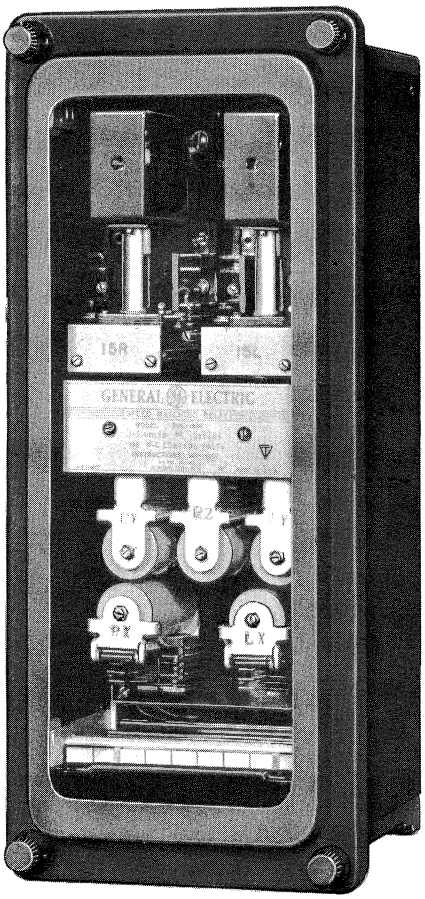
INSTRUCTIONS

GEI-19997D

SUPERSEDES GEI-19997C

SPEED-MATCHING RELAY



Type GTL11B

LOW VOLTAGE SWITCHGEAR DEPARTMENT

GENERAL ELECTRIC

PHILADELPHIA, PA.

A

SPEED-MATCHING RELAY TYPE GTL11B

INTRODUCTION

APPLICATION

The GTL11B relay is designed to match the speed of a generator about to be connected to a bus with the speed of the generators already supplying 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. These impulses are given once each slip cycle, and the duration of the impulses varies with the slip frequency.

The relay consists of two voltage units, with their associated capacitors and resistors, and five telephone type relays, all mounted in a size M1 drawout case. The speed-matching feature of the GTL11B is dependent entirely upon the sequence of operation of the voltage units, as described under "Relay Operation", and the telephone relay units make up the control and contact circuits of the relay.

Cover (8008994)

RATINGS

The GTL11B relay is available for 115 volt rating at all standard frequencies, with control circuits rated at all standard D-C control voltages.

The contacts of auxiliaries RX, RY, LX and LY in the synchronizing motor circuit (Between studs 6 and 9, or 6 and 10) will make, break and carry 1 ampere at 250V d-c or 2 amperes 125 d-c inductive.

BURDENS

The burdens of the a-c circuit, with branched impedances, varies with the angle of displacement between bus and generator voltages, as well as with the frequency. Table 1 gives values of burdens with power factors for various angles of displacement and frequencies of 50 and 60 cycles with both sources at 115 volts.

TABLE I

Angle G Leads B	60 Cycles	
	Volt-amps	P. F.
0	6.8	85% lag
45	3.5 (Min.)	97% lead
90	7.2	62% lead
135	12.2	73% lead
180	15.4	88% lead
225	16.6 (Max.)	99% lead
270	15.3	99% lag
315	11.8	92% lag
Angle G Leads B	**50 Cycles**	
	Volt-amps	P. F.
0	8.1	86% lag
45	4.1	93% lead
90	9.4	63% lead
135	15.3	74% lead
180	19.2	90% lead
225	20.5	99% lead
270	18.7	98% lag
315	14.2	91% lag

RECEIVING, HANDLING AND STORAGE

RECEIVING

These relays, when not shipped as part of a control panel, will be shipped in cartons designed to protect them against damage. Immediately upon receipt of the relay an examination should be made for any damage sustained during shipment. If injury or rough handling is evident a damage claim should be filed at once with the transportation company and the nearest General Electric Sales Office should be notified promptly.

