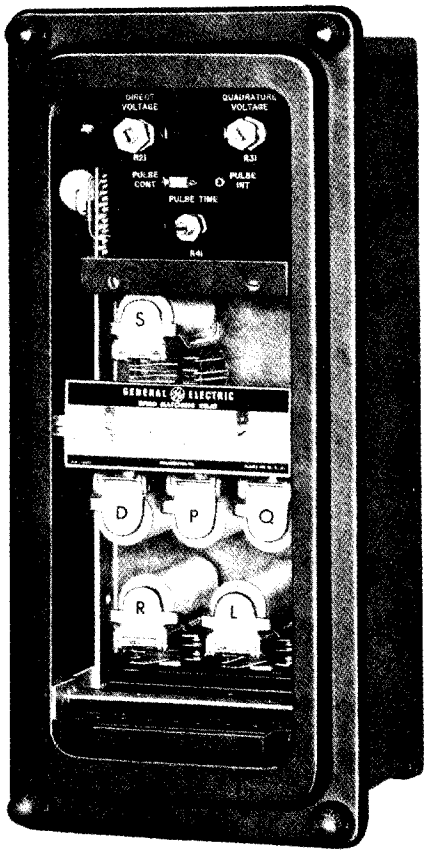
INSTRUCTIONS

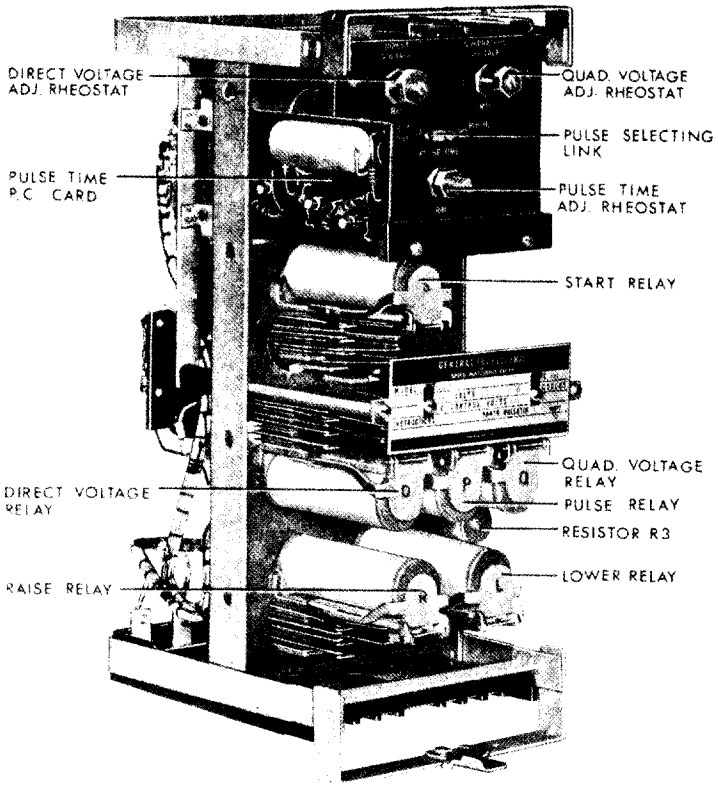
GEK-7352 B
Supersedes GEK-7352 A

SPEED MATCHING RELAY
TYPE GTL13B(-)A

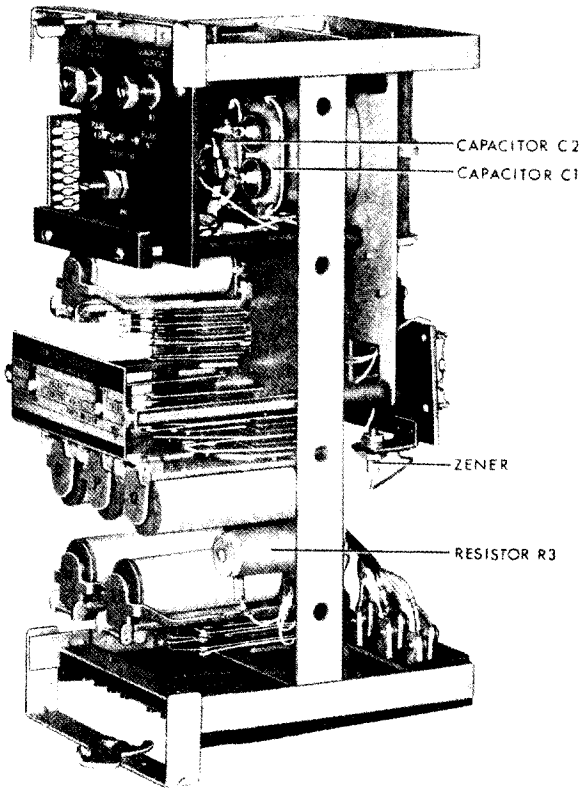


GENERAL ELECTRIC

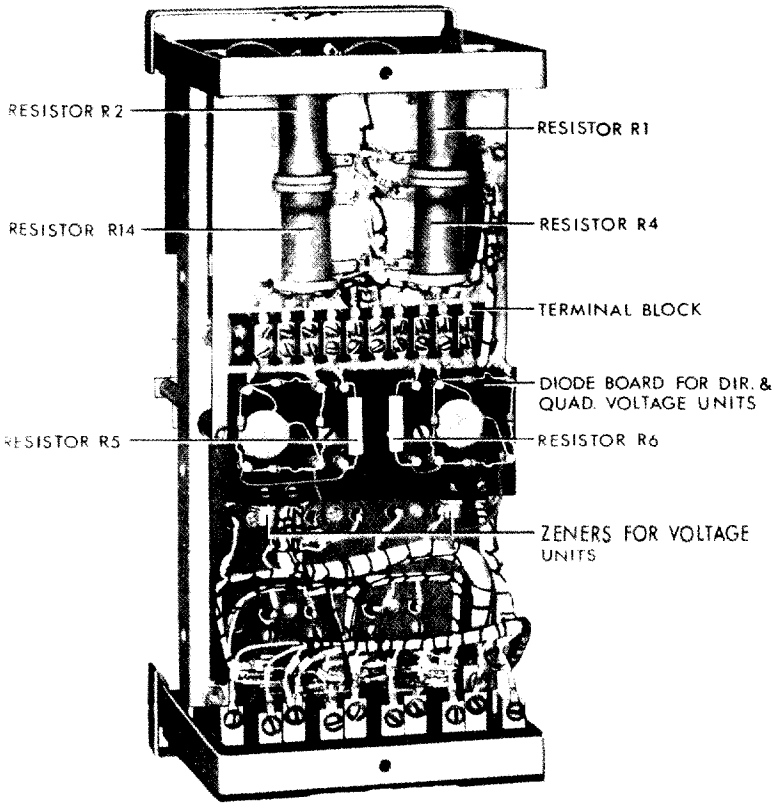
CONTENTS



A. Front View (8037608) Removed From its Case



B. Side View (8037610) Removed From its Case



C. Rear View (8037609) Removed From its Case

Figure 1 Speed Matching Relay Type GTL13B(-)A

SPEED MATCHING RELAY TYPE GTL13B(-)A

DESCRIPTION

The GTL13B relay is speed matching relay which is used to automatically match a generator frequency with a bus frequency. The relay contains high dropout NGV type voltage units, four telephone type auxiliary relays and associated capacitors, resistors and rectifiers. The relay contains a timer that employs solid state components to provide a readily adjustable speed changing pulse. The relay components are housed in an M1 case and the outline and drilling is shown in Fig. 8. The GTL13B relay is usually used in conjunction with an automatic synchornizing relay such as the GES. One GTL relay is required on each bus.

APPLICATION

The GTL13B relay is designed to match the frequency of a generator about to be connected to a bus with the frequency of the bus. To do this, the relay closes one set of contacts to produce a raise impulse if the generator speed is low or another set of contacts to produce a lower impulse if the generator speed is high. The relay can be adjusted to provide impulses once each slip cycle and the duration of the impulses is constant below a certain value of slip frequency. An alternate adjustment is availabe to provide a continuous speed changing pulse until the generator frequency closely approaches the bus frequency. Then the relay automatically provides one speed changing pulse per slip cycle. The relay can be inclined 30° from the vertical in any direction without affecting its operation. A starting unit is included to insure that the first speed changing pulse (and subsequent pulses) or the continuous speed changing pule is always in the correct direction.

