INSTRUCTIONS

GEK-34059A
Supersedes GEK-34059

AC PILOT WIRE CHECKING RELAYS

TYPES

BBA21A
BBA22B
BBA23A

GENERAL ELECTRIC

CONTENTS

INTRODUCTION

The Type BBA relays are sensitive polarized relays, known as pilot-wire checking relays, which provide a continuous automatic check for open circuits and short circuits on the wire-pilot channels used with Type CPD relays. This automatic check is obtained by circulating over the pilot wire loop a small direct current of constant magnitude when the pilot wire loop is intact, and using sensitive overcurrent and undercurrent elements to respond to changes in this current when the pilot wires become open circuited or short circuited.

DESCRIPTION

This instruction book covers Types BBA21A, BBA22B and BBA23A pilot wire checking relays.

The Type BBA21A relay is known as the sending-end relay since it includes a rectifier and insulating transformer, and is the source of the circulating direct current used to check the condition of the pilot wire circuit. It also includes two sensitive polarized relay units similar to that shown in Figure 3. One of these units has normally closed contacts (i.e. when de-energized), and is held in the picked-up position by the small direct current which normally circulates in the pilot wire loop. It is the function of this unit to drop out and sound an alarm should the pilot become open-circuited. The other unit has normally open contacts and is so designed that it will not operate on the small direct current normally circulating in the pilot. However, should the pilot wires become shorted the increase in d-c current will cause this unit to operate and close its contacts.

The type BBA23A relay is designed for use as the receiving-end relay when only the pilot wire checking function is required (i.e. no transferred trip function is involved). It includes a single sensitive polarized unit with a normally closed contact. This unit is designed to remain picked up on the normal circulating direct current, but to drop out should the pilot wires become either open circuited or short circuited.

The Type BBA22B relay is designed for use as the receiving-end relay when a transferred trip function is required in addition to the pilot wire checking function. It includes two sensitive polarized units. One unit is similar to that in the BBA23A and provides the pilot wire checking function. The other unit, equipped with a normally open contact and seal-in, is designed to remain reset on the normal circulating direct current but to operate on the higher circulating current which results when a "transferred trip" is initiated.

These and other features of the BBA relays are covered in greater detail in the section on OPERATING CHARACTERISTICS.

APPLICATION

The schematic diagram in Figure 1 shows the proper method of connecting BBA21A and BBA23A relays at opposite ends of a pilot wire circuit to provide a continuous check of the circuit.

The schematic diagram in Figure 2 shows the method of connecting BBA21A and BBA22B relays at opposite ends of a pilot wire circuit to provide both the automatic check function and the transferred trip function.

CAUTION: WHEN PILOT WIRES ARE USED TO INTERCONNECT PROTECTIVE RELAYS AT DIFFERENT LOCATIONS, IT IS POSSIBLE FOR HIGH VOLTAGES TO APPEAR BETWEEN THE PILOT WIRES AND GROUND AT EITHER OR BOTH TERMINALS. THESE VOLTAGES ARE USUALLY DUE TO DIFFERENCES BETWEEN STATION AND REMOTE GROUND POTENTIALS, BUT MAY ALSO RESULT FROM LONGITUDINAL INDUCTION IF THE PILOT WIRES ARE RUN ADJACENT AND PARALLEL TO POWER LINES FOR ANY DISTANCE. SINCE THE BBA RELAYS ARE CONNECTED DIRECTLY TO THE PILOT WIRES, PARTS OF THE RELAYS, AS WELL AS THE CONNECTING LEADS TO THE RELAYS, WILL BE AT THE SAME POTENTIAL AS THE PILOT WIRES.

The relays are subjected to a factory high-potential test of 10 KV (RMS) from pilot circuit studs to contacts and to relay frame. If it is anticipated that the potential difference between pilot wires and local station ground may exceed 75 percent of this value, or may exceed the insulation level of the connecting leads to the relay operating circuit, neutralizing transformers should be used, as shown as options in Figures 1 and 2. If the optional connection shown in Figure 2 for transferred trip initiation is used, the neutralizing transformer is essential.

BURDENS

The burden of the Type BBA11A relay is given in Table III.

TABLE III

FREQ.	VA	WATTS
60	6	3
50	9	3
25	6	2

CHARACTERISTICS

The BBA21A sending relay is provided with a self contained insulating transformer (1:1 ratio) and a full-wave rectifier bridge for supplying to the pilot wire loop the circulating direct current. The relay consists of two polarized units, one having normally open contacts that are closed when the current exceeds 6 milliamperes, and one with normally closed contacts (when de-energized) which are held open by the normal circulating current but which close when the current drops below 2 milliamperes.

The BBA22B receiving relay contains two polarized relay units which are adjusted with the same pick-up values as in the BBA21A. The relay also includes a seal-in unit operated by the overcurrent unit, but has no transformer or a-c rectifier.

The BBA23A is similar to the BBA22B except it only contains a polarized undercurrent unit and does not contain a seal-in unit.

The resistance of the coil circuit of each of these relays is approximately 16,000 ohms. The d-c output voltage of the sending relay is approximately 130 volts, and the normal circulating current is approximately 4 milliamperes. This current is practically independent of the pilot wire resistance (as long as it is less than 2000 ohms) because of the high resistance of the relay coil circuits.

During normal conditions the circulating direct current holds the contacts of all the relay units open, since the circulating current is above the drop-out setting of the undercurrent units, and below the pickup setting of the overcurrent units.

