Instruction Leaflet
41-251.2P

Type CRN-1 Reverse Power Relay 50 and 60 Hertz

Effective: June 1991
Supersedes I.L. 41-251.2N Dated April 1988
(I)Denotes Change Since Previous Issue

CAUTION

Before putting relays into service, remove all blocking which may have been inserted for the purpose of securing the parts during shipment, make sure that all moving parts operate freely, inspect the contacts to see that they are clean and close properly, and operate the relay to check the settings and electrical connections.

1.0 APPLICATION

The type CRN-1 relay is a single phase directionally controlled timing relay used to protect ac generators from motoring. When such a condition occurs and persists for a predetermined time interval, the generator may be tripped or an alarm sounded. The CRN-1 may also be used to sense lagging power factor load flow in an abnormal direction as shown in Figure 6. The directional unit has 30° maximum torque characteristics and the timer unit is adjustable from approximately 2 to 40 seconds.

2.0 CONSTRUCTION

The relay consists of a directional unit, a timing unit, and an indicating contactor switch unit.

2.1 TIMER UNIT (T)

The timer unit operates on the induction-disc principle. A main coil located on the center leg of an "E" type laminated structure produces a flux which divides and returns through the outer legs. A shading coil causes the flux through the left leg (front view) to lag the main pole flux. The out-of-phase fluxes thus produced in the air gap causes a contact closing torque. It is similar to a non-tapped version of the voltage unit of the CV Relay (see I.L. 41-201).

2.2 DIRECTIONAL UNIT (D)

The directional unit is a product induction cylinder type unit operating on the interaction between the polarizing circuit flux and the operating circuit flux.

Mechanically, the directional unit is composed of four basic components: a die-cast aluminum frame, an electromagnet, a moving element assembly, and a molded bridge.

The frame serves as the mounting structure for the magnetic core. The magnetic core which houses the lower pin bearing is secured to the frame by a locking nut. The bearing can be replaced, if necessary, without having to remove the magnetic core from the frame.

The electromagnet has two series-connected polarizing coils mounted diametrically opposite one another; two series-connected operating coils mounted diametrically opposite one another; and two locating pins. The locating pins are used to accurately position the lower pin bearing, which is mounted on the frame, with respect to the upper pin bearing, which is threaded into the bridge. The electromagnet is secured to the frame by four mounting screws.

The moving element assembly consists of a spiral spring, contact carrying member, and an aluminum cylinder assembled to a molded hub which holds the shaft. The shaft has removable top and bottom jewel bearings. The shaft rides between the bottom pin bearing and the upper pin bearing with the cylinder rotating in an air gap formed by the electromagnet and the magnetic core. The stops for the moving element contact arm are an integral part of the bridge.

