operating torque is present.

Test the holding action by connecting studs 2 and 10 together and apply rated voltage to studs 9 and 12. Close the contacts manually and note that holding action is present, but not strong enough to overcome mechanical resetting force. The holding action has been set at the factory; however, if some change in the holding action is necessary, the holding coil air gap may be controlled by moving the contact barrel and the stop screw the same amount. This will provide better control than trying to pivot the pole pieces at the holding coil.

If the relays are mounted in a vibration-free, the holding coil circuit may be bypassed by placing both coil leads on one of the brass inserts, with both control leads on the other brass insert.

CLUTCH SETTING CHECK

The clutch adjusting screw located on the right hand side of the moving contact arm near the shaft (see Figure 6) should be tightened until it bottoms against the shaft. It must be in this position to prevent the clutch from slipping.

With rated voltage and balanced 10 Ampere current at the angle of maximum torque, check that the clutch does not slip.

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 dimensions are shown in Fig. 2.

CONNECTIONS

The internal connections diagram for this relay is shown in Fig. 1. The external wiring diagram is shown in Fig. 4.

One of the mounting studs or screws should be permanently grounded by a conductor not less than No. 12 B&S gauge copper wire or its equivalent.

INSPECTION

At the time of installation, the relay should be inspected for tarnished contacts, loose screws, or other imperfections. Corrections should be made to the relay as described in the section, **PERIODIC CHECKS AND ROUTINE MAINTENANCE.**

CAUTION

EVERY CIRCUIT IN THE DRAWOUT CASE HAS AN AUXILIARY BRUSH. IT IS ESPECIALLY IMPORTANT ON CURRENT CIRCUITS WITH SHORTING BARS THAT THE AUXILIARY BRUSH BE BENT HIGH ENOUGH TO ENGAGE THE CONNECTING PLUG OR TEST PLUG BEFORE THE MAIN BRUSHES DO. THIS WILL PREVENT CT SECONDARY CIRCUITS FROM BEING OPENED. SEE FIG. 7 SHOWING A CUTAWAY VIEW OF THIS ASSEMBLY.

FIELD INSTALLATION TESTS

When installing the relay, it is necessary for the voltages and currents to go to the proper relay terminals.

Tests may be performed using a Weston phase angle meter and two relay plugs as shown in Fig. 11. Connect the relay as shown in the external wiring diagram, Fig. 4, and perform the tests outlined below.

Phase angle meter readings are the angles by which the current leads the voltage.

θ = Angle by which I_1 leads V_{1-2}

θ = 150° at unity power factor when the power flow is in non-trip direction

θ = 330° at unity power factor when the power flow is in the trip direction

Connect P_1 to common points 14R and 14B, P_2 to common points 13R and 13B								
Connect		3R	3B	5R	5B	7R	7B	Phase Angle Meter Reading
To	1	C1	C2	5B	5R	7B	7R	θ
	2	3B	3R	C1	C2	7B	7R	θ + 240
	3	3B	3R	5B	5R	C1	C2	θ + 120

Connect P_1 to common points 16R and 16B, P_2 to common points 15R and 15B								
Connect		3R	3B	5R	5B	7R	7B	Phase Angle Meter Reading
To	1	C1	C2	5B	5R	7B	7R	θ + 120
	2	3B	3R	C1	C2	7B	7R	θ
	3	3B	3R	5B	5R	C1	C2	θ + 240

Connect P_1 to common points 15R and 15B, P_2 to common points 14R and 14B							
Connect	3R	3B	5R	5B	7R	7B	Phase Angle Meter Reading
To 1	C1	C2	5B	5R	7B	7R	θ + 240
To 2	3B	3R	C1	C2	7B	7R	θ + 120
To 3	3B	3R	5B	5R	C1	C2	θ

TARGET AND SEAL-IN ELEMENT

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. Following this procedure prevents the right-hand stationary contact from getting out of adjustment. Screws should never be in both taps at the same time during normal operation.

For trip coils operating on currents ranging from 0.2 up to 2.0 amperes at the minimum control voltage, set the target and seal-in tap screw in the 0.2 ampere tap.

For trip coils operating on currents ranging from two to 30 amperes at the minimum control voltage, place the tap screw in the 2.0 ampere tap.

TIMING UNIT

The required time delay may be selected from the time versus time dial setting as shown in Fig. 3.

DIRECTIONAL UNIT

This unit is normally set at its minimum pickup value of the rated adjustable range (see **ACCEPTANCE TESTS**).

PERIODIC CHECKS AND ROUTINE MAINTENANCE

It is recommended that a mechanical inspection and an operation test be performed at least annually. The interval of the time for periodic checks on relays may vary depending upon the importance of the relay in the protective scheme and its environment, i.e., exposure to heat, moisture, and fumes.

In general, periodic checks serve to detect the two factors that can render the relay inoperative: excessive friction and contaminated contacts.

Check that the units have proper end play on both the disk and cup assemblies, approximately 1/64 inch.

For timing and directional units, a test for the minimum pickup value will determine whether the unit has undergone any changes in the circuit structures as well as reveal any undue friction. Small incremental changes in voltage or current that cause the moving assembly to move away from the back stop toward the contact will indicate a tendency to bind. The actual pickup value, if within limits, will give assurance that no changes have occurred in the circuit structure. Comparing a pickup value with its previous history of periodic checks is particularly useful in detecting whether the pickup value is rising over the years, which is an indication of impending trouble.

A flexible burnishing tool should be used for cleaning relay contacts. This is a flexible strip of metal with an etched-roughened surface, which in effect resembles a superfine file. The polishing action of this file is so delicate that no scratches are left on the contacts, yet it cleans off any corrosion thoroughly and rapidly. The flexibility of the tool insures the cleaning of the actual points of contact. 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.

A simple mechanical check of the directional unit, as follows, will reveal binding tendencies.

Remove the relay from its case and set on a bench. Tilt the relay until the moving assembly moves away from the contact or back stop. When there is no tendency of the relay to bind, any slight change in position should result in a change in the position of the moving assembly.

The clutch adjusting screw, located on the right-hand side of the moving contact arm near the shaft, should be tightened until it bottoms against the shaft. It must be in this position to prevent the clutch from slipping.

Check the operating time of the timing unit as outlined in **ACCEPTANCE TESTS**.

CALIBRATION

The following steps can be taken to calibrate the time and directional units.

TIME UNIT

The pickup of this unit is controlled by the spring just beneath the slotted adjusting ring. With any power applied to the relay, the spring is wound 690 degrees, which is sufficient to return the disk to its fully open position when the time dial is set at No. 10.