CONSTRUCTION

CASE

The BBA21A is mounted in a L1 drawout case which is not drawout because of the three high voltage studs brought out through the rear of the case. See the Outline and Panel Drilling (Figure 7). The BBA22B and the BBA23A are mounted in a M1 drawout case which like the BBA21A case is not drawout because of two high voltage studs brought out through the rear of the case. See the Outline and Panel Drilling (Figure 8).

POLARIZED UNIT

The polarized relay element (shown in Figure 3) is designed as a high sensitivity, low burden, direct current, polarized relay.

The unit consists of an Alnico permanent magnet; two silicon steel side plates each with one fixed and one movable pole piece; a Permalloy armature; a silicon steel tailpiece; an operating coil and a set of contacts.

The side plates and Alnico magnet are mounted so as to form a magnetic circuit completed through the air gap between the pairs of pole pieces. The tailpiece is centered between the side plates and hence in the permanent magnetic field by nonmagnetic shims.

The rear of the tailpiece is slotted and drilled to receive a slotted positioning cylinder in which is inserted the back end of the armature. The armature may be centered between the fixed pole pieces by rotating the positioning cylinder. A screw in the tailpiece clamps both the cylinder and the armature. An insulating fork which transmits the motion of the armature to the contacts is fastened to the front end of the armature.

In any event, since the BBA relays are connected directly to the pilot wires, precautions must be taken when inspecting the relays or testing them in place.

RATINGS

The sending end relays are rated 115 volts at 60, 50 or 25 cycles, while the receiving end relays have no voltage frequency rating since they operate on the small circulating direct current. However, both sending and receiving relays have an additional rating to describe the frequency of the CPD relay with which they are to be used.

These relays are factory tested at 10 KV from pilot-circuit studs to contacts and ground.

All relay contacts of the BBA21A and BBA23A relays and the alarm contacts of the BBA22B relay will take currents up to 30 amperes. They will carry a current of 5.0 amperes continuously and interrupt currents as follows:

TABLE I

CIRCUIT VOLTS	RESISTANCE LOAD		INDUCTIVE LOAD	
	WITHOUT ARC QUENCHER	WITH ARC QUENCHER	WITHOUT ARC QUENCHER	WITH ARC QUENCHER
24 d-c	10.0 Amps	15.0 Amps	0.75 Amps	1.75 Amps
48 d-c	1.5	7.5	0.50	1.65
125 d-c	0.4	6.0	0.35	1.60
250 d-c	0.3	5.0	0.20	1.50
115 a-c	4.0	6.0	3.0	5.0
230 a-c	2.5	5.0	2.0	4.0

The arc quencher circuit is a one microfarad capacitor shunted across the contacts to decrease current and voltage at the instant of break.

The Type BBA22B relay has self-contained seal-in contacts in the transfer-trip circuit and has a current-closing rating of 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:

TABLE II

	AMPERES, A-C OR D-C	
	2 AMP TAP (0.13 OHM)	0.2 AMP TAP (7 OHMS)
	TARGET AND SEAL-IN COIL	
Tripping Duty	30.0	5.0
Carry Continuously	3.0	0.3

The tap setting used on the seal-in element 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 2.0 amperes at the minimum control voltage. If this tap is used with trip coils requiring more than 2 amperes there is a possibility that the 7 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 the trip coils that take 2.0 amperes or more at minimum control voltage, provided the tripping current does not exceed 30 amperes at the maximum control 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 and seal-in coil of the protective relay.

OPERATING PRINCIPLES

POLARIZED UNIT

Since the Permalloy armature is mounted only at one end, it will behave like a cantilever beam and tend to restore itself to the point of zero deflection from its permanent position. This point should normally be located midway between the fixed poles on the side plates.

The effect of the permanent magnetic field may be best visualized by considering the element as a magnetic bridge. Since the reluctance of the silicon steel paths is negligible, the arms of the bridge are four air gaps, two fixed by the nonmagnetic shims centering the tailpiece, and two variable by varying the position of the armature or the position of the movable pole pieces. The Alnico magnet applies magnetomotive force at the ends of the parallel paths -- and the unbalance of the bridge is indicated by the flux flowing through the armature.

With the movable pole pieces equidistant from the center plane of the side plates, and the armature centered between the fixed pole pieces, no flux will pass through the armature and hence there will be no tendency for it to move to one side or the other. Should the armature be slightly displaced from the equilibrium position, flux will pass through it causing it to move so as to increase the initial displacement, and since the equilibrium was unstable, to go to the extreme limit of its travel.

The force, due to spring action, tending to restore the armature to an equilibrium position is linear with its displacement from the permanent position. The force, due to the magnetic field, tending to displace the armature from equilibrium is also nearly linear with displacement (except when the armature comes very near the pole pieces at the extreme end of its travel). It follows, that by adjusting the strength of the magnetic field with the movable pole pieces, it is possible to balance the restoring and displacement forces on the armature so that very little net force is necessary to move it.

Should the equilibrium position of the restoring force and the displacement force do not occur at the same point, there will be a constant force on the armature tending to move it to one side or the other. The current flowing in the operating coil offsets the position of magnetic equilibrium and hence causes the armature to move to one side or the other.

ACCEPTANCE TESTS

Immediately upon receipt of the relay an Inspection and Acceptance Test should be made to insure that no damage has been sustained in shipment and that the relay calibration has not been disturbed.

These tests may be performed as part of the Installation or Acceptance Tests at the discretion of the user. Since most operating companies use different procedures for Acceptance and Installation Tests, the following includes all applicable tests that may be performed on these relays.