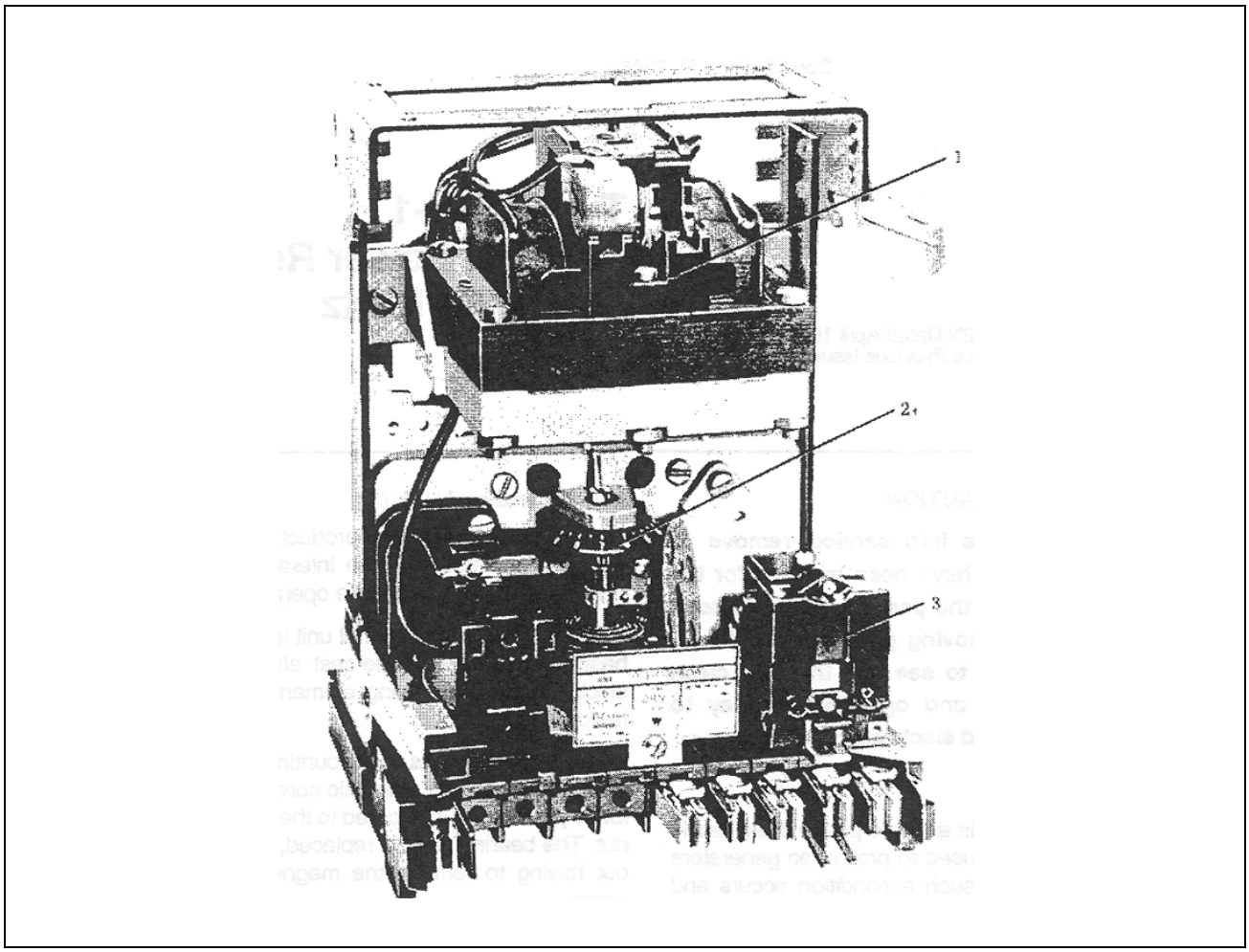

Figure 1. Type CRN-1 Relay Without Case. 1 = Directional Unit (D). 2 = Timer Unit (T). 3 = Indicating Contactor Switch (ICS).

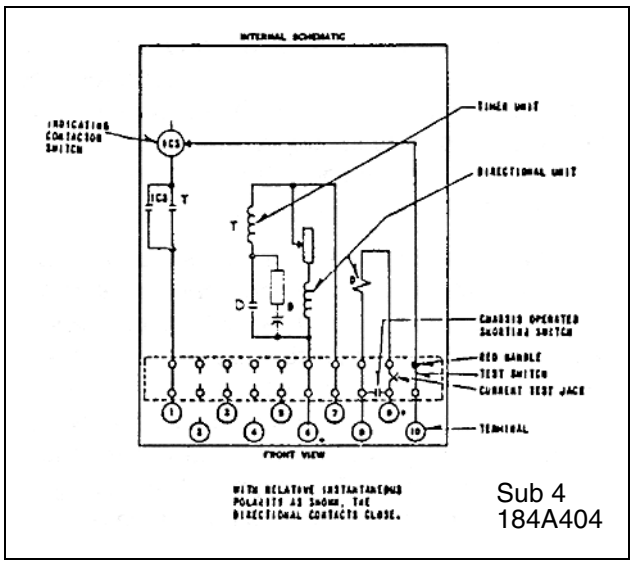

Figure 2. Internal Schematic of the Single Trip Type CRN-1 Relay in the FT-21 Case.

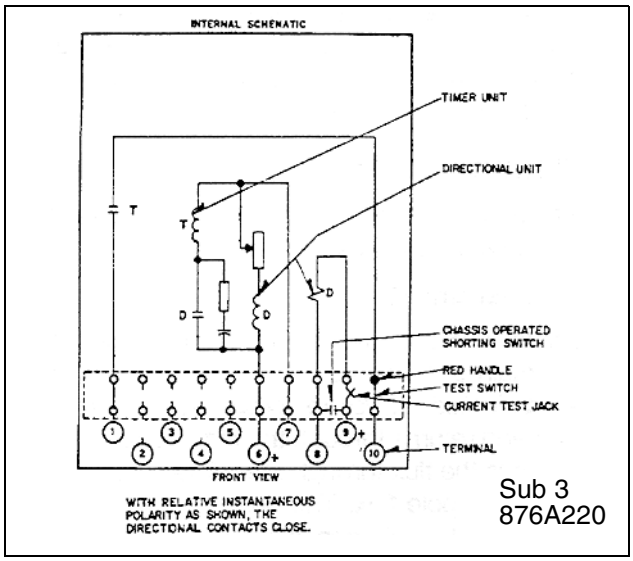

Figure 2a. Internal Schematic of the Single Trip Type CRN-1 Relay Without ICS Unit in the FT-21 CAse.