Application of the GTL relay to steam turbines with full-arc admission, with the speed matching equipment controlling the by-pass valve motor without the intervention of a governor may require an acceleration limit relay obtainable from a turbine manufacturer, or other auxiliaries, to stabilize the frequency by providing the necessary delays in the control.

RATINGS

The GTL13B relays have an AC rating of 115 volts, 60, 50, 40 or 25 cycles and DC ratings of 48, 125, or 250 volts. The GTL13B relay contacts used in the speed changing motor circuit will make, carry and break 1 ampere at 250 volts or 2 amperes at 125 volts DC. The pulse time is adjustable from 0.05 to 0.6 seconds. *

CHARACTERISTICS

OPERATING PRINCIPLES

The speed matching feature of the GTL13B relay is dependent entirely upon the sequency of operation of the voltage units D and Q. When the relay is connected to the system the operation is briefly as follows: If the generator frequency is below the bus frequency, the D and Q units will operate in such a way that they pickup the 15R unit and initiate speed raising impulses and block speed lowering impulses. If the generator speed is high, speed lowering impulses are initiated by the picking up of the 15L unit and speed raising impulses are blocked. The sequential operation of the relay is more completely described in the following paragraphs.

The coil of the D unit is connected directly between the bus and generator voltage (see Fig. 3) in series with a fixed and variable resistor (to permit adjustment of the relay pickup). The coil is energized from a full wave bridge type rectifier to provide smoother operation.

