INSTALLATION • OPERATION • MAINTENANCE

# INSTRUCTIONS

# TYPE DRC RELAY

## APPLICATION

The DRC is a multi shot reclosing relay for initiating the closing of a circuit breaker following protective relay operation.

Experience indicates the vast majority of circuit faults are of a temporary nature. High speed tripping and high speed reclosure minimize damage and system disturbance. Only sufficient dead time for arc deionization need be allowed before reclosing.

Another important function of a reclosing relay when used distribution circuits is to allow instantaneous tripping to protect a fuse for temporary faults and, by cutting out the instantaneous trip prior to the next reclosure, to allow the fuse to operate, minimizing the outage area for permanent faults.

The DRC provides:

1. Up to 3 reclosures to lockout.
2. Flexible tripping sequence, all instantaneous, all time delay or any combination in any sequence of time delay and instantaneous.
3. Static timing and semi-static control.
4. Reclose timing adjustment 0-45 seconds.
5. Lockout alarm contact and indication.
6. Adjustable reset initiation 10 to 60 seconds following successful reclosure.
7. Immediate return to "Home" (or reset) position following reset initiation.
8. Optional instantaneous trip following manual closing from lockout position.

## CONSTRUCTION & OPERATION

The type DRC Relay is composed of (1) an integrator (2) reclose timer printed circuit board (3) reset timer printed circuit board (4) voltage regulator (5) alarm relay (6) instantaneous trip relay (7) close relay and (8) lockout indication. All timing functions are accomplished through the use of semiconductor components. The identification of all components and their locations are shown in figures 1, 2, and 3.

### Reset Timer Board

Reset timer — The reset timer is controlled by the integrator and the auxiliary switches on the breaker. The front panel settings allow a choice of 5 different times for the resetting interval. The time delay circuit is of the quick reset type. This enables the reset times to always be consistent with times indicated on the front panel. Refer to figure 4 for component location and board layout.

### Reclose Timer Board

The reclose timer is controlled by the integrator. The front panel setting allows a choice of 5 different times for each interval of reclosing. The time delay circuit is of the quick reset type which allows a specific timing circuit to be used for all reclosing intervals. Refer to figure 5 for component location and board layout.

### Integrator

The integrator is a stepping switch that responds to signals from the reset timer board and sequences the relay through its preset functions.

### Close Relay

The operation of the close relay is controlled by the operation of a breaker auxiliary switch and the reclose timer.

### Alarm Relay and Lockout Indicator

The Alarm relay and the lockout indicator will be energized when the integrator is in the lockout position.

### Instantaneous Trip Relay

Operation of this relay is controlled by the integrator and the settings on the instantaneous tap block.