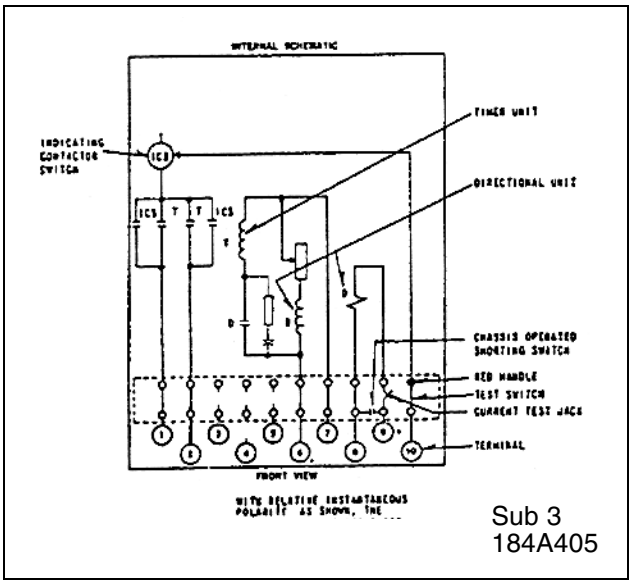

Figure 3. Internal Schematic of the Double Trip Type CRN-1 Relay in the FT-21 Case.

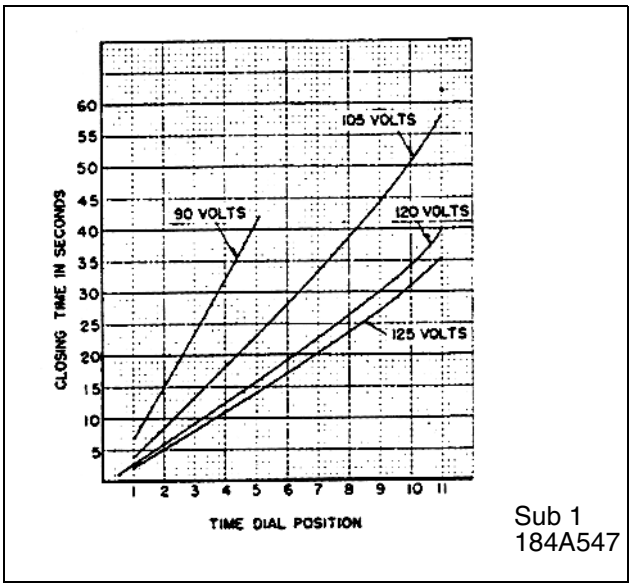

Figure 4. Typical Time Curves of the Timer Unit of the 120 volt Type CRN-1 Relay. Proportional voltages apply for the 208 and 240 volt relay.

The bridge is secured to the electromagnet and frame by two mounting screws. In addition to holding the upper pin bearing, the bridge is used for mounting the adjustable stationary contact housing. The stationary contact housing is held in position by a spring type clamp. The spring adjuster is located on the underside of the bridge and is attached to the moving contact arm by a spiral spring. The spring adjuster is also held in place by a spring type clamp.

With the contacts closed, the electrical connection is made through the stationary contact housing clamp, to the moving contact, through the spiral spring out to the spring adjuster clamp.

The timer unit cannot be energized unless the power flow is in the tripping direction because its potential coil is connected in series with the contacts of the directional unit. Hence, the relay is directionally controlled.

2.3 INDICATING CONTACTOR SWITCH UNIT (ICS)

The dc indicator contactor switch is a small clapper type device. A magnetic armature, to which leaf-spring mounted contacts are attached, is attracted to the magnetic core upon energizing of the switch. When the switch closes, the moving contacts bridge two stationary contacts, completing the trip circuit. Also during this operation two fingers on the armature deflect a spring located on the front of the switch, which allows the operation indicator target to drop. The target is reset from the outside of the case by a push rod located at the bottom of the cover.

The front spring, in addition to holding the target, provides restrain for the armature and thus controls the pickup value of the switch.

3.0 CHARACTERISTICS

The type CRN-1 relay is available with either a 120, 208, or 240 volt rating.

3.1 TIMER UNIT (T)

The timer unit is rated at 120, 208 or 240 volts, 60 hertz. The minimum operate value is 54% of rated voltage. The continuous overvoltage capability is 110% of rated voltage. Characteristic time curves are shown in Figure 4 for various voltages and time dial settings.