BBA21A

For type BBA21A sending relays, connect studs 7 and 8 to rated voltage and frequency, and connect a DC milliammeter and a variable resistor of 75K ohms (capable of carrying 10 milliamperes) in series across studs 22 and 23 at the rear of the case. See internal connections for the BBA21 (Figure 4). By adjusting the variable 75K ohm resistor increase the current until the undercurrent unit (right unit) armature commences to move and travels to the extreme right with no further increase in current and opens the contacts. This current should be between 2.9 and 3.1 milliamps. Increase the current to 5 milliamps and then decrease the current until the armature starts to move and travels to the extreme left with no further decrease in current and closes the contacts. This current should be between 1.9 and 2.1 milliamps. Increase the current until the overcurrent unit (left unit) armature commences to move and travels to the extreme right with no further increase in current and closes the contacts. This current should be between 5.9 and 6.1 milliamps. Increase the current to the maximum obtainable and decrease the current until the armature starts to move and travels to the extreme left with no further decrease in current and opens the contacts. This current should be between 4.9 and 5.5 milliamps.

BBA22B

For type BBA22B receiving relays, use 125 VDC connected through a DC milliammeter and a variable resistor to studs 28 and 29 at the rear of the case. Observe polarity; see internal connections for the BBA22B (Figure 5). CAUTION: Set the variable resistor for maximum resistance before applying the DC power. By adjusting the DC current, proceed with the current tests outlined for the BBA21A with the exception of applying a maximum of 12 milliamps before checking the overcurrent dropout.

BBA23A

For type BBA23A the connections are the same as the BBA22B but only perform the undercurrent test as outlined for the BBA21A. See internal connections for the BBA23A (Figure 6).

INSTALLATION PROCEDURE

LOCATION AND MOUNTING

Since the BBA relays are connected directly into the pilot wire circuit, which may be subject to high voltages to ground, it is recommended that the relay and the insulating transformer be located as near as possible to the point where the pilot wires enter the building in order to confine the hazardous voltage to as small a part of the station as possible. The location should also be clean and dry, free from dust or excessive vibration, and well lighted to facilitate inspection and testing. The BBA relays should be mounted on a vertical surface. The outline and panel diagrams are shown in Figures 7 and 8.

CONNECTIONS

Internal connections are shown in Figures 4, 5, and 6. External connections are shown in Figures 1 and 2.

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

SETTINGS

CAUTION: IN MAKING ANY SETTINGS ON THE RELAY, THE NECESSARY SAFETY PRECAUTIONS SHOULD BE FOLLOWED BECAUSE PARTS OF THE RELAY ARE CONNECTED DIRECTLY TO THE PILOT WIRES.

The relay receives the proper adjustment at the factory and, in general, these adjustments should not be disturbed. Should test reveal that the relay is not operating properly, refer to the section titled SERVICING.

Tap changes on the target and seal-in element are made by moving the screw holding the right-hand stationary contact of the seal-in element. To change the tap setting without disturbing the adjustment of the right contact, follow this procedure in changing taps: Place a screw from the left contact in the desired tap on the right contact. Remove the screw in the undesired tap and place it in the left contact where the first screw was removed. This keeps one screw in the right contact at all times and helps prevent the right contact from getting out of adjustment.

INSTALLATION TESTS

The connections and operation of the relays and pilot wire can be checked as follows:

When the sending relay is energized, the circuit-opening contacts of both relays should open, the circuit-closing contacts remaining open. Short circuiting the pilot wires should cause the circuit-closing contacts of the sending relay to close, and the circuit-opening contacts of the receiving relay to close. If the BBA22B is being used as the receiving relay, shorting studs 2 and 5 of the sending relay should cause the receiving relay circuit-closing contacts to make.

A more accurate check of each relay requires replacing the pilot wire by a d-c milliammeter and a variable impedance capable of varying the current between 2 and 6 milliamperes. It is important to check that positive polarity is on stud number 28 before these tests are made. Refer to the tests outlined in the Acceptance Test Section.

PERIODIC CHECKS AND ROUTINE MAINTENANCE

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

SERVICING

CONTACT CLEANING

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

POLARIZED UNIT ADJUSTMENTS

Contact settings on this unit should be such that tension closing contacts is approximately 10 grams while contact gap in full open position (armature at the limit of its travel) should be approximately .017". Tension is the force applied at the movable contact tip necessary to just barely part the movable contact tip from the stationary contact screw. The above may be set as follows (see Figure 3).

1. Turn the stationary contact screw such that the movable contact bears against it with a tension of 10 grams. Then turn the screw one full turn into the movable contact.

2. Loosen the nut which clamps the contact assembly to the contact base.

3. The contact assembly is retightened at the point where the contacts just make when the insulated fork is at the limit of its travel tending to open the contact being adjusted.

4. The stationary contact screw is turned one full turn away from the movable contact.

Note that this procedure sets contact gap the equivalent of one stationary contact turn at the armature limit tending to open the contact.

Adjustment of the polarized unit is made by changing the position of the adjustable pole pieces. The pole piece is adjusted by loosening the screws at the top of the side plates and turning the pole pieces by means of a small brass rod pushed into the holes around the circumference of the pole piece. After readjustment to the proper position, be sure to retighten the locking screws.