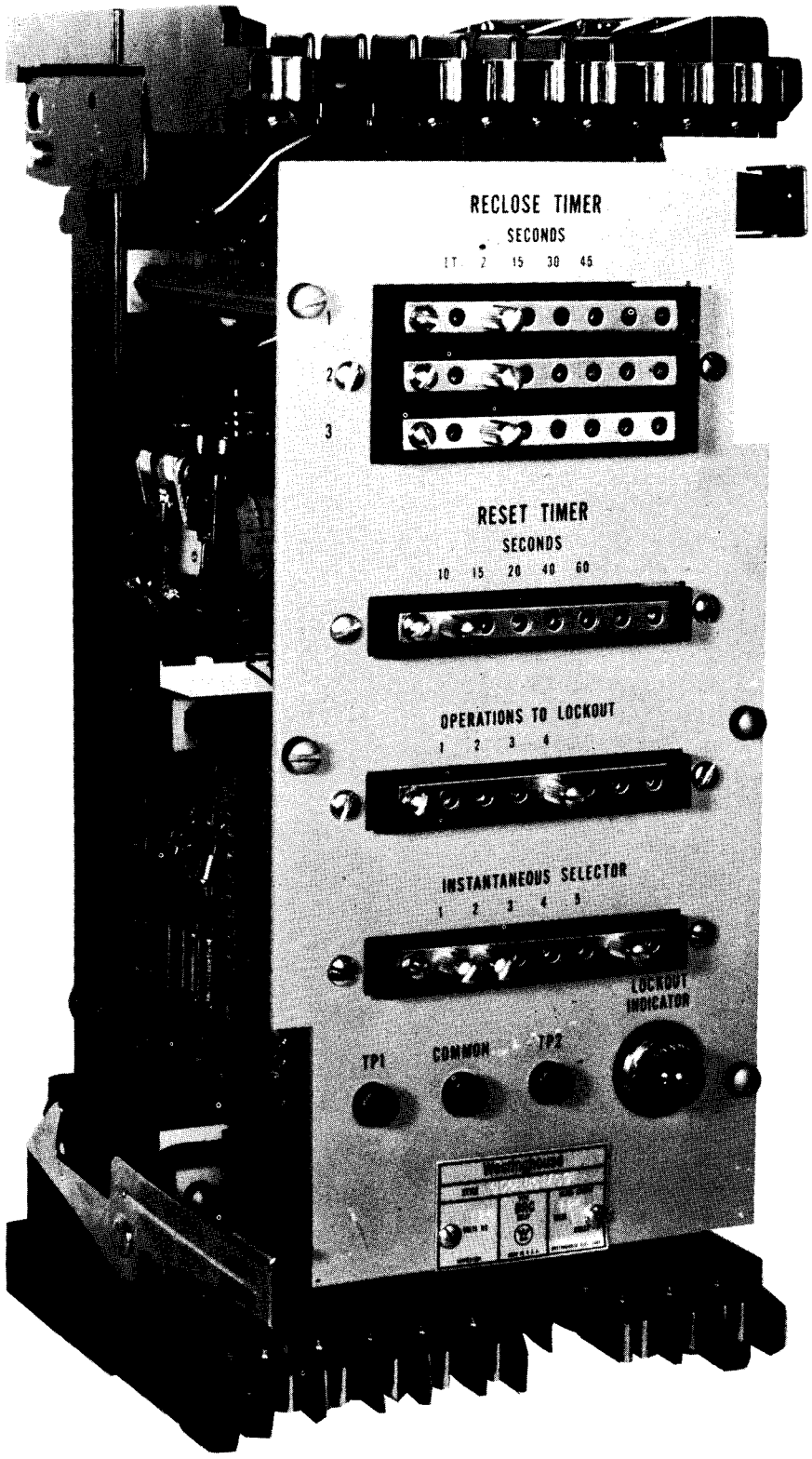



*Fig. 1 Type DRC relay (front view)*

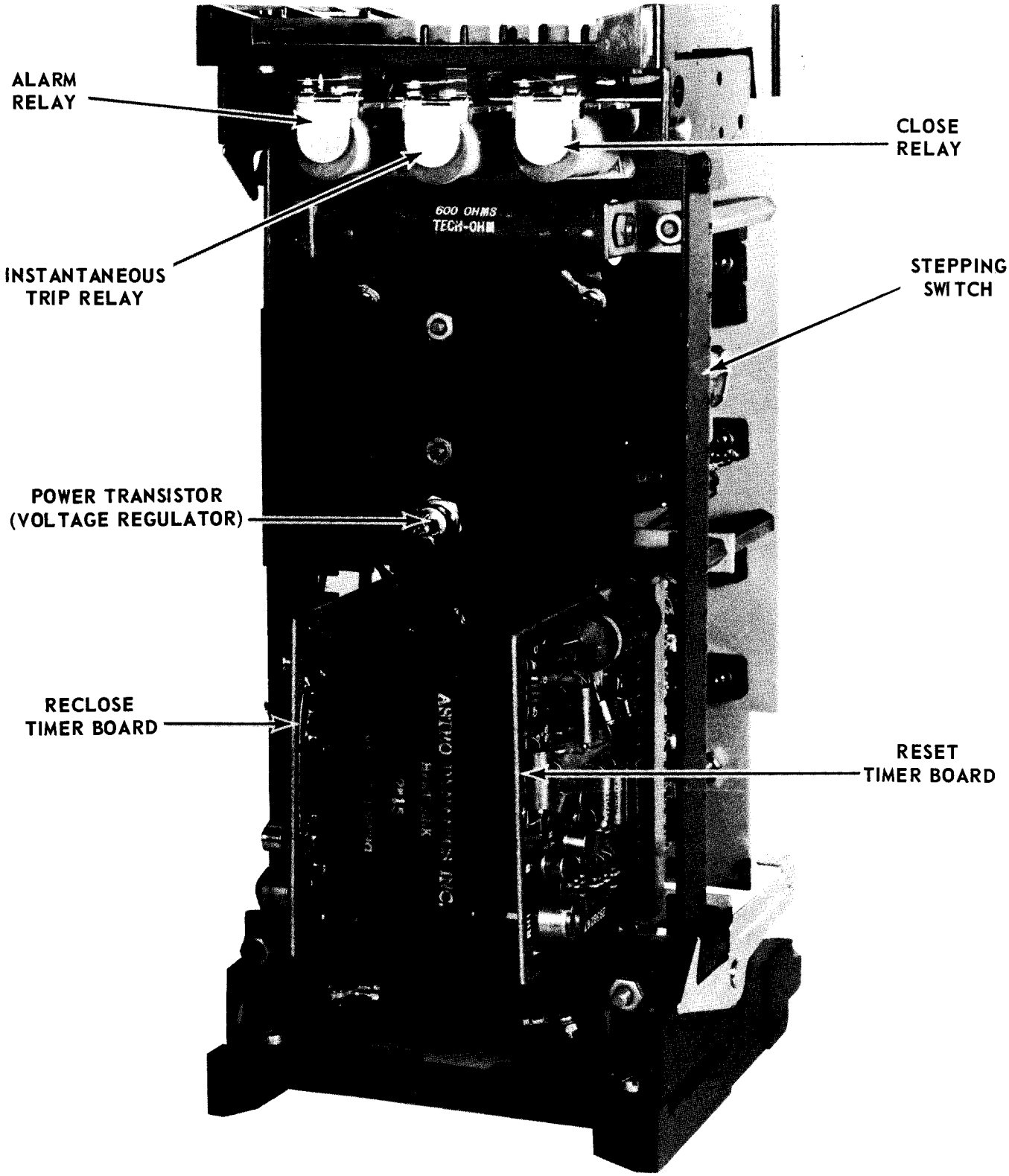



*Fig. 2 Type DRC relay (rear view)*

## Theory of Operation

Operation of the DRC relay will be described with the aid of Figures 3 and 6. We will assume that the DRC relay is set for two instantaneous and two time delayed operations and that a permanent fault occurs on the line being protected.

Device 50 picks up and sends a trip signal to terminal 15 of the DRC relay. This signal is coupled to the ITX relay through the Stepping switch, step 10, and the instantaneous selector position 1. The ITX relays pick up and send a trip signal to the breaker and the breaker opens.

When the trip coil was placed across the station battery, a positive pulse was fed to terminal 10, to pin 3 on board 293B267 of figure 3 and then to the gate of SCR-2 of that board. This pulse turns SCR-2 on and places the regulated voltage across the integrator coil through the normally closed integrator contacts (SS) and level 2 of the integrator. As the armature of the integrator picks up, the normally closed contacts of the integrator (SS) open, stopping current flow, shutting off SCR-2. The integrator armature compresses a spring when the coil is energized.

When the SS contacts open and the coil is de-energized, the spring moves the take-off arm to step 1. The internal wiring of the integrator is such that the integrator coil is re-energized through the normally closed SS contacts, the take-off arm of level 3 and step 1. The integrator now moves to step 2.

The reclose timer is now energized through the take-off arm of level 4, step 2 and interval one of the RECLOSE TIMER tap block. With the input removed from the base of transistor $T_5$, because of the opening of the $52_a$ switch between terminals 8 and 9 (DRC relay), the resistor-capacitor timing circuit commences to charge to a voltage that will be sufficient to allow current to flow into the base of transistor T6 through zener diode Z2. This signal is amplified by transistor T6 and applied to the gate of SCR-3, turning SCR-3 on and placing the close relay across the regulated voltage through the 52b contact (terminals 4 and 5, terminal 20 and the 43 switch). The CR contacts energize the closing circuit, which closes the main contacts for the breaker and prepares the breaker for another tripping operation. When terminal 20 loses its positive voltage, due to the opening of the 52b, the close relay drops out.

When the breaker has closed, terminal 9 goes highly positive and base current is applied to transistor T5 discharging the time delay capacitors (C8, C9) on the reclose timer (board 293B174 on fig. 3), thus setting it up for the next reclosing interval.