Between the generator source and the common point a resistor and capacitor are connected in series with the resistor next to the generator source. Also an identical capacitor and resistor are connected between the bus supply and the common point but with the capacitor next to the bus supply. The coil of the Q unit is connected between the junction points of the two resistor-capacitor circuits in series with a fixed and adjustable resistor and with a bridge type rectifier supplying the coil. The values of the resistors, and capacitors, are such that the absolute value of their impedance is identical at the relay rated frequency. Thus the voltages appearing across each resistor and capacitor are equal but

* Indicates revision

with a 90° angle between these voltages. The vector relationship of the voltages across these capacitors and resistors and the voltages which will appear across the D and Q coils can be best understood by referring to Figure 2.

The upper vector diagram of Fig. 2 shows the vector relationship of all voltages when the bus and generator voltages are in phase. As will be noted, the D coil voltage is then zero while the Q coil has a one per unit voltage. As the generator speeds up with respect to the bus, the Q coil voltage drops and the D coil voltage increases. When the generator voltage is 90° ahead of the bus voltage, then the D coil voltage has become 1.4 times the per unit value and the Q coil voltage has reached zero. If the generator continues to speed up, then when its voltage is 180° ahead of the bus voltage, the D coil voltage has become 2 times the per unit value and the Q coil voltage has become one time the per unit value.

In like manner, when the generator voltage is 270° ahead of (or 90° behind) the bus voltage, the D relay coil voltage is 1.4 times the per unit value and the Q voltage is 1.4 times the per unit value.

It is apparent that we can adjust the pickup calibration of the D unit to pickup when the generator voltage leads the bus voltage by 90°. If the supply voltages is 115 volts, the D unit is calibrated to pickup at 1.3 x 115 or at 150 volts. As shown in Figure 2, if the generator frequency is lower than the bus frequency the D unit will pickup when the generator voltage is 90° behind the bus.

The Q unit is set to pickup when the generator voltage and bus voltage are in phase or 180° out of phase. With a 115 volt supply, the Q unit is adjusted to pickup at .90 x 115 or 104 volts.

Assume that the generator and bus voltages are in phase but the generator frequency is lower than the bus frequency. The Q unit will pickup at once and the D unit will pickup when the generator is 90° behind the bus. The Q unit will dropout at 180° displacement and D unit when the generator is 270° behind the bus. When D first picks up the start unit S is de-energized and no speed changing signal is given (see Fig. 3). The pulse terminating unit "P" picks up without time delay, picking up S which seals in and the "P" unit stays up blocking any speed changing pulses until the D unit drops out. When the D unit again picks up it will provide a speed lowering (or raising) pulse since the S unit remains picked up until the GTL relay is turned off. Thus the first and all subsequent speed changing pulses are in the correct direction.

Under the conditions above, (as shown in Fig. 2 and 4), the 15R unit will pickup when the D unit picks up the second time to start a speed raising impulse. The R unit seals in through the D unit contact (normal connection) to provide a speed raising pulse as long as D remains picked up unless the pulse is terminated by the P unit. When R picks up it finds S picked up and P dropped out and it charges the 3 mfd capacitor through the rheostat. While the capacitor is charging Q2 and Q3 are turned on and they delay the charging process and hold the Q1 base negative with respect to its emitter. When the capacitor is charged up then Q2 and Q3 turn off and Q1 turns on. If D is still up then P picks up dropping out R, thus terminating the raise pulse. P stays picked up until D drops out. This insures one speed changing impulse each slip cycle.

The time of the speed changing impulse is determined by the length of time of the slip cycle if the slip frequency is high (it will be one half of the slip cycle duration) and by the pick up time of the P unit if the slip frequency is low. The speed changing impulses are always in the right direction. The pulse time is adjustable from 0.05 to 0.6* seconds.

The GTL relay supplies speed changing impulses only during that half of the slip cycle when the generator voltage is displaced more than 90° from the bus voltage. Thus if the generator voltages does not make a full circle with respect to the bus voltage, it will oscillate back and forth in that half of the slip cycle which permits synchronizing.

An alternate method of operation is available to reduce the duty on R and L speed changing contacts and to provide faster synchronizing. The alternate operation is provided when the pulse selecting link is moved to the "pulse cont." position. This change permits the R (or L) relay to seal up directly to the plus bus. Then if the GTL relay is turned on when the generator frequency differs considerably from the bus frequency, the operation is as follows: When D picks up to initiate a raise (or lower) pulse it picks up R (or L) and this starts the timer. If D drops out before P picks up it discharges the capacitor which resets the timer without picking up P. The R (or L) relay stays picked up and when D again closes it starts the timer again. As the generator frequency approaches the bus frequency the time of each slip cycle gets longer and longer and when the pickup time of P is shorter than one half a slip cycle it picks up terminating the speed changing pulse and it seals up to provide only one speed changing pulse per slip cycle. Thus if P is set with a pickup time of 0.5 seconds then a continuous pulse will be provided until the generator frequency reaches 59 (or 61) cycles. If the pick up time of P is 0.1 seconds then a continuous pulse will be provided until the generator frequency reaches 55 (or 65) cycles. These values are for 60 cycle relay but similar operation will occur for relays which have a different frequency rating. The GTL13B relay will operate correctly if it is turned on when the generator frequency is 75 percent or more of the bus frequency.