4.0 DIRECTIONAL UNIT (D)

The directional unit has its maximum torque when the current leads the voltage by 30°. The relay should be connected using the 30° connection. When using this connection the maximum torque of the relay occurs at 100% P.F. The pickup value is .02 amp at rated voltage and maximum torque angle. The pickup may be increased to .05 amp or higher by increasing the spring tension.

4.1 TRIP CIRCUIT

The main contacts will safely close 30 amperes at 250 volts dc and the seal-in contacts of the indicating contactor switch will safely carry this current long enough to trip a circuit breaker.

The indicating contactor switch has two taps that provide a pickup setting of 0.2 to 2 amperes. To change taps requires connecting the lead located in front of the tap block to the desired setting by means of a screw connection.

4.2 TRIP CIRCUIT CONSTANT

Indicating Contact Switch (ICS)

0.2 ampere tap	6.5 ohms dc resistance
2.0 amperes tap	0.15 ohm dc resistance

5.0 SETTINGS

There is only one setting to be determined. This is the time delay of the voltage operated timer, and it is adjusted by the time dial position. Figure 4 gives a curve of time delay vs. time dial setting for various impressed voltages. Time is approximately proportional to time dial setting.

5.1 INDICATING CONTACTOR SWITCH (ICS)

No setting is required on the ICS unit except the selection of the 0.2 or 2.0 amperes tap setting. This selection is made by connecting the lead located in front of the tap block to the desired setting by means of the connecting screw. When the relay energizes a 125 or 250 volt dc type WL relay switch, or equivalent, use the 0.2 ampere tap.

6.0 INSTALLATION

The relays should be mounted on switchboard panels or their equivalent in a location free from dirt, moisture, excessive vibration and heat. Mount the relay vertically by means of the rear mounting stud or studs for the type FT projection case or by means of the four mounting holes on the flange for the semi-flush type FT case. Either the stud or the mounting screws may be utilized for grounding the relay. External toothed washers are provided for use in the locations shown on the outline and drilling plan to facilitate making a good electrical connection between the relay case, its mounting screws or studs, and the relay panels. Ground wires are affixed to the mounting screws or studs as required for poorly grounded or insulating panels. Other electrical connections may be made directly to the terminals by means of screws for steel panel mounting or to the terminal stud furnished with the relay for thick panel mounting. The terminal stud may be easily removed or inserted by locking two nuts on the stud and then turning the proper nut with a wrench.

For detail information on the FT case refer to I.L. 41-076.

For correct operation, the type CRN-1 relay should be connected so that maximum torque occurs for unity power factor on the system. Since the directional unit has a 30° characteristic, this may be accomplished by using the connections shown in Figure 5.

The voltage operated timer unit should be connected across the line. External schematic for this application as shown in Figure 5.

7.0 ADJUSTMENTS AND MAINTENANCE

The proper adjustments to insure correct operation of this relay have been made at the factory and should not be disturbed after receipt by the customer. If the adjustments have been changed, the relay taken apart for repairs, or if it is desired to check the adjustments at regular maintenance periods, the instructions in Section 6.1, “Acceptance Check” should be followed.

All contacts should be cleaned periodically. A contact burnisher Style # 182A836H01 is recommended for this purpose. The use of abrasive material for cleaning contacts is not recommended, because of the danger of embedding small particles in the face of the soft silver and thus impairing the contact.

7.1 ACCEPTANCE CHECK

The following check is recommended to insure that the relay is in proper working order.

a. Timer Unit (T)

   The directional unit contacts must be in the closed position when checking the operation of the timer unit.

b. Contact

   By turning the time dial, move the moving contacts until they deflect the stationary contact to a position where the stationary contact is resting against its backstop. The index mark located on the movement frame should coincide with the “O” mark on the time dial. For double trip relays, the