HANDLING

Reasonable care should be exercised in unpacking the relay in order that none of the parts gets injured or the adjustments disturbed.

STORAGE

If the relays are not to be installed immediately, they should be stored in their original carton in a place that is free from moisture, dust and metallic chips. Foreign matter collected on the outside of the case may find its way inside when the cover is removed and cause trouble in the operation of the relay.

These instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the General Electric Company.

DESCRIPTION

The relay consists of two voltage units, with their associated capacitors and resistors, and five telephone type relays, three of which have a time-delay feature, all mounted in a size M1 drawout case.

The voltage elements are of the plunger type, with moving contacts fastened directly to the armature assembly. The pickup is adjustable over a wide range by changing the position of the plunger on the aluminum plunger rod; the units have been carefully adjusted at the factory and should not require further adjustment under normal operating conditions (see Adjustments and Tests). The plunger type construction assures a high ratio of dropout to pickup.

RELAY CASE

The case is suitable for either surface or semi-flush panel mounting and an assortment of hardware is provided for either mounting. The cover attaches to the case and also carries the reset mechanism when one is required. Each cover screw has provision for a sealing wire.

The case has studs or screw connections at the bottom for the external connections. The electrical connections between the relay units and the case studs are made through spring backed contact fingers mounted in stationary molded inner and outer blocks between which nests a removable connecting plug which completes the circuits. The outer block, attached to the case, has the studs for the external connections, and the inner block has the terminals for the internal connections.

The relay mechanism is mounted in a steel framework called the cradle and is a complete unit with all leads being terminated at the inner block. This cradle is held firmly in the case with a latch at the top and the bottom and by a guide pin at the back of the case. The cases and cradles are so constructed that the relay cannot be inserted in the case upside down. The connecting plug, besides making the electrical connections between the respective blocks of the cradle and case, also locks the latch in place. The cover, which is fastened to the case by thumbscrews, holds the connecting plug in place.

To draw out the relay unit the cover is first removed, and the plug drawn out. Shorting bars are provided in the case to short the current transformer circuits. The latches are then released, and the relay unit can be easily drawn out. To replace the relay unit, the reverse order is followed.

A separate testing plug can be inserted in place of the connecting plug to test the relay in place on the panel either from its own source of current and voltage, or from other sources. Or, the relay unit can be drawn out and replaced by another which has been tested in the laboratory.

