Effective: April 1987

Supersedes I.L. 41-222.2H dated February 1984

✪ Denotes Change Since Previous Issue

Type CP
Reverse Phase Relay

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 setting and electrical connections.

1.0 APPLICATION

The type CP relay is a three phase induction disc type relay that operates upon phase reversal to disconnect a motor from a circuit. The relay may not operate for an open phase on the motor unless the motor is so heavily loaded that normal voltage cannot be maintained on all phases. Normally, the relay will operate as soon as the machine is stopped and prevent it from being started again if one phase wire is open.

This relay may also be applied to close its contacts on either three phase overvoltage or three phase undervoltage conditions on a system. For example, one relay is used to initiate source breaker trip and another relay is used to supervise alternate source breaker closing on automatic bus transfer schemes.

The CVQ relay performs a similar function for motor protection - supervision of supply breaker closing, low-voltage, and single-phasing protection. The CVQ is a more sophisticated relay, providing more sensitive single-phasing protection than does the CP relay; that is, the CVQ will detect single-phasing of a predominately motor load, where the motors are lightly loaded.

2.0 CONSTRUCTION AND OPERATION

The type CP relay consists of a three phase voltage unit, an indicating contactor switch when supplied, and an indicating voltage switch when supplied. The principal component parts of the relay and their location are shown in Fig. 1. ✪

A. VOLTAGE UNIT (CP)

The electromagnet is an "E" type laminated structure with a coil mounted on each leg. A wye connection is formed by connecting one lead of each coil together. The other lead of the coils are connected to separate phases of a three phase system.

When the coils are energized with a three phase voltage, a flux is induced in each leg of the electromagnet. These fluxes are out-of-phase with respect to each other since they are induced by out-of-phase voltages. The path of the three fluxes is across an air gap in which a disc is located. The out-of-phase fluxes cause a torque to be produced on the disc which moves to a position in its travel that corresponds to the three phase voltage applied to the electromagnet. The disc will remain in this position until the applied three phase voltage is changed, at which time, the disc will move to a new position that corresponds to the new voltage.

The out-of-phase fluxes are such that a positive sequence voltage tends to close the high voltage contact while a negative sequence voltage tends to close the low voltage contact. A reversed phase (which means negative sequence phase rotation) will cause the relay's low voltage contact to close.

This contact will also close on unbalance voltages that contain a negative sequence component suffi-

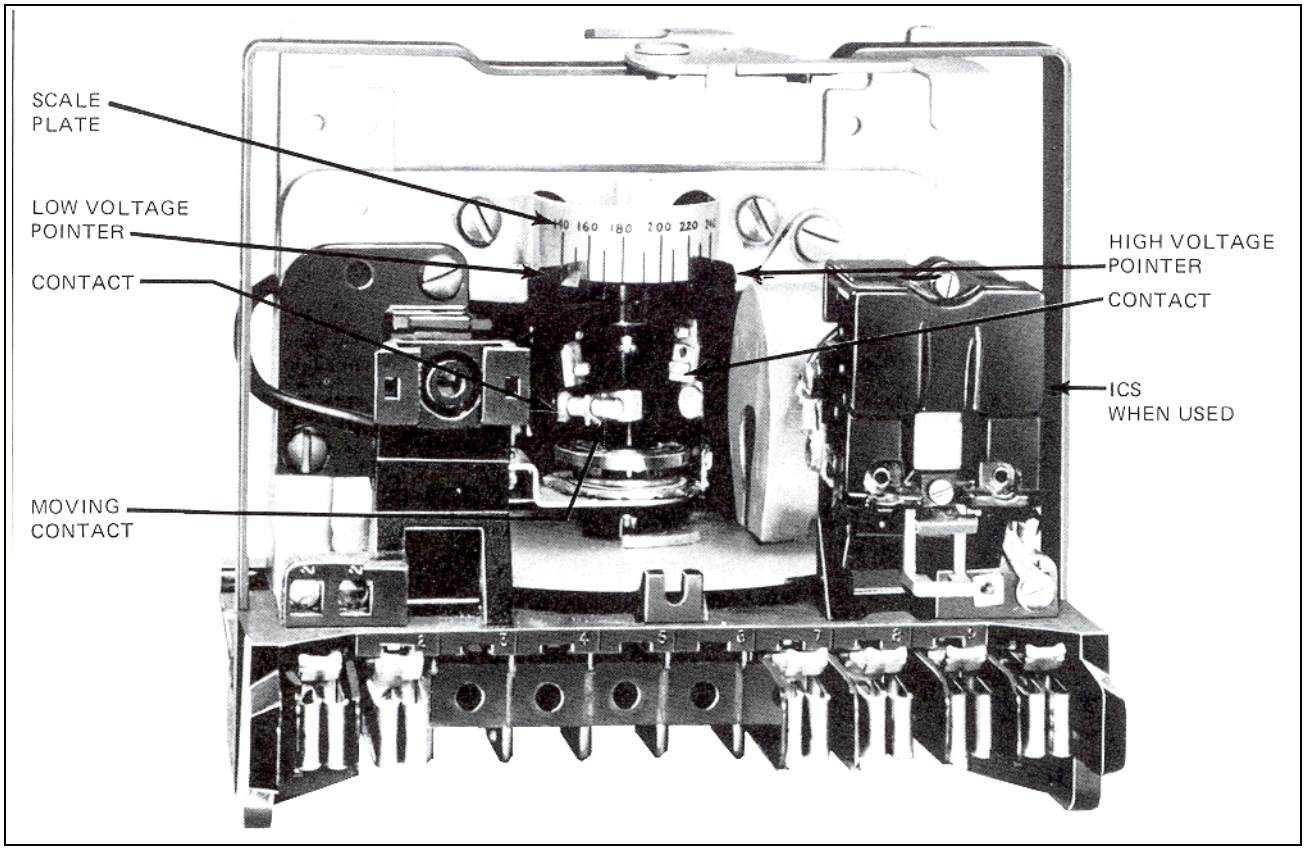


Fig. 1. Type CP Relay Without Case.