To calibrate for pickup, set the time dial at the No. 1 position. Then apply voltage to a value equal to 50 percent of the rating. The control spring can then be adjusted to just cause the relay contacts to make.

To calibrate for time, set the time dial at the No. 10 position. Then apply rated voltage to the relay to determine the operating time to close the contacts (which should be 30 seconds). Use the drag magnet to alter this time: moving the magnet towards the disk shaft shortens the time; moving it toward the disk's edge lengthens the time.

DIRECTIONAL UNIT

The pickup on this unit is controlled by the spring just beneath the adjusting ring, with holes to provide a means for adjustment. The holes are spaced at 60 degree intervals, that also provide a measure of the spring wind-up.

Without any power applied to the relay, set the control spring to cause the moving contact to come to rest at a position parallel to the sides of the relay. The back stop and barrel contacts are set to provide for the maximum motion of the moving assembly.

NOTE: **Before** checking or calibrating the relay, it should be **preheated** (energized with three-phase rated voltage as shown in Figure 10) for 30 minutes.

Apply rated three-phase voltage, with a One-Two-Three sequence, to the relay per Fig. 10. The unit will develop some voltage bias torque, the direction of which depends upon the position of the slot in the inner magnetic core of the relay. The inner core can be adjusted by loosening the hex nut which secures it to the cast iron frame. Rotate the core, in the semi-tightened position, until the moving contact assumes the same position as when no voltage was applied, i.e., zero voltage bias torque. Tighten the locknut securely, and recheck the torque to assure that tightening the nut did not alter the setting.

Apply current (per Fig. 10) to set the zero torque characteristic. Set the resistors one equal to the other as the adjustments are made, so that the relay develops zero torque at 120 degrees and 300 degrees.

Place the contacts and back stop into position for a 20 mill air gap. Wind up the control spring about 360 degrees. Test for pickup at the angle of maximum torque. The pickup value should be equal to or higher than the maximum value of the adjustable range. Reset the spring for a pickup value equal to the minimum value of the adjustable range.

The holding coil is set as described in the **ACCEPTANCE TESTS.**

CLUTCH SETTING

See **ACCEPTANCE TESTS** - BOTTOM UNIT.

RENEWAL PARTS

Sufficient quantities of renewal parts should 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 and 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, Figure 4 has been changed.

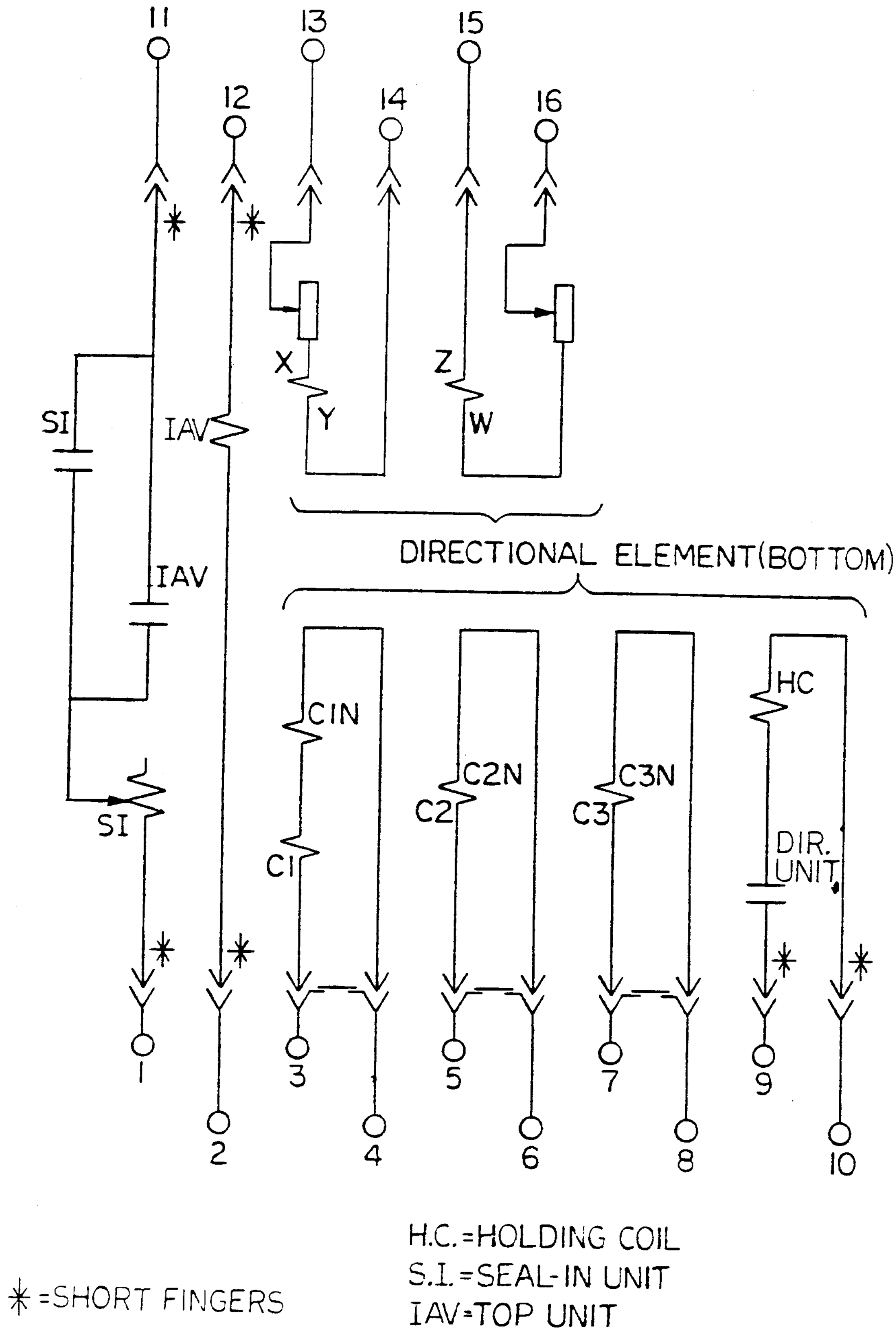


FIG. 1 (0246A2292-1) Internal Connection Diagram for GGP53C Relay (Front View)