RELAY OPERATION

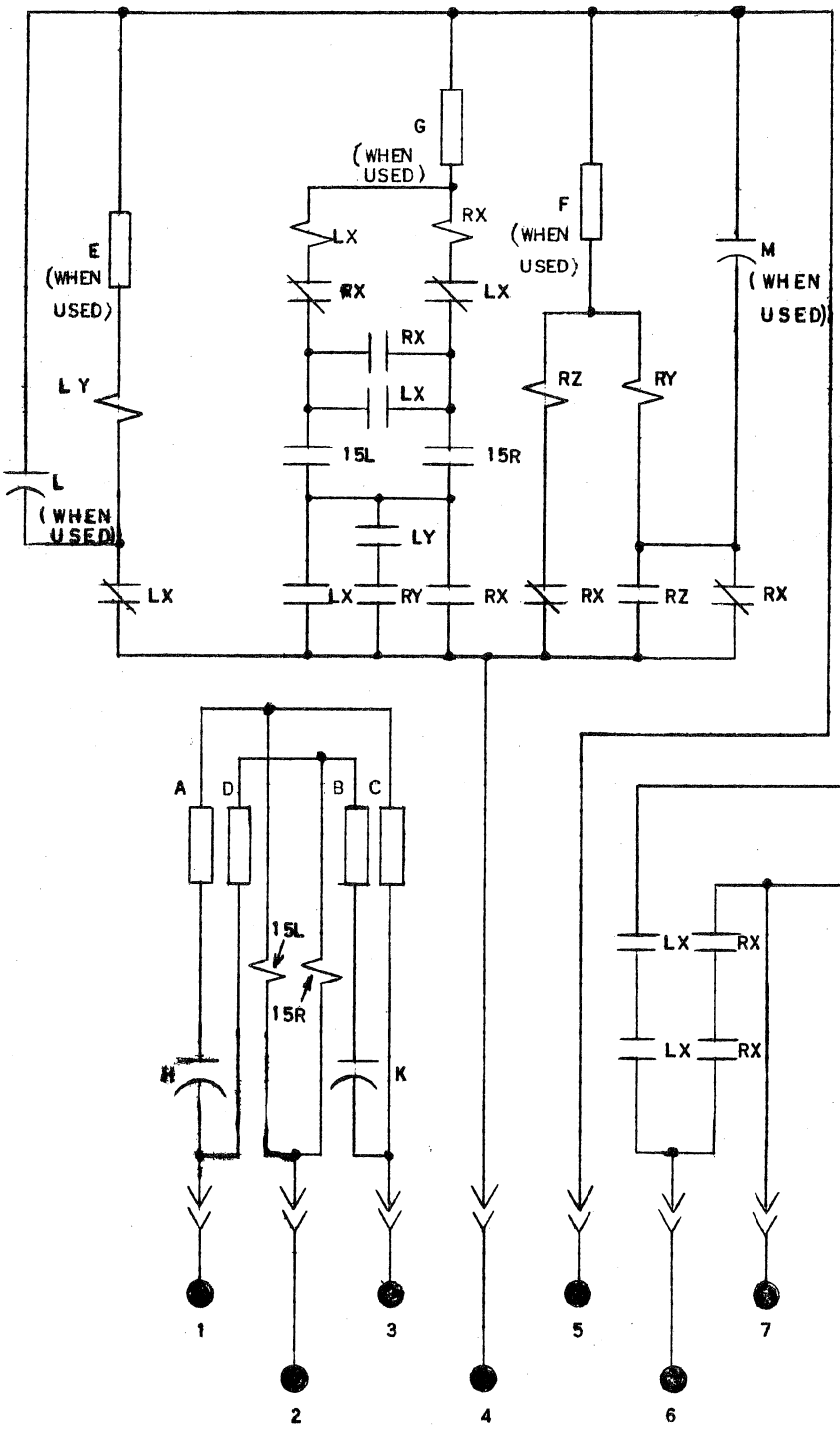
The speed-matching feature of the GTL11B relay is dependent entirely upon the sequence of operation of the plunger units, known at 15R and 15L in automatic switching equipment. If the device is connected to the system as indicated in Fig. 1, the operation is briefly as follows: If the generator frequency is below bus frequency, the 15R unit and the associated auxiliaries will operate in such a way as to initiate speed-raising impulses and block speed-lowering impulses. If the generator speed is high, speed-lowering impulses are initiated and speed raising impulses blocked. The sequential operation of the relay is more completely described in the paragraphs that follow.

As shown in Fig. 1, the coils of 15R and 15L are each connected to both bus and generator sources through branched impedances. The coil of 15R is connected to the bus terminal through a series capacitor and resistor, and to the generator terminal through a resistance only. The coil of 15L is connected oppositely to bus and generator terminals through a capacitor and resistors whose values are identical with those used in the 15R circuit. The values of resistance and capacitance are so proportioned that maximum voltage on the relay coils occurs when the displacement between bus and generator voltage is 45° with bus voltage as reference (positive 45° for 15R and negative 45° for 15L). Thus there is a total displacement of 90° between the characteristics of the two relays. Furthermore, each of the relays receives minimum voltage at 135° displacement (positive for 15L and negative for 15R). These statements assume equal voltages of normal value on machine and bus.