It should be emphasized that the angles shown in Fig. 2 are only approximate values. They will

* Indicates revision

be most nearly realized when the generator and bus voltage are at their normal values. If generator and bus voltages are unequal or vary from their normal values, the angle may deviate from the values shown. However, for the values of abnormal voltage usually encountered, one slip cycle will be divided into four zones that are near enough to being equal to assure satisfactory operation. Adjustment of all units are such that the following conditions are maintained:

1. That 1/4 of a slip cycle is enough time to allow auxiliary R or L to pickup or to drop-out.

2. That 1/4 of a slip cycle is enough time to permit P to pick up or drop out.

BURDENS

Due to the impedances, the burden of either AC circuit vary with the angle of displacement between the bus and generator voltages as well as with the frequency. Maximum burden occurs when the generator voltage is 180° from the bus. With 60 cycle frequency, the maximum burden is about 13 volt amperes and about 15 volt amperes at 50 cycles.

For the resistance of the DC components, see Figure 3.

CONSTRUCTION

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 easily removed when desired. To do this, the relay is **first** disconnected by removing the connection plug **which** completes the electrical connections between the case block and the cradle block. To test the relay in its case, this connection block can be replaced by a test plug. The cover, which is attached to the front of the relay case, contains an interlock arm which prevents the cover from being replaced until the connection plugs have been inserted.

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. For outline and drilling dimensions, see Figure 8.

Every circuit in the drawout case has an auxiliary brush as shown in Fig. 6 to provide adequate overlap when the connecting plug is withdrawn or inserted.

RECEIVING, HANDLING AND STORAGE

The 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 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. If the relays are not to be installed immediately, they should be stored in their 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.