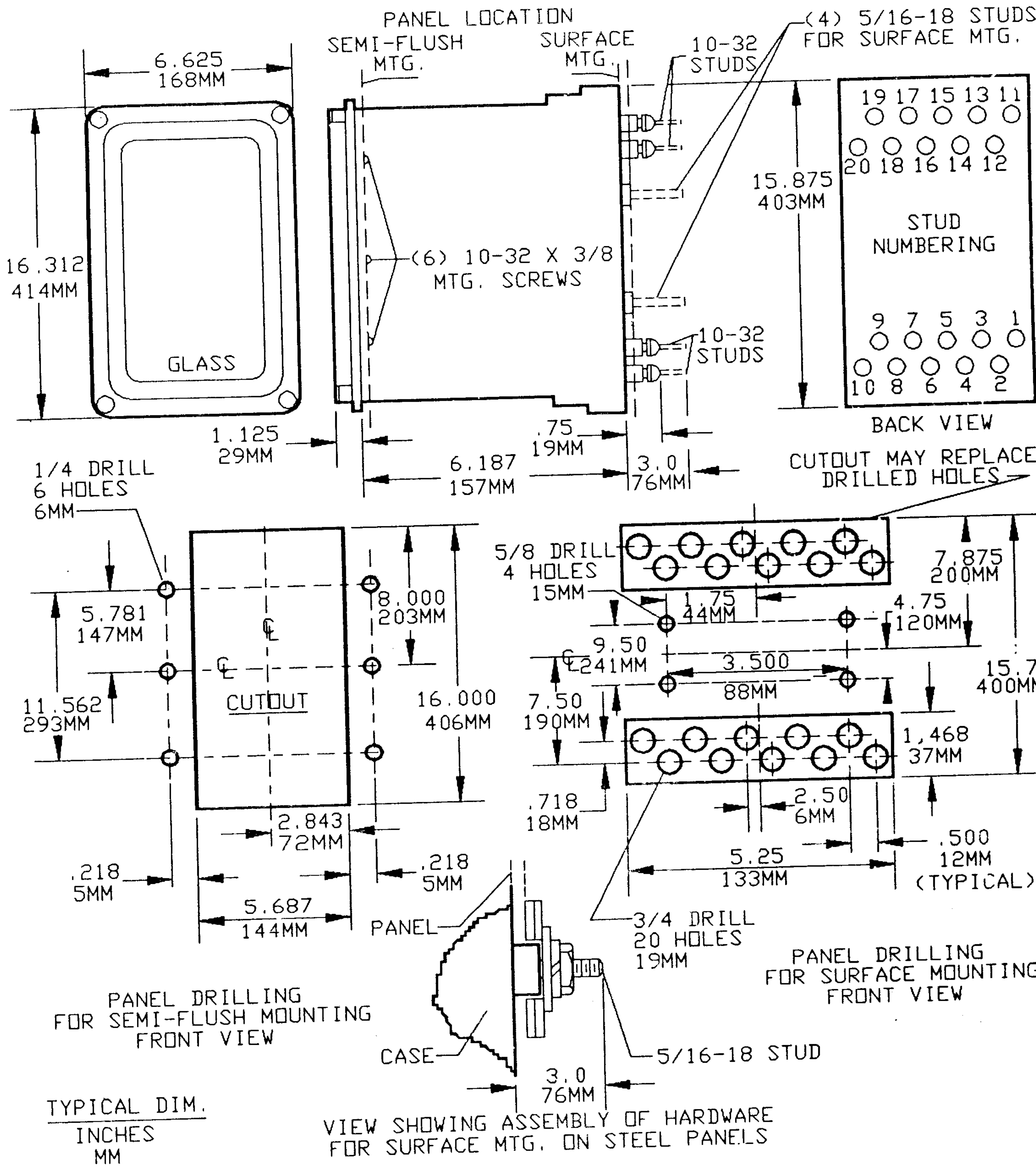


Figure 2 (K-6209274 [6]) Outline and Panel Drilling Dimensions for the GGP53C Relay