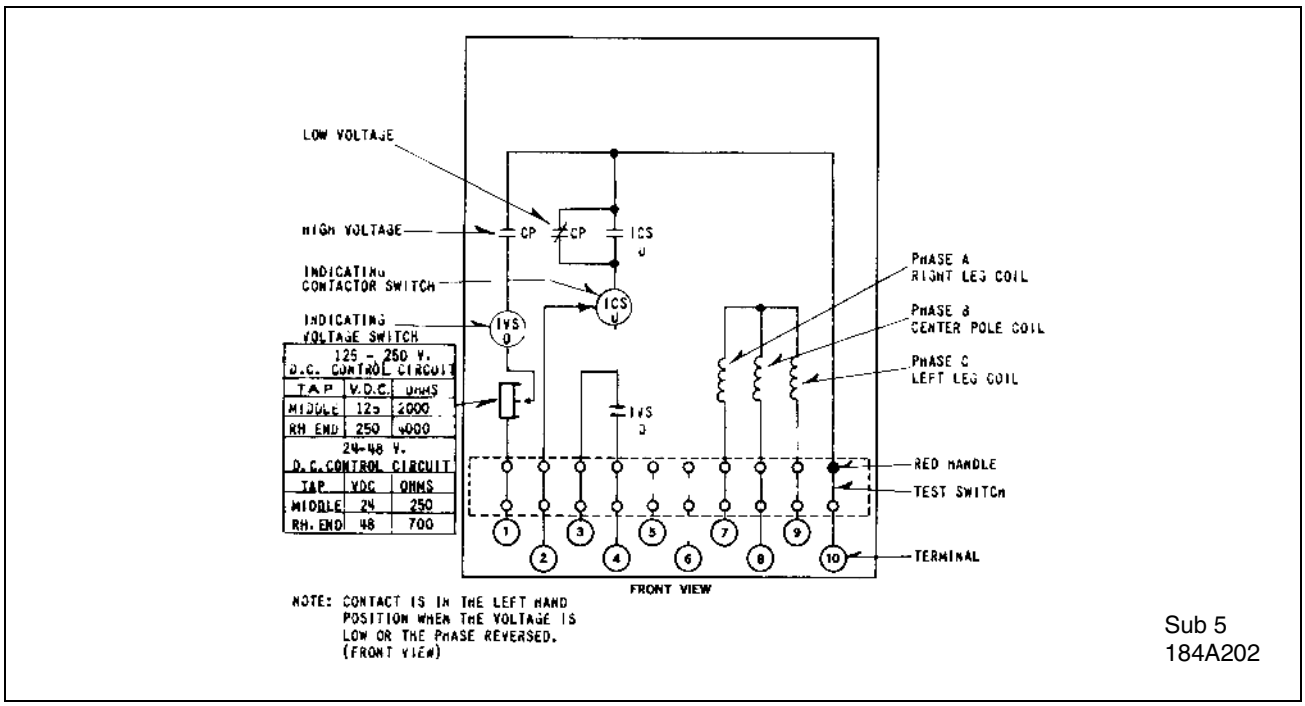


Fig. 2. Internal Schematic of the Type CP Relay with Independent Contacts in the Type FT-11 Case.

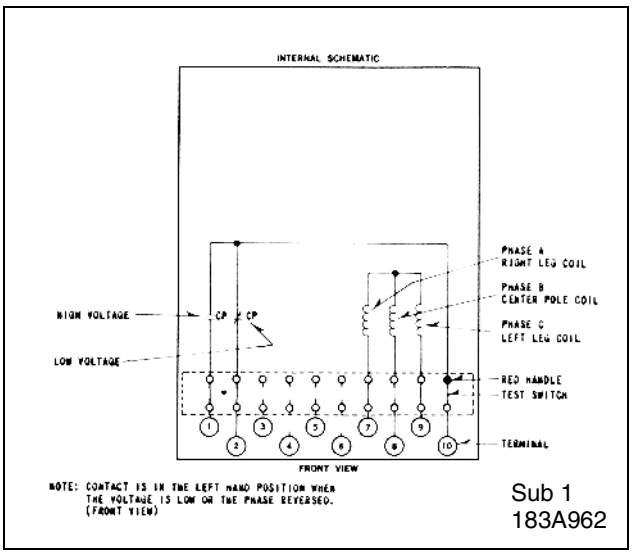


Fig. 3. Internal Schematic of the Type CP Relay in the Type FT-11 Case.