The reset timer (board 293B267 on fig. 3) was energized through step 2, the take-off arm of level 1 and the RESET TIMER tap block. The time delay capacitors (C1 to C3) were kept inoperative by terminal 5 being highly positive and supplying base drive for transistor $T_2$. This kept the time delay capacitors short-circuited. With the breaker closed and base drive removed from transistor T2, the time delay capacitors will start to change up and attempt to turn on SCR-1 and reset the integrator to its home position (step 10). Device 50 will trip open the breaker before the reset timer sends a signal to SCR-1 to reset the integrator.

Since the DRC Relay was set for two instantaneous faults, another instantaneous fault takes place in a similar manner to that which was described for the previous operation. The positive pulse fed back to terminal 10 and thence to the gate of SCR-2, turned SCR-2 on, advancing the integrator to step 3.

To insure consistent reclose times when set for more than one instantaneous reclosure, the positive side of the reclose timer's time delay capacitors is short-circuited by the integrator take-off arm of level 7 on the previous step 1 and the present step 3 and subsequent steps 5 and 7.

The internal wiring of the integrator (level 3) now pulses the integrator to step 4. The reclose timer's resistor-capacitor time delay circuit, is now energized through the moving arm of level 4, step 4 and the setting on the RECLOSE TIMER tap block interval 2 and will operate in accordance with that setting. After a predetermined time delay SCR-3 turns on and the close relay is energized. The close relay contacts energize the close circuit, closing the breaker's main contacts. The 52b contact opens removing the regulated voltage from terminal 20. This allows the close relay to drop out. During the time that the reclose timer was operating, the reset timer was held inoperative by the positive voltage on terminal 5. This voltage supplies base drive for transistor T2, making T2 conduct, short circuiting the capacitors in the reset timer time delay circuitry.

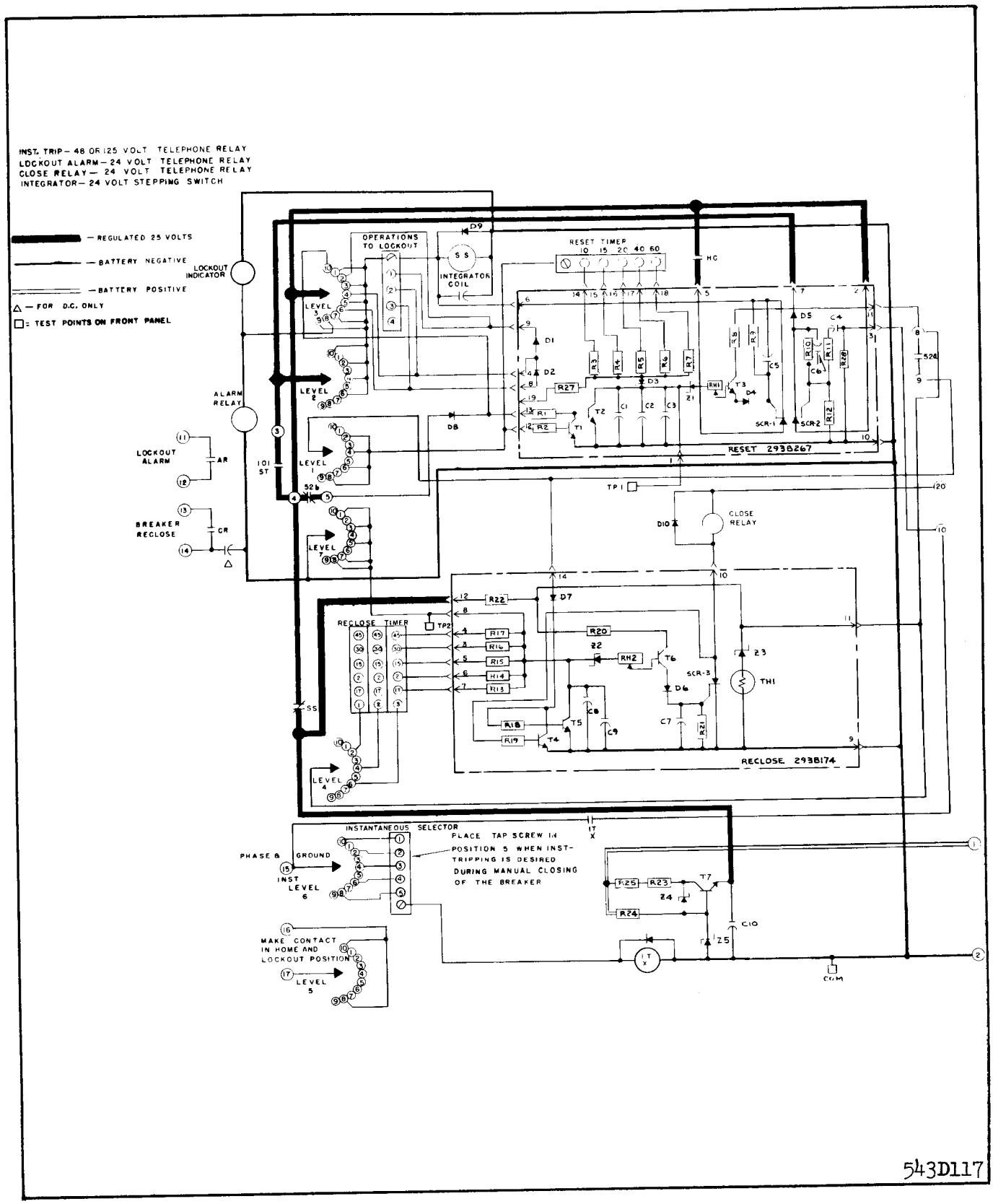



*Fig. 3 Internal schematic of the type DRC relay.*

When the base drive is removed from transistor T2, the reset timer attempts to time out and reset the integrator to the home position (step 10). Device 50 again senses the fault and the trip signal gets as far as the INSTANTANEOUS selector tap block and reaches a dead end as the DRC relay was not set for an instantaneous operation on the third and forth operations.

Device 51 also senses the fault and after a time delay sends a trip signal to the breaker trip coil.

This again places the station battery across the trip coil opening the breaker. While the breaker is opening, a positive pulse is sent to the gate of SCR-2 through terminal 10 (DRC relay). This pulse turns on SCR-2 placing the integrator coil across the regulated voltage, moving the integrator to step 5.