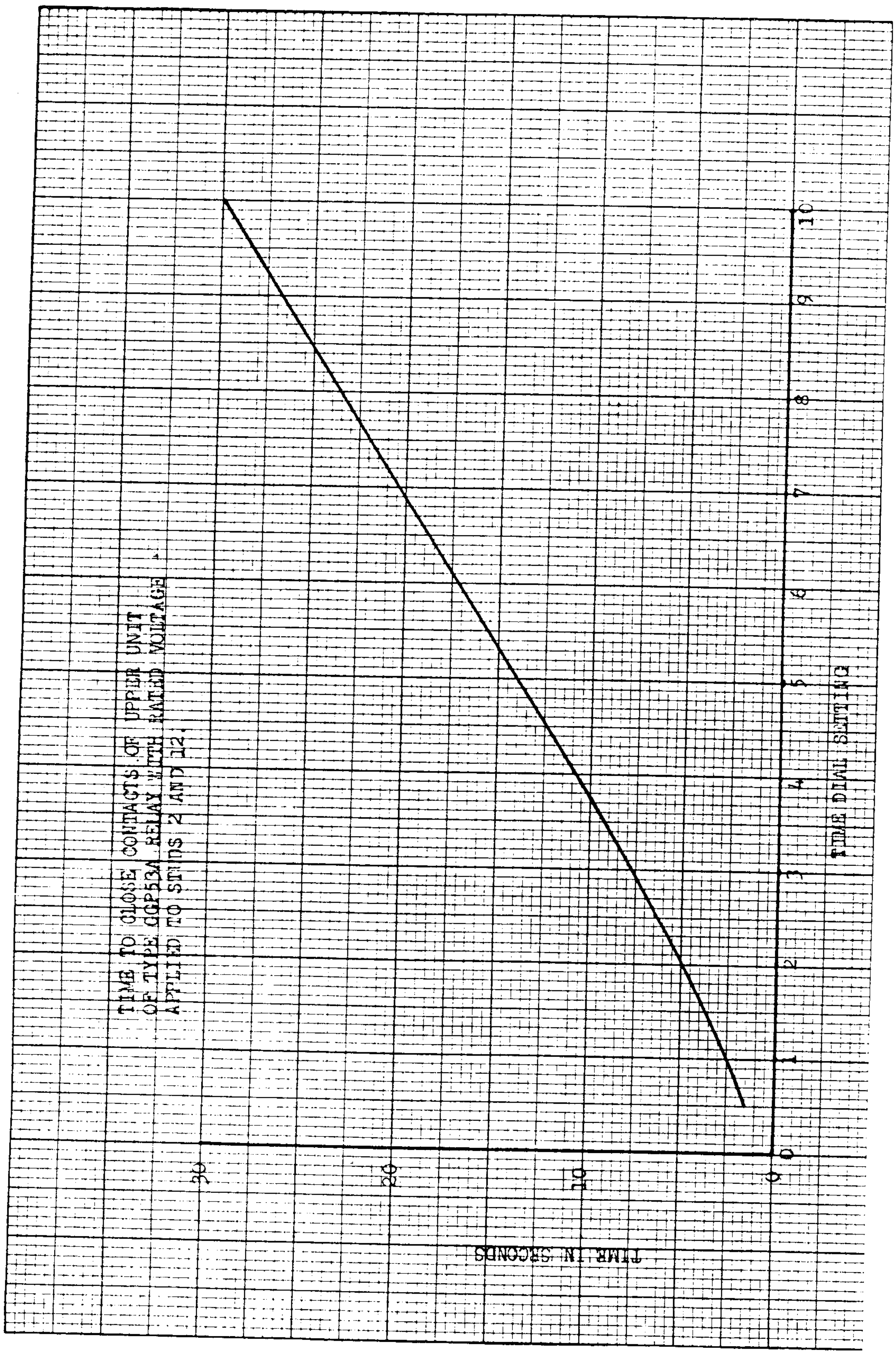


FIG. 3 (K-6400766-0) Time Curve for the GGP53C Relay (Top Unit)