The settings of the two plunger units are made so that each has a zone of 180° during which the device is picked up. Since the two relay characteristics are 90° apart, one slip cycle is divided approximately into 90° zones as follows: Both devices open, 15R closed, both devices closed, 15L closed. The diagram in Fig. 2 illustrates more clearly the operation of the plunger units as the vector representing generator voltage shifts through 360° with respect to bus voltage. If the generator frequency is low the angle by which generator voltage leads bus voltage will be decreasing, and the diagram should be read in a clockwise direction. If generator frequency is high the angle of lead will be increasing and the diagram is read in a counter-clockwise direction.

SEQUENCE OF OPERATION

A more detailed description of the sequential operation of 15R and 15L follows, with references to the chart in Fig. 2 and the elementary diagram in Fig. 1. As an example, assume that generator frequency is below bus frequency and that the relay is first excited when the generator voltage is in the 180° lead position. Device 15R will operate at 135°. Its normally open contact will operate auxiliary RX through the normally open contacts of RY and LY,



CIRCUIT CONSTANTS

A-C CIRCUITS

VOLTS	115	115	100	115
FREQ.	60	50	50	25
A	1200Ω	1000Ω	900Ω	2200Ω
B	1200Ω	1000Ω	900Ω	2200Ω
C	1800Ω	1400Ω	1250Ω	3000Ω
D	1800Ω	1400Ω	1250Ω	3000Ω
H & K	2 MUF	3 MUF	3.5 MUF	3 MUF
R & L	510Ω	510Ω	510Ω	3200Ω

D-C CIRCUIT

VOLTS	110 OR 125	250	220	48	24
E	2500Ω	7500Ω	6000Ω	—	—
F	1200Ω	3800Ω	3000Ω	—	—
G	500Ω	2500Ω	2000Ω	—	—
L &M	2 MUF	2 MUF	2 MUF	2MUF	—
LX	1200Ω	1200Ω	1200Ω	1200Ω	300Ω
LY	2500Ω	2500Ω	2500Ω	2500Ω	650Ω
RX	1200Ω	1200Ω	1200Ω	1200Ω	300Ω
RY	2500Ω	2500Ω	2500Ω	2500Ω	650Ω
RZ	2500Ω	2500Ω	2500Ω	2500Ω	650Ω

Fig. 1 (K-6400164)