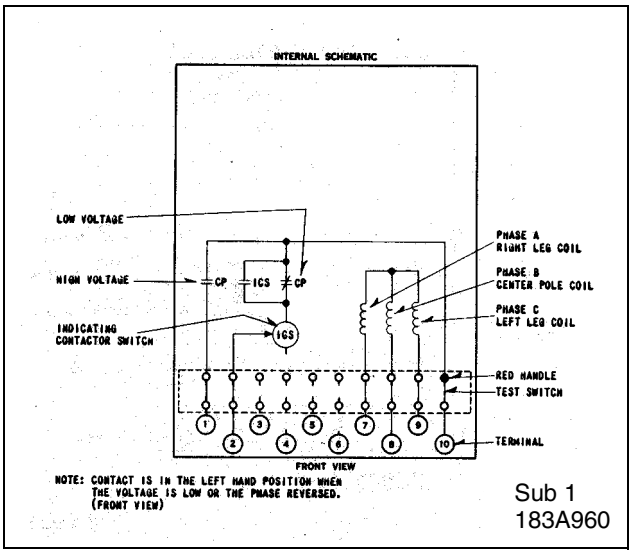


Fig. 4. Internal Schematic of the Type CP Relay with Indicating Contactor Switch in the Low Voltage Circuit in the Type FT-11 Case.

cient to reduce the relay torque to its low voltage trip point.

B. INDICATING CONTACTOR SWITCH (ICS)

The indicating contactor switch is a small d-c operated clapper type device. A magnetic armature, to which leafspring mounted contacts are attached, is attracted to the magnetic core upon energization 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 case.

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

An ac indicating contact switch (ACS) is used where the relay contacts connect to an ac trip or control circuit.

C. INDICATING VOLTAGE SWITCH (IVS)

The indicating voltage switch has the same construction as the indicating contactor switch.

3.0 CHARACTERISTICS

The type CF relay has adjustable high and low voltage contacts which can be set around the periphery of a scale. The ranges of adjustment of the contacts are as follows:

120 volt relay - - - - - - - - - - - - - - - - - - - 70 to 120 volts
240 volt relay - - - - - - - - - - - - - - - - - - 140 to 240 volts
480 volt relay - - - - - - - - - - - - - - - - - - 280 to 480 volts
208 volt relay - - - - - - - - - - - - - - - - - - 120 to 220 volts

If either of the adjustable contacts are set for a value of voltage within these ranges, the relay will just close its contacts when the balanced three phase line to line voltages equal this value. For such a condition, the relay is operating at its minimum trip point, and the operating times on repeated operations are not repetitive within close tolerances. However, voltages greater than the overvoltage setting or less than the undervoltage setting, result in relay timing operations which are consistent for repeated trials.

The relay has inverse timing; that is, the greater the increase in voltage the faster the relay contacts will close. Typical time curves for various contact settings are shown in Figs. 6 and 7.

TRIP CIRCUIT

The main contacts will close 30 amperes at 250 volts d-c and the seal-in contacts of the indicating contac-

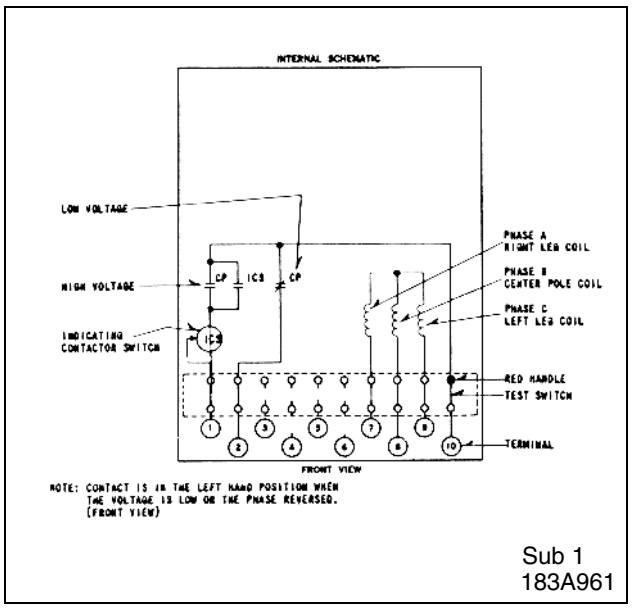


Fig. 5. Internal Schematic of the Type CP Relay with Indicating Contactor Switch in the High Voltage Circuit in the Type FT-11 Case.

tor switch (when supplied) will carry this current long enough to trip a circuit breaker.

The indicating contactor switch (when supplied) has two taps that provide a pickup setting of 0.2 or 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.

TRIP CIRCUIT CONSTANT

Indicating contactor switch (ICS) (When Supplied).

0.2 ampere tap - - - - - - -6.5 ohms d-c resistance
2.0 ampere tap - - - - - - 0.15 ohms d-c resistance

INDICATING VOLTAGE SWITCH (IVS) (WHEN SUPPLIED)

The indicating voltage switch (IVS) has a series resistor. The IVS will operate when 80% d-c rated voltage is applied to the IVS circuitry.

4.0 INSTALLATION

The relays should be mounted on switchboardseparated to allow for a minimum contact gap of 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 panel. Ground wires should be 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 Instruction Leaflet 41-076.

5.0 SETTINGS

There are two independent relay adjustments. These are the high and low voltage contact settings as described under “Characteristics”. These settings determine the balanced three phase line-to-line voltage at which the relay contacts trip. The relay timing is not an independent adjustment, since it is fixed by the contact settings chosen. Typical time curves for various contact settings are given in Figs. 6 and 7.