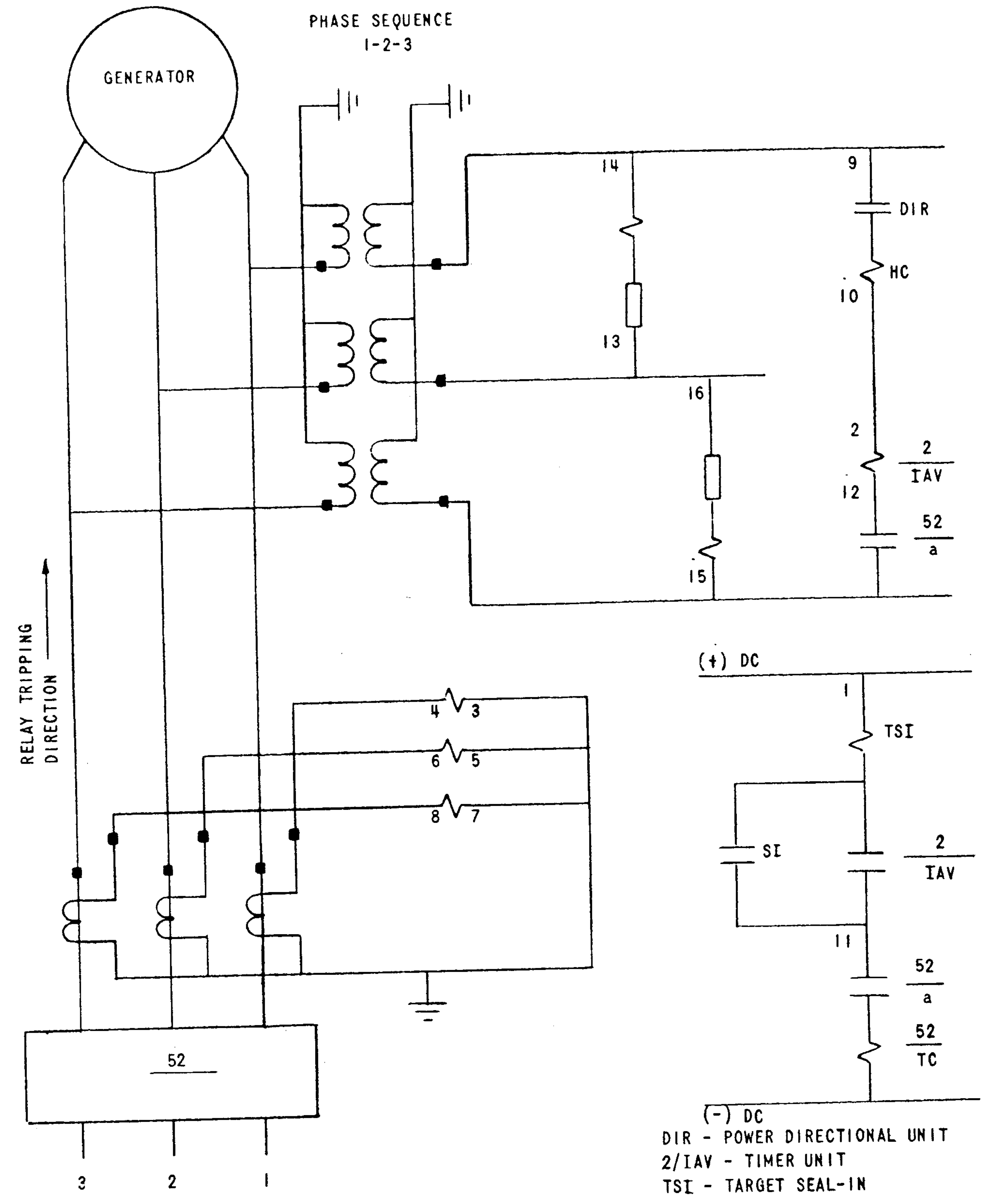


Figure 4 (0246A6841 [1]) External Connection Diagram

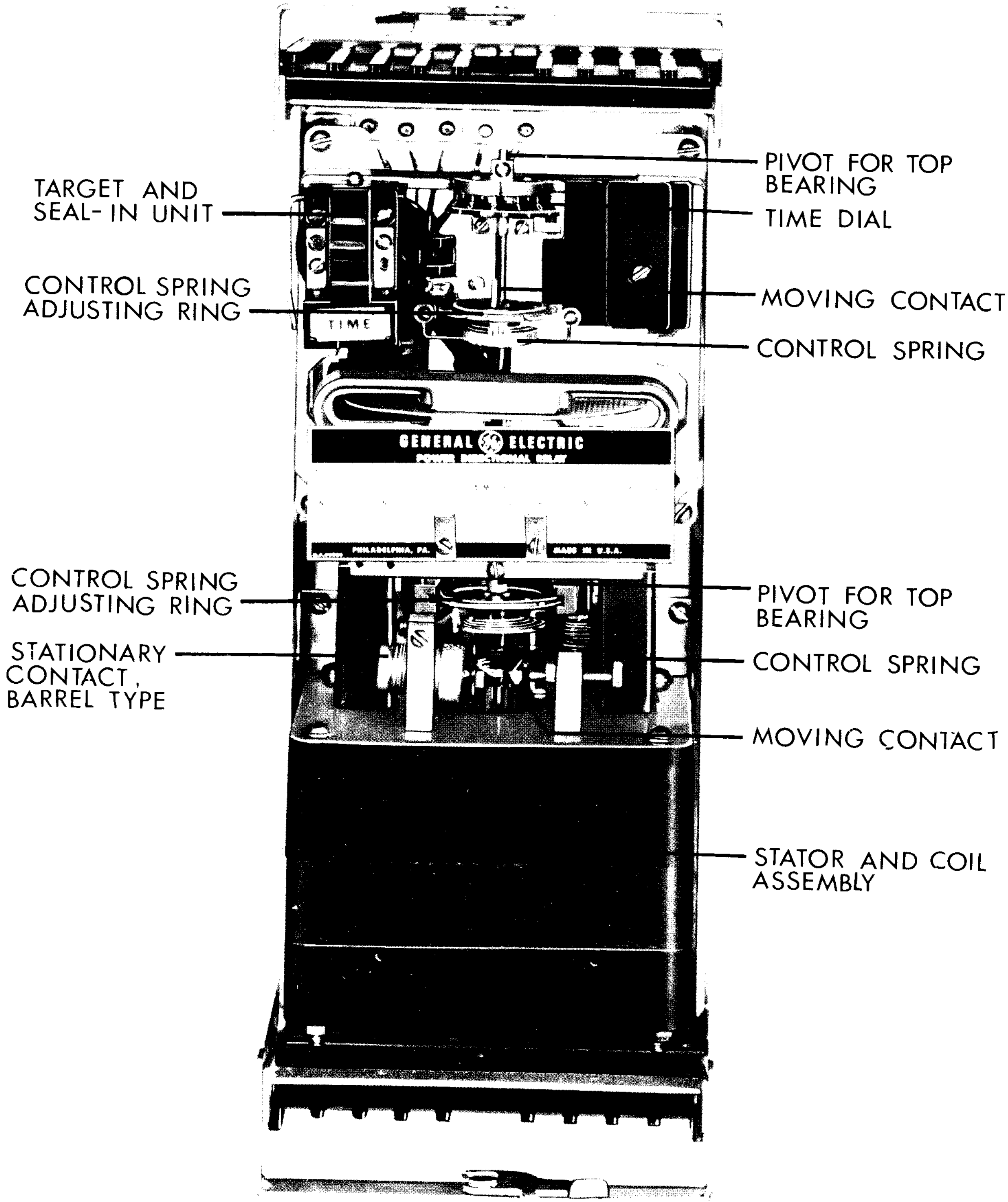


FIG. 5 (8041752) Type GGP53C (Front View)

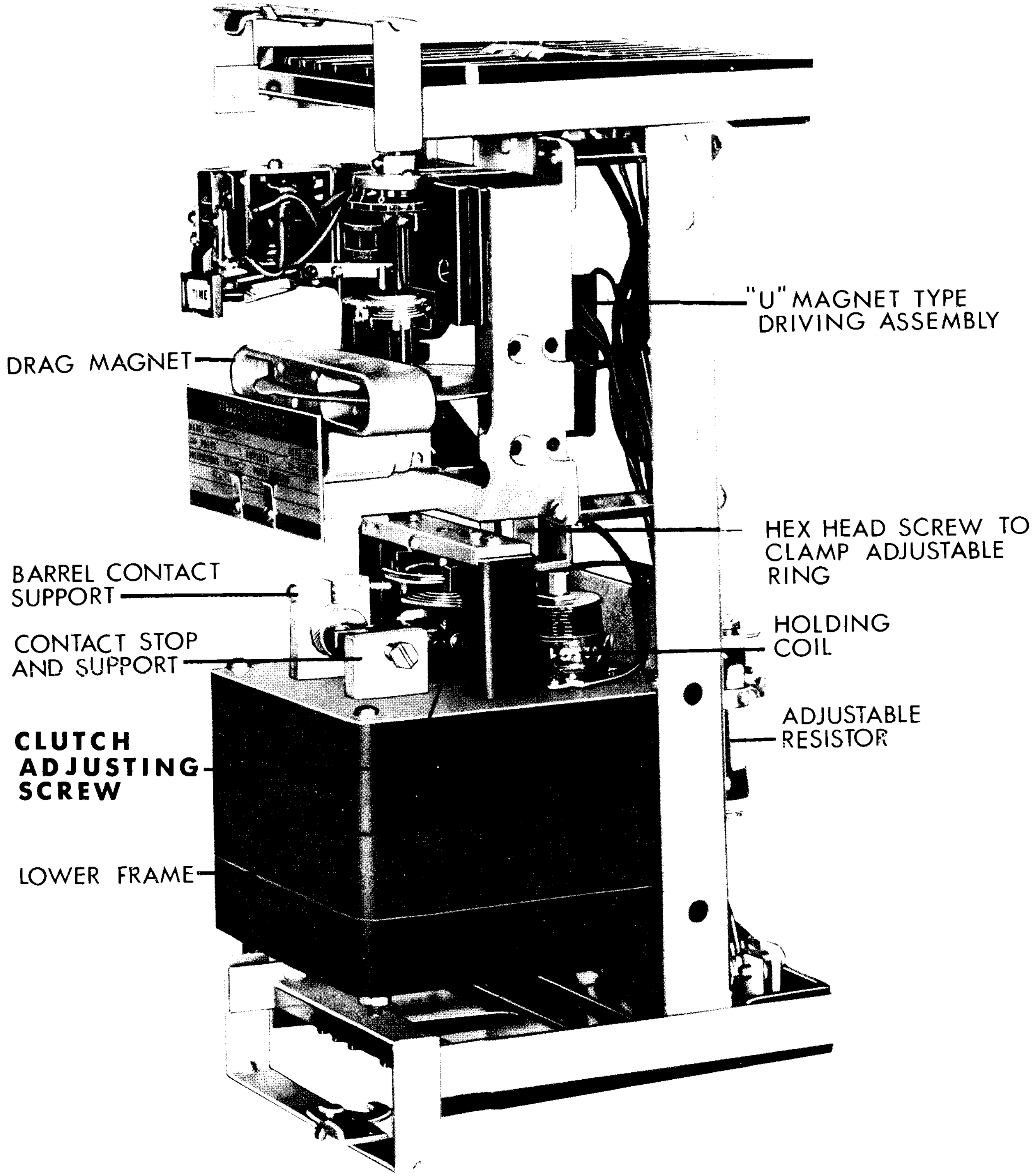


FIG. 6 (8041751 Rev. 1) Type GGP53C (3/4 Front View)