The snap action described for the current limits given in the section titled ACCEPTANCE TESTS can be accomplished by adjusting the movable pole pieces correctly (see figure 3). In general, moving both poles an equal distance to the right biases the armature to the left which increases pickup and dropout currents. Also, increasing the separation between pole pieces increases th ratio of dropout to pickup. This, however, will make the action of the unit increasingly sluggish. Finally, the left pole has more effect on pickup while the right pole has more effect on dropout so long as their gaps are fairly even.

RECEIVING, HANDLING AND STORAGE

These relays, when not included as a part of a control panel, will be shipped in cartons designed to protect them against damage. Immediately upon receipt of a relay, examine it for any damage substained in transit. If injury or damage resulting from rough handling is evident, file a damage claim at once with the transportation company and promptly notify the nearest General Electric Apparatus Sales Office.

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

If the relays are not to be installed 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.

RENEWAL PARTS

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

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

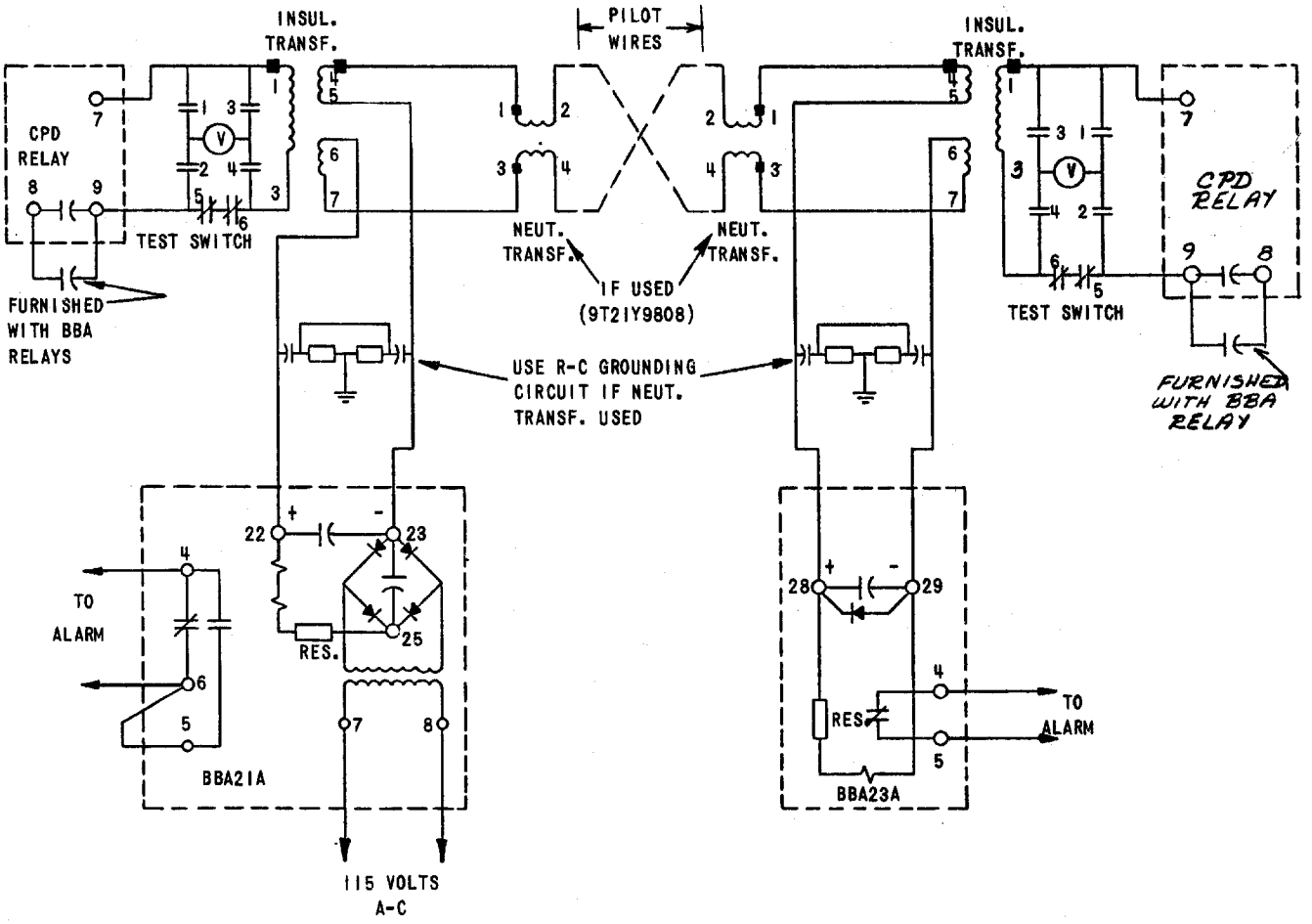


FIG. 1 (0246A7913-1) Schematic Diagram Of Connections To Relay Types BBA21A And BBA23A For Automatic Supervision of A-C Pilot Wires Used With Type CPD Relays