For motor protection set the low-voltage contact at the minimum permissible operating voltage. (This contact may also close when the motor is operated single-phased, provided the open phase voltage is not held too close to normal by the motor. A motor operating near full load or a motor connected in parallel with substantial static load will not be able to maintain near normal open-phase voltage.) Where the high voltage contact supervises supply breaker closing, it must be set lower than normal voltage. For example, set the high-voltage contact at 90% and the low-voltage contact at 80% of rated voltage. The high and low-voltage contacts must be sufficiently separated to allow for a minimum contact gap of about ✪ 0.020 inch. This corresponds to a voltage setting separation of about 7%.

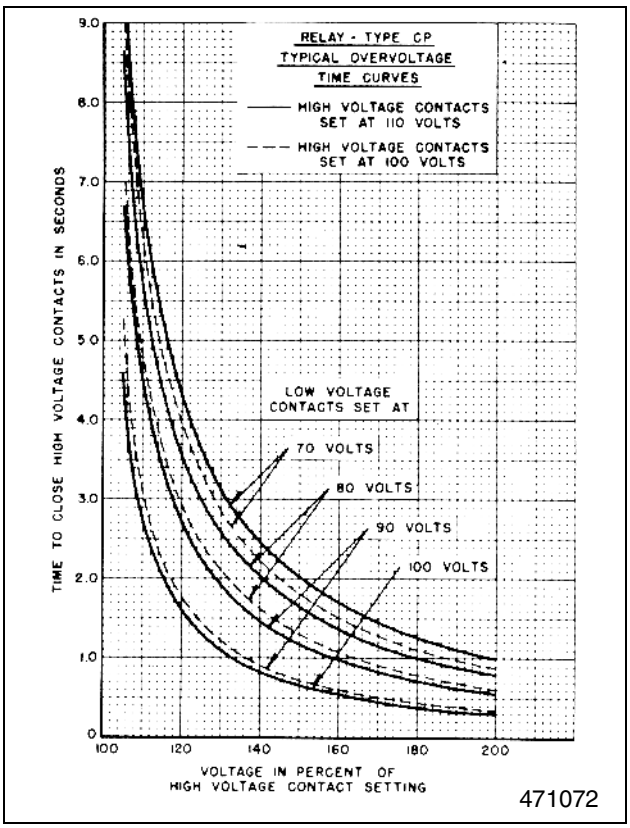


Fig. 6. Typical Overvoltage Time Curves for the Type CP Relay.

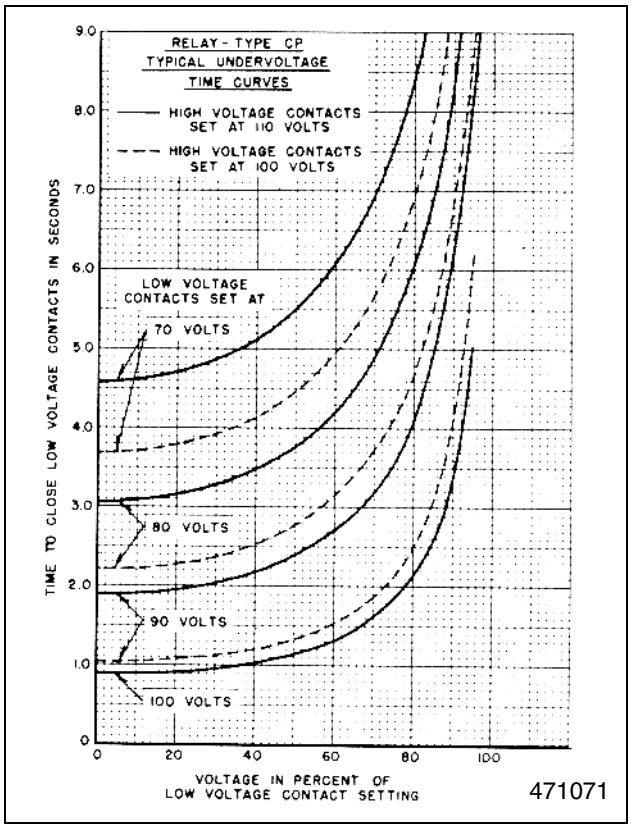


Fig. 7. Typical Undervoltage Time Curves for the Type CP Relay.

INDICATING CONTACTOR SWITCH (ICS)
(When Supplied)

No setting is required on the ICS unit except the selection of the 0.2 or 2.0 ampere 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 volt or 250 volt d-c type WL relay switch, or equivalent, use the 0.2 ampere tap. For 48 volt d-c applications set ICS in 2 ampere tap and use S#304C209G01 type WL relay or equivalent.

INDICATING VOLTAGE SWITCH (IVS)
(When Supplied)

No setting is required on the IVS unit except for the selection of the required voltage tap on the tapped resistor.

6.0 ADJUSTMENT AND MAINTENANCE

The proper adjustments to insure correct operation of this relay have been made at the factory. Upon receipt of the relay, no 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:

A. CP UNIT

1. **Contacts** - Set the left-hand adjustable contact in the center of the scale and adjust the voltage until the moving contact just makes. Set the left-hand contact back out of the way and bring the right-hand contact up until the contacts just make. The pointer should be within ± 1/32” of where the left-hand pointer was.