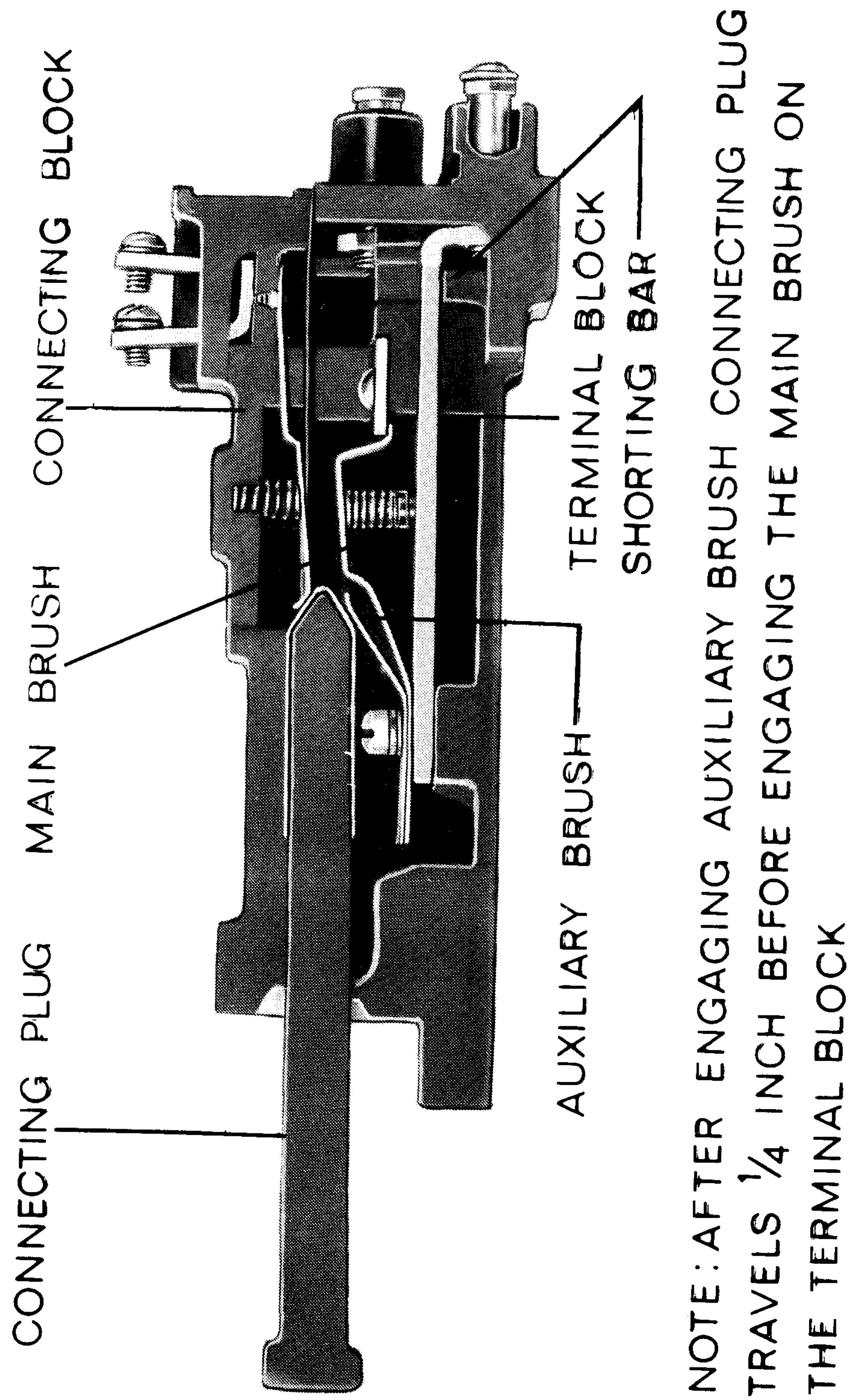


FIG. 7 (8025039) Cross Section Drawout Case Showing Position of Auxiliary Brush

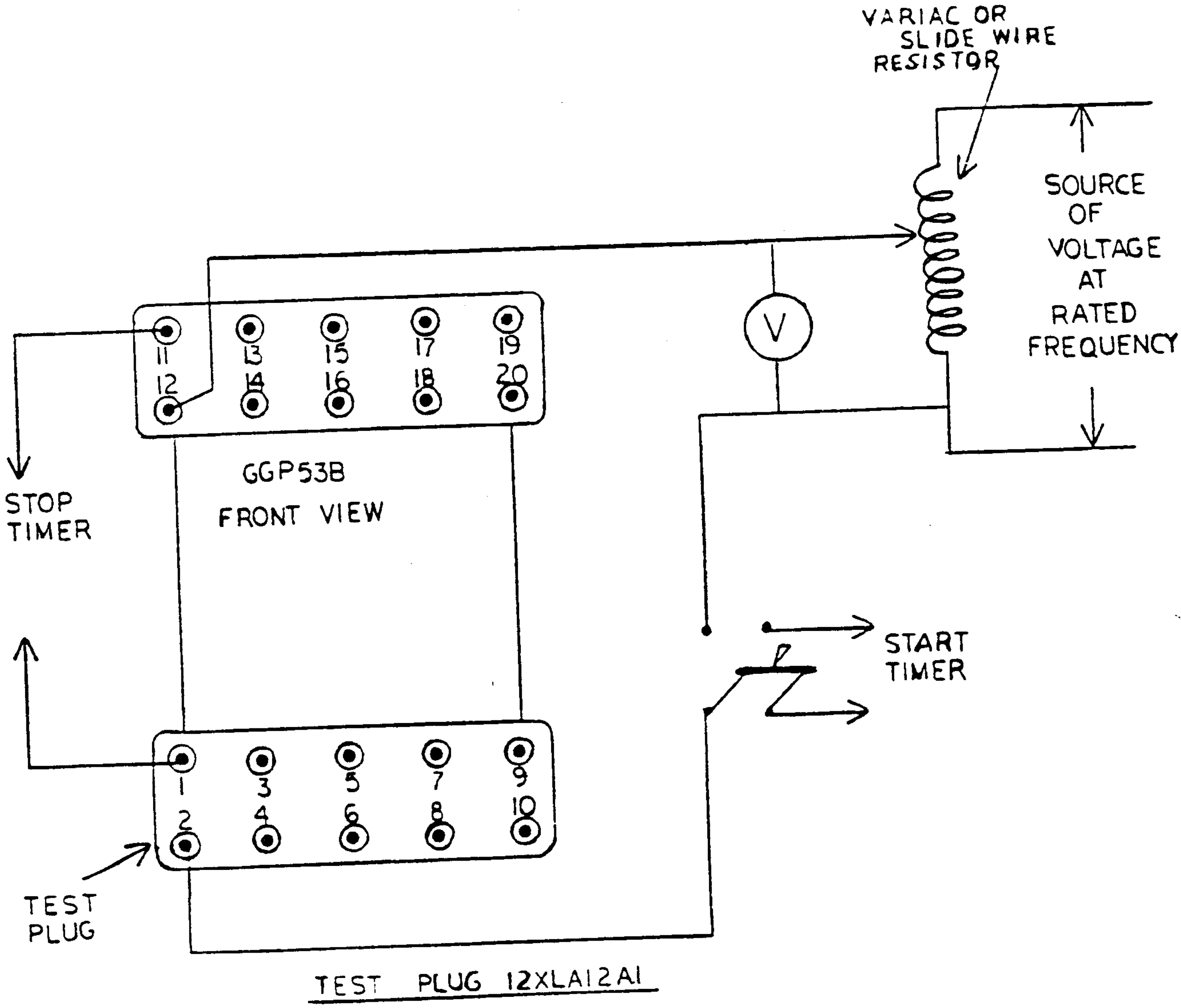