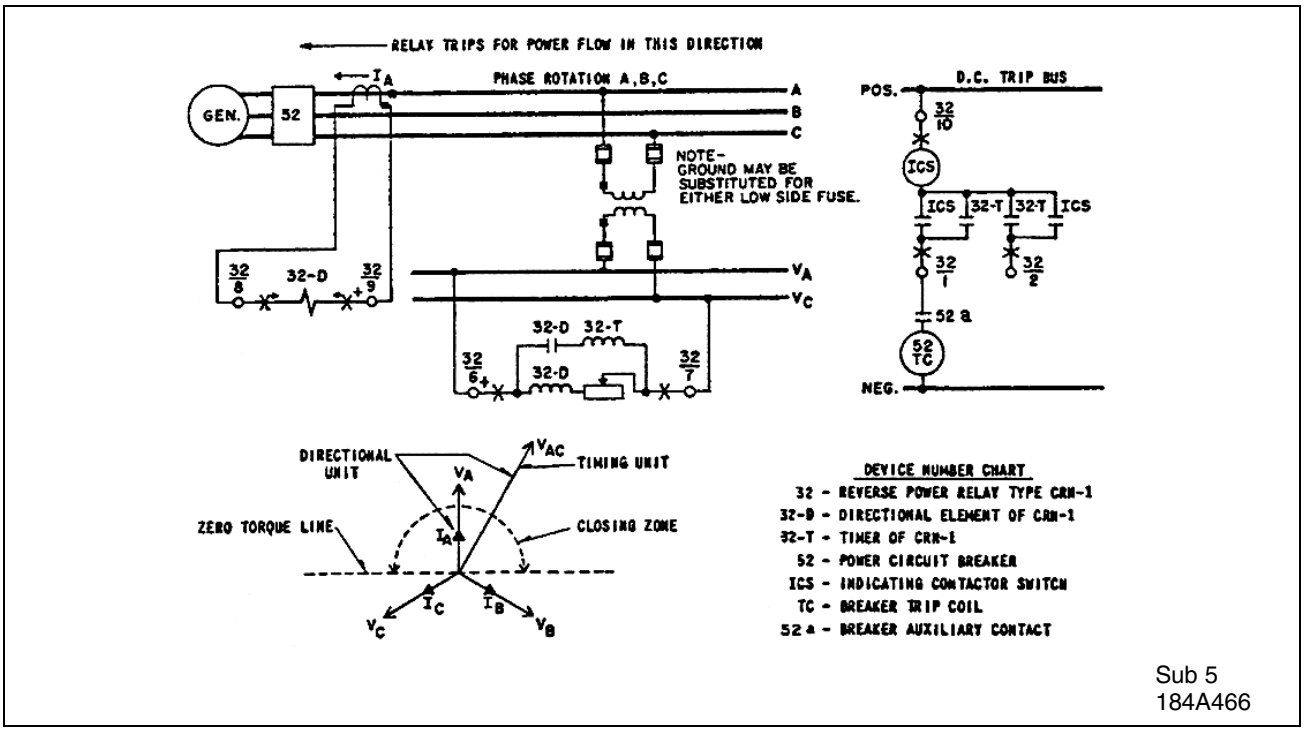

Figure 5. External Schematic of the Type CRN-1 for Reverse Power Protection.