2. **Minimum Trip Voltages** - Check the scale markings by setting either of the two contacts at a value marked on the scale, then alternately apply this voltage plus 3% and minus 3%. Contacts should make and break.

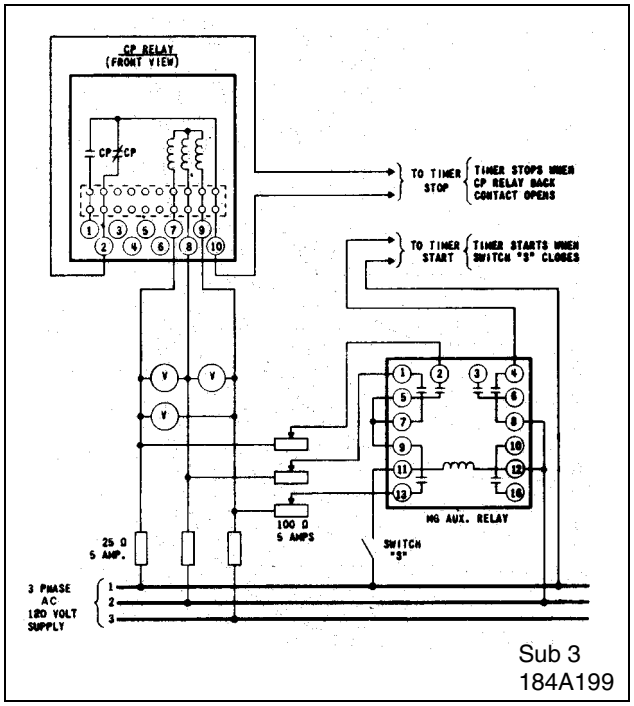


Fig. 8. Diagram of Test Connection for Checking the Undervoltage Time Curves of the Type CP Relay.

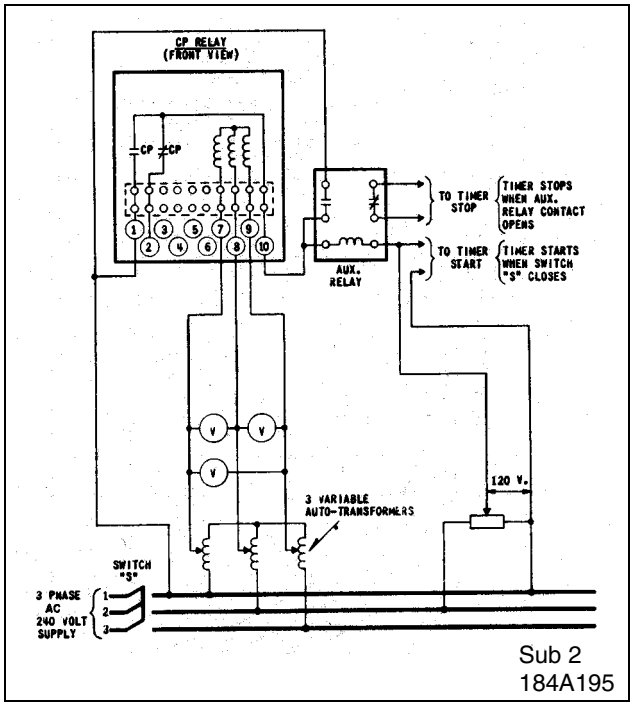


Fig. 9. Diagram of Test Connection for Checking the Overvoltage Time Curves of the Type CP Relay.

Check all of the scale markings in a similar manner.

3. **Time Curve** - The time curve can be checked by the use of the circuits of Figs. 8 and 9.

B. INDICATING CONTACTOR SWITCH (ICS)

Close the main relay contacts and pass sufficient d-c current through the trip circuit to close the contacts of the ICS. This value of current should not be greater than the particular ICS 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.

C. INDICATING VOLTAGE SWITCH (IVS)

Close the main relay contacts and apply rated d-c voltage across terminals 1 and 10. The contacts of the IVS unit should close and the indicator target should drop freely.

6.1 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.

All contacts should be periodically cleaned. A contact burnishes S#182A836HO1 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 contact and thus impairing the contact.

6.2 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 until it is apparent that the relay is not in proper working order (See “Acceptance Check”).

A. CP UNIT

1. **Contacts** - Apply sufficient voltage to the relay, to make the disc float in the center of its travel. Move either of the adjustable contacts until it just makes with the moving contact. If, the two contacts pointers do not meet at the same point on the scale, adjust the follow on both adjustable contacts. The contacts should just make with the moving contacts when the pointers meet on the scale. Approximately the same follow should be in each of the adjustable stationary contacts.

2. **Minimum Trip Voltage** - The adjustment of the spring tension in setting the minimum trip voltage is most conveniently made with the damping magnet removed.

Set either of the adjustable stationary contacts in the center of its travel. (For example, on the 120 volt relay, set the contact on the 95 volt setting.) Apply this voltage to the relay. Wind up the spiral spring by means of the spring adjuster until the stationary contact and moving contact just make.

Check the other scale markings by setting the adjustable contact on these markings and applying the corresponding voltage. The moving contact should make and break within plus or minus 3% of the value marked on the scale.

3. **Time Curve Calibration** - Install the permanent magnet and connect the relay as per the circuit of Fig. 8.