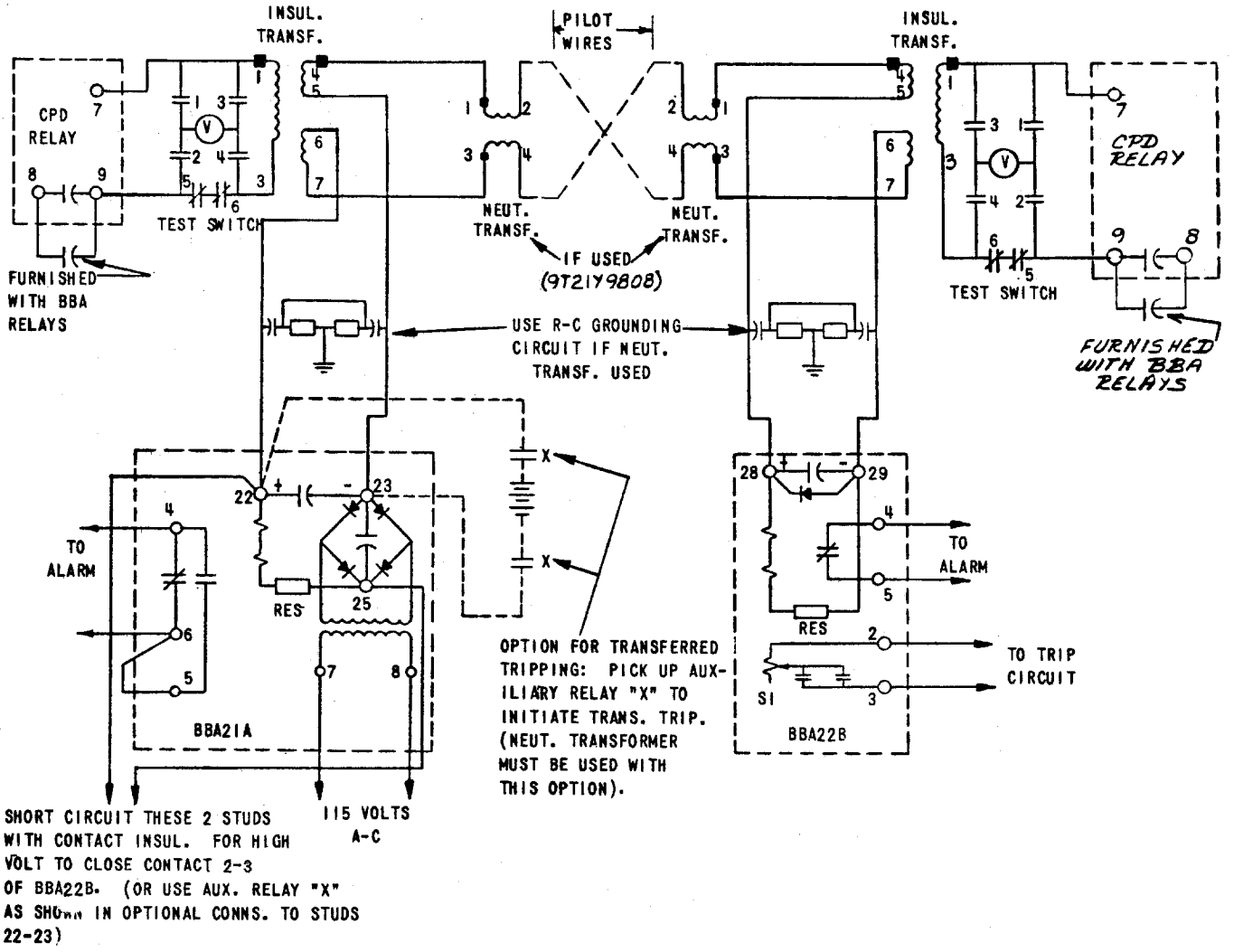


FIG. 2 (0246A7914-3) Schematic Diagram Of Connections To Relay Types BBA21A And BBA22B for Transferred Tripping And Automatic Supervision Of A-C Pilot Wires Used With Type CPD Relays