Fig. 1 Elementary Diagram of the Type GTL11B Speed-Matching Relay

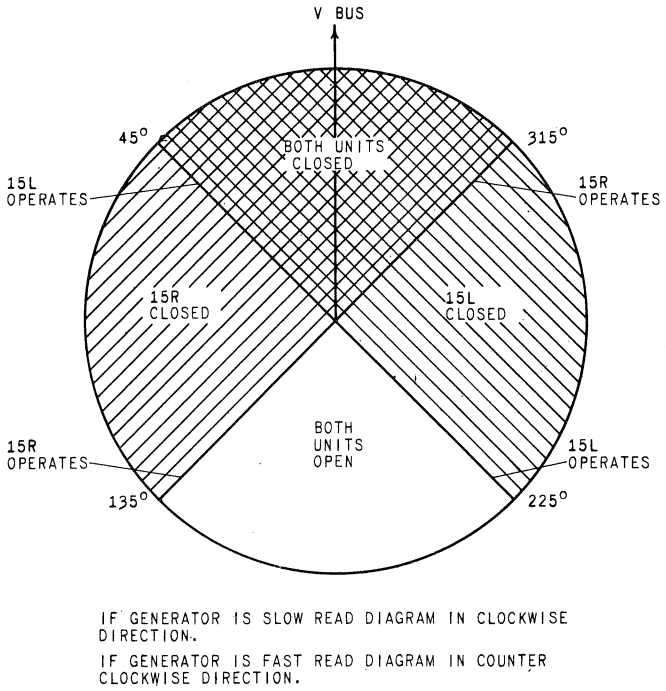


Fig. 2 Sequential Operation of 15R and 15L in the Type GTL11B Relay

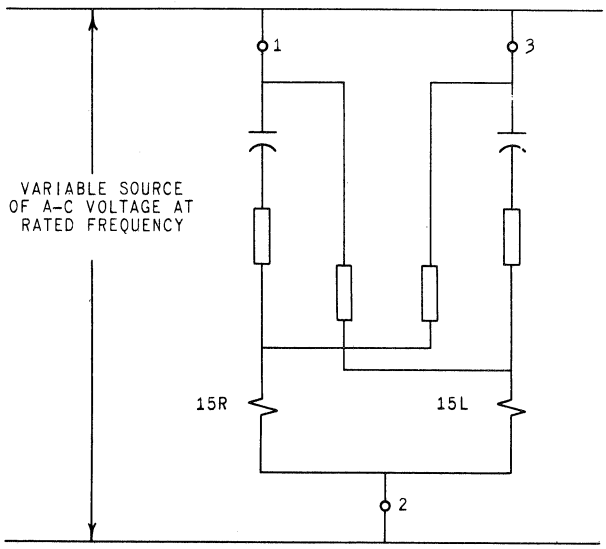


Fig. 3 Test Connections for Adjusting 15R and 15L in the Type GTL11B Relay

Fig. 2 (K-6400103)

Fig. 3 (K-6400108)

now closed because RY and LY are picked up, and the normally closed contact of LX. When RX operates, it seals itself in around RY and LY contacts, de-energizes relay RZ, and completes the circuit to the synchronizing motor, through the normally open contacts of RY, giving the motor a speed raising impulse. The speed raising impulse is maintained for the time interval required for the RZ-RY combination to dropout, opening the RY contacts between studs 7 and 9. At approximately 45° device 15L operates, closing its normally open contact. However, the speed lowering auxiliary LX is blocked by a contact of RX and no speed lowering impulse is given. At 315° device 15R drops out, but RX remains energized through contacts of 15L and RX. At 225° device 15L drops out, de-energizing RX and returning the circuit to its inital condition. It should be noted that a normally closed contact of RX by-passes the normally open contact of RZ so that both RZ and RY coils are re-energized simultaneously. If the generator speed is high, the operation is the same except that 15L operates first, operating LX, de-energizing the time delay relay LY, and initiating a speed lowering impulse. The adjustment of the time-delay relays RZ, RY, and LY is discussed in the section on adjustments and inspection.

The duration of the speed matching impulses is equal to about 3/4 of one slip cycle, or to the time setting of LY unit or RZ-RY combination, whichever is the smaller. It is possible for the initial impulse to accelerate the synchronizing motor in the wrong direction. If the relay is energized when the generator voltage vector is in the 45° to 315° zone there will be a race between devices 15R and 15L, since both are normally picked up in this zone. It is possible for the wrong device to operate first blocking the other circuit, and initiating an impulse in the incorrect direction. This condition is automatically corrected, however, after one slip cycle.

It should be emphasized that the angles shown in the diagram in Fig. 2 are only approximate values. They will be most nearly realized when the generator and bus voltages are at their normal values. If generator and bus voltages are unequal or vary from their normal values, the angles 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. Adjustments of 15R and 15L are such that the following conditions are maintained.

1. There is enough time between the pickup of 15R and 15L to allow auxiliary RX or LX to pickup.
2. Devices 15R and 15L must overlap in the picked up position for sufficient time to hold up RX or LX.
3. Devices 15R and 15L must both be dropped out long enough for RX or LX to dropout.

INSTALLATION

LOCATION AND MOUNTING

The relay should be mounted on a vertical surface in a location reasonably free from excessive heat, moisture, dust, and vibration. The relay case may be grounded if desired using at least No. 12 B&S gage copper wire. The panel drilling for the GTL11B is given in Fig. 4 for the drawout case.

CONNECTIONS

The internal connections of the GTL11B relay in drawout case are shown in Fig. 1.

ADJUSTMENTS AND TESTS

The relay has been adjusted at the factory to secure the performance described under "Relay Operation", all adjustments were made for operation at the rated voltage shown on the nameplate.