Set the high voltage contact on 100 volts and the low voltage contact on 70 volts. (For the 240 volt relay, multiply these values by two. Similarly for the 480 volt relay, multiply these values by four.) For the 208 volt relay set the high voltage contact on 170 volts and the low voltage contact on 120 volts. Apply rated voltage and frequency to the relay to allow the high voltage contact to make. Suddenly drop the voltage to zero and adjust the permanent magnet gap until the relay operates in 3.7 ± .15 sec.

Check the closing time of the high voltage contact by use of Fig. 9. With the voltage originally zero, suddenly apply rated voltage and frequency to the relay. The high voltage contact should close in 3.9 seconds ± 0.2 sec.

B. INDICATING CONTACTOR SWITCH (ICS)

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

7.0 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.

8.0 ENERGY REQUIREMENTS

The type CP relay when energized at rated frequency and voltage balanced 3 phase has the following VA burden for each phase.

Freq. Hertz	Phase	Watts	Vars	VA	Lagging Power Factor Angle
60	Phase A	.25	2.82	2.83	85
	Phase B	.37	1.92	1.96	79
	Phase C	1.11	2.50	2.73	66
50	Phase A	.35	3.37	3.39	84
	Phase B	.53	2.28	2.34	77
	Phase C	1.48	2.79	3.16	62

The continuous voltage rating of the relays is 110% of rated voltage.

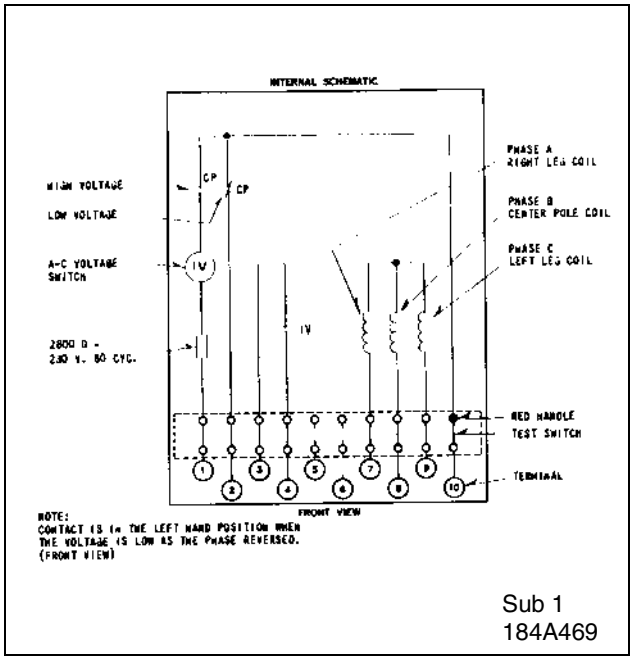


Fig. 10. Relay Type CP Reserve Phase, 3 Phase, 3 or 4 Wire, S.P.D.T., with ac Independent Voltage Switch in Type FT-11 Case.

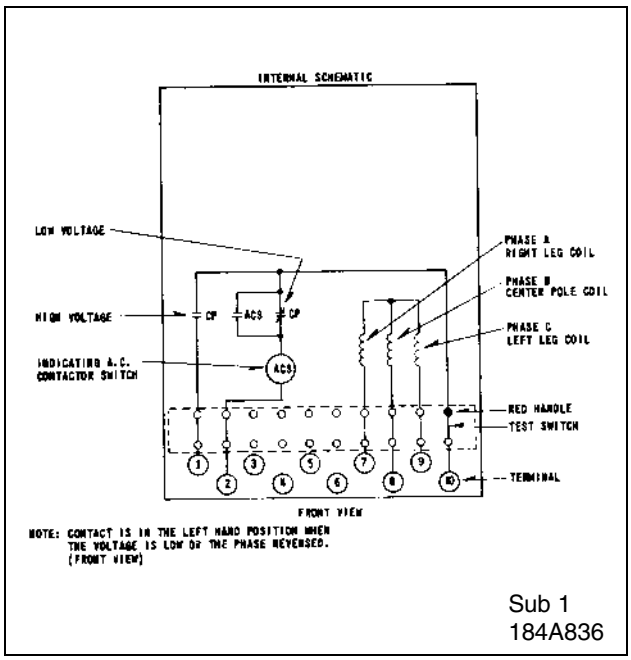
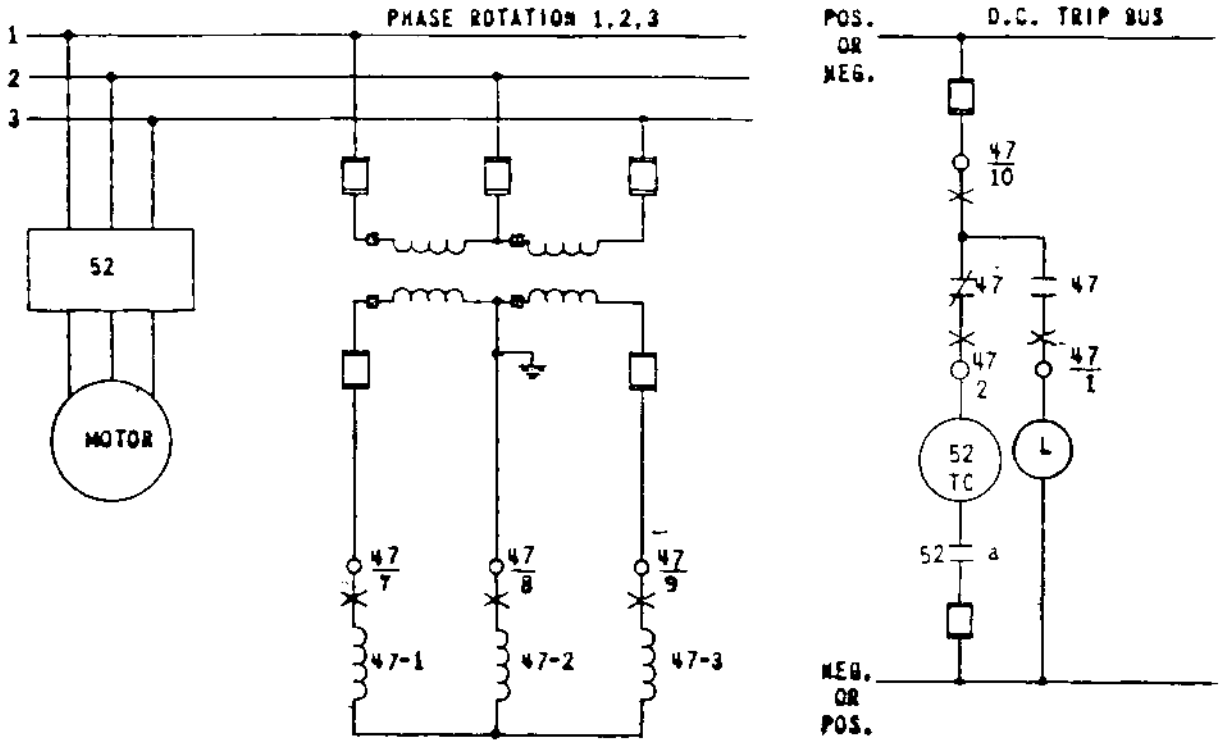