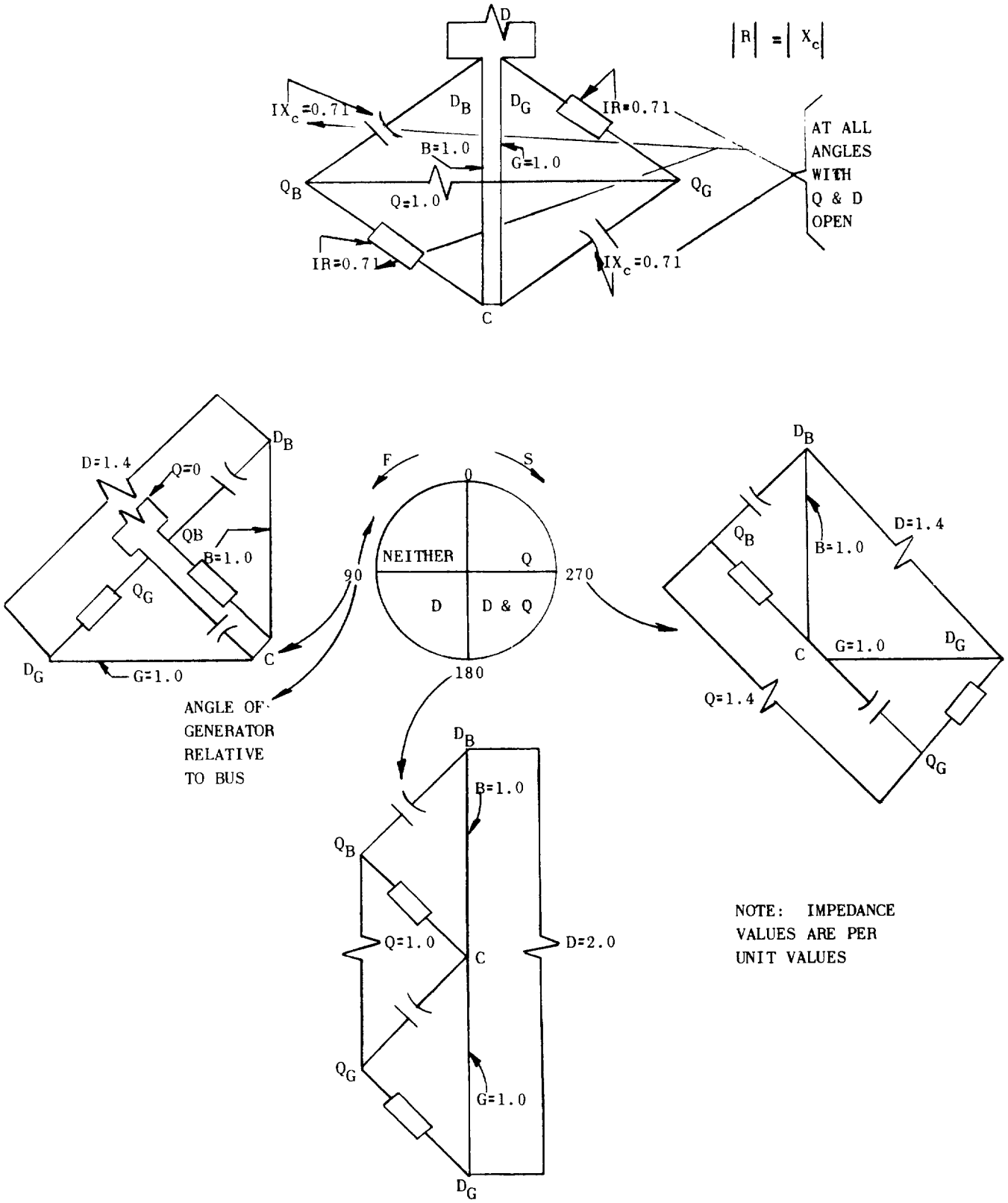


Fig 2. (0203A8538-0) Phasing Relations in the GTL13B Relay

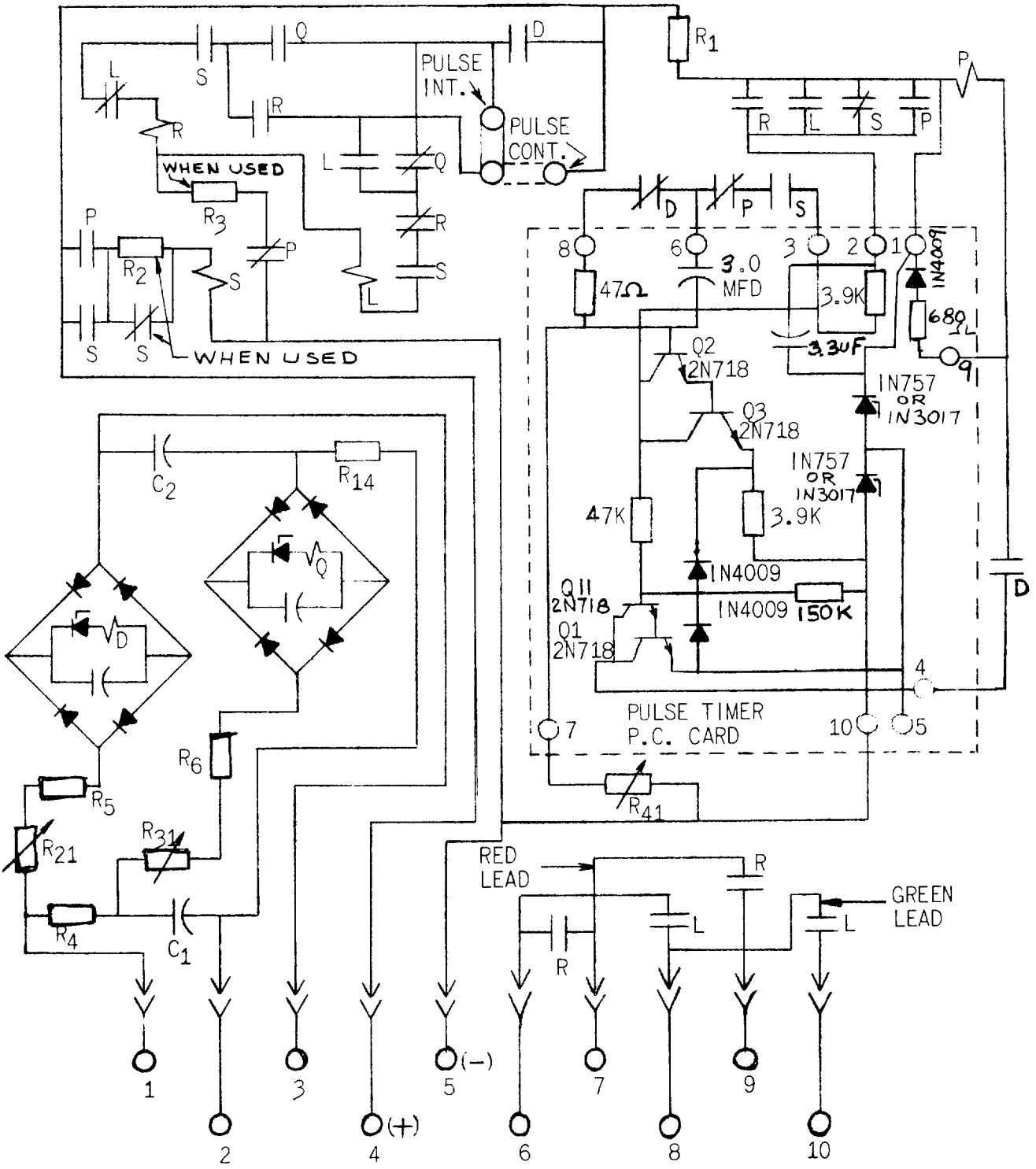


Fig 3. (0203A8624-3 Sh 1.) Internal Connections Diagram for Type GTL13B Relay (Front View)