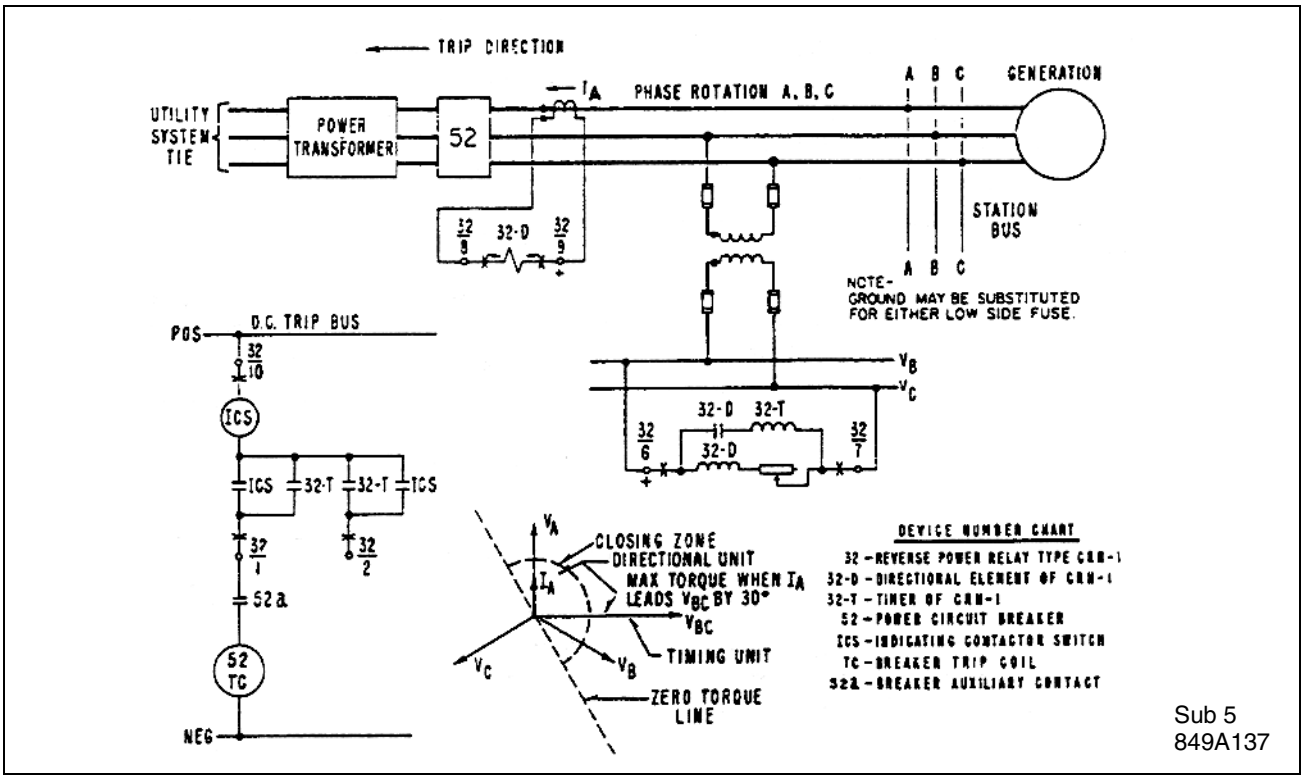

Figure 6. External Schematic of the CRN-1 Relay to Prevent Reverse Magnetization When Utility Tie is Removed From the Local System.

follow on the stationary contacts should be approximately 1/64".

For relays identified with a "T", located at lower left of stationary contact block, the index mark on the movement frame will coincide with the "O" mark on the time dial when the stationary contact has moved through approximately one-half of its normal deflection. Therefore, with the stationary contact resting against the backstop, the index mark is offset to the right of the "O" mark by approximately .020". The placement of the various time dial positions in line with the index mark will give operating times as shown on the respective time-voltage curves. For double trip relays, the follow on the stationary contacts should be approximately 1/32".

c. Minimum Operate Voltage

Set the time dial to position 6. Alternately apply 54% of rated voltage plus 3% and minus 3%. The moving contact should leave the backstop at plus 3% and should return to the backstop at minus 3%.

d. Time Curve

Figure 4 shows the time curve for the CRN-1 relay. With the time dial set to the indicated position, apply the voltages specified and measure the operating time of the relay. The operating times should equal those of Figure 4 plus or minus 5%.

7.1.1 Indicating Contactor Switch (ICS)

Close the main relay contacts and pass sufficient dc current through the trip circuit to close the contacts of the ICS. This value of current should not be greater than the particular ICS tap setting being used. The indicator target should drop freely.

The contact gap should be approximately .047 between the bridging moving contact and the adjustable stationary contacts. The bridging moving contact should touch both stationary contacts simultaneously.

7.1.2 Directional Unit (D)

a. Contact Gap

The gap between the stationary contact and moving contact with the relay in a de-energized position should be approximately .022".

b. Sensitivity

The respective directional units should trip with value of energization and phase angle relationships as indicated in Table 1. The pickup may be increased to .05 amp or higher by increasing the spring tension.

7.2 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 time intervals as may be dictated by experience to be suitable to the particular application. Phantom loads should not be used in testing induction-type relays because of the resulting distorted current wave form which produces an error in timing.

All contacts should be periodically cleaned. A contact burnisher Style #182A836H01 is recommended for this purpose. The use of abrasive material for cleaning contacts is not recommended, because of the danger of embedding small particles in the face of the soft silver and thus impairing the contact.

7.3 CALIBRATION

Use the following procedure for calibrating the relay if the relay has been taken apart for repairs or the adjustments have been disturbed. This procedure should not be used unless it is apparent that the relay is not in proper working order. (See Section 6.1, "Acceptance Check").

TABLE 1

DIRECTIONAL UNIT SENSITIVITY				
Relay Type	Ratings Volts	Values for Min. Pick-up† Volts	Amperes	Phase Angle Relationship
CRN-1	120, 208, 240	Rated Rated	.020 .023	I leading V by 30°†† I In-phase with V.

† The energization quantities are input quantities at the relay terminals.

†† Maximum torque angle.