FIG. 8 (0226A6958-0) Test Diagram for Disk Unit (Upper Unit)

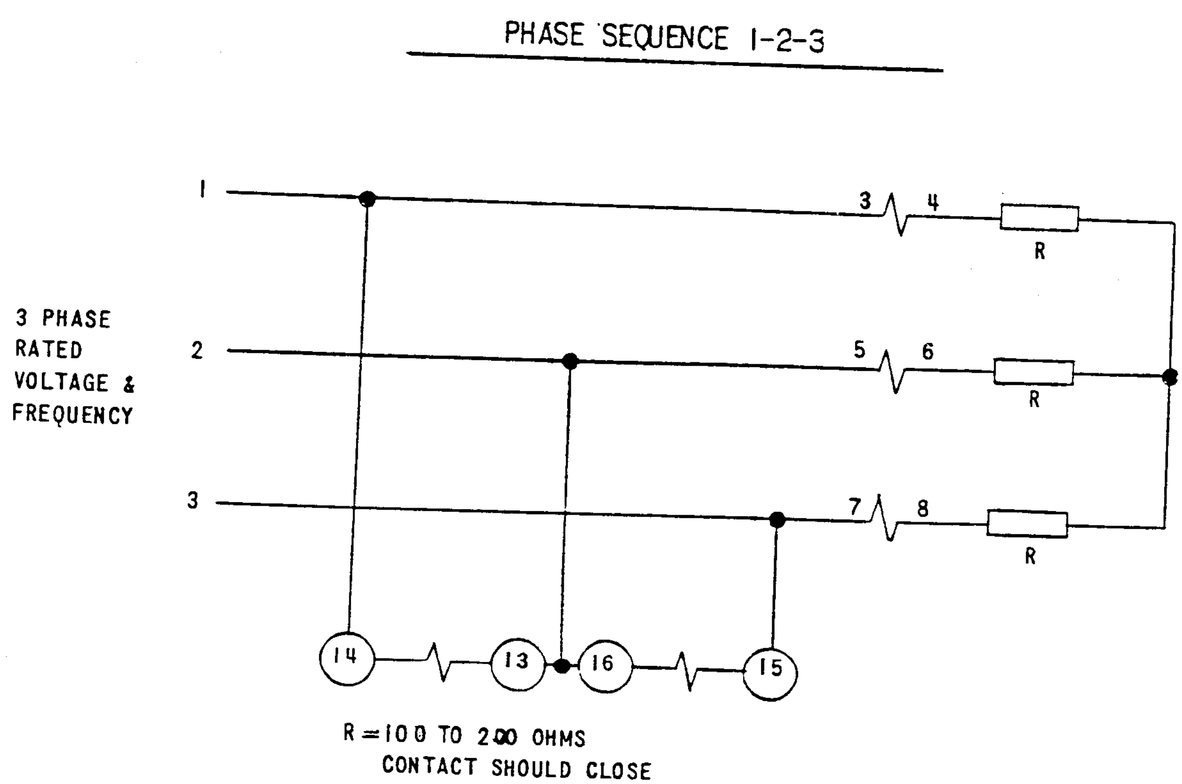
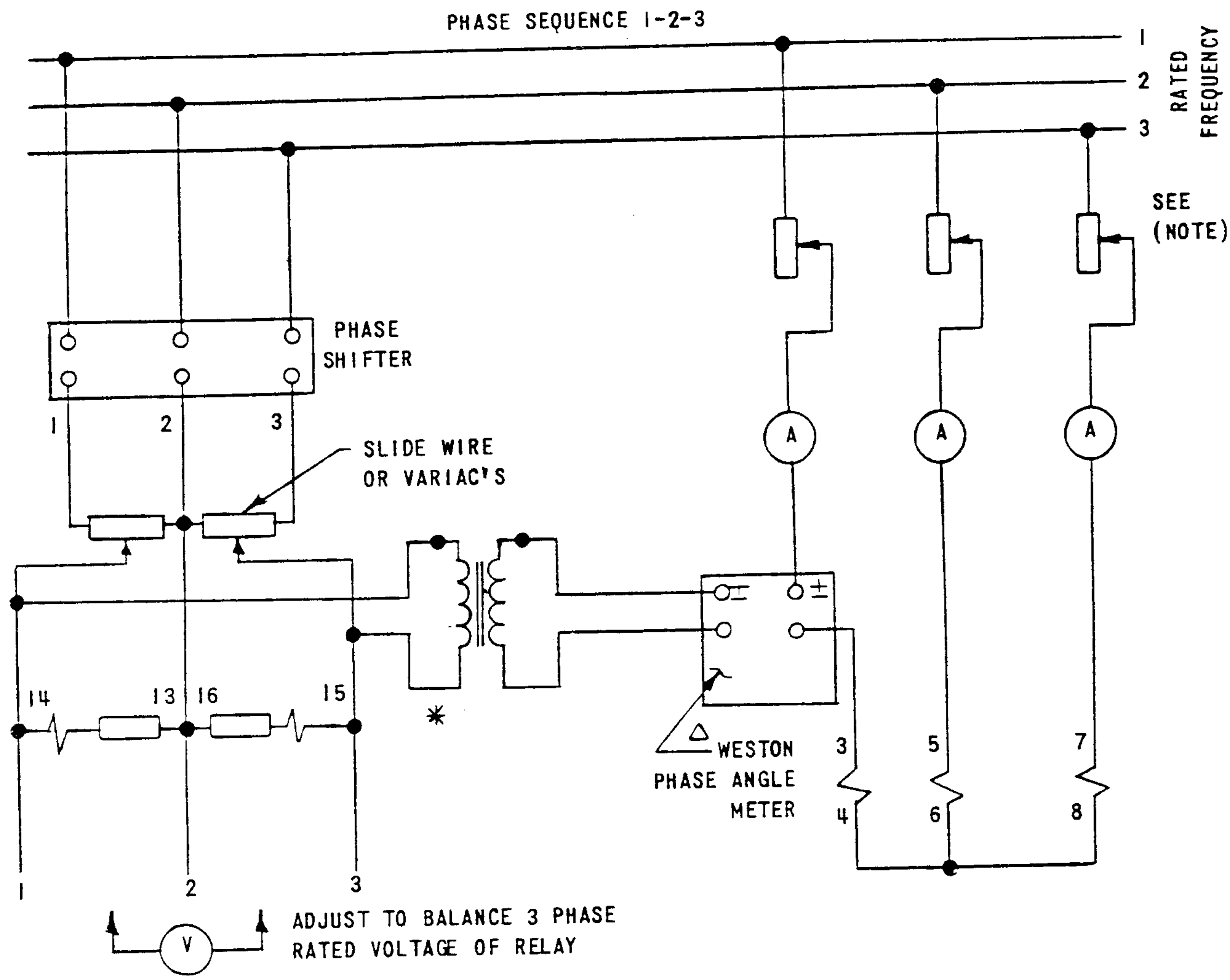