The reclose timer time delay capacitors (C8 and C9) are short circuited by the take-off arm of level 7 and step 5. The internal wiring of the integrator coil through the normally closed contacts of the integrator (SS), the take-off arm of level 3 and step 5 and upon opening of the SS contacts the integrator moves to step 6.

The reclose timer is energized through the moving arm of level 4, step 6 and interval three of the RECLOSE TIMER tap block. After the predetermined time delay, SCR-3 turns on picking up the close relay. The close relay contacts energize the closing circuit, which closes the breaker main contacts, and prepares the breaker for another operation. The potential at terminal 20 drops to zero and de-energizes the close relay. Terminal 9 goes positive and base current is applied to transistor $T_5$ discharging the time delay capacitors in the reclose timer. The reset timer is energized through the moving arm of level 1, and step 6 and it will attempt to reset the integrator to its home position (step 10).

The fault reappears and device 51 goes through another time delayed operation as no instantaneous operation was preset on the INSTANTANEOUS SELECTOR tap block. When the trip coil is placed across the battery, a positive pulse is fed to the gate of SCR-2 through terminal 10. SCR-2 turns on and conducts current through the moving arm of level 2, step 6 and the integrator coil. The integrator moves to step 7 and then the internal wiring of the integrator (level 3) moves the arm to step 8. Levels 2 and 4 have no connections on step 8 as this is the "lockout" step. The reclose timer is kept inoperative by the action of level 7. This level places a short circuit across capacitors C8 add C9.

The reset timer is energized through the moving arm of level 1, step 8 and the RESET TIMER tap block setting. The time delay capacitors are short-circuited due to the base drive applied to transistor T2 by the positive voltage on terminal 5. The relay will remain in this condition until the breaker is manually or electrically closed.

Close the breaker utilizing the 101 switch, the reset timer will attempt to time out and reset the integrator to its home position (step 10). Assuming the fault still exists, the breaker will trip out time delayed unless a tap screw has been placed in the number 5 position of the INSTANTANEOUS SELECTOR tap block (under this condition an instantaneous operation will take place). When the trip coil is placed across the station battery, a positive pulse is again fed to the gate of SCR-2 on board 293B267 of figure 3 through terminal 10 (DRC relay). The cathode of SCR-2 is connected to the integrator coil through the take-off arm of level 2 and steps 10, 2, 4, and 6. With no connection made on step 8, level 2, SCR-2 cannot be turned on as there is no complete path for current to flow, and the integrator remains at step 8 or "lockout."

Since the relay was at step 8 after the last operation, the relay will remain at "lockout" until it is manually or electrically closed. If we now assume that the fault has been cleared and the breaker is closed in, terminal 9 becomes positive and energizes the reset timer through the moving arm of level 1, step 8 and the "Reset Timer" tap block setting. With no base drive into transistor T2, transistor T2 will not conduct allowing the time delay capacitors C1 to C3 to charge up to a voltage of sufficient magnitude to make Z1 conduct current into the base of transistor T3. Transistor T3 amplifies the signal which is applied to the gate of SCR-1. SCR-1 turns on placing the integrator coil across the regulated voltage through the integrator contacts (SS) and the homing contact (HC). As the armature pulls in, the integrator contact (SS) opens, allowing the integrator to move to step 9. The internal wiring of the integrator (level 3) through the integrator contacts (SS), the take off arm of level 3 and step 9 energizes the integrator coil, moving the integrator to step 10 or the integrator's home position. All circuits are de-energized except for step 10, level 3, which

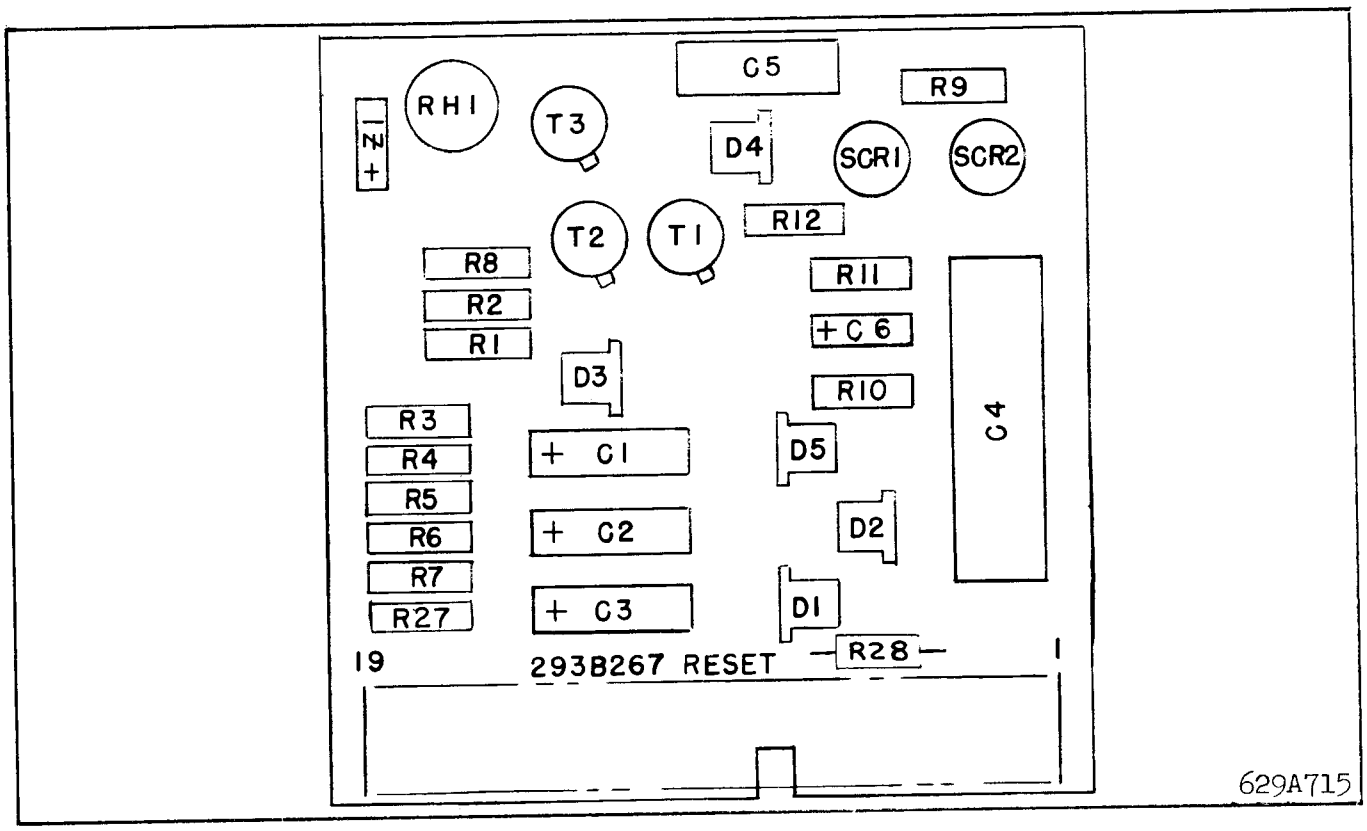



*Fig. 4 Component location of Reset printed circuit board for the type DRC relay.*