For normal operation it should not be necessary to change the adjustments for the plunger-type units in any way. However, if the relay is to be operated at source voltages that differ substantially from the nameplate rating, the plunger units should be recalibrated. Connect the relay as indicated in the test connection diagram in Fig. 3. Set the plunger units to pickup at 70% ± 2% of desired source voltage. The pickup value is decreased when the plunger is turned towards the top of the plunger rod, and is increased when the plunger is moved the opposite way.

The telephone relays with slugs have been adjusted for time delay dropout as follows: Relay LY from 1/4 to 3/8 seconds. Relays RZ and RY from 5/8 to 3/4 seconds measured from the time RZ is de-energized until RY drops out.

Because of the various characteristics of different governors and synchronizing motors, it may sometimes be desirable to change these settings. It is recommended that, if these time settings are changed, the difference between them be maintained at such a value that their ratio remains approximately the same. The time delay may be adjusted by loosening the locknut on the front of the armature and changing the position of the brass residual screw. This screw should be backed out to increase time delay, or turned in to decrease the time adjustment. After the poistion of the residual screw has been changed, the contact operating arm should be bent so as to restore the contact pressures to their original values. To check contact pressure, bend contact operating arm so that, with a .006" feeler gage between armature and pole piece, the normally open contacts just make when the armature is operated by hand to the picked up position. If this adjustment is not made, the change in contact pressure resulting from the change in armature travel may offset the effect of the residual screw adjustment.