MODEL	FORM									
12GTL13B(-)A	1	2	3	4	5	6	7	8		
VOLTS A.C.	115	115	115	115	115	115	115	115		
FREQUENCY	60	60	50	50	40	40	60	60		
CONTROL CIRCUIT V.D.C.	125	250	125	250	125	250	48	24		
RESISTANCE IN OHMS										
D COIL	2500	2500	2500	2500	2500	2500	2500	2500		
L COIL	1200	1200	1200	1200	1200	1200	1200	250		
P COIL	400	400	400	400	400	400	400	400		
R COIL	1200	1200	1200	1200	1200	1200	1200	250		
S COIL	1300	1300	1300	1300	1300	1300	1300	1300		
Q COIL	2500	2500	2500	2500	2500	2500	2500	2500		
R1	5K	10K	5K	10K	5K	10K	1K	175		
R2	1.5K	4K	1.5K	4K	1.5K	4K	400	NONE		
R3	500	2K	500	2K	500	2K	NONE	NONE		
R4, R14	2650	2650	2500	2500	2650	2650	2650	2650		
R5	6K	6K	6K	6K	6K	6K	6K	6K		
R6	1K	1K	1K	1K	1K	1K	1K	1K		
R21, R31	7.5K	7.5K	7.5K	7.5K	7.5K	7.5K	7.5K	7.5K		
R41	1M	1M	1M	1M	1M	1M	1M	1M		
CAPACITANCE IN MUF										
C1, C2	1.0	1.0	1.25	1.25	1.5	1.5	1.0	1.0		

Fig 3a. (0203A8624-2 Sh 2.) Internal Connections table for type GTL13B Relay (Front View)