feeds a positive voltage to the base of transistor T2 through resistor R1 in the reset timer. This positive voltage makes transistor T2 conduct, discharging the reset timer's time delay capacitors (C1 to C3) and keeps the capacitors discharged when the integrator is at its home position (step 10). The homing contact (HC), a cam operated switch, is open at step 10 and keeps the integrator coil from being energized when at the integrator's home position. The lockout indicator and alarm relay were energized by level 3, step 8, and will remain energized until the integrator is returned to its home position (step 10). The DRC relay is now reset and ready to go through a full sequence in line with the settings made at the beginning of this description.

## CHARACTERISTICS

### Tripping Sequences

The tripping sequences can be all instantaneous, all time delayed or any combination of instantaneous and time delayed as desired.

### Reset Time

The reset timer can be set for 10, 15, 20, 40 and 60 seconds resetting time.

### Reclose Time

The reclose timer can be set for instantaneous, 2, 15, 30, and 45 seconds reclosing time for each reclosing interval or any combination of the aforementioned times.

### Operations to Lockout

The DRC relay can be set to lockout the breaker after 1, 2, 3, or 4 operations.

## ENERGY REQUIREMENTS

**Station Battery** – 48 – 125 VDC.

0.175 amps. at 125VDC in the "Home" position.
0.275 amps. at 125VDC in the Lockout position.
1.0 amp. at 125VDC during stepping switch operation.

## SETTINGS

### FRONT PANEL SETTINGS

#### 1. Reclosing timer

Tap screws may be placed in different numbered (reclosing times) taps for all three intervals or in the same number for all intervals. A tap

## INTEGRATOR LEVEL AND STEP FUNCTIONS PLUS TAP BLOCK SETTINGS

| INTEGRATOR | STEP 10 HOME POSITION | STEP 1 | STEP 2 | STEP 3 | STEP 4 |
|---|---|---|---|---|---|
| Level 1 and RESET TIMER TAP BLOCK SETTING | No connection | No connection | Energize reset timer time delay circuit † | No connection | Energize reset timer time delay circuit |
| Level 2 | Pulses integrator to step 1 when SCR-2 turns on | No connection | Pulses integrator to step 3 when SCR-2 turns on | No connection | Pulses integrator to step 5 when SCR-2 turns on |
| Level 3 and OPERATIONS TO LOCKOUT TAP BLOCK SETTING | Supplies base drive for T2 to keep reset timer inoperative | Pulses integrator to step 2 | Pulses integrator to step 3 when set for one operation to lockout | Pulses integrator to step 4 | Pulses integrator to step 5 when set for 1 or 2 operations to lockout |
| Level 4 and RECLOSE TIMER TAP BLOCK SETTING | No connection | No connection | Energizes reclose timers time delay circuit through interval one | No connection | Energizes reclose timers time delay circuit through interval one |
| Level 5 | Make contact between terminals 16 and 17 | No connection | No connection | No connection | No connection |
| Level 6 and INST. TAP SETTING | Determines Instantaneous operations | No connection | Same as step 10 | No connection | Same as step 10 |
| Level 7 | No connection | Short circuits reclose timer time delay capacitors | No connection | Same as step 1 | No connection |

† If fault is cleared, reset timer will time out and energize the integrator coil directly on even numbered steps, level 3 will pulse the integrator on odd numbered steps moving the integrator to the home position.

## INTEGRATOR LEVEL AND STEP FUNCTIONS PLUS TAP BLOCK SETTINGS

| INTEGRATOR | STEP 5 | STEP 6 | STEP 7 | STEP 8 LOCKOUT POS. | STEP 9 |
|---|---|---|---|---|---|
| Level 1 and RESET TIMER TAP BLOCK SETTING | No connection | Energizes reset timer time delay circuit † | No connection | Energizes reset timer time delay circuit † | No connection |
| Level 2 | No connection | Pulses integrator to step 7 when SCR-2 turns on | No connection | No connection | No connection |
| Level 3 and OPERATIONS TO LOCKOUT TAP BLOCK SETTING | Pulses integrator to step 6 | Pulses integrator to step 7 when set for 1,2, or 3 operations to lockout | Pulses integrator to step 8 | Energizes lockout indicator and alarm relay | Pulses integrator to step 10 (home position) |
| Level 4 and RECLOSE TIMER TAP BLOCK SETTING | No connection | Energizes reclose timers time delay circuit through interval 3 | No connection | No connection | No connection |
| Level 5 | No connection | No connection | No connection | make contact between terminals 16 and 17 | No connection |
| Level 6 and INST. TAP BLOCK SETTING | No connection | Same as step 10 | No connection | Same as step 10 | No connection |
| Level 7 | Same as step 1 | No connection | Same as step 1 | Same as step 1 | No connection |

† If fault is cleared, reset timer will time out and energize coil directly on even numbered steps, level 3 will pulse the integrator on odd numbered steps moving the integrator to the home position (step 10).

screw must be in each interval, otherwise the breaker will not close on that interval. When operating on less than 4 operations to lockout, the reclosing intervals will be dropped starting with the third interval first; i.e., for 3 operations to lockout the control will reclose in accordance with the tap screws in intervals one and two and then the control will proceed to lockout. The number above the tap indicates the time duration of the reclosing interval.

**2. Reset timer**

Place tap screw in proper tap to obtain the desired reset time. The number above the tap indicates the time duration of the reset interval.

**3. Operations to lockout**

Place tap screw in desired tap for obtaining 1 to 4 operations to lockout. The number above tap indicates the number of operations that will occur before lockout is reached.