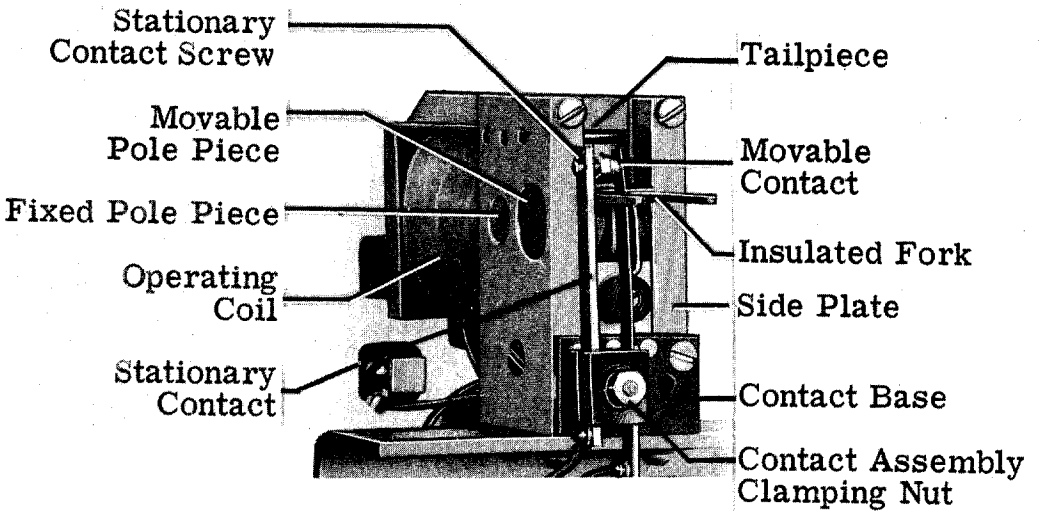
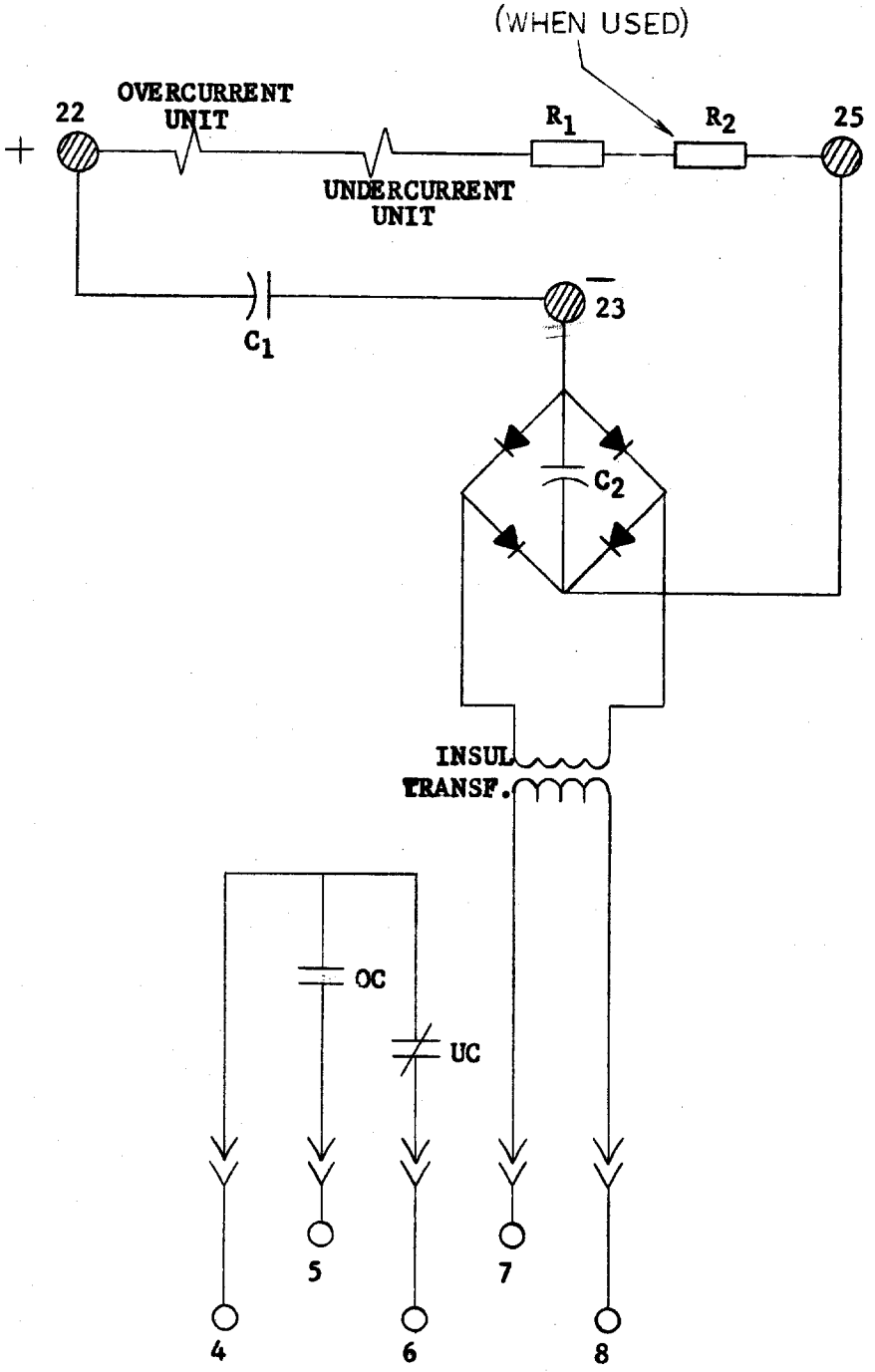
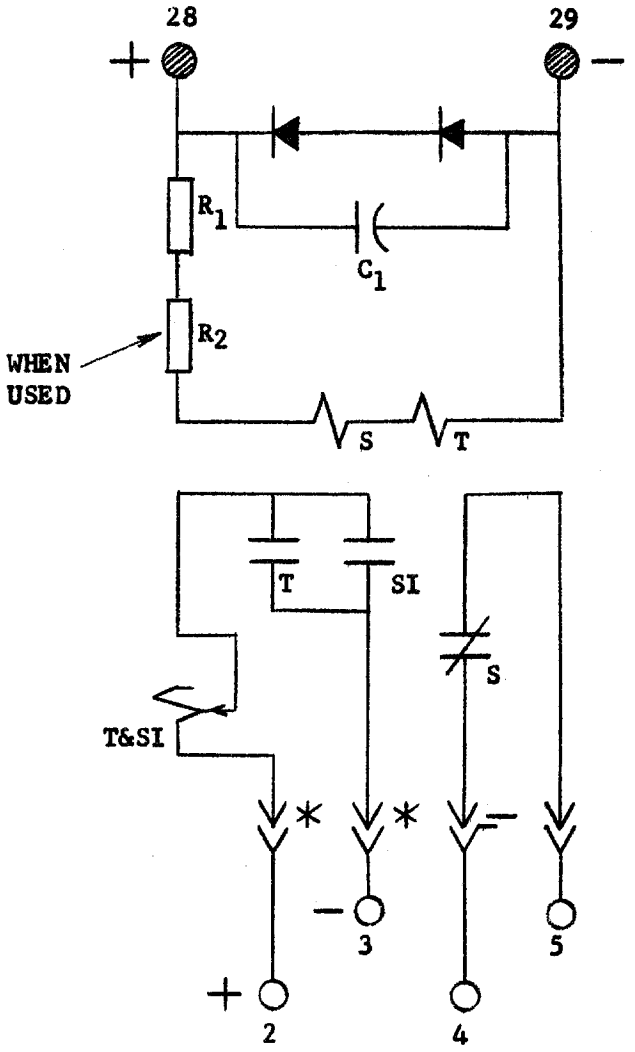


FIG. 3 (857797) Polarized Relay Element Of The Type BBA Relays



NOTE: HIGH VOLTAGE STUDS 22,23,25 PROJECT THRU REAR OF CASE. LEADS & BUSHINGS MUST BE REMOVED FROM THESE STUDS BEFORE CRADLE CAN BE WITHDRAWN.