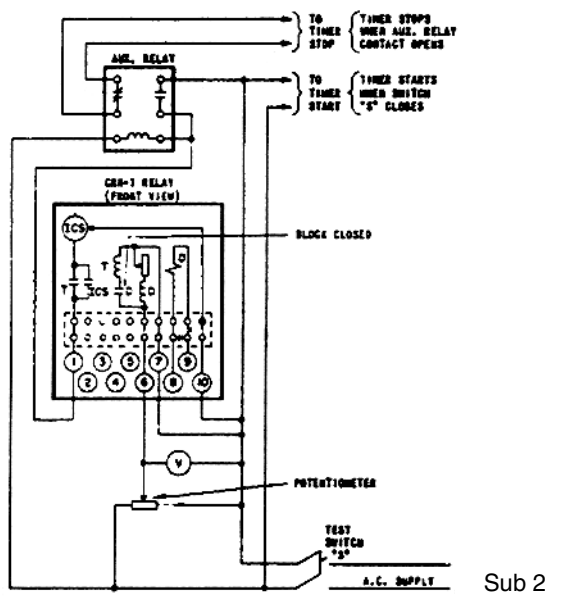

Figure 7. Test Connections for the Timer Unit of the Type CRN-1 Relay in the Type FT-21 Case.

7.3.1 Timer Unit (T)

a. Contact

By turning the time dial, move the moving contacts until they deflect the stationary contact to a position where the stationary contact is resting against its backstop. The index mark located on the movement frame should coincide with the "O" mark on the time dial. For double trip relays, the follow on the stationary contacts should be approximately 1/64".

For relays identified with a "T", located at lower left of stationary contact block, the index mark on the movement frame will coincide with the "O" mark on the time dial when the stationary contact has moved through approximately one-half of its normal deflection. Therefore, with the stationary contact resting against the backstop, the index mark is offset to the right of the "O" mark by approximately .020". The placement of the various time dial positions in line with the index mark will give operating times as shown on the respective time-voltage curves. For double trip relays, the follow on the stationary contacts should be approximately 1/32".

7.4 MINIMUM OPERATE VOLTAGE

The adjustment of the spring tension in setting the minimum operate voltage of the relay is most conveniently made with the damping magnet removed. Close the directional contacts.

With the time dial set on "O", wind up the spiral spring by means of the spring adjuster until approximately 6 3/4 convolutions show.

Set the relay dial to position 6.

Adjust the control spring tension so that the moving contact will leave the backstop at 65 volts +1.0% and will return to the backstop at 65 volts -1.0%. This value is for the 120 volt relay. Proportional voltage apply for the 208 and 240 volt relay.

7.5 TIME CURVE CALIBRATION

Install the permanent magnet.

Set the time dial to position #11. Apply rated voltage to terminals 6 and 7 with the directional contacts closed. Adjust the permanent magnet keeper until the operating time is 40 seconds ± 3%.

7.6 INDICATING CONTACTOR SWITCH - UNIT (ICS)

Close the main relay contacts and pass sufficient dc current through the trip circuit to close the contacts of the ICS. This value of current should be not greater than the particular ICS tap setting being used. The indicator target should drop freely.

7.7 DIRECTIONAL UNIT (D)

The upper pin bearing should be screwed down until there is approximately .025" clearance between it and the top of shaft bearing. The upper pin bearing should then be securely locked in position with the locknut. The lower bearing position is fixed and cannot be adjusted.

The contact gap adjustment for the directional unit is made as follows:

With the moving contact in the normally opened position, i.e., against the right stop on bridge, screw in the stationary contact until both contacts just close as indicated by a neon lamp in the contact circuit. Then, screw the stationary contact away from the moving contacts 3/4 of a turn.

The clamp holding the stationary contact housing need not be loosened for the adjustment since the clamp utilizes a spring-type action in holding the stationary contact in position.

The set screw in the stationary contacts have been factory adjusted for optimum follow and thus adjustment should not be disturbed.

The moving contact assembly has been factory adjusted for low contact bounce performance and should not be changed.

7.8 MAXIMUM TORQUE ADJUSTMENT

Apply rated voltage to terminals 6 and 7, and 4 amperes to terminals 8 and 9, making sure the polarities are correct. With the voltage and current in phase, the contacts should close. Now adjust the angle between current and voltage to 120° (current leading the voltage). Adjust the resistor to just close the contacts. Contacts should open when the angle between current and voltage is 120° + 1° leading.

The sensitivity adjustment is made by varying the tension of the spiral spring attached to the moving element assembly. The spring is adjusted by placing a screwdriver or similar tool into one of the notches located on the periphery of the spring adjuster and rotating it. The spring adjuster is located on the underside of the bridge and is held in place by a spring type clamp that does not have to be loosened prior to making the necessary adjustments.

The spring is to be adjusted such that the contacts will close as indicated by a neon lamp in the contact circuit when energized with the required current and voltage as shown in Table 1. This table indicates that the spring can be adjusted when the phase angle relationship between the operating circuit and the polarizing circuit is at the maximum torque angle or when the circuit relationship has the operating and polarizing circuits in phase. It is recommended that a single phase (in phase relationship) set-up be used as a matter of ease and convenience.