**4. Instantaneous operation**

Place tap screws in the desired taps for obtaining instantaneous operation. The numbers above the taps indicate which of the sequence of trips that would be instantaneous. For instantaneous operations on the first two trips tap screws should be placed in the taps numbered 1 and 2. Time delayed trips will occur on all positions that do not have a tap screw. A tap screw must be placed in position 5 when instantaneous tripping is desired during manual closing of the breaker.

## ADJUSTMENTS & MAINTENANCE

The proper adjustments to insure correct operation of this relay have been made at the factory. Upon receipt of the relay, no customer adjustments other than those covered under "SETTINGS" should be required.

**Acceptance check**

The following check is recommended to insure that the relay is in proper working order: Before proceeding, connect relay to breaker as per Figure 6 or to auxiliary test relay per Figure 7.

1. a) Instantaneous tap screws in positions 1 & 2.
   b) Operation to lockout tap screw in position 4.
   c) Reset timer tap screw in 10 second position.
   d) Reclosing timer intervals, all tap screws in the 2 second position.
2. Energize the over current relay with a value of current that will insure that the instantaneous trip attachment will pick up. Observe if the DRC relay locks the auxiliary test relay open in the correct number of operations and not if the correct number of instantaneous and time delayed operations occur in line with the settings made in the proceeding paragraph. The reclose times should be 2 seconds plus or minus 5%.
3. Close the auxiliary test relay and simultaneously start a stop watch. Time the interval that elapses before the integrator resets. The integrator will be resetting when the lockout light on the front panel of the relay goes out. This time should equal the front panel Reset Timer setting plus or minus 10%.

**Routine Maintenance**

All relays should be inspected periodically and the time of operation should be checked at least once every year or at such other intervals as may be indicated by experience to be suitable to the particular application.

## CALIBRATION

Use the following procedure for calibrating the relay, if the relay has been taken apart for repairs or the adjustments disturbed. This procedure should not be used until it is apparent that the relay is not in proper working order. (See acceptance check).

**1. Reset time calibration**

Place tap screw in 20 second position of reset timer tap block. Trip open the test relay with the 101 switch. Place VTVM from test point 1 to common, close test relay utilizing the 101 switch and adjust RH-1 (reset board) so that the lockout light goes out when 3.25 to 3.35 volts can be seen on the VTVM. Repeat the above operation except start a stop watch when closing the test relay and time the interval until the lockout light goes out. This should equal the reset timer tap block setting plus or minus 5%. Readjustment of RH-1 can be made to bring the reset time within the tolerance stated above.

**2. Reclose time calibration**

Place tap screw in 15 second positions of the

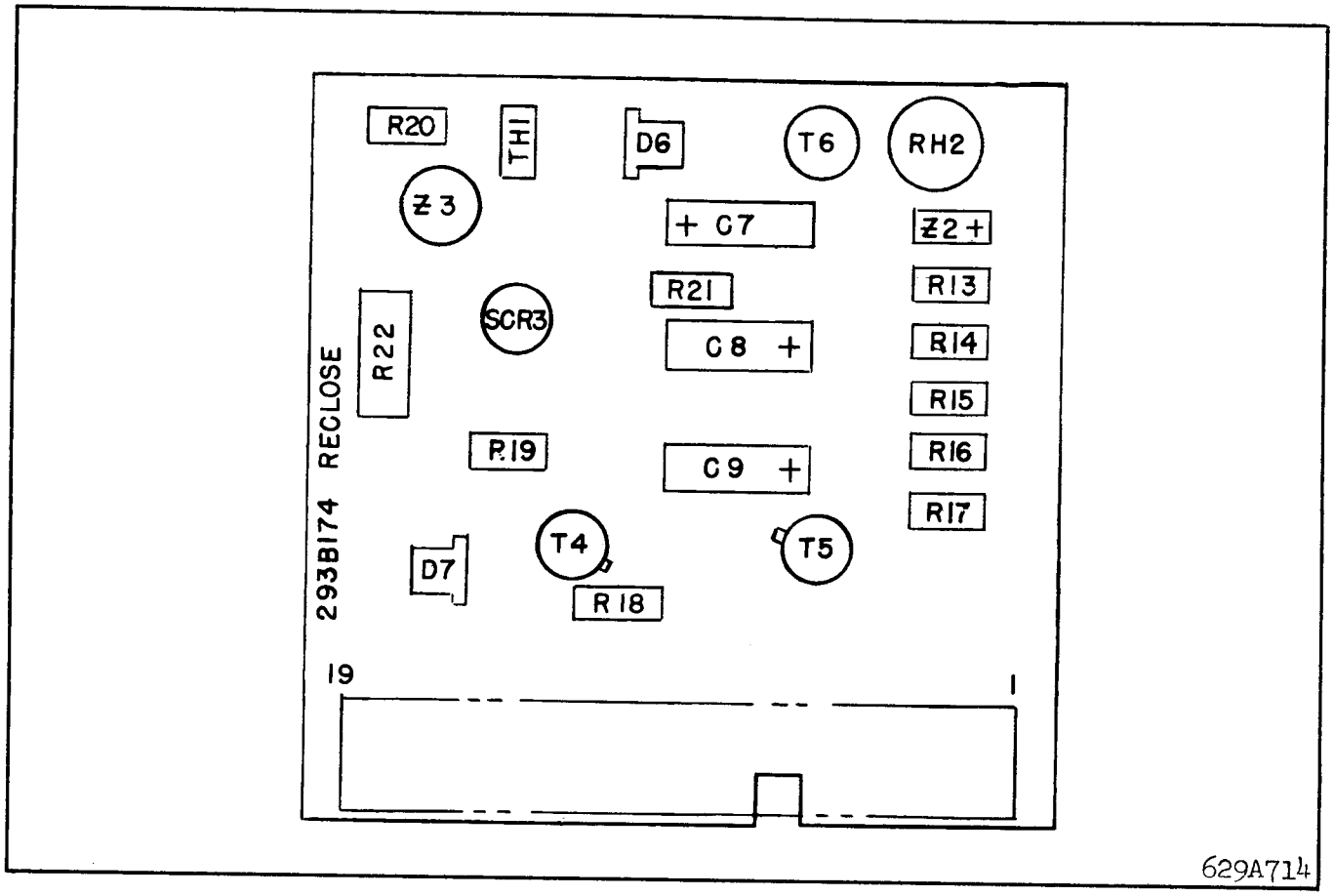



*Fig. 5 Component location of Reclose printed circuit board for the type DRC relay.*

reclose timer tap block. Place VTVM from test point 2 to common. Trip test relay open by energizing terminal 8 and 9 of overcurrent relay with 2X tap value setting. Adjust RH-2 (reclose board) so that the test relay recloses when 3.25 to 3.35 appears on the VTVM. Repeat the tripping of the test relay and start a stop watch when the test relay opens. Time the interval until the test relay closes. This should equal the reclose timer tap block setting plus or minus 5%. Readjustment of RH-2 can be made to bring the reclose time within the tolerance stated above.