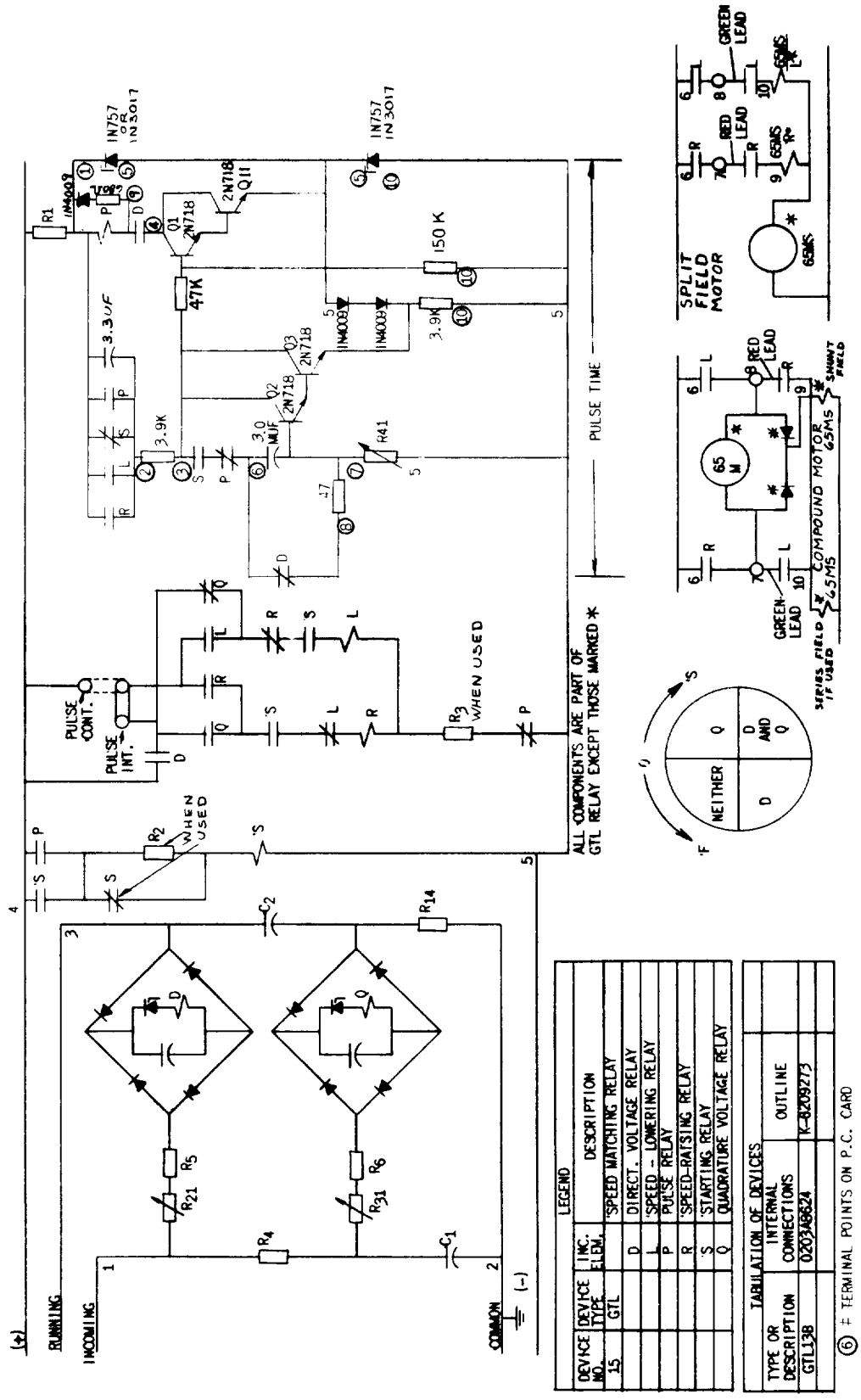


Fig 4. (0137B9686-4) Typical External Connections for the GTL13B Relay

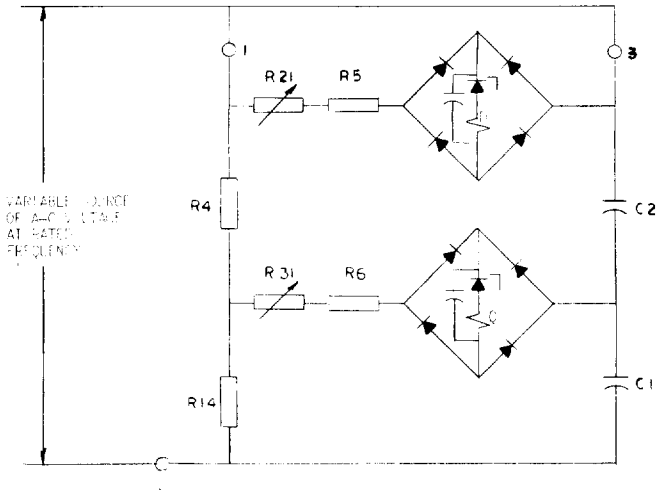
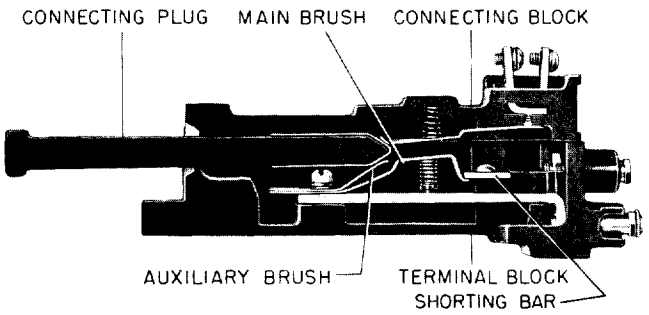


Fig 5. (0203A8539-1) Test Connections for Adjusting Pickup



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

Fig 6. Cross Section of Drawout Case Showing Position of Auxiliary Brush and Shorting Bar (8025039)

ACCEPTANCE TEST

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 the the relay calibrations have not been disturbed.

VISUAL INSPECTION

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

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

MECHANICAL INSPECTION

It is recommended that the following mechanical adjustments be checked:

1. Operate each unit by hand; allow it to reset to insure that units are free from friction or binds.

2. With the telephone type auxiliary relay deenergized, each normally open contact should have a gap of .010-.015. Observe the wipe on each normally closed contact by deflecting the stationary contact members towards the frame. Wipe should be approximately .005".

The wipe on each normally open contact should be approximately .005" shim between the armature and the pole piece and operating the armature by hand. The normally open contacts should make before the armature strikes the shim.

ELECTRICAL

The relay has been carefully adjusted at the factory to secure the performance described under the section on CHARACTERISTICS. No electrical tests are recommended until the relay is installed in its final location and these are described in the section on INSTALLATION PROCEDURE.

INSTALLATION PROCEDURE

If after the performance of the ACCEPTANCE TESTS the relay is held in storage before shipment to the job site, it is recommended that the visual and mechanical inspection described in the section on ACCEPTANCE TESTS be repeated before installation.

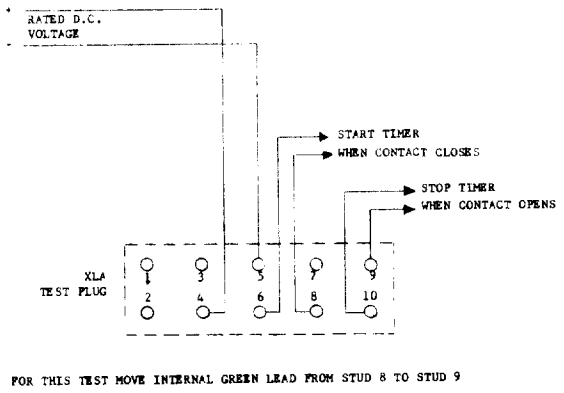


Fig 7. (0207A7852-0) Connections for time test for the GTL13B Relay

The following electrical adjustment should be made with the relay in its case, perferably mounted in its permanent location.

Using connections shown in Fig. 7, and rated DC voltage, adjust the pulse time to the desired value by means of the "pulse time" rheostat. Operate D relay manually to energize pulse timing circuit.

Using the connections shown in Fig. 5, check that the pickup of the Q unit is 90 percent of rated voltage. With a variable AC source connected to studs 1 and 3 only adjust the D unit to pickup at 130 percent of rated voltage.

The GTL13B relay may be used with a split phase or compound governor motor. See Fig. 4 for recommended connections.

PERIODIC CHECKS & 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 enviroment, 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 following points be checked at an interval of from one to two years.

Repeat the visual and mechanical inspection and voltage unit electrical test described in the section on INSTALLATION PROCEDURE.