Fig. 11. Relay Type CP Reserve Phase, 3 Phase, 3 or 4 Wire, S.P.D.T. Contacts with Indicating ac Contactor Switch in Low Voltage Circuit in Type FT-11 Case.



DEVICE NUMBER CHART

47 — REVERSE PHASE RELAY, TYPE CP
47-1) —
47-2) — PHASE 1, 2 AND 3 COILS RESPECTIVELY
47-3) —
52 — POWER CIRCUIT BREAKER
TC — BREAKER TRIP COIL
a — BREAKER AUXILIARY CONTACT
L — INDICATING LAMP

Sub 1
184A200

Fig. 12. External Schematic Diagram of the Type CP Relay in the Type FT-11 Case.

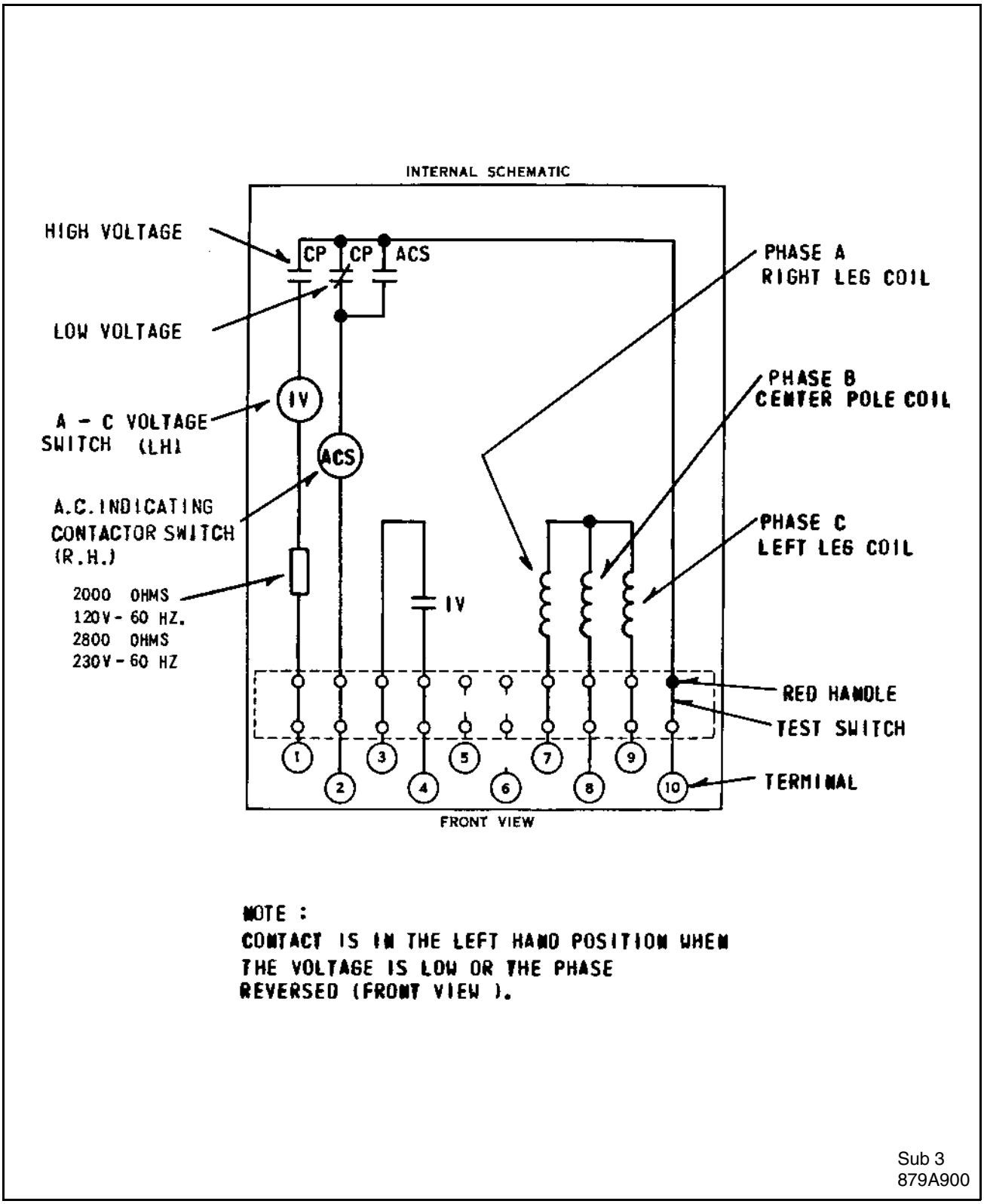


Fig. 13. Relay Type CP Reverse Phase, 3 Phase, 3 or 4, S.P.D.T. with A.C.S. in Low Voltage Circuit and with A.C. Independent Voltage Switch in Type FT-11 Case.

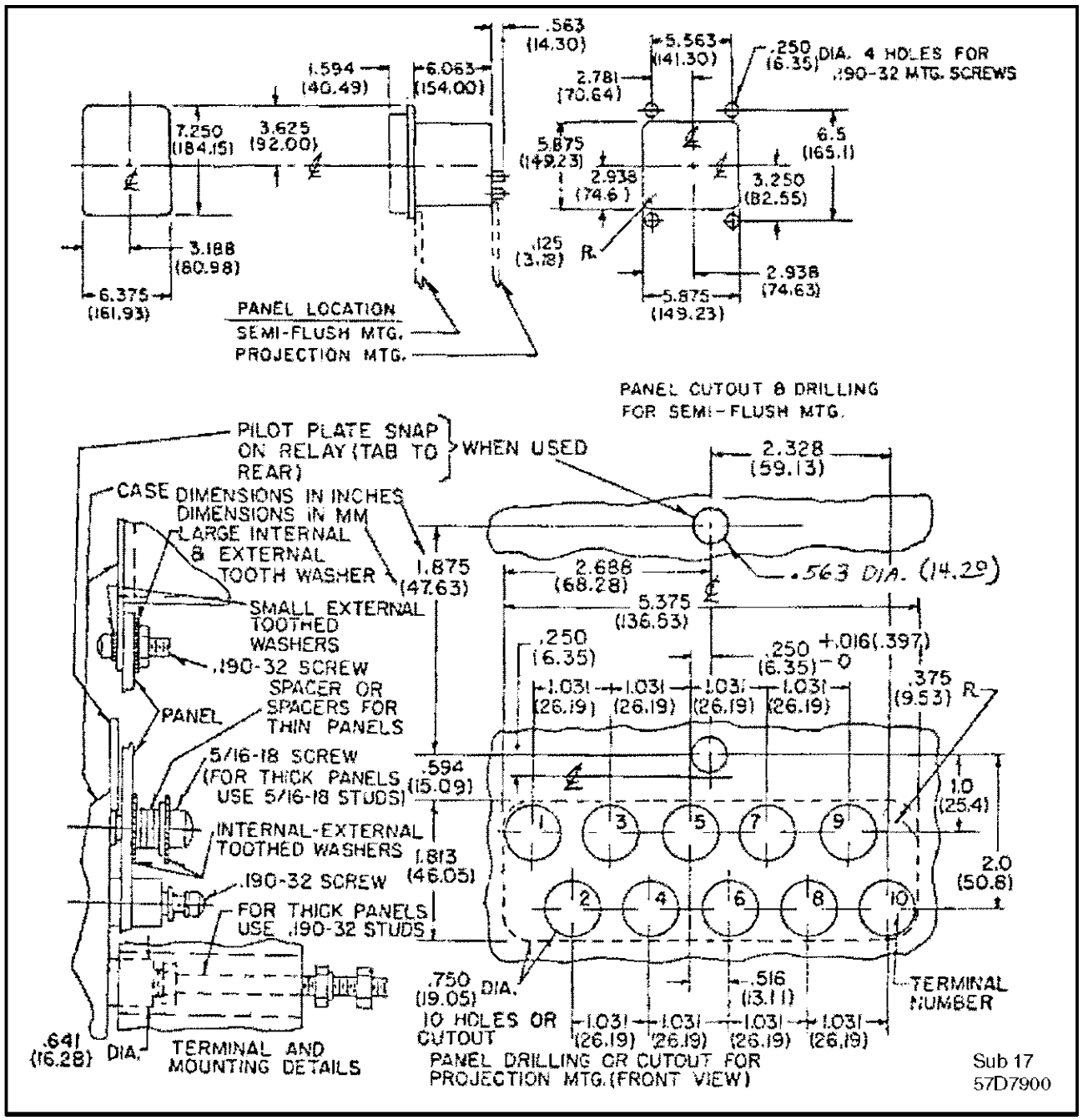


Fig. 14. Outline and Drilling Plan for the Type CP Relay in the Type FT-11 Case

IL 41-222.2 - Revision J

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