## RENEWAL PARTS

Repair work can be done most satisfactorily at the factory. However, interchangeable parts can be furnished to the customers who are equipped for doing repair work. When ordering parts, always give the complete nameplate data.

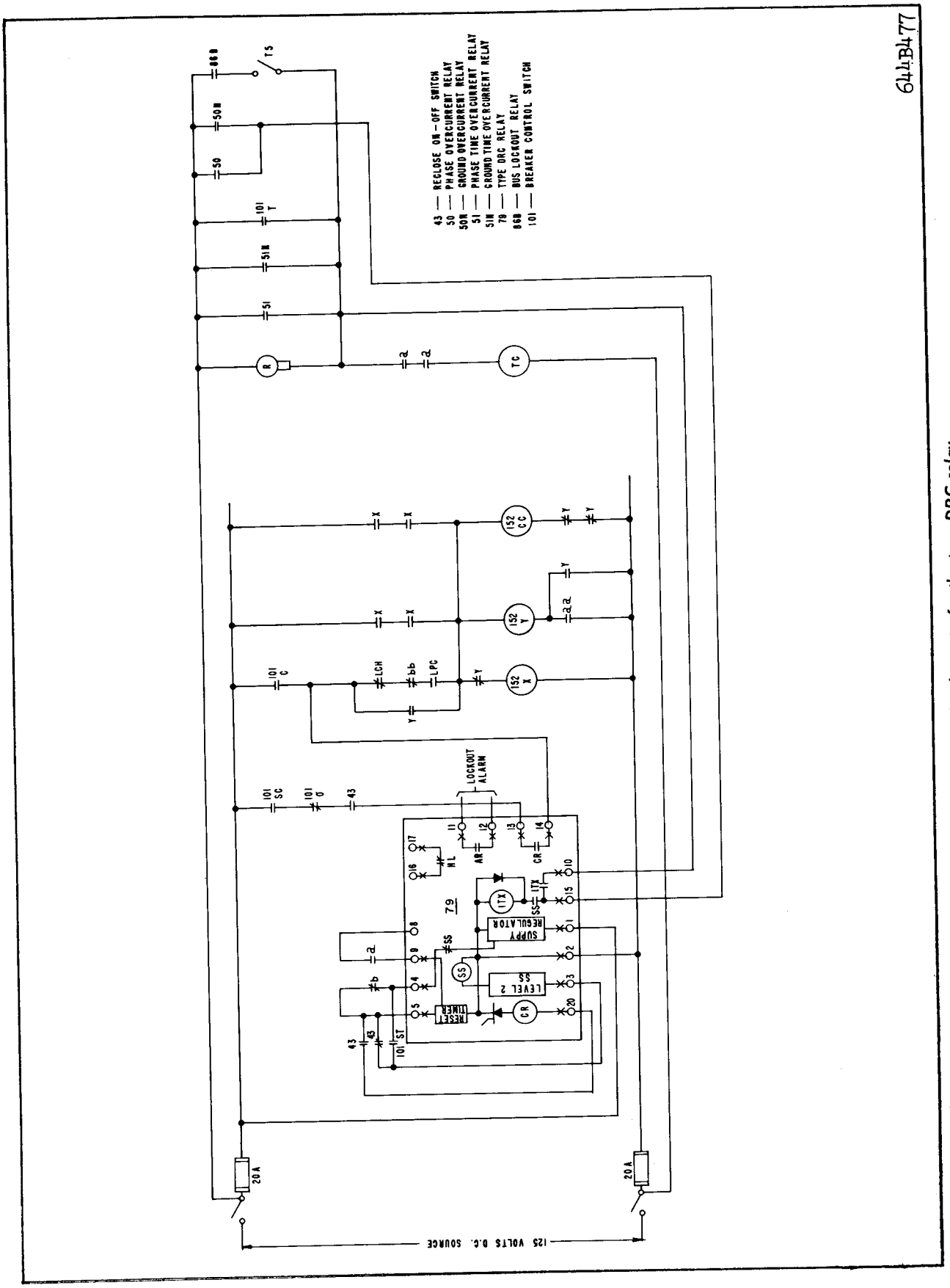



*Fig. 6 External schematic for the type DRC relay.*