8.0 RATINGS

Circuit Continuous	Voltage - 100% of Rating
	Current - 5 Amperes

9.0 ENERGY REQUIREMENTS

The 50 and 60 hertz burden of the units of the type CRN-1 relay are as follows:

Coil	Burden at	Volt Amperes	*Power Factor
Timer	Rated Voltage	6.5	73°
Directional Potential	Rated Voltage	3.5	60°
Directional Current	5 Amperes	5.5	47°

*Angle that current lags the voltage

10.0 RENEWAL PARTS

Repair work can be done 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.

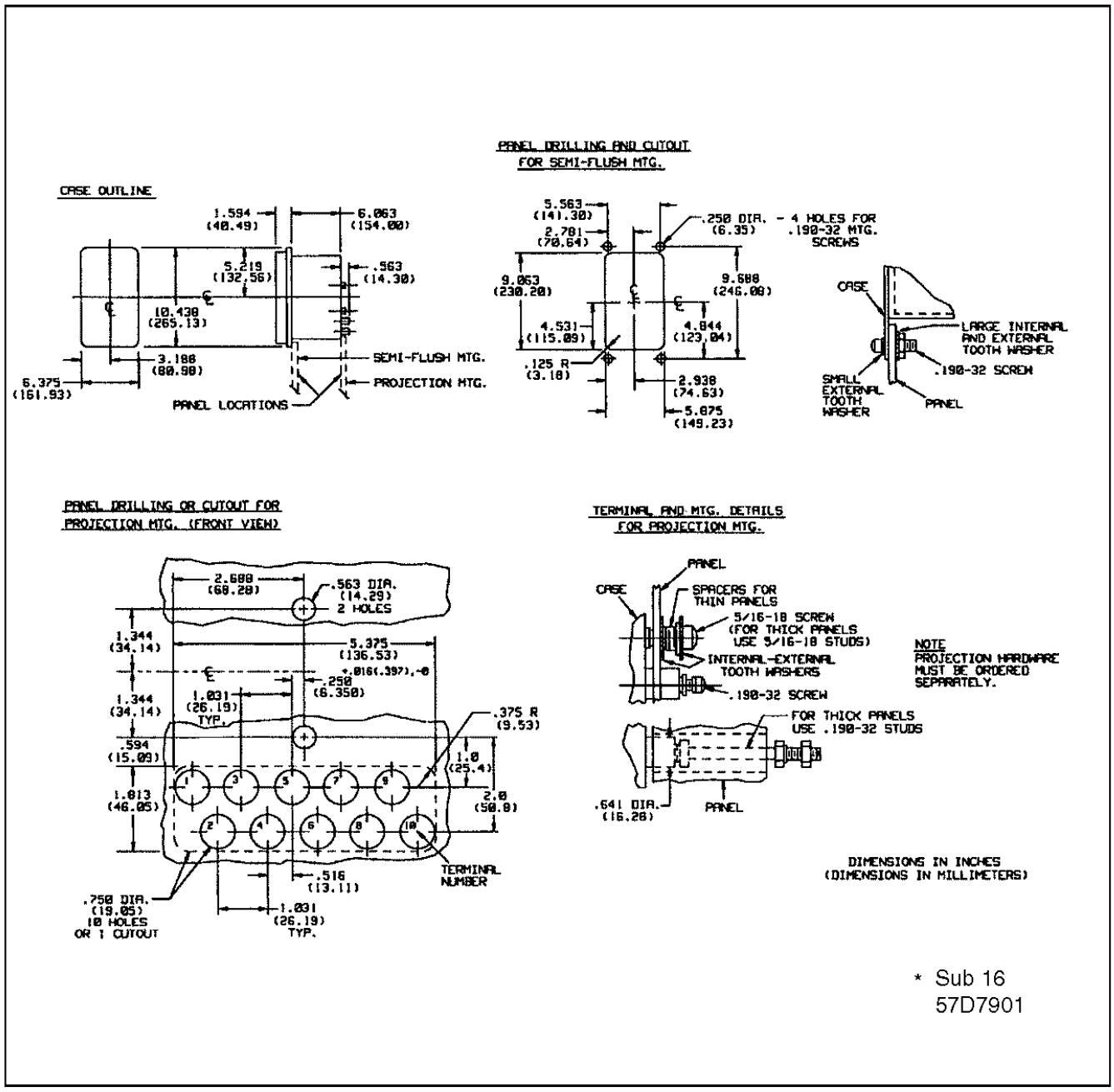

Figure 8. Outline and Drilling Plan for the Type CRN-1 Relay in the Type FT-21 Case.

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