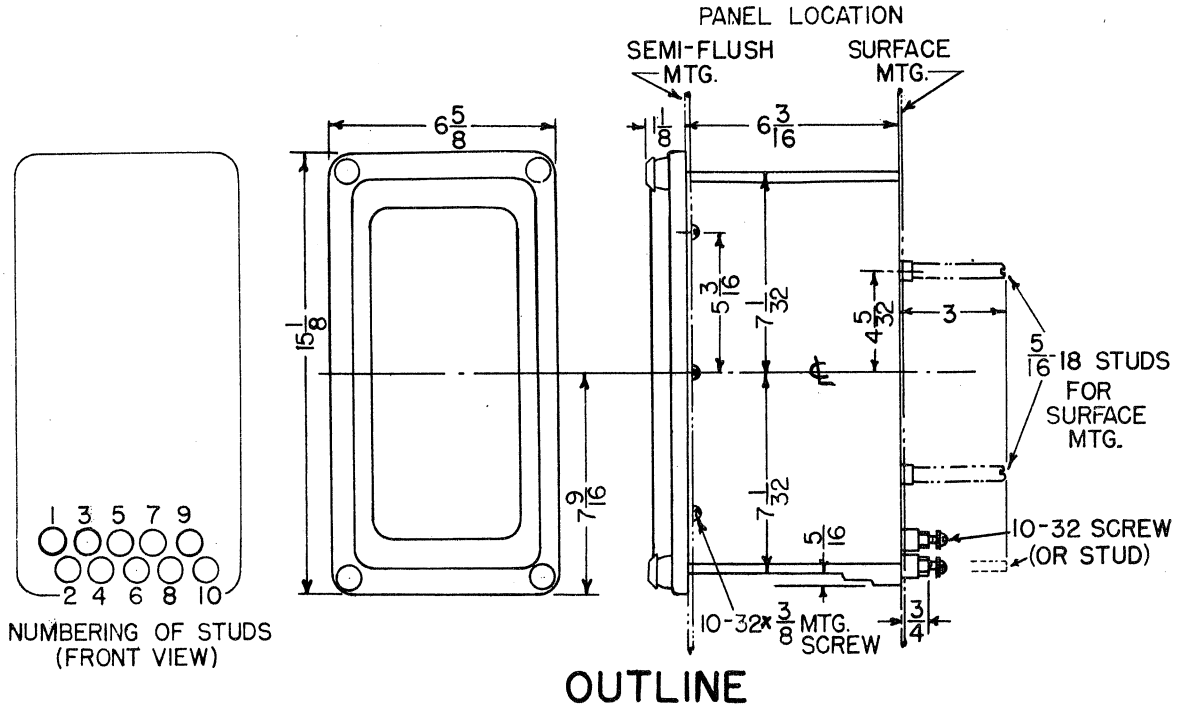
MAINTENANCE

An operation test and mechanical inspection of the relay and its connections should be made at * least once every six months. If the contacts require cleaning burnish with the burnishing tool supplied with the relay tool kit. Do not use crocus or emery cloth as they tend to embed insulating particles in the contact surfaces. Avoid touching the contact surfaces with the fingers.

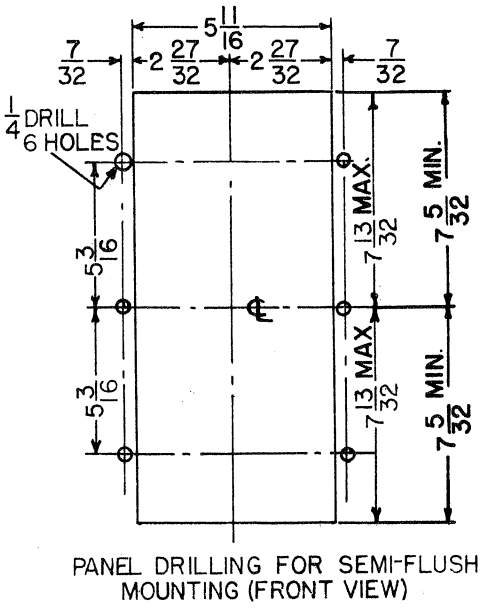
RENEWAL PARTS

Orders for renewal parts should be addressed to the nearest Sales Office of the General Electric Company, giving the name or a description of part wanted, quantity required, and complete nameplate data. If possible give the General Electric Company's requisition number on which the relay was furnished. Refer to GEF-3955 for a list of parts.

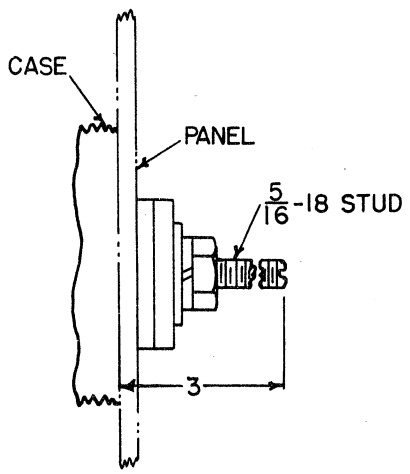
* Denotes change since superseded issue.



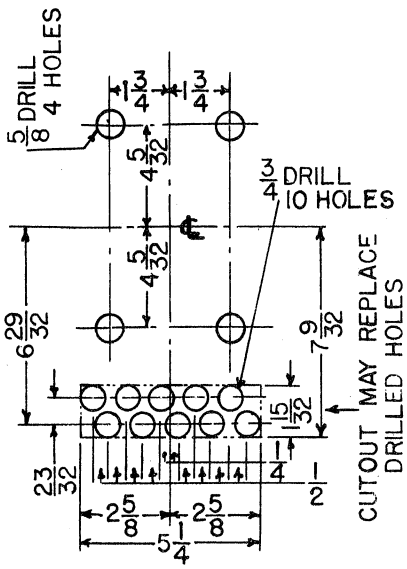
OUTLINE



PANEL DRILLING FOR SEMI-FLUSH MOUNTING (FRONT VIEW)



VIEW SHOWING ASSEMBLY OF HARDWARE FOR SURFACE MTG. ON STEEL PANELS



PANEL DRILLING FOR SURFACE MOUNTING (FRONT VIEW)

Fig. 4 (K-6209273)

Fig. 4 Outline and Panel Drilling for Size MI Case