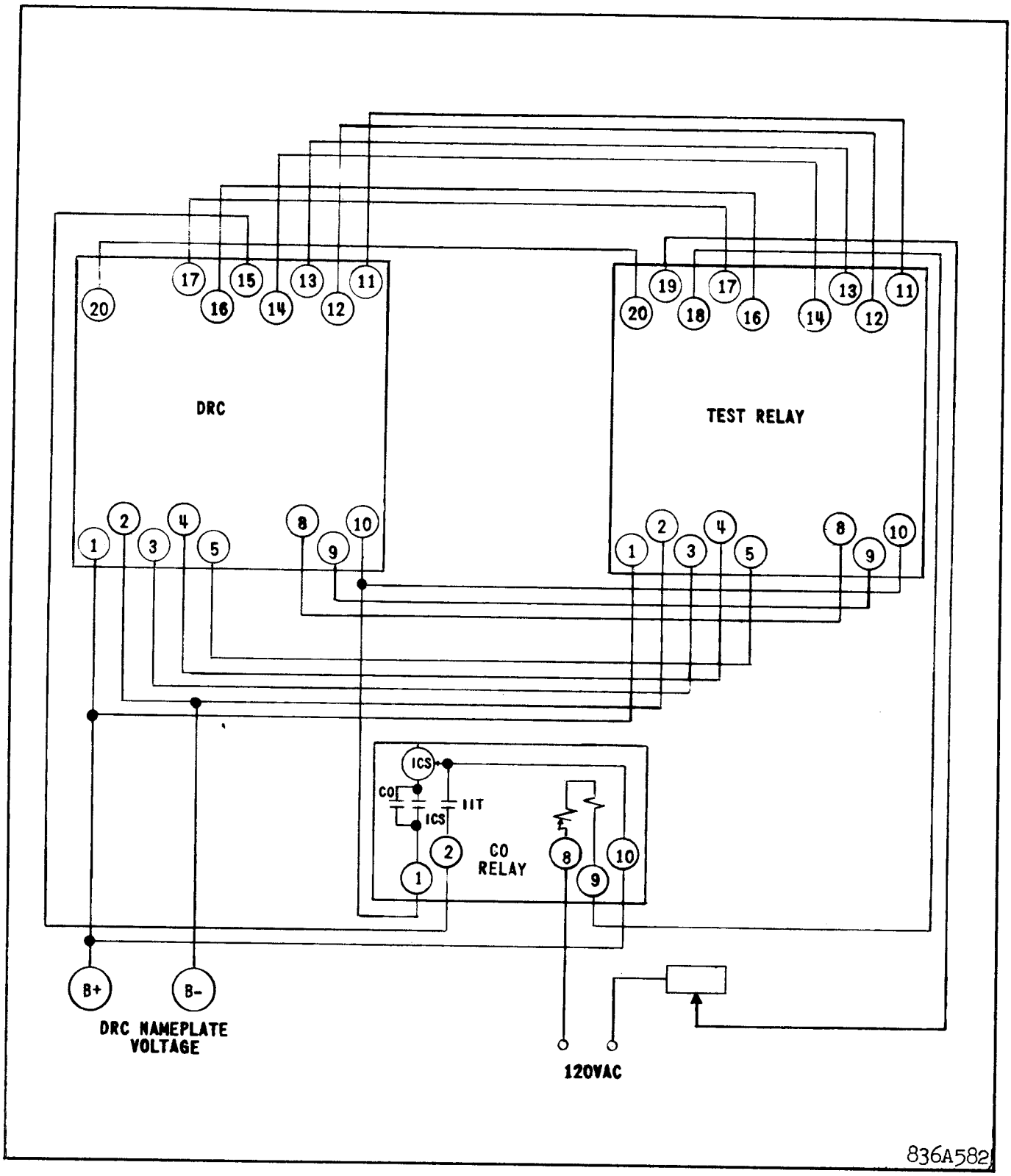



*Fig. 7 Test diagram for the type DRC relay.*

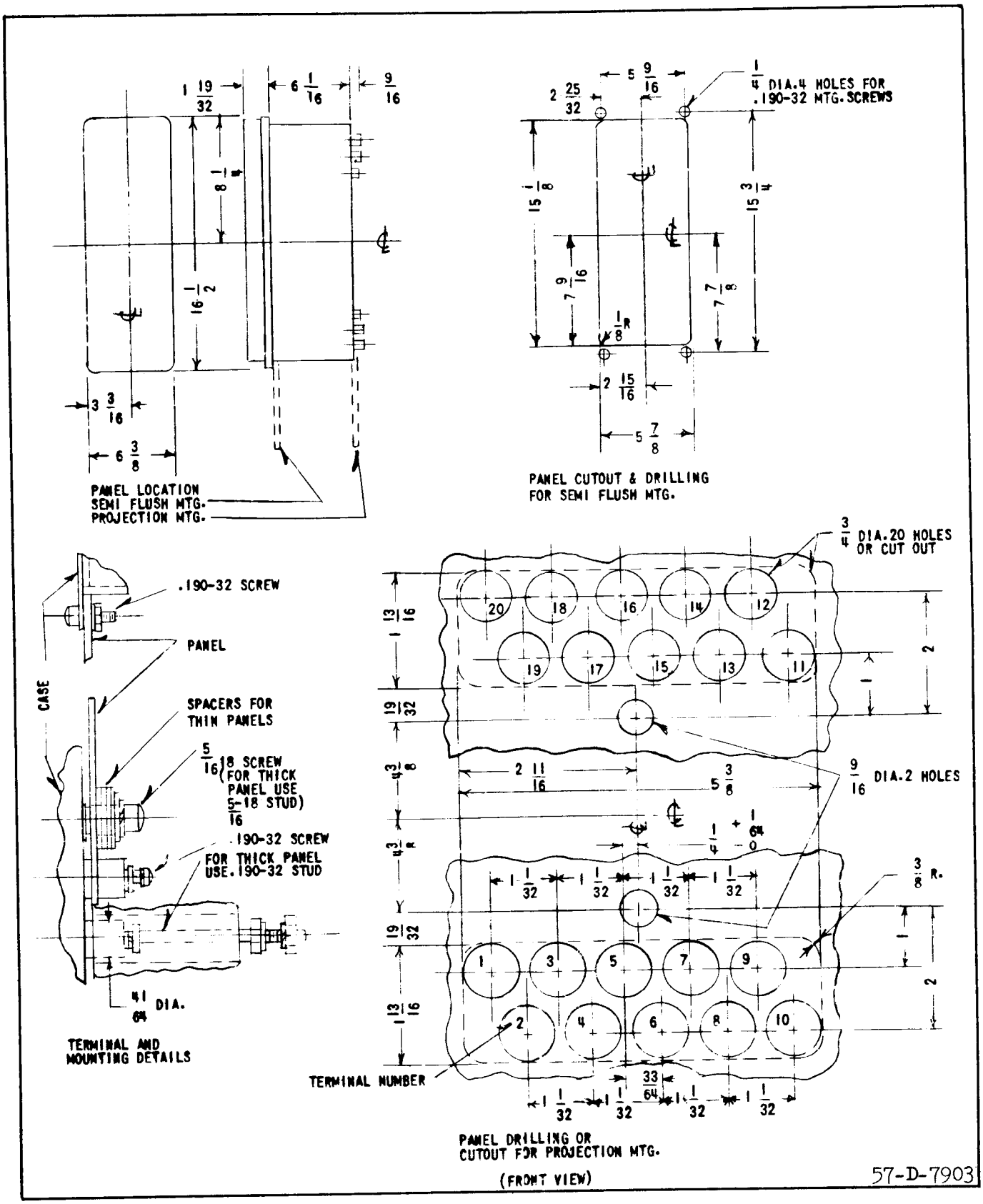
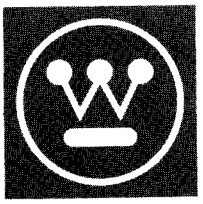



*Fig. 8 Outline and drilling plan for the type DRC relay in the FT-32 case.*



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