SERVICING

The relay has been adjusted at the factory to secure the performance described under "Relay Operation"; all adjustments were made for operation at rated voltage shown in the nameplate. If adjustments are found necessary, proceed as follows:

For normal operation, it should not be necessary to change the adjustments for the voltage units in any way. However, if the relay is to be operated at source voltages that differ substantially from the nameplate rating, the D and Q units should be recalibrated. Using connections indicated under the section on INSTALLATION PROCEDURE, adjust the potentiometers to set the relays at the required pickup.

The speed changing pulse duration can be changed by means of the "pulse time rheostat", R41.

For cleaning relay contacts, a flexible burnishing tool should be used. This consists of an etched roughened strip of flexible metal, resembling a superfine file which removes corroded material quickly without scratching the surface. The flexibility of the tool insures the cleaning of the actual points of contact. Never use knives, files, abrasive paper or cloth to clean fine silver contacts. A burnishing tool as described above can be obtained from the factory.

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 give complete nameplate data. If possible, give the General Electric requisition number on which the relay was furnished.

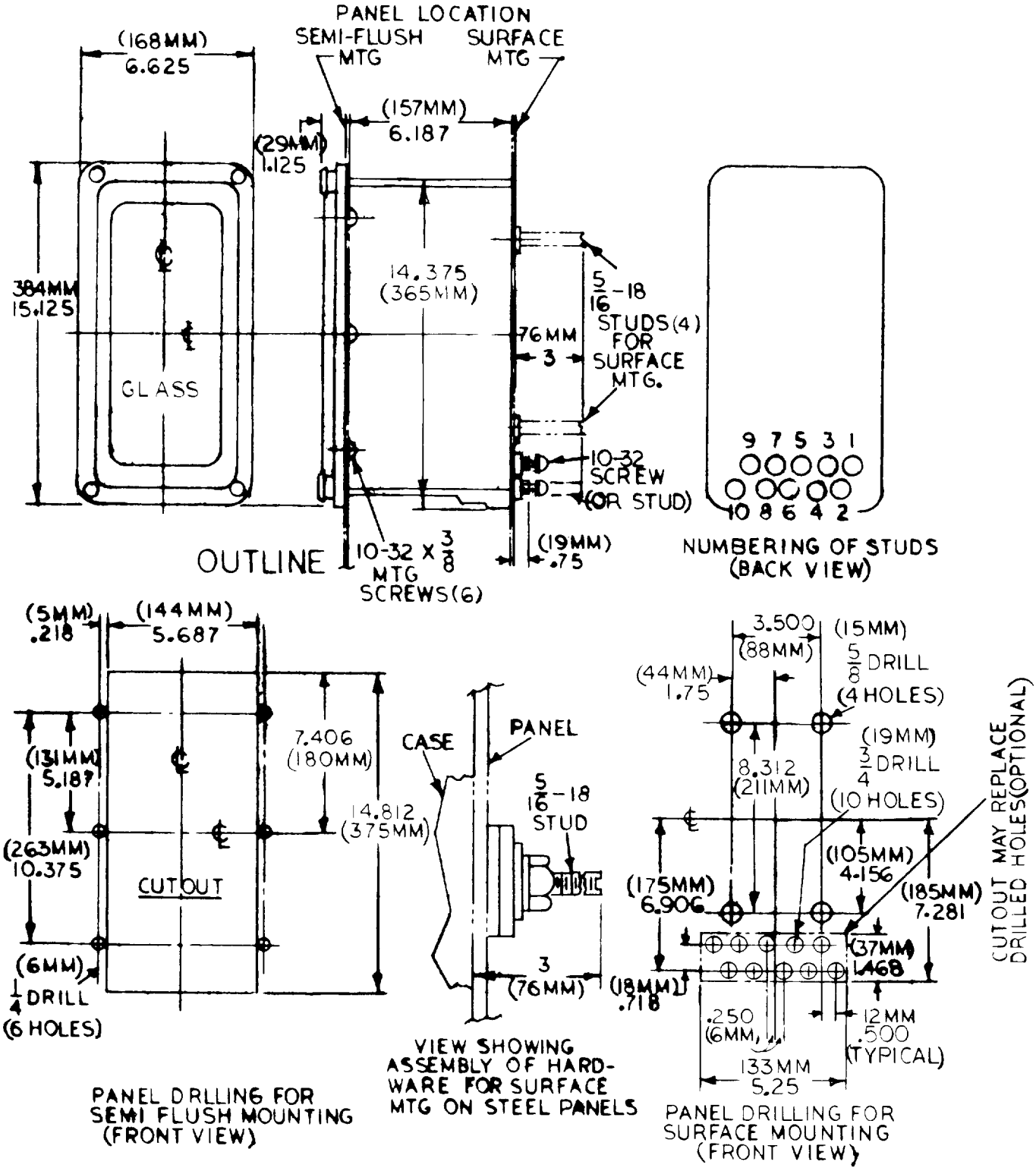


Fig 8. (6209273-4) Outline and Panel Drilling

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