FIG. 9 (0246A7942-0) Polarity Test Diagram for the GGP53C Relay



NOTE: 1. WHEN SETTING PHASE SHIFTER FOR ZERO OR MAX. TORQUE ANGLES, USE APPROX. 2 AMPS PER PHASE. THE CURRENT CIRCUIT OF THE PHASE ANGLE METER WILL REQUIRE THIS LEVEL OF CURRENT FOR ACCURACY. LEAVE PHASE SHIFTER AT MAX. TORQUE ANGLE WHEN CHECKING MIN. P.U. VALVES.

NOTE: 2. FOR MINIMUM PICK-UP CHECKS USE 3 FIXED RESISTORS PLUS 3 RHEOSTATS IN TANDEM TO PROVIDE AN ADJUSTABLE CONTROL FOR THE REQUIRED BALANCED THREE PHASE CURRENTS.

△= THE WESTON PHASE ANGLE METER READS THE ANGLE BY WHICH THE CURRENT LEADS THE VOLTAGE. THE ZERO TORQUE ANGLES SHOULD OCCUR AT 120° & 300° (MAX. TORQUE TO CLOSE THE CONTACT AT 30 DEGREES).

*= TRANSFORMER TO APPLY PROPER VOLTAGE TO PHASE ANGLE METER.

FIG. 10 (0246A7943-0) Test Circuit for the Bottom Unit of the GGP53C Relay

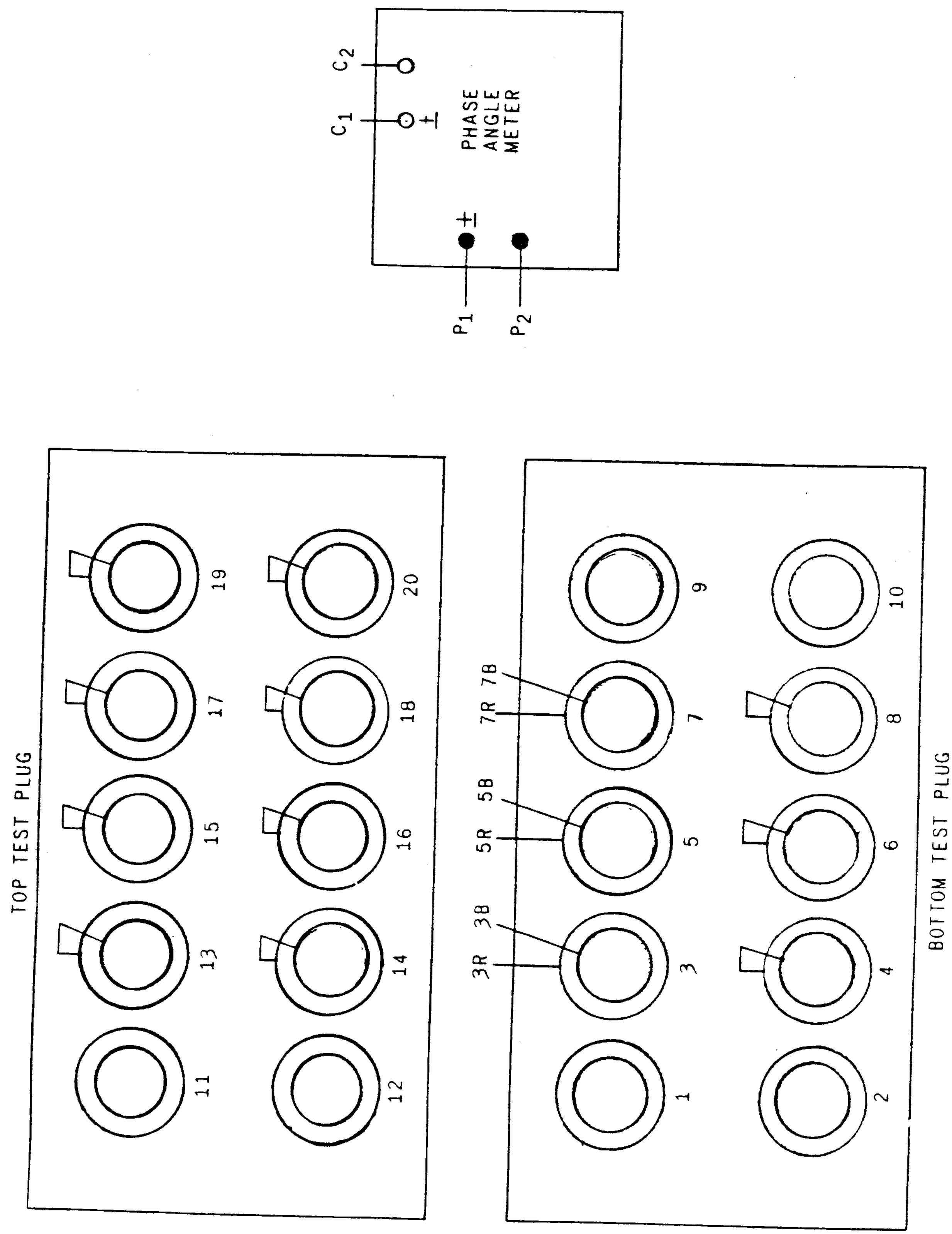


FIG. 11 (0264B0417 Sh. 1-0) Test Plug Connection Diagram for GGP53C

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