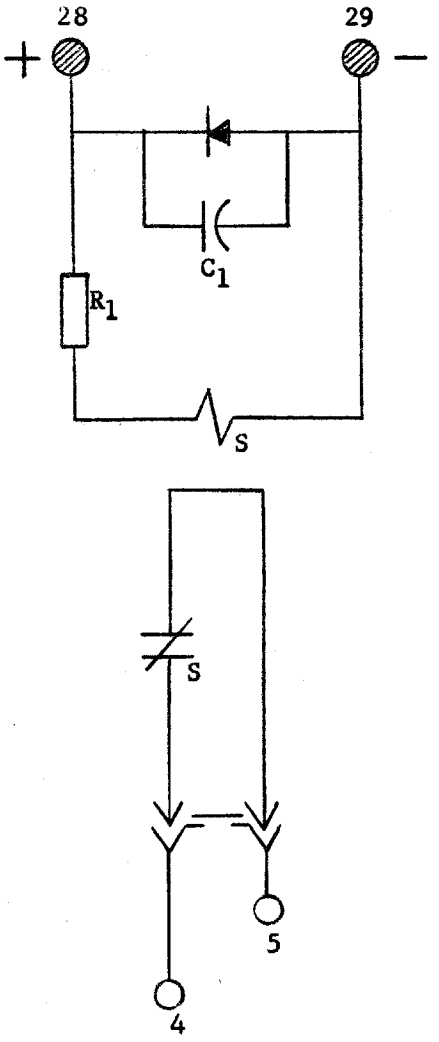
FIG. 4 (0208A2303-1) Internal Connection Diagram For The BBA21A Relay



*= SHORT FINGER

HIGH VOLTAGE STUDS (28& 29)PROJECT THRU REAR OF CASE. LEADS & BUSHINGS MUST BE REMOVED FROM STUDS 28 & 29 BEFORE CRADLE CAN BE WITHDRAWN.

FIG. 5 (0207A7853-0) Internal Connections Diagram For The BBA22B Relay



HIGH VOLTAGE STUDS (28 & 29) PROJECT THRU REAR OF CASE. LEADS & BUSHINGS MUST BE REMOVED FROM STUDS 28 & 29 BEFORE CRADLE CAN BE WITHDRAWN.

FIG. 6 (0207A7854-0) Internal Connections Diagram For The BBA23A Relay

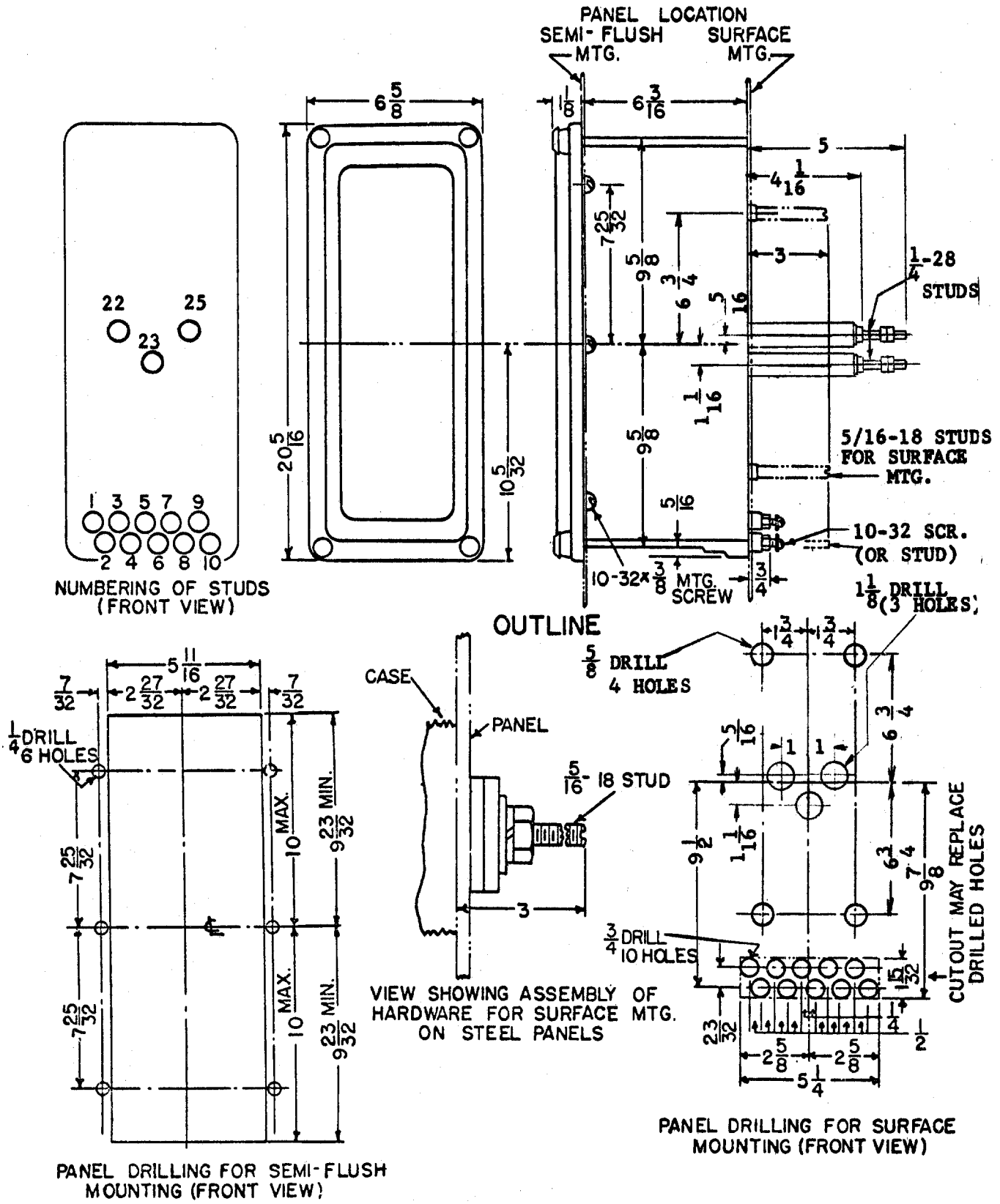


FIG. 7 (0207A5573-0) Outline And Panel Drilling Dimensions For The BBA21A Relay

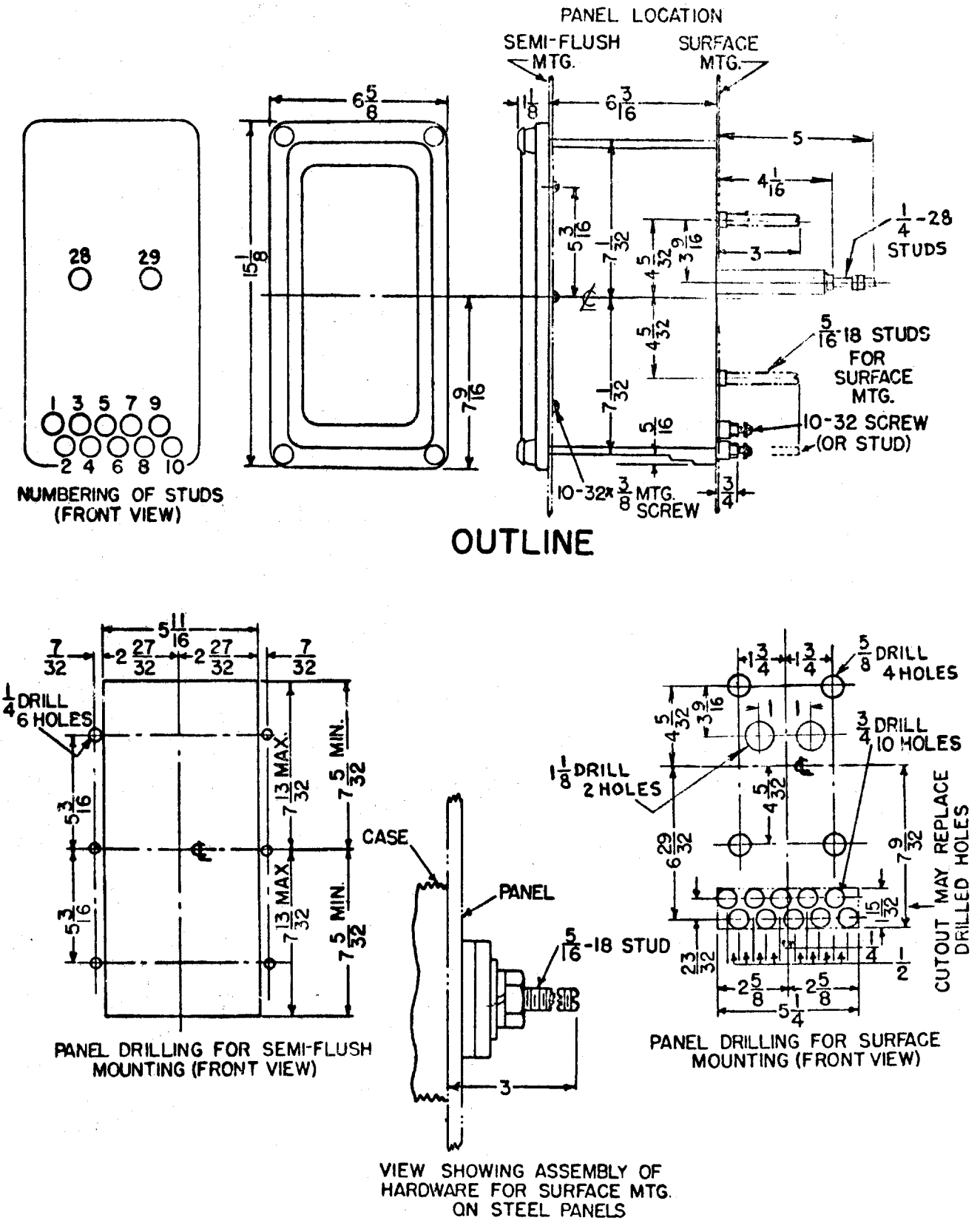


FIG. 8 (0207A5528-0) Outline And Panel Drilling Dimensions For The BBA22B And BBA23A Relays